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To our readers . . .

In an earlier number of the BULLETIN (March, 1961), Fr. Frank R. Haig, S.J. attempted to show, under several aspects, that the profession of a priest and that of a scientist are not merely compatible in essence and conjoined by circumstance, but that, in the right man, they represent harmonious elements of an integral vocation embracing permanent Christian values. As the qualifications for competence both in priests and in scientists continue to be raised and multiplied, further discussion of this sort may assist the understanding and thus the motivation of an apostolate that promises to grow no less strenuous than important in years to come. The topic is pursued in the present number from an explicitly theological point of view. From an analysis of the essential meaning of the priestly and religious states themselves, Fr. Ernest G. Spittler, S.J. suggests that a Jesuit can see his scientific career as an authentic phase and his scientific accomplishment as a distinctive fulfillment of his primary vocation, to serve as a mediator between God and men.

Several years ago, considerable dismay was felt among scientists who read the results of a study on "The Image of the Scientist among High School Students." That their profession should appear in the eyes of adolescents to be complex, arduous, even dangerous, and to that extent uninviting, would have been easy for an elder generation of scientists to believe. But what the study actually revealed, that students thought of scientists as leading dull, passive, and lonely lives, came as rude disenchantment to men who a few decades earlier had embraced their calling with a sense of adventure and challenge. Reflecting on their disappointment, not a few have wondered how many of the features in this dreary image may have been fashioned out of the students' experience in high school science classes, dispiritedly recording catalogues of facts and formulae dictated by tedious instructors in paraphrase of textbooks more tedious still. In the following pages, Mr. Roy A. Drake, S.J. suggests simple yet often neglected means whereby the high school science teacher can encourage among his students those dispositions of experimental curiosity, technical inventiveness, and theoretical imagination wherein science displays its distinctive humanism, and whereon it depends for its very life.

THE PRIEST-SCIENTIST IN THE CHURCH

ERNEST G. SPITTLER, S.J.

Factual presuppositions

If we survey human societies and cultures, we find a striking association of learning with the priestly classes. The emphasis, of course, is always on learning in relation to sacred things, or in connection with sacred worship. Thus, for instance, astronomy was cultivated by the Babylonians and Egyptians for the sake of its relevance to astrological worship and magical practices. Among the Jews, religious learning was perhaps the only form of learning considered worthy of a man's total dedication. It was, quite naturally, concentrated in the priestly class, both by reason of the priests' role in the social structure and by divine command.

Similarly, in the history of the Church, we find a constant association of learning with the priestly and religious states. One need only think of the role of the monasteries in the preservation and spread of ancient classics, along with the Church's own treasures of religious learning.

In the Society, we find a constant tradition of learning, secular as well as theological and religious. In all these examples, one must understand that the learning in question was that kind of learning that was valued by the particular society, age, or culture.

I would suggest that such a widespread and long-standing association of learning with the priesthood in all cultures, and particularly in the Church, constitutes an antecedent probability that there is a certain fittingness to this association, even if one cannot allow a connection of necessity.

Theological presuppositions

Authority. Modern Popes have not only encouraged the thorough intellectual formation of priests, but have also urged bishops to send capable and interested priests for specialized studies, even in the secular arts and sciences (see, for instance, *Acta Apostolicae Sedis*, 28 (1936), 35–36). The Society has incorporated into its Institute as an important apostolic work, the pursuit of scholarship (*Epit.*, n. 685). St. Ignatius did not fail to encourage the cultivation of every kind of genuine learning, and Fr. Janssens mentions it among the foremost apostolates of the contemporary Society (*Acta Romana*, 11 (1947), 315).

Nature of the priesthood and religious state. The priest is a man

totally dedicated to the service of God on behalf of men. Thus, he plays a mediator's role, especially through the administration of the sacraments, the offering of Mass, and public prayer. The religious state implies a special consecration of one's person and activities to God. The Jesuit priest, on both scores, has an essentially apostolic orientation, towards the salvation and perfection of souls.

Priest and layman in the Church. The priestly and the lay states are different but complementary roles within the Church. The priest has a special grace-mediating function with respect to the layman, as the layman has a grace-mediating function with respect to the non-Catholic world. But we may say that whereas the layman's role is mediatorial to the non-Catholic only, the priests' role is mediatorial to the Catholic laity and to the non-Catholic. Also, we may note that the priest is set apart from temporal engagements, while the layman is committed to them by his very role.

Relation between the natural and supernatural. Every legitimate human vocation has an "obediential potency" for the supernatural, because every human being has such a potency. No legitimate human vocation is distorted, destroyed, or degraded by reason of its elevation to the supernatural. Quite the contrary is true, in fact: elevation to the supernatural tends to bring nature closer to its own intrinsic perfection, at least by removing certain obstacles to its realization. By reason of the elevation to the supernatural, human activity is elevated to a wholly new level and becomes capable of actions otherwise impossible. Hence, the relation between the natural and the supernatural is better conceived as a subordination of one order to another, not simply as means to end, but with each order preserving a certain autonomy of its own.

Reasons for the priest's presence in science

Accident. According to one school of thought, the reason why there should be priests in science is simply the historical accident that whereas the Church has seen fit to set up and maintain educational institutions, there are not enough lay Catholic teachers able or willing to teach science in them. Or else, they argue that owing to historical circumstances, science and technology have either grown up apart from the influence of the Church, or drifted away from it, or at least have become imbued with a spirit that tends to ignore, if not to undermine, religious faith. The presence of priests in these areas of human learning is conceived of as a potential antidote to these baneful influences. Once, however, Catholic laymen are established in these fields, the priest will drop out, because he will no longer be necessary.

