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To our readers . . .

What is the value of high school science? Should it yield its place to mathematics, at least for students planning a subsequent college science program?

We have all heard these questions posed, and perhaps have asked them ourselves. They exemplify an interesting class of problems—problems about high schools that cannot be solved without the help of college teachers. Likewise, of course, there are questions relating to colleges that call for an answer from the high schools. Fortunately, the wholesome trend toward increased communication between American high schools and colleges has had its effects in the Jesuit educational system. But for all that, things are not what they might be, and a more extensive exchange of news and views is in order.

We like to think that the BULLETIN, like the Association itself, is contributing to the cause of better high school-college communication. Where news is concerned, it may help our correspondents to keep this aim in view, among others, in submitting their reports.

As for views, we have included in this issue the answers of a number of college physics teachers, as reported by Fr. James J. Ruddick, S.J., to the questions proposed above, along with some reflections on other aspects of high school physics. The author himself calls for discussion of his thoughts; may his invitation not go unheeded!

The communications motif can be noticed in another section of the present BULLETIN, too—this time with a difference. In earlier issues we have asked readers to send us their comments on opinions expressed in this journal. Happily, our own invitation, at least, has not gone unheeded, and we are able to present some reflections communicated to us by Fr. Joseph F. Mulligan, S.J., on the contents of our March 1961 number. We think Fr. Mulligan's disagreement with a point expressed by Professor William J. Thaler in that issue will shed further light on the financial problems of our graduate science departments.

Since Fr. Mulligan begins his letter by calling attention to some articles of specific interest to priests working in science, we shall take this opportunity to add one more title to his list. For an excellent discussion of a basic problem often put before the priest-scientist, we highly recommend the article by Fr. Bruce Vawter, C.M., "Biblical Interpretation and the Positive Sciences," *The Homiletic and Pastoral Review*, 61 (September, 1961), 1127–38.

A COLLEGE TEACHER VIEWS HIGH SCHOOL PHYSICS

JAMES J. RUDDICK, S.J.

Traditionally, but inaccurately, college physics teachers have said, "We would rather our college physics students had not been exposed to high school physics at all!"

Such a remark is, to say the least, somewhat disturbing to high school science teachers. Even while admitting that there are poorly trained physics teachers, they rightly ask their college colleagues what precisely is considered faulty in the teaching of high school physics. The answer is usually some comment about centrifugal force and a confusion between mass and weight, with a few atrocious "typical errors" tossed in for effect.

Since the situation in the teaching of both high school and college science has changed radically in the last few years, it would be well to forget what may have been true in the past, and, for the overall benefit of both college and high school science, to reconsider the situation. The following comments are intended, first of all, to clarify the actual state of affairs, and then to express the point of view of at least some college teachers who have given thought to the problems of high school physics.

High school physics teachers

Anyone who has taught or worked with high school science teachers is very well aware that their training in physics varies from almost nothing to one or more years of graduate study in the field. It is just as foolish to ignore the M.S. man as it is to ignore the teacher who is teaching physics with perhaps not even an introductory college physics course as background. Hence, in endeavoring to improve the quality of high school teaching, it is by no means enough to call for a program of intensified course work, summer institutes, and the like. Attention must also be given to the teacher with a college physics major background or even with an M.S. degree from a strong graduate department of physics. In the long run, it is more important to assist and encourage the good teachers than to help along the poor ones.

Low morale. Poor training is one obvious source of poor teaching of physics. However, low morale on the part of science teachers is often an unsuspected cause of much poor science teaching. Recognition and encouragement are quite as important for the secondary level as for the college level. When the college professor, for example, treats the good

high school teacher as a *very* distant cousin, that good teacher is likely to become a poor teacher or not a teacher at all. "Nothing I can do will help the situation, so why bother?" If college teachers harp on the "poor training" of students, making no distinction between good and poor students, what incentive is there for the introductory teacher to put forth a continued effort?

Another element of this problem is the psychological one. The teacher who is, perhaps through no fault of his own, ill prepared in physics can at least learn with the students. But it is very hard for him to bring himself to this, if he is continually being put on the defensive. The poor teacher becomes worse when constantly challenged as to his competence.

One further comment on morale. College teachers are considered "physicists;" high school teachers are considered "teachers." They often —not usually, let us hope—teach other subjects. Furthermore, making allowance for the teacher who *wants* such work as, say, coaching the basketball team, they are often involved in extra-curricular activities that have nothing to do with their professional interests. It would seem that an important element in the professional standing and recognition of high school physics teachers is that their work in physics be considered primary. The American Association of Physics Teachers has a Steering Committee for the High School Journal Project. The Committee comments in a recent release:

> While it is undoubtedly true today that most teachers of high school physics must also teach in one or several other subjects, it is not desirable that their interest in physics be secondary to another subject. We shall always want our teachers to be liberally educated, but we should like to see every physics teacher a specialist in physics and his course capably taught, even though he also teaches in other fields.

With regard to lay teachers, it is encouraging to see that one of the chief morale builders, salary, is becoming much more satisfactory than even ten years ago. (The grapevine recently carried news of a college teacher who went into high school teaching on Long Island because of the excellent salary scale!)

Improved teacher training. Despite the number of very poorly trained teachers, the situation has improved sharply in the last few years. It is now relatively easy for high school physics teachers to obtain grants of one type or another for summer study. The institutes for science teachers that have been sponsored by the NSF over the past few years have done a great deal to improve teaching by giving subject-matter instruction, and by engendering enthusiasm for the more recent developments in the various fields of science.

It should be especially noted that, even if the NSF is interested in supporting *ad hoc* programs (for example, institutes to prepare teachers for the Physical Science Study Committee program), it is also very willing to consider programs of independent study, sequential course institutes, and other approaches that educators may propose. It may well be that the ultimate improvement will be due more to the concentrated study of basic fields (as in sequential course institutes) than to the scatter-shot institutes that endeavor to remedy an immediate lack by covering vast fields of science in survey lectures.

Advancing curricula. The training of high school teachers is all the more important as "college" material gradually filters into the high school curriculum. It has been a rather surprising turn of events in the last few years to find that "graduate school" material is now being taught regularly in college courses (quantum mechanics, for example), and "college" material is being taught in the high school (calculus, for example). Presumably the trend will continue. Better-trained teachers, improved curricula, and more efficient pedagogical techniques will enable secondary school students to learn matter that their parents would have considered suitable only for college.

However, the college teacher is cautious in eliminating the elementary sections of college physics curricula. He is only too aware of the importance of fundamental concepts and principles. Unless he is confident that his students have been in the hands of well-qualified teachers, he is surely going to review the matter himself. Perhaps the greatest sources of his caution are the familiar problems of mass *vs.* force and of centrifugal force (see below).

The college teacher is thus looking forward to having a part of his own work taken over by the high school teacher, perhaps even to the extent of eliminating the introductory college physics course as it is now taught. This can only happen if high school teachers are well-trained, interested, and recognized physicists.

High school physics in the curriculum

The trend in physics education today is away from the encyclopedic knowledge that characterized most textbooks of a generation ago. The college physics courses are eliminating more and more elements that once were considered necessary, or at least indispensable, for the beginning physics student. There is even more reason for the high school courses to avoid striving for "completeness." It is suggested that the following points be used as aims and as norms for the retaining of material in the courses: arousing interest in physics, showing what physics is today, and presenting certain key ideas and principles.

Interest in physics. The question has been posed, "Are high school physics courses merely inspirational? And if they are, does the value of offering them to students already interested in science outweigh the value of giving such students more training in mathematics?" Science courses in high school are not *merely* inspirational, but the instilling of an interest in science is certainly one aim. (For some students, of course, this interest should lead to a desire of a career in the field.) Studies of outstanding scientists—not to mention informal questioning of scientists—have shown that a frequent time for awakening the spark of scientific interest is the high school period.

High school teachers are the ones best qualified to say what elements of high school teaching give rise to true student interest. It would seem that the following ingredients are among the necessary ones: ability on the part of the teacher, enthusiasm, presentation of science as a field in which, though great discoveries have been made, there still remain many puzzles.

Physics as it is. Many times students have remarked how different college physics is from high school physics. The element that strikes them is the treatment of complex problems and the idea that many problems are still not completely solved. The simplifications and approximations that are normally necessary in introductory courses should not obscure the fact that the world is really something quite complex. Physics is *not* a neatly tied package of facts and principles. No one can truly appreciate it who has been imbued with the idea that it is a science in which one studies the embalmed learning of the past.

Physics today emphasizes certain topics that were not treated or not given much attention in past decades. Since not everything can be covered, it is only to be expected that physics courses today treat topics of current interest: wave motion, momentum, radiation, statistics, and nuclear phenomena. To omit practically all mention of such topics in favor of detailed descriptions of motors, specific heats of metals, and the like, does not reflect the flavor of modern-day physics.

Key ideas and principles. It is undeniable that there is an informative aspect to the teaching of high school physics and chemistry. In the laboratory, this means first of all developing certain basic measuring skills, and secondly, appreciating the significance of measures of precision and accuracy. The matter covered in the lectures is, however, the major problem. Which topics of classical physics should be covered in the high school course? Which elements, if any, of atomic physics should be stressed? How should the units of electricity and magnetism be treated? What of the use of pounds of force and pounds of mass? Electronics is important in the

physics research laboratory; should it be introduced in the high school course?

It is my impression that college teachers would be very happy if their physics students came to them with a reasonably thorough knowledge of the following topics:

1. One-dimensional kinematics
2. Newton's laws of motion and basic applications in dynamics
3. Elastic collisions in a plane
4. Wave motion, including interference (light and sound)
5. Thermometry and temperature
6. Electrostatics (force, potential) of point charges
7. Magnetic fields and their interaction with moving charged particles

There are numerous other topics that college teachers would consider almost equally important: motion in a plane, inelastic collisions, hydrostatics (as a foundation for hydrodynamics), electrostatics of plane parallel surfaces, the elements of atomic structure, statistics of radioactive decay. The seven topics listed would, however, be acceptable to nearly everyone.

There is a note of caution that experience injects into any consideration of syllabi: one must be careful of the treatment of the mass/force pound and of the concept of centrifugal force.

No physicist finds any confusion between the ideas of force and mass. Even though he, with Newton, tends to feel that weight is a "natural" characteristic of a body, he nonetheless realizes that this is only due to the presence of a body that exerts a gravitational force. Long experience has shown him that mass is defined in an utterly different way. It is associated with weight, but not at all the same as weight. Yet he finds many beginning students thoroughly confused. They have been exposed to textbooks (and perhaps teachers) that propose questions such as this one: "How much acceleration will be given a 16-pound mass by an unbalanced force of 16 pounds?"

Similarly, centrifugal force is no problem. It is recognized as the "reaction" of a rotating object on the source that keeps it in its path of rotation. Or, *in terms of the accelerating (thus, non-inertial) system,* it is the fictitious force needed to preserve equilibrium. Students, however, usually get the idea that centrifugal force is (relative to the usual inertial system) a real force needed to preserve equilibrium. Consider this example from a current textbook: "At the height of the loop [in aviation acrobatics] the centrifugal force on the plane must be greater than the weight of the plane and the pilot; otherwise both would fall." Is it any wonder that students are confused? A really capable teacher is needed to overcome the impression that such a statement makes!

Enthusiasm. But information is not all. Much more important is enthusiasm. Any college teacher would prefer to have a student arrive with enthusiasm developed in a study of specific heats, than arrive with a brainful of stolidly memorized facts and principles. The difference ultimately comes from the high school teacher—and the topics that interest him. If he inspires his class with the physics of electron tubes, who would wish to have it otherwise?

The physics student himself

No educator can forget that his proper work is not precisely teaching a subject—whether physics, or English, or history—but teaching students. What has the college teacher experienced in dealing with students who come to him from high school physics courses?

Lack of retention. A common phenomenon is that the freshman or sophomore states with emphasis that he doesn't recall his high school physics. This statement should, of course, be taken with a grain or two of salt, but its frequency surely indicates that retention is rather low. For this reason, the selection of topics is perhaps far less important than overcrowded syllabi would indicate. Or perhaps the methods used in "informing" high school students should be changed. In any event, college quizzes often show very little retention from high school courses.

"Know-it-all" students. There is occasionally a student who plays the "know-it-all" role: "I had all this in high school. Professor So-and-So bores me." The teacher may be irritated by the student's immaturity. However, he knows it will soon pass—and he should teach so that it passes quickly! In this regard there is a related problem that may never show on the surface. The really good student may *not* be learning much new material in his introductory college course. Such students are normally not the ones to comment—and the sharp edge of their interest may be permanently dulled by an imperceptive teacher. They may show up only rarely—college teachers are notably restrained in enumerating them—but they must be given special treatment. If their instructor can succeed in showing them some of the specialized facets of even introductory courses, or if they are put into intermediate courses at once, an enthusiastic response may be the healthy result. This is indeed a problem that the colleges are tackling at the present moment. One of the aims of the Commission on College Physics, for instance, is to study ways of helping the gifted students who come to college with excellent physics backgrounds.

Project enthusiasts. The students who have been active in science fair projects are often enough students who enjoy "gadgeteering" but do not

relish the academic elements of physics. They may perhaps be joined with the radio amateurs, many of whom follow a non-scientific curriculum in college and retain their radio work as a lively hobby. There are, however, some project enthusiasts, even if only a small minority, who do very well in college. It is hard to tell the difference *a priori*. One is tempted to make the facile judgment that these latter students are the ones with "a real scientific interest in experiments," while the others are motivated by a "desire of novelty." It is not at all clear that this is so. The true state of affairs may rather be poor guidance and insufficient inspiration of the right kind. Of those who end up with physics merely as a hobby, perhaps many could have found satisfying and productive careers in science. The high school teacher and the college teacher alike must pause to consider the possibility.

Articulation in Jesuit schools

The above comments on three phases of college-high school relationships in physics have been developed through many conversations with colleagues on both levels. It is to be hoped that they are sufficiently vigorous to stir up further discussion of a point in which Jesuit schools, as part of a nationwide college-high school system, have not only a very special interest but a particularly desirable advantage.

CANISIUS COLLEGE

REPORTS OF SCIENTIFIC ACTIVITY

High Schools

Boston College High School. The chemistry department has replaced its text book of the previous year, Baxter and Steiner's *Modern Chemistry*, with *Chemistry*, by Garrett, Richardson, and Kieffer. The latter has been found more satisfactory, and easier for the students to follow. This past summer Mr. John Hanrahan, S.J. attended the Chemical Bond Approach (CBA) Institute at Tufts University. Fr. Francis Buck, S.J., working on an NSF grant, did research on phosphorus compounds at the University of Arizona.

In physics, Fr. James McCaffrey, S.J. is doing degree work at Boston College. His place has been taken by Mr. Claffey, formerly of Whitman High School.

The senior advanced mathematics class is using Thomas' *Elements of Calculus*, under the instruction of Fr. Whitney Sullivan, S.J., chairman of the mathematics department.

Fordham Prep. The five seniors who attended NSF-sponsored summer institutes were most enthusiastic about their respective courses, and reports on their performance were equally enthusiastic. Ten seniors in the science honors program will take their physics and/or mathematics with the freshmen of Fordham College. Six will be in Fr. Canavan's physics class and nine will take mathematics under Dr. Kwat.