Intrinsic relation. A second position seeks an intrinsic relation between the priestly and the scientific professions in the vocation of the priest-scientist. Its proponents argue that the vocation of the priest-scientist is to be understood by analogy with the vocation of the foreign missionary. Just as the foreign missionary is sent to certain regions to carry the message of Christ to those who do no know him, so too the priest-scientist is sent to a certain stratum of modern society. Just as the foreign missionary, once he is designated for his work, must devote his time and attention to learning the language, customs, and culture of the people to whom he is sent, so too the priest-scientist must devote himself to acquiring the habit of scientific thought and to promoting its interests and purposes. Just as the missionary priest, so too the priest-scientist, shares in the grace-giving mediatorial role of the priest in the Church. Other things being equal, the effectiveness of the priest's mediatorial role will be enhanced, the more completely and the more perfectly he is able to identify himself with the aims, interests, habits of thought, and activities of the people to whom his apostolate is directed. But the scientific community is constituted precisely by the activity of scientific investigation, with its distinctive methods and atmosphere. Now, one of the problems is that this atmosphere is highly charged with a spirit of scientific humanism, as well as with rationalism and materialism. Yet these ideologies are not usually arrived at reflectively; rather, they are absorbed even before scientific competence is attained, precisely because they are not properly scientific in character. They are metaphysical or quasi-religious presuppositions.

Appropriateness. A third position looks for a middle ground between the first and second. That is, it tends to understand the role of the priest-scientist in terms of appropriateness, to ask whether there is not a certain fittingness about the presence of priests in scientific disciplines. Its adherents analyze the situation much as do those of the second position—in terms of the analogy of the foreign missionary, adaptation, and the mediatorial role of the priesthood in life of grace. They admit with the first position, however, that if there were enough Catholic lay scientists adequately grounded both in scientific skills and habits of thought and also in the complete integration of these with their religious beliefs and the apostolic implications of life of grace, then there might not be any need for priests to engage in this kind of work. However, with the second position, they seek a closer connection between the priest as mediator and the layman in the Church. The priest communicates grace in a way, and with an effectiveness, that is not ordinarily true of the layman. Hence, the priest-scientist serves principally for the advantage of the lay Catholic scientist, to enable him to attain integration between his religious life

with its apostolic implications and his scientific vocation with its demands upon his time and energies. It is the lay Catholic who will be most effective in influencing his non-Catholic scientific associates. Not that the individual priest will not do so at all, but if one considers the impact of the apostolate of the whole Chruch upon the scientific community, it appears to be the layman who has the most frequent, intimate, and sympathetic contacts with the non-Catholic scientific world. Hence, it is through the layman that the Church reaches the scientific community most effectively.

One may observe, too, that the priest-scientist is in a uniquely effective position to accomplish his own work. For he has in common with the lay Catholic scientist the life of faith to be communicated, as well as the habit of scientific thought and activity with which this life of faith is to be integrated. Over and above this, he possesses from his own studies for the priesthood the means of achieving a deliberate integration of his life of faith with his scientific vocation. The layman, on the other hand, finds it almost impossible to achieve this integration in the same ways as the priest has the opportunity of doing. For scientific studies today are so demanding and so lengthy that the layman simply cannot, practically speaking, afford to spend the necessary time in philosophical and theological studies that would enable him to achieve a deliberate integration equalling that possible to the priest. Nor does the layman have the priest's motivation to acquire this knowledge and understanding. Furthermore, for a long time to come, the vast majority of Catholic scientists are going to receive their scientific training in non-religious, if not anti-religious, contexts. Notice, too, how difficult it is for the priest himself to acquire that degree of knowledge, and integration of knowledge with the life of grace, which the times seem to demand—and this when he has both the motivation and the opportunity to do so! It would seem that the priest-scientist can be the mediator of such integration by his example, counsel, and educational activities.

Even though it is in principle possible for the lay Catholic scientist to achieve a degree of integration of his life of faith with his scientific vocation without there being any need of priest-scientists, still would not such an integration be more easily and more quickly achieved through living contact with priests who have attained it in their own lives, and are thus better able to help others to do so?

The role of the priest-scientist

Dimensions in the vocation of the Jesuit priest-scientist. It seems to me that any discussion of the role of the priest-scientist in the Church

must take into consideration several dimensions of activity, together with an appreciation of the sometimes complex interrelationships that may exist between them. Thus, for an adequate consideration of the role of the Jesuit priest-scientist in the Church, one must consider at least three dimensions to his vocation. The first dimension coincides with the vocation of every Christian. For whatever characterizes the vocation of the Christian also fundamentally characterizes the vocation of the priest. The second dimension corresponds to the religious state of the Jesuit priest-scientist. Over and above elevation to the supernatural life of grace, which he has in common with every Christian, the religious state sets a man apart from the world and commits him to a life according to the counsels. A third dimension corresponds to the priestly vocation, in which a man "taken from among men is appointed for men in the things pertaining to God" (*Hebr. 5:1*).

No legitimate human activity is excluded by the fact that one is a Christian. But both the priestly calling and the religious life exercise a limiting function on the kinds of activities in which one may engage, and this from two sources: ecclesiastical authority, which determines what is essential and proper to both the religious and the priestly vocations, and various external circumstances of time, place, and social or religious custom. I would include under the first both the general prescriptions of canon law and those defined by the particular religious institute. Both, obviously, are subject to a great deal of flexibility according to changing circumstances of time and place, and the differing needs of the Church.

Religious and priestly vocations. Now, since the Christian way of life in general, and the religious life in particular, are essentially liberating, it seems to me that one must strictly limit the kinds of human activity from which the religious is excluded by reason of his state of life. A given human activity must be obviously incompatible with the religious state before it can be excluded on principle. I say, on principle, because it could still be excluded for some accidental reason, such as the religious sensibilities of the Catholic people of a certain time, place, or age. We must consider the possibility that certain kinds of activity are excluded not in themselves but in the way in which they are pursued outside the religious state. We must also be careful not to exclude certain kinds of activity merely because other customs, times, and places have so excluded them; or merely because they are new forms of human activity or new modifications of old forms.

Like the religious state, the priestly calling limits the areas of activity in which one may engage. The vocation of the religious priest, the possible range of his activities, is affected by both sets of limits. But at the

same time, precisely because of the confluence of the priestly and the religious characters in one person, it may actually open certain activities to him that would not otherwise be possible or suitable for a priest only or a religious only, or at least would be less suitable.

If we compare the religious vocation with the priestly vocation a bit more carefully, we can see that in common with the religious vocation, the priestly vocation implies a consecration, a setting apart for the service of God. Unlike the religious state, it does not involve the three vows, though the priest should observe their spirit. Unlike the religious vocation, the priestly vocation is a consecration for the express purpose of mediation. The priest is to continue the mediatorial role of Christ himself, and thus extend the priesthood of Christ to all times and places, particularly through the distribution of grace by the offering of sacrifice and prayer. But the mediator's role implies some kind of union with each of the parties of mediation. Hence, because of his relation to both parties, his mediatorial role implies an integrating function, a bringing together of the two parties, a function of uniting. This union-effecting function is not only symbolized by the mediator but also realized in him.

Mediatorial role. From these considerations, it seems that the priest who is at the same time a religious and a scientist is in a remarkably effective position to make the influence of Christ felt in the modern world, through a very important segment of modern society, the scientific and technological community. His religious profession provides him with a unique standpoint from which to understand and appreciate scientific knowledge and the scientific vocation in itself, apart from all the influences that tend to distort, cheapen, or exaggerate it when pursued in a non-religious atmosphere. Through the habit of scientific knowledge, he has a certain connection with both the Catholic and non-Catholic scientific communities. Through his faith and grace-life, and particularly against the background of his philosophical and theological grasp of it, he has a link with the lay Catholic scientist. His priesthood lays upon him the function of mediator between man and God—mediator, first, for the entire Church, and through the Church, for the whole of mankind. But superimposed upon this general mediatorial function, and shaping it, can we not distinguish a more special (through also more limited and less necessary) mediatorial office flowing from a special relation to the lay Catholic scientific community, and through them to the world scientific community? And can we not say that this more specific mediatorial function pervades all of the priestly offices—the offering of the Holy Sacrifice, the recitation of the Divine Office, the administration of the sacraments?

Is there not a certain fittingness that in and through the priest-scientist,

not only his own scientific work, but the scientific work of the entire scientific community, be consecrated to God in the Mass? For in the Mass, the priest offers to God in Christ his whole life and all its activities, together with those of the entire Mystical Body. Is it not fitting that each important area of human activity receive a *conscious* remembrance in some Masses? True, the Catholic layman surely can and should do this, too. But it seems that there would still be an appropriateness in bringing this offering as close as possible to the throne of God in and through the priest.

It seems that this remembrance could be extended to include all the ends for which the Holy Sacrifice is offered. Thus, one could unite in the Holy Sacrifice all the scientific endeavors of man, in a spirit of *gratitude* to God for bestowing upon man such blessings as he has through the progress of the sciences. One could offer the Holy Sacrifice in a spirit of *adoration* of the power and wisdom of the Triune God, as manifested in the marvelous realities of creation uncovered by the patient labor of the scientist. One could offer the Mass in a spirit of *reparation* to God for the abuse of the results of scientific progress, misuse of the goods it has made possible, abuse by non-believers to undermine belief in him: sins of pride by which man attributes to his own powers these gifts of God, refusing to admit his dependence upon God. And one could *petition* for the graces to enlighten the minds and enflame the hearts of those devoted to the pursuit of science to use its results in accord with the requirements of human dignity and the law of God, to recognize God the Creator in his works, and to pursue truth with humility and recognition of dependence upon God.

How, then, may we summarize the role of the priest-scientist in the Church? I think we must say that the role of the priest-scientist (1) lies primarily *within* the Church, (2) is directed primarily to the lay Catholic scientific community (broadly conceived, including technologists, engineers, and those with related vocations), (3) is fundamentally apostolic and mediatorial in character, (4) for the Jesuit, at least, will commonly be realized in some aspect of educational work, and (5) is a hidden apostolate. This is not to deny that the priest-scientist also has an important role to play in the Church's apostolate to the non-Christian world and within the priestly community itself.

Consequences. If the role of the priest-scientist is viewed in this light, it is evident that there is no single way in which it is exercised. Rather, great latitude is possible for its application, depending upon the circumstances of time, place, opportunity, individual talent, and always, enlightenment by the Holy Spirit. It does not commit every priest who is

engaged in science to as single-minded a pursuit of science as is possible for the lay scientist. Neither does it deny that individual priests may be so called. It does point out that the priest's engagement in such a single-minded pursuit of science is conditioned in a sense in which the layman's is not. And for the religious, this conditioning is more severe than for the priest, by reason of the religious vows.

It does not lay an impossible burden of achievement upon the priest-scientist. It does not say that the priest-scientist must become another Einstein or Newton, if he is to live up to the Church's expectations of him. The Church would certainly not be disappointed if one or other of her priests should attain to such a stature, but this is not what justifies their presence in science, nor is it the criterion of their success or failure in their mission. The Church does expect, even demand, of the priest-scientist that degree of competence that would be required of anyone engaged in similar work.