Seniors Franklin Bonin and Dennis Marks (son of Dr. Louis Marks of the biology department) have been selected for the Science Honors Program, Joint Program for Technical Education, at Columbia University. Participants in this program will meet on Saturdays for three hours, but most of the 300 students involved work throughout the afternoon as well.

Dr. Patrick Shea, chairman of the Prep physics department attended an institute on Advanced Placement Physics at Kent State University this past summer. Mr. Raymond McCormick, S.J. studied radioisotopic techniques at Fordham University. Mr. Robert Weimann has joined the faculty as a mathematics and chemistry teacher.

Loyola High School. In the current year three separate courses in physics are being given. Three classes are taking a "traditional" course; two classes are following the Physical Science Study Committee (PSSC) program; and a senior honors class is using *Modern University Physics* by Sears and Zemansky. The last group is taking its second year of physics.

In mathematics, the School Mathematics Study Group (SMSG) program has been introduced in the first two years. This is the second year of a

four-year plan to introduce the program throughout the four years. Also being taught is a course in analytic geometry and calculus for the senior honor students.

St. Joseph's Prep. Fr. Stephen Garber, S.J. was chosen as one of forty teachers from a five-state area to participate at the Physical Science Symposium held at Temple University, October 22–25, under the sponsorship of the United States Army, Frankford Arsenal. Fr. Garber is also vice-president of the Philadelphia Science Teachers Association, and committee chairman of its science fair committee.

Chemistry students from the Prep participated in a research program for high school students conducted at La Salle College. Of 240 applicants, twenty-four were accepted, with four alternates. Four of the twenty-four were from the Prep, the largest number from any one school. Two of the alternates were also from the Prep.

Colleges and Universities

University of the Ateneo de Manila, Philippines. The Ateneo initiated its first summer institute for science teachers on a grant of $20,000 from the Philippine National Science Development Board and the Asia Foundation. Classes were held from April 10 to May 19, 1961, for fifty-five public school and ninety-five private school teachers coming to Manila from forty-three provinces. Each student received a stipend to cover personal expenses for the six weeks. These 150 enrollees were screened from 840 applicants.

The chemistry program, under the guidance of Fr. William Schmitt, S.J., introduced into the Philippines the Chemical Bond Approach (CBA) text for a first course in chemistry. The course was taught by Dr. Arthur Livermore, of Reed College, Portland, Oregon, who is one of the originators of the CBA program in the United States. Dr. Livermore was brought over to the Philippines for the summer by the Asia Foundation. He followed the progress of the course with the aid of standardized tests developed for the CBA program.

The physics section of the institute was handled by Fr. Joseph Priestner, S.J. and Fr. Francis Glover, S.J. Fr. Glover introduced the new Physical Science Study Committee (PSSC) course, and began the day with a TV physics class lecture. This was followed by a problem and discussion group period and two lectures before noon. The afternoon was given over to two laboratory periods in laboratories utilizing PSSC equipment as well the Ateneo equipment.

The biology courses were directed by Fr. John Bauer, S.J., who introduced biochemical and biophysical material into the high school cur-

riculum as a means of modernizing the biology program. The laboratory period was devoted to microtechnique. Participants made fifty slides of botanical and zoological specimens. Three hours of lectures each day were devoted to biological chemistry, botany, cytogenetics, and laboratory techniques.

In directing the mathematics program, Fr. Wallace Campbell, S.J. used the text, *Sets, Operations, and Patterns*, written by Fr. Stanley Bezuszka, S.J., of Boston College. Stress was put on set theory, as well as the methods, structure, and postulational approach of mathematics.

Boston College. A biographical sketch of Fr. James Skehan, S.J. of the geology department will appear in Volume 20 of *Who's Who in American Education*. Fr. Skehan was listed in the 1955 edition of *American Men of Science,* and a revised form of his listing will appear in the forthcoming tenth edition.

Geology. The blasting of the Wachusett-Marlboro Tunnel, one of the longest bedrock tunnels in North America, has recently been completed, and in the course of the work Fr. Skehan and his students mapped the geology of the tunnel in detail. This tunnel exposes the most complete cross-section of the earth's crust in New England, and for that reason has stimulated great interest as a source of excellent data and potential solutions to regional geological problems.

The potential water resources of the city of Brockton also came under the geological and geophysical scrutiny of the department of geology. Fr. Skehan and his students outlined twenty possible water-producing areas in the city for further study by seismic methods.

Of the thirty-six undergraduate geology majors, several were employed in geology and related fields during the summer: two students in field mapping as members of the United States Geological Survey, two (along with two graduate students) in soil mechanics, and one in engineering geology. Another one of these students has assisted Fr. Skehan in subsurface mapping as a full-time participant in the NSF Undergraduate Research Participation Program.

Canisius College. Faculty research and the undergraduate research program were active during the past summer.

Biology. Dr. Vincent P. Stouter, chairman of the department of biology, has received a grant of $10,516 from the United Fund of Buffalo and Erie County to study pre-meiotic growth phenomena in the alga, *Protosiphon botryoides*. The investigation will be an extension of the study made on the sexuality of *Protosiphon* and *Botrydium* by Dr. John L. Blum, also in the biology department at Canisius. In Dr. Blum's work various

meiotic stages were found and described. A very pronounced growth of zygotes, prior to meiosis, was also noted. In the present investigation it is planned to ascertain the nature of this growth phenomenon.

Zygotes, which arise from the fusion of morphologically similar swimming cells, will be cultured in media containing inhibitors of DNA synthesis. In another line of experimentation, the zygotes will be grown in media containing concentrations of colchicine sufficient to block spindle formation. In a third set of experiments, zygotes will be treated with the radioactive isotope, tritiated thymidine, and radioautographs of the treated zygotes will be made. Each of these experiments should shed light on the nature of the zygotic enlargement. In the DNA-inhibited series, it is hoped that the premeiotic growth will be blocked. In colchicine-treated zygotes, the inhibition of the formation of the first meiotic spindle should permit the detailed study of the chromosomes of *Protosiphon,* and their comparison with ordinary vegetative stages. The labeled zygotes should provide data on the incorporation of thymidine in DNA synthesis, and it is hoped that a quantitative study of these zygotes will cast light on the extent and rate of DNA synthesis.

Dr. Blum is engaged in two projects at the present time. He is studying the ecology of algal mats which inhabit the upper reaches of salt marshes along the Atlantic Coast of the United States. Of interest are the conditions of life and reproduction of these algae. Also under investigation are the relation of the rather severe habitat (ranging from dry to submerged, with the water varying from highly saline to brackish) to the algae themselves, and the relation of the algae to the higher marsh plants which surround them. The most detailed work is being done in the large salt marsh at Barnstable, Mass.

Simultaneously Dr. Blum is preparing a flora of the blue green algae of the Atlantic Coast of the United States. This is intended to become an illustrated guide to the American marine and brackish-water species of this large group, which figures importantly in the ecology of marine habitats, and which has not in recent years received any summary monographic treatment.

Chemistry. The chemistry department has had undergraduate students participating in research work during the past four summers. Some reflections on the merits of this program by Dr. Herman A. Szymanski, chairman of the department, follow.

> The NSF usually invites the grant administrator to a sectional meeting at which the undergraduate research programs are discussed. I have always found these meetings to be very stimulating. The general opinion of those attending seems to be that the undergraduate student does profit from spending the sum-

mer at the college doing research. My own impression has been that the job done can range from one equivalent to graduate research to one which is very poor in quality. Most of the students involved go to graduate school, and I think that for those students the experience has been very helpful.

Some of the problems which I have had the students do include setting up and operating a Raman spectrometer and a single-beam infrared spectrophotometer, preparation of addition compounds, and gas chromatography. We have had no problem with careless handling of expensive instruments, even by students just entering their junior year.