A few words, finally, on the last characteristic of the role of the priest-scientist in the Church. His is a hidden apostolate. This observation affects all the others. For the deepest level of the role of the priest-scientist in the Church, his apostolic and mediatorial function, is necessarily a hidden one, in the order of grace and the supernatural. And where it is most vital it is most hidden, even in its most "exterior" aspect, personal contact with fellow scientists, whether Catholic or non-Catholic. It is also hidden because it is ordered primarily to the Catholic lay scientist. It is the layman that the priest must thrust forward, while he himself remains in the background—and this not merely because he cannot do what the layman can, but rather because he ought not. It is also hidden because for the Jesuit it will most often be realized in educational work of some kind, and education is a notoriously inglorious kind of work in most of its aspects.

West Baden College

AIDS TO EFFECTIVE HIGH SCHOOL SCIENCE TEACHING

ROY A. DRAKE, S.J.

A basic quality of a good teacher is the ability to impart to his students a liking, or even an enthusiasm, for the subject he is teaching. But unfortunately, the ways and means of developing student interest cannot easily be analyzed and catalogued, as can, for example the techniques of clear presentation. For, as every teacher knows, the ability to arouse in the student a desire to learn more about the subject is largely a question of the teacher's personal response to his subject and his class. Even granted, however, the personal nature of this response, there is room, I believe, for some observations that might be of interest and of value to other Jesuit science teachers.

No teacher can communicate to his students an interest in his subject—and still less an enthusiasm for it—if he does not himself possess these attitudes in a high degree. The teacher must himself contain a flame before he can hope to fire the imagination of his pupils. He must possess a sense of wonder before the mysteries of the universe, he must stand in awe before the marvels of the physical world about him, before he can stimulate a like response in his hearers.

Digressions in class. It should never be considered a waste of class time to digress occasionally from the sequence of the text and speak of the theories of the expanding universe, of the number and magnitude of the stars, or of the size and complexity of the molecules. Nor should one hesitate to spend several classes on a purely historical approach to the class matter, showing the struggle of men's minds to discover the secrets of the material universe about them. Such digressions serve a dual purpose if presented just before extended holidays when the students' interest and attention are easily distracted from their work. Too often the student identifies the limits of a subject with the contents of his textbook. It is necessary to demonstrate that any text presents only the fundamentals upon which a broad and imposing superstructure is erected. A brief examination of the superstructure gives significance to the foundations and renders the labor spent on them more meaningful.

Directed reading. Among the means of stimulating in the student a desire to know more about a subject one of the most fruitful is directed reading. By giving the student an article and asking him to read it, or by assigning the class a reading assignment beyond the textbook, the teacher can

introduce him to minds other than his own. This fresh approach, this new material, might strike just the response that is desired. A convenient procedure, employed by many teachers, involves saving appropriate articles clipped from journals such as *Scientific American, Atlantic Monthly,* or *Reader's Digest*; if each article is stapled into a manila folder and filed, it may be given to the student at the proper time with the request that he read it and record his reaction in the form of either a summary or a criticism, depending on the content. Such material often has a freshness to it that is hard to capture between the covers of a book. For a student it takes on the nature of a personal challenge.

It often happens, when the teacher recommends a good book on a particular subject, that the student dutifully takes down the name and, having convinced himself that he has no desire to read this book (or perhaps any book), he promptly forgets what he has written. An effective substitute is to suggest instead a chapter of the book, and this not as a general recommendation to the class, but as a personal bit of advice to the student. Quite frequently the student reads the entire book once he has started it and found it interesting. If the teacher is aware of a good treatment of course material in certain chapters of a particular book, he may find it helpful to note this on a file card to be given to a student with the request that he read the matter and write a review or evaluation of it.

Science department library. It is debatable whether the science department should attempt to start a collection of its own books. If the school library does not accept paperbound books, second hand high school and college texts, or stray issues of professional and scientific journals, then there is an argument for a science library. Such a library would not be intended to replace the school library, but rather to supplement it. A wealth of extra books can be obtained from second-hand book stores and from the parents and friends of the students. Doctors, dentists, and professional scientists often have books collecting dust on their shelves and would be glad to donate them to the school if they were asked. With small encouragement, the students will start their own science libraries.

School library. When it comes to obtaining books for the student a fundamental problem is that of selection. Often the librarian depends upon the teacher to recommend the books. I suggest that the teacher "pass the buck" one step further and tell the students that they must recommend the books. Their requests, of course, will be supplemented as the need arises. Tell the students that the library is for them, and that if they read a review of a book that should be included, they should ask for it. It is also possible to get them to make a survey of the science books in the library and determine whether some particular section—chemistry,

say, or astronomy or botany—ought to be augmented. Every attempt should be made to get the student to feel that the library is his to use, not just to admire.

Films. There are available a large number of films on scientific subjects. Most of these are worthwhile. Some are useless. Some are worth class time to show, some to be shown only after class. How can the busy teacher select the movies to show and plan when to show them? One solution is to put the students to work making a card catalog listing science films according to their subject matter. Each card might give the source of the film and its length, together with an evaluation of its quality and level of advancement. The evaluation could be based on a published review or on personal reaction, but in any case its source should be stated on the card. At the beginning of the school year a group of students can evaluate the available films and lay out a schedule of movies in accordance with a broad outline of the matter to be covered by the teacher during the year. The films are all ordered together and a record is made of the order; as they arrive, these students show them at the assigned time—lunch period, after school, or during class—and see to the packaging of the films for return to the lending agencies.

Science projects. The question is frequently asked: what place have science projects in a school science program? Science projects, whether individual or group undertakings, can help the student by presenting him with a personal challenge, by encouraging him to study and evaluate a scientific problem, and by forcing him to read and to ask the help of mature scientists. I say that a project *can* do these things, if it is wisely chosen and directed. On the other hand, a science project can reduce to an effort in craftsmanship, devoid of real scientific learning value. For the teacher the question is one of the relative value of the time he must spend in directing the projects, time that might be more profitably spent on other work. I think the teacher must constantly ask himself whether the project is helping the student to learn. A project that requires little construction but much evaluation of recorded information is naturally worth more than, say, the building of a radio receiver. I do not wish to imply that the student cannot learn by experience many of the practical problems of instrumentation, but if his learning be terminated there, he will rather have grasped only some aspects of technology without reaching the level of the scientific elements involved. We should not deprive the student of an experimental understanding of scientific principles by limiting his goal to the assembly of an electronic kit.

On the other hand, I am not in agreement with those extremists who would close school science workshops and prohibit projects undertaken

by the students. Many a piece of demonstration apparatus has been provided to science departments through the labor of interested students. Although Jesuit schools are not trade schools, this should not preclude our giving students the opportunity to use their hands in developing mechanical skills. To limit one's horizons to this level, however, would be a great error.

The crux of the problem lies in helping the student to find a project compatible with his ability and with the equipment at hand. The material needs of the school are secondary. It is rare that the required instrumentation cannot be located in local industries and borrowed from them. I feel that it is better to borrow a pulse counter and set a student working on plotting fall-out decay than to have the student build the pulse counter himself. One is science, the other is craftmanship. Once a project can be decided upon, advice and assistance can be obtained from professional scientists in the area. As a matter of fact, I have found that it often pays to ask these professional men to suggest a project. They are then much more willing to assist in directing the student.

What of the "science fairs" that have become an annual institution in many cities throughout the country? More and more time and energy are expended on projects destined to appear at them. To many teachers they seem a waste of time. I am inclined to give a qualified "Amen" to this opinion. My qualification is this: if the projects are research experiments, experiments performed by the students, with the results recorded and properly evaluated, then the science fair is doing a fine service in stimulating scientific creativity in the schools. If, however, the projects are mere cardboard demonstrations of topics thoroughly treated in books, with no development or original content coming from the student—if they are no more than toy assemblies of models—then they are indeed a waste of time. Let the students make models if they will, but let them bring them to the neighborhood hobby show, not to a science fair.

One final word on science projects. We must make the students reach above their heads; we must force them into learning situations. Make them look up things for themselves. Hesitate to give out answers. Have them write to college science departments and professional research laboratories if they have need of advice. I have found that college and laboratory personnel respond most favorably to such requests for assistance. And close cooperation of the Jesuit high school with local colleges and industrial laboratories redounds to the good of the entire school.

Lasting sources of ideas. No field of learning is changing so rapidly as is science. To be a science teacher today demands constant reading of select journals and association with other teachers in the field. It is too easy to get stale and out of date. Exchanges with other science teachers,

especially through our contacts with them in professional organizations, can give us new approaches to tired problems, fresh ideas, new leads on grants, demonstrations, and, if you will, just plain encouragement. We ought to be aware, too, that we often have quite a few of our own insights to offer and should not be shy about presenting them.

To be a good science teacher is a big task, but it is rewarding. As in all good teaching, there is here an influence that reaches beyond the chairs in the classrooms. In shaping the Catholic scientists of tomorrow we are shaping the men of tomorrow and the world of tomorrow.

Some Helpful Sources

Deason Hilary J., ed., *The Traveling High School Science Library*. An annotated catalog of two hundred selected science and mathematics books circulated by the AAAS and the NSF to senior high schools. Also lists publications of the National Science Teachers Association on science career opportunities and science projects. 25¢. May be ordered from The Director, High School Traveling Science Library Program, AAAS, 1515 Massachusetts Avenue, N.W., Washington 5, D.C.

Deason, Hilary J., ed., *An Inexpensive Science Library*. A selected list of over three hundred paperbound science and mathematics books for high school students and nonspecialist adult readers. AAAS, Washington 5, D.C.

Deason, Hilary J., ed., *The AAAS Science Book List*. A selected list of over a thousand titles recommended for secondary school and community libraries. AAAS, Washington 5, D.C.

The Joe Berg Foundation, *Science Seminars, An Operational Guide*. Plans and methods of operation of various types of science seminars for outstanding talent. Free. The Joe Berg Foundation, 1712 South Michigan Avenue, Chicago 16, Illinois.

National Science Teachers Association, *New Developments in High School Science Teaching*. Describes new directions in high school science teaching; evaluates new courses; lists sources of materials avaliable on seminars and special programs. $1.50. NSTA, 1201 16th Street, N.W., Washington 6, D.C.

National Science Teachers Association, *The Science Teacher*. Especially the sections on "Classroom Ideas" and "Science Teaching Materials"; the latter includes book reviews and information on apparatus, equipment, and audio-visual aids. Annual subscription, $6.00. NSTA, 1201 16th Street, N.W., Washington 6, D.C.

Pepe, Thomas J., *Free and Inexpensive Educational Aids*. Lists free and inexpensive (less than 25¢) booklets, books, slides, films, posters, folders, and charts. $1.35. Dover Publications, Inc., 180 Varick Street, New York 14.