The students try very hard to earn a summer appointment. We usually choose a student on the basis of his grades, his interest in chemistry, and the recommendations of his professors. Usually they are entering their junior or senior year of college. It is my feeling that the student gets his pride in his department and his ambition to go to graduate school by talking and working with the professors outside of class. The summer research program has given us more time for this sort of contact.

Fairfield University. The office of Aerospace Research, United States Air Force, has allocated $10,000 for photochemical research under the direction of Fr. Robert E. Varnerin, S.J. The contract, granted through the Geophysics Directorate of the Cambridge Research Laboratory, is to be applied to the study of methyl radicals produced in photochemical reactions. Currently being studied is the photolysis of acetone-propane mixtures.

Active research at Fairfield was initiated late in 1958 when Dr. John A. Barone of the chemistry department received a Research Corporation grant. Shortly thereafter, the chemistry department opened a research lab for faculty research, making it possible to expand the research program. Dr. Barone's work in anti-metabolites and anti-cancer agents has received continuing support under two additional NIH grants and an NSF grant for undergraduate research participation.

Additional grants have also stimulated research in the biology department under Dr. Donald J. Ross and Dr. John A. Klimas.

Fordham University. Fr. J. Franklin Ewing, S.J. is engaged in producing, with Dean James S. Donnelly of the Fordham School of Education, a series of Catholic geography books for the grade schools. These are books of human geography, and the emphasis is on the holistic approach.

Among the recent publications of Fr. Ewing are:

"Community development and the missionary." *Missiology in Africa Today,* ed. Desmond J. Hatton. Dublin: M. H. Gill & Son, 1961, pp. 25–41.

"The Human Phenomenon," *Theological Studies,* 22 (1961), 86–102. This is a review article on *The Phenomenon of Man* by Pierre Teilhard de Chardin, S.J.

Georgetown University. An In-Service Institute for high school teachers of physics and the physical sciences will be held at Georgetown during the academic year 1961–62. Fr. Matthew P. Thekaekara, S.J., acting head of the physics department, is the director of the institute, and Mr. Edward J. Finn of the physics faculty will be teaching the course. The institute is being held under the sponsorship of the NSF which has made $10,300 available to cover tuition and allowances for travel and books for fifty participants. Sessions meet on Saturday mornings and consist of formal instructions in basic physics, laboratory assignments and demonstrations to aid physical intuition. Integration of mathematics into physics and blending of twentieth-century physics with earlier physics will be among the major objectives of the institute.

Medical Center. Tests seeking ways to determine physical and mental fitness regardless of calendar age are under way at the medical center. They are being conducted in a special laboratory, with airplane pilots being tested for milestones of aging physical and mental conditions.

While concentrating on civilian airplane pilots, because these lose their flying licenses at the age of sixty regardless of their ability to continue flying, the study is expected to throw light on the problem of aging as a whole. The new Georgetown laboratory is seeking to find out when and how aging processes begin to occur. A twenty-five year project is planned.

Areas of the aging process under investigation are biochemistry, vision and hearing, neurological changes, pulmonary changes, and behavioral sciences. The laboratory is directed by Dr. Arthur E. Wentz, chief of the Clinical Research Branch of the Federal Aviation Agency's Bureau of Aviation Medicine.

Observatory. In the academic year 1960–61 three doctorates in astronomy were awarded, and one master's degree. There were fifty-two undergraduate students, of whom two were astronomy majors, and thirty-two graduate students.

In the field of spectroscopy, Dr. C. C. Kiess has continued his observations of high dispersion spectra of the planets Jupiter and Venus. Plans have been made to undertake laboratory studies of the absorption and reflectance spectra of the oxides of nitrogen with a large Littrow spectrograph. Messrs. A. Kiasatpoor of Iran and Kalarakal of India have been making observations of the solar spectrum with the large Wadsworth spectrograph, continuing the investigations of the faint lines in the solar spectrum that have been carried on at Georgetown for the past eight years. Mr. George Coyne, S.J. has been taking high dispersion spectrograms of various features on the moon, which he is comparing with carefully made calibrations on the microdensitometer.

The observatory has continued collaborating with the Research and Analysis Section of the Army Map Service to provide the exact positions of a series of lunar craters for a new map of the moon. Measurements have been made on photographs taken at the Lick Observatory and loaned to the Army Map Service for this purpose.

Efforts to obtain observations of flares fired from rockets were unsuccessful during the past year. Twenty-two observatories along the eastern part of the United States participated in this project for the Air Force Cambridge Laboratories. Failures were due not to the equipment of the volunteer observers, but to the rockets and flare mechanisms. The aim of the project is practical use of such flares for geodetic purposes. The volunteer observers have found that the count-down for a simple flare test can be as tiring as any satellite launching with delays of three to four hours. It was to be Georgetown's task to measure the positions of these flares against star fields, but this part of the project has not yet been activated.

Dr. Vera C. Rubin has done a considerable amount of computational work in collaboration with Dr. de Vaucouleurs on the brightness of galaxies. This project will continue during the coming year.

Le Moyne College. Fr. Robert O. Brennan, S.J., chairman of the physics department, was elected to the executive committee of the New York State Section of the American Physical Society for 1961–63.

Chemistry. Dr. Clifford J. McGinn is at present investigating the possibility of resolving racemic mixtures by means of azeotrope formation. If a d_1-l_1 pair forms an azeotrope with a third optically active substance, d_2, one of the following situations may arise: the solution will consist of a mixture of two azeotropes, d_1-d_2, and l_1-d_2; or it will consist of a single azeotrope having three components, d_1-l_1-d_2. If the former occurs, the individual azeotropes will in fact be diastereoazeotropes and their properties may be different, with resolution then possible. If the latter occurs, and the mole fraction of d_1 equals that of l_1, resolution cannot be effected. If the latter occurs and d_1 does not equal l_1, a partial resolution may be effected.

The results thus far indicate that for the systems studied, d_1-d_2, l_1-d_2, and d_1-l_1-d_2 are in fact different. It also appears that the azeotrope formed was d_1-l_1-d_2 when the mole fraction of d_1 and l_1 were different. Unfortunately, resolution was not effected because a fractionating column of high enough efficiency to bring about separation was not available.

Dr. George A. Pearse, Jr., is currently engaged in a research program concerned primarily with organic-analytical reagents and their application

to analytical spectrophotometric procedures. He has recently completed work on a spectrophotometric procedure for the determination of vanadium; this was the subject of a paper presented at the 1961 fall meeting of the American Chemical Society and published in *Analytical Chemistry*. Dr. Pearse was awarded a $7200 two-year NSF grant for research in the field of synthesis and analytical application of amidooximes.

Loyola College. Dr. William O. Negherbon, head of the biology department, was chairman of the section on toxicology at the First International Congress of Agricultural Medicine at the Faculty of Medicine, Tours, France, July 6–13, 1961. Dr. Negherbon was elected vice-president of the International Association of Occupational Hygiene in Agriculture. He has been invited to give a seminar on modern insecticides at the Lublin Institute of Occupational Hygiene in Poland in the summer of 1962, and to lecture at the Kiev (USSR) Institute of Occupational Hygiene and Diseases. At the Tours congress, Dr. Negherbon was awarded the memorial medal of L'Institut Pasteur by its director, Dr. Trefonel.

Also in the biology department, Fr. Joseph A. Burke, S.J. has been awarded $10,000 and a two-year extension on his grant from the National Institute of Mental Health. His research concerns the physiological action of psychopharmacological agents. Work on the original grant extended from September of 1959 to September of this year and was done in collaboration with Dr. Charles G. Wilber, formerly at Loyola and now dean of the graduate school at Kent State University in Kent, Ohio. Funds for the original grant plus the extension total $33,000 for four years. Research is done on the project both at Loyola and at the Marine Biological Laboratory, Woods Hole, Massachusetts.