Saterstrom, Mary H., and John W. Renner, *Educators Guide to Free Science Materials*. Lists and gives information on 1,164 free science items: films, filmstrips, charts, bulletins, pamphlets, exhibits, posters, and books. $6.25. Educators Progress Service, Randolph, Wisconsin.

Science and Math Weekly. A new (started in 1960) journal for students and teachers; of very high quality. Contents always include science news headlines; four articles: biology, physics, chemistry, mathematics; outline of an elementary research problem; miscellaneous items. About thirty-five issues a year; annual subscription, $1.00. American Education Publications, Education Center, Columbus 16, Ohio.

Science Clubs of America, *Sponsor Handbook*. Lists sources of free and low-cost science materials, such as career guides, new instrument specifications, public relations media offered by industry, films, pamphlets, product samples. $1.00. Science Clubs of America, Science Service, 1719 N Street, N.W., Washington 6, D.C.

Selected References on Audio-Visual Publications. Kodak pamphlet S-10. Free. Eastman Kodak Company, Rochester 4, New York.

Sources of Motion Pictures and Filmstrips. Kodak pamphlet S-9. Free. Eastman Kodak Company, Rochester 4, New York.

Taylor, John K., Phoebe Knipling, and Falconer Smith, ed., *Project Ideas for Young Scientists*. Brief suggestions for original projects in mathematics and various sciences for high school students. $1.25. Joint Board on Science Education, 1530 P Street, N.W., Washington 5, D.C.

UNESCO, *The Construction of Laboratory Apparatus for Schools, Series II: Secondary*. Complete drawings and instructions for building sixty-four pieces of apparatus commonly used in physics, including a wave trough and generator and falling body apparatus. $8.00. UNESCO Publications Center, 801 3rd Avenue, New York.

UNESCO Source Book for Science Teaching. Simple demonstrations with dime store materials. Bibliography lists books, periodicals, and sources of apparatus for science teaching. $3.00. UNESCO Publications Center, 801 3rd Avenue, New York.

WESTON COLLEGE

REPORTS OF SCIENTIFIC ACTIVITY

High Schools

Fordham Prep. Two science honors students from junior year attended the fifteen-week Saturday course in geology, mineralogy and crystallography at the American Museum of Natural History. They were among the twenty students enrolled in the course sponsored by the Texaco Foundation and a private grant. Fordham Prep was also represented at a series of lectures during the Christmas week at the Rockefeller Institute. Four students attended the five lectures on methods of separation given by Lyman C. Craig, Stanford Moore, and William H. Stein, all members of the institute.

The Prep Science Club has sponsored a very popular series of lectures during the past year. Dr. Patrick Shea of the Prep faculty inaugurated the series with a discussion on "Pressures and Fluids." Dr. Albert Sica, dean of the Fordham School of Pharmacy, spoke on "Careers in Pharmacy," and Fr. Charles Taylor, S.J. explained the role of "The Liberal Arts in Pharmacy." Fr. Frederick Canavan, S.J., acting chairman of the Fordham physics department, lectured on the "Transuranic Elements," and gave the students a tour of the physics department. Dr. Leo Yanowski of the Fordham chemistry department traced the "History of Chemical Warfare" for the club and its forty guests from the science club of Mount Saint Ursula Academy. Mr. James F. O'Brien, S.J. (*Buff.*), studying in Fordham's biology department, lectured on the mechanisms of "Cell Division and Reproduction." Fr. Charles J. Lewis, S.J., chairman of the mathematics department at Fordham, explained some "Classical Problems in Construction with a Straight Edge and Compass." Fr. J. Franklin Ewing, S.J., of Fordham's anthropology department, gave a movie-illustrated talk on his famous dig. Mr. Thomas E. Murray, S.J. (*Buff.*), studying physics at Fordham, demonstrated and discussed "Nuclear Magnetic Resonance."

In addition to the above lecture series, the students had a seminar in which they discussed their own projects and fields of interest. The science seminar room is busy almost every day of the week with a discussion on astronomy, physics, chemistry, or biology.

Gonzaga High School. Dr. Paul A Mullan, a practicing pediatrician and brother of Fr. Robert F. Mullan, S.J., of Gonzaga's biology department, recently spoke to over 250 students about the medical profession. His short lecture followed the showing of "I am a Doctor," the film pre-

pared by the American Medical Association to stimulate interest in a medical career. The association is concerned with the decrease in number and quality of applicants for medical school. Dr. Mullan gave a realistic appraisal of the training of a doctor and his future career.

Eugene Quindlen, a senior at Gonzaga, was judged the outstanding participant in last summer's High School Research Program conducted by the Washington Heart Association, and was chosen to report on his research before the assembled doctors and benefactors of the association in January. Dr. Andrew Prandoni of the Georgetown Medical School is the chairman of the program, which is now in its fourth year. Over three hundred public and private high school students attend a series of three Saturday morning lectures, are taken on a tour of one of the local hospitals, and then compete in a written examination. The winners are selected to receive a $200 fellowship to do research the following summer in one of the area laboratories. It was after this competition and research that Mr. Quindlen was selected for his outstanding work. His report, delivered before the meeting of the Washington Heart Association, described his work at the George Washington University School of Medicine. It stated in part:

> The entire research program in the biochemistry department was centered around cholesterol, and our project was to observe drug effects on cholesterol absorption in rats. We wanted to find out whether certain drugs would decrease the cholesterol absorption in the rat. It takes exactly five days to obtain effects from a certain dosage; but, since the variations and possibilities of different amounts and different drugs and other unaccounted variables are numerous, there are many uncertainties to be faced before positive results can be found.
>
> We fed rats a diet containing our drug, all of the necessary ingredients for cholesterol esterification and absorption, and free radioactive cholesterol C^{14}. After twenty-four hours we took the lymph samples and checked them both by chemical analysis and by counting techniques for the amount of cholesterol absorbed.
>
> As far as this research project has progressed, no exceptionally surprising results have appeared. Two of the drugs used, pectin and MK-135, did decrease the cholesterol absorption. The normal absorption level in the rat is about 35%. Pectin decreased the absorption to 20%, and MK-135 decreased it to 13%.
>
> The most important thing I learned in these two months was the nature of research itself. I learned how measured, painstaking, and uncertain it is. I worked with and met people from all over the world, people from Korea, the Philippines, Malaya, Great Britain, Germany, and Pakistan. I learned to respect their ideas, not only about scientific problems, but also about other problems. It is in this form of education that this program particularly achieved its purpose. I am sure that the Board of Planners had this purpose in mind: to give the student a good picture of research as it really is.
>
> For me, I think the program was a success and that it accomplished its purpose. I did not talk with any of the other fellowship winners about their

work. I do not know whether they saw what I saw; but, as for me, I know: I saw science, I saw research, I saw my future.

St. Joseph's Prep. Fr. Stephen A. Garber, S.J., of the chemistry department, has been awarded a grant for $361 from the American Academy of Arts and Sciences for a "Study of some physical and chemical properties of selected salts in N,N'-Dimethylformamide." He will be assisted by some of his students on the project. Fr. Garber has also been offered fellowships for a summer institute in chemistry by Bowdoin, Illinois and Seattle.

In physics, Fr. Francis Carmody, S.J. will attend an NSF summer institute at the Illinois Institute of Technology. Fr. George Hohman, S.J. has been offered similar fellowships to Rutgers, Fordham, Washington, and Nebraska Wesleyan.

Colleges and Universities

Boston College. The geology department is the recipient of a bequest now valued at $13,000. The purpose of the bequest is to promote geological research and publication.

Geological studies in the Wachusett-Marlboro tunnel continue. To date, approximately six of the eight miles have been mapped in detail by Fr. James W. Skehan, S.J. and his students. Interested groups of geologists who have recently been conducted through the tunnel include groups from the United States Geological Survey and the Massachusetts Institute of Technology.

Several seniors in geology have been mapping new exposures of bedrock in Medford and Newton in the vicinity of Pine Hill and Hammond Pond Parkway. One of the sophomore students in geology has been engaged part-time by Weston Geophysical Engineers, Inc., to compile from published and unpublished sources information on the bedrock geology of eastern Massachusetts and New Hampshire.

Dr. Gordon Rittenhouse of the Shell Research Company, Houston, Texas, spent three days at Boston College as the American Geological Institute Visiting Geoscientist. He is a specialist in the field of sedimentation and the origin of oil. Dr. Rittenhouse gave a series of six lectures including one to the Geologists of Eastern New England. On the occasion of the charter meeting of the newly-formed Geology Club at Boston College, Dr. Rittenhouse delivered a lecture on "Geology in the petroleum industry."

An article by Fr. Skehan entitled, "Engineering uses of geology and geophysics," appeared in the February issue of the *Journal of Water Pollution Control* as a feature article.

Canisius College. New faculty members, research facilities, and laboratory experiments highlight recent developments at Canisius.

Biology. The department has several new professors. Miss Katherine P. Treanor first joined the staff in September, 1960. She is a graduate of D'Youville College in Buffalo, and will receive her Ph.D from the University of Buffalo in June, 1962. Her major field of interest is biochemical genetics, and her doctoral dissertation concerns a biochemical investigation of certain minute mutations in *Drosophila*.

In September, 1961, Mr. A. Alan Alexander and Miss Ann L. Stocking also began teaching in the biology department. Mr. Alexander graduated from the University of Massachusetts and did graduate work at Springfield College and the University of Buffalo. He expects to receive his Ph.D. in the latter part of 1963. He is at present doing research for his dissertation on the micro-ecology of Moss Lake, a New York State bog. He specializes in ecology and anatomy. Miss Stocking attended Albion College and the University of Michigan, from which she received the A.B. and M.A. degrees. Her special field of research and interest is experimental embryology.

In the recent reallocation of space in "Old Main," the principal building on campus, small animal quarters were provided for the biology department. About $5000 was used to convert the old library storage facilities into animal quarters and a work room. The quarters have several noteworthy features: thermostatically-controlled temperature, forced ventilation, cage sterilizers, instrument sterilizers, movable cage racks, a low temperature frog tank, a large aerated aquarium with running water, and chick incubators. Present denizens of the quarters include hamsters, several varieties of mice, zebra fish, frogs and chick embryos.

Chemistry. Last June Dr. Robert Conley transferred from Canisius to Seton Hall University. His place has been taken by Dr. Ronald Erickson. Dr. Erickson is a graduate of Bradley University, and received his Ph.D. in chemistry from the State University of Iowa in February, 1959. From November, 1958, to January, 1960, he held a fellowship at the University of Texas, where he worked with Professor P. S. Bailey on the ozonation of the carbon-nitrogen double bond. During the following year he worked as a NATO fellow in Karlsruhe, Germany with Professor R. Criegee on small ring chemistry and on the ozonation of anthracenes and of Feists ester derivatives. From January to August, 1961, he again worked with Professor Bailey at Texas. In addition to continuing his research on ozonation, he synthesized anti-cancer compounds. At Canisius Dr. Erickson is teaching an undergraduate and two graduate courses in organic chemistry.