Scranton University. The university received a request from the NSF to submit a proposal for an academic year In-Service Institute running consecutively for three years. The biology, chemistry, mathematics, and physics departments have each submitted separate proposals for continuation of this program at Scranton which has been on a yearly basis since 1959–60.

Chemistry. Two students won third prize in the fifth annual contest in colloids and surface chemistry sponsored by the Continental Oil Company and conducted by the University of California. Seven students spent the past summer doing research in the NSF-sponsored undergraduate research participation program. This program continues throughout the academic year on an NSF grant extending from 1960–61 through 1961–62.

The university supported a successful workshop for high school students, twenty-six in number, during the past summer.

The chemistry department has published its own freshman laboratory manual. It is also running a special program for advanced freshman students, consisting of a first semester of freshman chemistry, a second semester of quantitative analysis, and a second year of advanced quantitative and instrumental analysis. The program is experimental at present and is restricted to fourteen students.

Scholasticates

Shrub Oak. The physics majors have been using the air pump, filter geiger counter, and scalar circuits acquired by Fr. Thomas L. Cullen, S.J. They have been studying the natural radiation of radon and thoron from the ground as a means of detecting fallout from recent nuclear tests. Meteorological obstacles prevented detection of fallout from the French tests in April. However, positive results were obtained from the Russian tests, and the fallout detected with the filter geiger counter over a twenty-four hour period was well over a thousand times greater than normal. Future experiments look forward to the determination of the half-life of the fallout as well as further observations on the daily and hourly variations of the natural ground exhalation of radon and thoron. Difficulties with electronic components of the apparatus have temporarily delayed the work.

The Secchi Science Academy elected Mr. Peter Fink, S.J. as president and Mr. Ronald Mizen, S.J. as secretary. The academy has drawn up the year's program of student and guest lectures, with occasional technical movies. Mr. Louis M. Savary, S.J., of Catholic University, gave the first lecture on the field of statistics.

Fr. James J. Fischer, S.J. attended an NSF institute at Bowdoin College, Maine, for college teachers of mathematics. It consisted of lectures on probability and algebraic structures, and a seminar on the ideal college program and texts. The algebra was presented in the new approach introduced by E. Artin's *Geometric Algebra,* and emphasized the advantages of this geometrical treatment.

Weston College. Among the incoming theologians were: Mr. Donald J. Plocke, S.J., with a doctorate in biophysics from MIT; Mr. James M. Schecher, S.J., with a master's degree in physics from the University of Maryland; and Mr. John J. Williamson, S.J., with a master's degree in mathematics from Fordham University.

Fr. Edward MacKinnon, S.J. taught a summer course in physics at Fordham.

Woodstock College. A number of theologians spent the past summer doing research, teaching courses, attending institutes, or completing graduate studies.

Biology. Mr. George D. Ruggieri, S.J. (*Md.*) spent the summer at the New York Aquarium continuing his research on the effects produced by various biologically active substances on the development of the sea urchin. He worked with Dr. Ross F. Nigrelli, chairman of the department of biochemistry and ecology at the aquarium. He also collaborated with Dr. Morton Padnos of the Waldemar Medical Research Foundation, Inc. on immunological studies of marine forms.

Chemistry. Mr. James F. Salmon, S.J. (*Md.*) completed his doctoral studies in inorganic chemistry at the University of Pennsylvania. His dissertation research was part of a general program at Pennsylvania studying the lighter elements of Groups III, IV, and V of the periodic table. The dissertation is entitled: "Some properties of tetramethyldisiloxydialuminum and the interaction of boron phosphide diiodide with ammonia and ethylamine."

> An investigation was made of the products of the reaction between dimeric $(CH_3)_2AlBr$ with $(SiH_3)_2O$. The principal product is dimeric $(CH_3)_2AlOSiH_3$. This fluffy white solid decomposes at room temperature into a colorless glass and gaseous SiH_4. The colorless glass is a polymer containing a Si-O-Al backbone, and the reaction is an example of inorganic condensation polymerization. Rate studies of this decomposition were carried out over a range of temperatures. These studies, coupled with proton magnetic resonance spectra of both the dimeric reactant and the dimeric product, enable one to postulate a mechanism for the formation of the latter and for its decomposition.
>
> The interaction of dimeric $(CH_3)_2AlOSiH_3$ with the Lewis acids, BF_3, BCl_3, and B_2H_6, and with the Lewis base, $(CH_3)_3$ were also studied.
>
> A description was given of properties of the new compounds, BPNH and $BPNC_2H_5$, which are formed by the interaction of BPI_2 with ammonia and ethylamine.

Mr. Charles L. Currie, S.J. (*Md.*) spent the summer doing research in the Molecular Kinetics Section at the National Bureau of Standards, Washington, D.C. Working in collaboration with Dr. James R. McNesby he studied the vacuum-ultraviolet photolysis of cyclopropane. Vacuum-ultraviolet photochemistry has been of recent interest, since it allows the study of relatively high energy processes while avoiding some of the complications of radiation chemistry with its extremely high energy input. Resonance lamps using hydrogen and rare gases are used as the light sources.

Mathematics. Mr. John A. Lutts, S.J. (*Md.*) completed his work for the doctorate at the University of Pennsylvania. His dissertation in the field

of point-set topology was entitled: "Some imbedding properties of locally compact Hausdorff spaces which possess unisolvent systems". An abstract follows.

> An investigation was made to find out what imbedding properties a locally compact Hausdorff space X can have, if for some arbitrary but fixed integer $n \geqslant 2$, a set of n continuous functions $F = \{f_1, \cdots, f_n\}$ can be defined on X so that each f_i has its values in some fixed locally compact Hausdorff skew field K, and so that the set F has the following property: for any set of n elements $\{k_1, \ldots, k_n\}$ in K, not all zero,
>
> $$\sum_{i=1}^{n} k_i f_i(x) = 0$$
>
> has at most n — 1 solutions in X. Such a system of functions is called a K-valued unisolvent system of order n.
>
> The results found include generalizations of old findings as well as some new ones. When the study is restricted to σ-compact, locally compact Hausdorff spaces, it can be proved that if the skew field K is not connected but is infinite or if K is the field of real numbers, then X can be imbedded into K (i.e., is essentially a subset of K) unless X is a one-sphere. Also, if X is compact Hausdorff and K is the field of complex numbers, then X can be imbedded into K when X is locally connected or is connected and can be separated by a certain finite set of points. Some very limited results were given in the case when K is a finite field or the skew field of quaternions. Included also are some results that relate unisolvent systems to classical approximation theory, which motivated, in part, the study of such systems.

On an NSF grant Mr. James F. Smith, S.J. (*Buff.*) attended a five-day conference on undergraduate research in mathematics at Carleton College, Northfield, Minnesota. The conference, under the direction of Professor Seymour Schuster, was held to discuss the problem of why there have been so few applications made for undergraduate research participation programs in mathematics, while the response to such programs in other fields has been very enthusiastic. Among the participants were Professors R. L. Wilder, Paul C. Rosenbloom, and Kenneth O. May.

Mr. Joseph E. Billotti, S.J. (*N.Y.*) spent the summer at the Research Institute for Advanced Study (RIAS) in Baltimore. In conjunction with this work he attended the OSR-RIAS Symposium on Non-Linear Differential Equations held at the United States Air Force Academy. One of the purposes of this international meeting (among the eight or nine countries represented were Russia, Poland, and East Germany) was to further the contact between mathematicians and engineers in a field so important to both. Thus each of the five days included two or three sessions of round table discussion on one of the major areas of interest, as, for example, "Oscillations and asymptotic behavior," and "Control and stability."

Mr. Andrew P. Whitman, S.J. (*N.O.*) spent the past summer in Boston while pursuing his mathematical research at the Harvard University Library and consulting with some mathematicians at Brown University. He continued work on a paper in connection theory, as well as beginning new research in differentiable manifolds and Grassmann algebras.

A six-credit course in linear algebra was given to eleven rhetoricians at St. Andrew-on-Hudson by Fr. Arthur E. Morgan, S.J. (*N.Y.*). These rhetoricians will take mathematics or science as their minor during their philosophate studies. The course began with a one-week review of solid analytic geometry, and the remaining time was spent on modern algebra and its application to vector spaces. The text used was D. C. Murdoch's *Linear Algebra for Undergraduates.* During the regular school year this class is substituting a calculus course for the regular Greek course.

At Wernersville, Fr. Francis Greene, S.J. (*Md.*) taught the summer course in mathematics. Not restricted to future science students, the course sought to communicate some basic insights into mathematics and mathematical method by developing ideas on number systems, a deductive system for algebra, Boolean algebra, analytic geometry, transfinite numbers, and non-Euclidean geometries. The text was M. Richardson's *Fundamentals of Mathematics.* In addition, each student was required to submit a report on a book chosen from a list of about thirty. Those selected to start calculus during rhetoric year were given a review of algebra, along with some new topics such as determinants and partial fractions.

Physics. Mr. Robert A. J. Brungs, S.J. (*Md.*) completed his doctoral studies in solid-state physics at St. Louis University. His dissertation was entitled: "Semiconductor properties of monocrystalline boron". An abstract of the research is given below.

> Five samples of the β-rhombohedral form of boron were cut from a larger piece of this material. Three of these samples were single crystals, one a double crystal, and the last was nearly polycrystalline. Because of boron's hardness (9.7 on Mho's scale), its brittleness, and the small size of the single crystals, the cutting was done by hand. This consisted in etching ten mil tungsten wire in aqua regia and using the etched wire as a saw. The crystals were analyzed with x-ray techniques to determine the type of structure (boron shows at least four crystalline structures), and the orientation of the crystal planes in the samples. The three single crystals were approximately $4 \times 1 \times 0.8$ mm.
>
> These samples were then used to determine the width of the forbidden energy gap in boron in three orthogonal crystal directions. This was accomplished by measurements of the electrical resistivity, the photoconductivity, and the Hall effect. For the first time the experimental values for the band gap agreed within experimental error for each of these types of measurement. The band was found to be of the order of 1.3 electron volts wide, and may be slightly anisotropic.

Fr. Christopher Wilson, S.J. (*N.Y.*) received fellowships for two summer institutes for theoretical physics, one at Brandeis University and one at the University of Colorado. He attended the latter which concentrated on scattering theory and offered a number of lectures on particular aspects of nuclear and elementary particle theory. About fifteen professors from universities here and abroad made up the faculty, and there were seventy-five pre-doctoral and post-doctoral participants in the institute. Among those in attendance were: Fr. James Carter, S.J. (Loyola University, New Orleans), Fr. Patrick Heelan, S.J. (Irish Province, currently a Fulbright fellow at Princeton's Palmer Physical Laboratory), and Dr. Robert Carovillano (Boston College).

Graduate Studies and Research

Johns Hopkins University. Working on his doctoral dissertation in nuclear physics, Mr. Timothy E. Toohig, S.J. (*N.E.*) has collaborated in important new discoveries in the field of elementary particles. A summary of the work follows.

In collaboration with the Duke University high energy group, the Johns Hopkins University group has obtained an exposure of the Alvarez seventy-two inch hydrogen bubble chamber (filled with deuterium) to a 1.23 Bev/c beam of mesons. The mesons were produced by the bevatron at the Lawrence Radiation Laboratory in Berkeley, California. In May the Hopkins group began looking for a new heavy meson that had been predicted by a number of theoreticians. The prediction was made to correlate the observed nuclear structure with the electromagnetic form factors for neutrons and protons which had been derived from the electron scattering experiments at Stanford and Cornell.

While the work was in progress at Johns Hopkins, a report originated from Berkeley that the particle had been found with a mass of 790 Mev by analyzing anti-proton annihilations in hydrogen. This was about 300 Mev heavier than predicted. The data available at Johns Hopkins were processed immediately on the IBM 7090 and showed the sought-for particle clearly in the reaction:

$$\pi^+ + \mathrm{d} \rightarrow \mathrm{p} + \mathrm{p} + \pi^+ + \pi^- + \pi^\circ.$$

A kinematic fit was made to find those events where the invisible π° was present, and to find the effective mass of the three-pion system in those events by applying energy and momentum conservation to the two visible protons and a third neutral particle. The plot of number of events *vs.* effective mass shows a striking deviation from phase space between 740 and 800 Mev. This confirms the existence of the Berkeley particle, but indicates a slightly lower mass value than that assigned by the Berkeley group.

A second peak was also evident at an effective mass of about 550 Mev. The statistics are still low for this peak, but this is hoped to be the particle predicted

by the theoreticians. The particle found by the Berkeley group and independently at Hopkins would then be another particle.

A preliminary report on these two peaks was made by Dr. Aihud Pevsner of Johns Hopkins University at the International Conference on Elementary Particles at Aix-en-Provence, France, on September 15, 1961.

From our readers . . .

To the Editors: Congratulations on the first issue of the newly-revived Bulletin. All of the issue, but especially Fr. Frank Haig's excellent article and Fr. Allan Panuska's interview with Dr. William Thaler, made interesting reading.

For readers of Fr. Haig's article who are interested in probing further into the role of the priest-scientist, there are two excellent articles which have not received the attention they deserve, and which may therefore have escaped the attention of readers of the Bulletin. One is the article, "Science and Apologetic Motivation," by Fr. Robert O. Brennan, S.J., in the Woodstock publication, *The Theologian,* 8 (1952), 58–64. The other is an article by Fr. Ernan McMullin, entitled "Science and the Priest," which appeared in the Maynooth journal, *The Furrow,* 9 (1958), 763–74.

Problems of graduate science departments. In the interview reported by Fr. Panuska, Dr. Thaler honestly faced up to many of the problems that plague graduate science departments in Catholic universities today. I must confess, however, that while agreeing with Dr. Thaler on the importance of outstanding Catholic science departments, and concurring in his analysis of the causes of the weakness of many Catholic universities in science, I find it hard to agree with some of his proposals to improve the present situaition.

Certainly we would all admit that the chief solution is in "providing adequate salaries and facilities for the graduate science faculty." The only really essential thing in the make-up of a first-rate university is a first-rate faculty. Despite this rather obvious fact, many universities still seem to fail to understand the nature and the value of their professors. If a university science department can attract and hold really competent science professors, everything else will follow. The government is pouring so much money into scientific research and the provision of laboratories and equipment in science that we can be sure there will be an abundance of funds available to the institutions with adequate scientific staffs in the years ahead, whether these institutions be under public or private control.

In attracting and holding competent science professors, however, our universities run full against a tremendous financial problem. Dr. Thaler's solutions to this problem are supplementary stipends for outside consulting and extra remuneration from research grants and contracts for university scientists. The first of these is at least a partial solution to the problem of faculty salaries in science, though there are obvious difficulties involved.

The second, however, is to most American educators a completely unacceptable answer to a problem so pressing that we may be tempted to grasp at illusory solutions.

Outside consulting. Consulting outside the university is certainly financially rewarding for a university scientist, and it can also be academically rewarding in the contacts it brings him with government and industrial scientists. As a result, most of the outstanding universities of the country permit a limited amount of consulting by their faculty members. The maximum amount permitted is one day a week, and many universities allow only one or two days a month. The danger here, of course, is that the consulting may take the professor away from the university too much, and distract him from teaching and basic research. There is also the ever-present possibility that he will be lured away permanently by an industrial or government laboratory when he experiences in the concrete the difference between his university salary and his consulting fees. We had sad experience with this latter possibility at Fordham just last year. As Dr. Thaler so well said, "There is need for developing a research atmosphere in graduate science departments," but to do this requires a faculty and student body who are "around" most of the time. A faculty member who drops in to meet his classes and have office hours once or twice a week is of little value in building up a research atmosphere, or a strong science department. Hence, if consulting is permitted, it must be controlled carefully so that the students and the university are not made to suffer by the professor's obligations outside the university.

An unacceptable solution. Dr. Thaler seems to feel that an even better solution to the financial problem is to permit professors to take additional compensation during the academic year from research grants and contracts. This is considered a completely unacceptable practice by most of the major universities of this country. A study made in 1956 of the policies of twenty-four outstanding universities in the United States (none of them Catholic) indicated that only three permitted extra compensation for participation in research during the academic year, and then only under very special conditions (Herbert Longenecker, *University Faculty Compensation Policies and Practices in the United States.* Urbana: University of Illinois Press, 1956). The argument is that the faculty members should not be paid extra for what they should be doing in any case, since research is an essential part of their professorial responsibilities. Hence it is hard to see Dr. Thaler's argument that a faculty member will be unwilling to apply for grants to support his research "if besides his teaching duties he has this research responsibility and gets no additional remuneration from it." A university faculty member has an obligation to do

research. If a research grant will provide equipment, stipends for student assistants, and summer salary for the professor himself, it is hard to see why a properly motivated professor would not seek such grant funds, even if they did not supplement his own salary during the academic year. By facilitating his research work, research grants enable him to be more productive, and hence lead indirectly to promotions in rank and the consequent increases in salary.

Allowing professors to supplement their salaries from grants and contracts during the academic year can open the doors to great abuses. In addition to the inequity to professors in other departments where grants and contracts are much more difficult to obtain, situations arise in which professors choose research projects not in terms of intrinsic interest or profit to students or university, but in terms of financial rewards to the professor himself. For this reason almost all of the major universities in the country have strong policies against such extra remuneration. That the foremost scientists in the country agree with such a stand is clear from the policies of the NSF, and from the recent statement of the President's Science Advisory Committee: "However, no such charges against grants and contracts should be permitted for extra compensation to individual faculty members during the regular academic year" *(Scientific Progress, the Universities, and the Federal Government,* A Statement by the President's Science Advisory Committee. Washington: Government Printing Office, November 15, 1960, p. 30).

Other possibilities for increased compensation. But what about the basic problem of inadequate compensation of faculty members in science? How is this to be solved if we exclude extra compensation from grants during the academic year? In the first place, his problem is gradually being eased (or at least being made part of a more general problem) by the overall increase in faculty salaries in all departments all over the country. The salaries of science professors are still not competitive with those of industrial scientists, but then again the salaries of English and economics professors are not competitive with those of lawyers or businessmen, and so it is not entirely fair to put scientists in a special class by themselves. Science professors can supplement their salaries very nicely by a limited amount of consulting during the year and by working full-time on research grants during the summer months (preferably at the university), for which they will receive approximately two-ninths of their academic-year salary. When these pieces are added together, the sum-total is not a princely salary, but it is at least adequate for raising and supporting a family. In addition, most universities have pension and insurance plans which are of considerable help to their faculty; and tuition

plans for children of faculty members can represent great savings in this day when college education is becoming so expensive. When all is said and done, however, the fact remains that any university professor must be willing to make sacrifices to stay in academic life, and the fact that so many are willing to make these sacrifices attests to the non-monetary compensations of academic life that are so attractive to academic people.

These non-monetary aspects of the life of a university professor often assume a tremendous importance in his eyes. He wants to have the freedom to teach and do the research he is interested in; to have the respect of his students, his colleagues, and the university administration; to feel that he has something to say about the policies of the university. An adequate appreciation of the importance of these factors can often do much to compensate for a university's inability to pay salaries competitive with those of industry.

Aid to universities for increasing research time. One of the most important desires of any worthwhile university professor is time and facilities for research. In the sciences the facilities can often be provided from outside sources, but the university administration must provide the time. This can be done with no financial loss to the university by an arrangement which is being looked on with increased favor by the NSF and other government agencies. Here, part of a professor's salary is paid from a research grant, and the university correspondingly decreases his teaching load. Thus a professor might teach two courses a semester instead of three (and most research scientists today feel that two courses is a maximum if they are to do productive research), with one-third of his salary paid by the agency supporting the research and two-thirds by the university. This arrangement is free of the objections mentioned above with regard to extra remuneration during the academic year, and has obvious advantages for all concerned. The faculty member is happier because he has more time for research. The university can increase its staff without any added expense, and has additional faculty members available to share the load of thesis direction, consultation with students, and other common departmental and university obligations.

The advantages of such an arrangement have caused the NSF to encourage grant applications drawn up in this way, even though the NSF explicitly excludes the possibility of extra remuneration for faculty from grants during the academic year. Again, in the recent statement of the President's Science Advisory Committee referred to above, universities are urged to request a part of faculty salaries from government sources. The only condition laid down is that the universities must avoid situations in which a professor becomes partly or wholly responsible for raising

his own salary. If universities are firm in accepting institutional responsibility for payment of faculty salaries, however, they are urged to seek federal support for salaries as well as for equipment and facilities. The final recommendation of this committee (*ibid.*, p. 30) is worth quoting in full on this point:

> Since the Federal Government has a deep interest in a rapid increase in the quality and quantity of the nation's teaching scientists, its agencies should in general seek forms of support for basic research and graduate education which will permit universities to enlarge their permanent faculties. In particular, the government should allow charges against all Federal grants and contracts for time spent by faculty members on work so supported. (However, no such charges against grants and contracts should be permitted for extra compensation to individual faculty members during the regular academic year.)

Future government assistance. This statement, as well as the whole tenor of this very important brief of the Science Advisory Committee, indicates that the government will take steps to ease the financial burdens of the universities in their teaching and research programs in science in the years ahead. This, then, is the time when our universities should be willing to make sacrifices to strengthen their science faculties as much as possible, for government money will continue to flow to the universities with respected scientists on their staffs. In an effort to attract such scientists, however, our universities should be careful not to make policy decisions on the basis of expediency which may in the long run prove to be disastrous. Every administrator or teacher of science in our colleges or universities should read this document, which is a blueprint of the government's policies toward science in the universities in the years to come.

JOSEPH F. MULLIGAN, S.J.
Chairman, Department of Physics
Fordham University

OFFICIAL REPORTS AND NOTICES

The 1961 Meeting at Fordham

First General Meeting

The thirty-sixth annual meeting of the American Association of Jesuit Scientists (Eastern States Division) was called to order by Rev. Clarence C. Schubert, S.J., President, at 7:30 P.M. on Wednesday, August 30, 1961, in Room 103, Freeman Hall, Fordham University.

Rev. Vincent T. O'Keefe, S.J., Academic Vice-President of Fordham University, representing Very Rev. Laurence J. McGinley, S.J., President of the University, welcomed the members of the Association to the Fordham campus.

A motion was made and passed that the Secretary's report be accepted as submitted. The President then appointed the committees on nominations and resolutions.

The President introduced Mr. James F. Smith, S.J., Woodstock College, Editor of the Bulletin, who asked for opinions on editorial policy, format, and news items of the 1961 Bulletin. The news items submitted should be more detailed in order to be useful, he remarked. He asked for more copy, mentioned those to whom the Bulletin is sent, and suggested articles on the following topics as suitable for publication: engineering in Jesuit colleges, use of TV in high schools and colleges, use of science libraries and museums, use of visual aids, extra reading assigned to science and mathematics students, reports on outstanding high schools, such as the Bronx High School of Science.

Fr. Joseph Mulligan congratulated Mr. Smith and his staff on their work during the past year, and commented that the Bulletin in its present form is close to what it should be.

Fr. James J. Ruddick raised the question whether proceedings of the present meeting and abstracts of papers read at the meeting would be published in the Bulletin. Mr. Smith said he would like to have these and would be happy to publish them.

Fr. Schubert announced that on Thursday evening, August 31, there would be an open forum to discuss the objectives of the Association.

The President gave an interesting illustrated lecture entitled "Field Emission Microscopy."

The meeting adjourned at 9:00 P.M.

Final Business Meeting

The meeting was called to order at 9:30 A.M., September 1, in Room 103, Freeman Hall, by the President, Fr. Schubert.

Fr. Schubert expressed his thanks to Fr. Frederick Dillemuth of Fordham University for his work in helping with the arrangements for the meeting. He asked Fr. Walter Feeney, Acting Secretary, to read the Treasurer's report. The report stated that the Association had a positive balance of $2,765.74 as of September 1, 1961. A motion was made and passed that the report be accepted.

The President called on the Secretaries of the various sections to announce newly-elected officers, if any. Those reported were:

Chemistry section: Chairman, Fr. Arthur Kehoe, St. Peter's College; Secretary, Mr. Ramon Salomone, Fordham University.

Mathematics section: Secretary, Fr. Francis O'Connor, Brooklyn Prep.

All other sections reported that no elections were held.

The Committee on Resolutions was then asked to report; Fr. Merrill Greene presented the following report on behalf of the committee:

> The members of the American Association of Jesuit Scientists (Eastern States Division), assembled at Fordham University for their thirty-sixth annual meeting, hereby resolve:
>
> 1. That they are sincerely grateful to Very Reverend Laurence McGinley, S.J., President of Fordham University, for his generosity in inviting the Association to meet at Fordham this year, and to Fr. Vincent O'Keefe, S.J., Academic Vice-President, for his gracious and cordial welcome on behalf of the President, and to Fr. Lawrence Walsh, S.J., Provost of the University, for the efficient arrangements for their stay on the Fordham campus.
>
> 2. That they are sincerely grateful to Mr. James Smith, S.J. and his colleagues for their generous and effective work in publishing the BULLETIN.
>
> 3. That the President of the Association write a letter of condolence on behalf of the members to the near relatives of the late Fr. Joseph Cosenza, S.J., former member of the Association.
>
> 4. That the President of the Association write a letter of sympathy and encouragement on behalf of the members to Fr. John Frisch, S.J., of the Association, who is seriously ill.
>
> 5. That the President of the Association write letters of congratulations to the following jubilarians of the Association: Frs. John Tobin, S.J., Aloysius Kelsch, S.J., and Joseph Busam, S.J.
>
> Merrill F. Greene, S.J.
> James Harley, S.J.
> James Pallace, S.J.

A motion was made and passed that the resolutions be accepted.

The President asked if there was any other business that the members wished to discuss. Fr. Fischer reported that Mr. Smith had requested that the minutes of the meeting and the slate of new officers be sent him for publication in the BULLETIN. Fr. Persich brought up the matter of amending the permissions requested from the four Provincials so as to include those theologians from Woodstock and Weston who write papers for the meeting. Fr. Reardon commented that many theologians at Woodstock and Weston would be interested in writing papers for the mathematics section and so should be invited.

Fr. Schubert brought up the question of reimbursing the host institution at future meetings by charging a registration fee to the Fathers in attendance. Fr. Reardon suggested that members in houses where meetings occur should find out whether such expense is treated as an unfair burden. Fr. Schubert added that his suggestion was not prompted by any reluctance on the part of officials at Fordham; quite the contrary was true. Fr. Canavan remarked that the host university gains something by having the meeting on its campus; for example, publicity. Fr. Schubert stated that according to the Constitutions the Executive Council can decide this matter, but he preferred to get the members' opinions first. Fr. Martus asked if such a registration fee would help much. The matter was left undecided.

Fr. Schubert then called for a report from the Committee on Nominations. Fr. Reardon read the report: for President, Fr. James Harley, Georgetown University; for Secretary, Fr. John MacDonnell, Holy Cross College. A motion was made and passed that the nomi-

nations be closed. Fr. Feeney, Acting Secretary, cast one vote for the Association for Fr. Harley as President, and one vote for the Association for Fr. MacDonnell as Secretary.

Fr. Harley then took over from Fr. Schubert and presided over the remainder of the meeting. He invited all to write suggestions for conduct of future meetings and other business of the Association. He also stressed the value of the Association, of which he has been a member since 1927, in encouraging and stimulating Ours involved in the teaching of science and mathematics. Fr. Harley further suggested that those who regularly attend meetings encourage fellow members of respective communities to attend when possible.

No other business came before the house. A motion was made and passed that the meeting adjourn. The meeting was adjourned at 10:15 A.M.

WALTER J. FEENEY, S.J., *Acting Secretary*
per JOHN J. MACDONNELL, S.J.

PROGRAM OF THE SECTIONS

Physics. Thursday, August 31, 1961, Room 103, Freeman Hall.

1. *Current Physics: Optical Pumping in Rubidium.* Fr. Joseph F. Mulligan, S.J., Fordham University.

2. *Current Physics: Hyperons, Who They Are and What They Do.* Fr. James J. Ruddick, S.J., Canisius College.

3. *Past Physics: The Geology of the Appalachian Mountains.* Fr. James W. Skehan, S.J., Boston College.

4. *Future Physics: Scholasticate Training in Mathematics for Science Majors.* Fr. James J. Fischer, S.J., Loyola Seminary, Shrub Oak.

5. *A Teacher Views McCue's* The World of Atoms. Fr. Peter F. Hess, S.J., St. Peter's Prep.

6. *The Discovery, Undiscovery, and Rediscovery of Element 102* (with slides). Fr. Frederick L. Canavan, S.J., Fordham University.

7. *Laboratory Physics in High School.* Mr. Robert W. Dahlke, S.J., Brooklyn Prep.

8. *Physics Laboratory Work at Collège Ste.-Marie.* Fr. Roland Saint-Denis, S.J., Collège Ste.-Marie, Montreal.

9. *Laboratory As Experiment.* Fr. Joseph T. Watson, S.J., St. Peter's Prep.

Chemistry. Thursday, August 31, 1961, upper amphitheater, Chemistry Building.

1. *Demonstration of Paramagnetism in d-Electron Elements.* Fr. Joseph A. Martus, S.J., College of the Holy Cross.

2. *Mechanism of an S_ni Reaction.* Mr. James L. Lambert, S.J., Loyola College, Baltimore.

3. *The McQuaid Summer Science Institute.* Fr. William H. McBride, S.J., McQuaid High School.

4. *Potential Energy Curves from Scattering Cross Sections.* Fr. Robert D. Cloney, S.J., Woodstock College.

5. *Synthesis of Some Prolan Derivatives.* Mr. Ramon A. Salomone, S.J., Fordham University.

Mathematics. Thursday, August 31, 1961, Room 106, Freeman Hall.

1. *Teaching Machines and Self-Instruction Programs.* Fr. James J. Fischer, S.J., Loyola Seminary, Shrub Oak.

2. *Research in Mathematics for College Undergraduates.* Mr. James F. Smith, S.J., Woodstock College.

3. *Report on Advanced Placement.* Fr. Timothy P. Reardon, S.J., Regis High School.

4. *Discussions on the School Mathematics Study Group Courses.*
First Course in Algebra. Mr. Francis A. Fallon, S.J., St. Peter's Prep.
Geometry. Mr. Charles J. Zimpfer, S.J., McQuaid High School.
Elementary Functions. Mr. Edward F. Cavey, S.J., Georgetown Prep.

Philosophy and Science. Wednesday, August 30, 1961, 3:00 P.M., Room 106, Freeman Hall.

The Cosmology Course: Aims and Difficulties. Fr. Walter Feeney, S.J., Weston College.

Open discussion and comments, with particular emphasis on what should be the subject matter for such a course.

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