Dr. Raymond Annino, assistant professor of chemistry, was recently awarded a Petroleum Research Foundation grant of $5600 for a two-year program of undergraduate research participation in analytical chemistry. Dr. Herman Szymanski, chairman of the department, and Dr.

Annino have received a joint NSF grant of $6000, also for undergraduate research participation. The areas under study will be electroanalytical and physical chemistry.

Physics. The department recently produced one of the Canisius College Forum programs on station WKBW-TV. The program considered various types of laboratory work done by physics majors in college. Dr. Daniel F. Dempsey, with the assistance of one of his sophomore students, demonstrated several of the rather thought-provoking experiments that he has assigned for his general physics class. One of the topics discussed was a "kitchen-made" radiation dosimeter, which his students made and calibrated. More advanced experiments were discussed by Dr. David G. Keiffer and one of the senior physics majors. They demonstrated an experiment in nuclear magnetic resonance, as done in the junior advanced laboratory.

A new set of experiments has been worked out for the senior lab. Although the experiments are more or less standard, several of them involve radiochemical techniques new to physics majors. Results have been very satisfactory. For example, the determination of the half-life of K^{40} both with standard source samples and with the techniques of absolute counting has proved surprisingly accurate. Another experiment has been the study of the spectra of X-ray machines with scintillation counters.

The radiation lab has also collaborated with the biology department in calibrating X-ray doses. Miss Ann L. Stocking has had her histology students study the effects of 750 rads of absorbed dose on white mice, as a function of the time since irradiation. Doses were given with the 140-kev X-ray machine.

Mathematics. The department is making a survey of Western New York high school mathematics programs to gain information for a re-evaluation of the freshman curriculum at Canisius. Ninety-nine schools were contacted in March, and the number of rapid responses was very encouraging. The survey will determine how many of these schools are using the modern experimental programs such as the SMSG or Illinois program.

Fordham University. The NSF is sponsoring summer institutes and undergraduate research participation programs in both the mathematics and physics departments.

Mathematics. The department received a grant of $72,190 for a summer In-Service Institute for high school teachers of mathematics. Invited by the NSF to submit a proposal for a three-year sequence of institutes, the department has organized a six-institute sequence leading to a master's degree in three years. Approval of the degree by the university and the state department of education is pending.

The mathematics department has also received $12,000 from the NSF for an undergraduate research participation and/or independent study program. This will enable the department to support twelve of its best undergraduates at $60 per week for eight weeks during the summer, while they continue independent study on various projects in analysis and algebra. During the academic year sixteen undergraduates will be supported while they continue their research projects.

Physics. The physics department has received a grant of $9600 from the NSF for a combined program of research participation and independent study for undergraduates who are members of the science honors program. Eight students will spend the summer participating in research and independent study in seismology, Raman spectra, nuclear physics, and theoretical physics.

Professor Walter Henneberger has received a grant to cover his research during the summer in electromagnetic theory. Dr. Henneberger has been appointed to a research fellowship at the Institute for Advanced Study in Dublin and will go there in September.

Dr. Joseph Budnick has set up a laboratory in the physics of solids. Much of the equipment was donated by the Watson Laboratories of IBM. Dr. Budnick presented a paper at the Baltimore meeting of the American Physical Society, and will present a paper at the International Conference on Resonance and Relaxation Phenomena to be held at Eindhoven, Holland, this summer.

Dr. Hans Bomke has been active on a classified project for the armed services.

A new undergraduate program for physics majors has been initiated this year. The traditional general physics course has been dropped. The entering freshmen take an intensive twelve-hour course in mathematics which carries them into advanced calculus. Sophomores take intermediate level courses in mechanics and electricity and magnetism, both of which can be taught on a somewhat higher level owing to the improved mathematical background of the students. Funds have been sought from the NSF to help initiate this program, and support would seem to be forthcoming.

Georgetown University. The third annual summer conference on recent advances in astro-geophysics will be held at Georgetown August 6–29. Emphasis will be placed on the physics of the bodies of the solar system, in particular the earth, insofar as our knowledge is based on visual, spectroscopic, rocket, satellite and radio-astronomical methods. The ground-work will be laid during the first week through a series of basic lectures by staff members of the university departments of physics and astronomy. Staff members and guest speakers will handle major research topics during the rest of the conference, each in his own area of research. Special pro-

gram features are experimental and observational work at the observatory with astronomical telescopes, electronic computers, and high dispersion spectrographs. Field trips will be made to important research centers in and around Washington.

College teachers of physics and astronomy are eligible, as well as other college teachers with sufficient background in astronomy. The conference is sponsored by the NSF. Each of the thirty-two participants selected will receive a stipend of $360, plus travel allowance. No tuition fees will be charged. For further information and application blanks, write to Fr. Matthew P. Thekaekara, S.J.

Holy Cross College. An alumnus of Holy Cross, Dr. Harry J. Goett, has recently been in the news as director of the Goddard Space Flight Center, Greenbelt, Maryland. Dr. Goett received his degree in aeronautical engineering from New York University after graduating from Holy Cross in 1931. He joined the National Advisory Committee for Aeronautics, now the National Aeronautics and Space Administration (NASA), as an engineer on the full-scale wind tunnel at Langley Field, Virginia. In 1940 he transferred to the newly-established Ames Aeronautical Laboratory at Moffett Field, California, where he was responsible for the design and initial operation of various subsonic and supersonic wind tunnel facilities, including the largest wind tunnel in the world. In subsequent years he has been engaged in aeronautical research, specializing in the flight control problems of aircraft. In September of 1959, Dr. Goett was appointed director of the Goddard Space Flight Center. In this capacity he has been responsible for the organization of the center and the supervision of many projects in the nation's space and satellite programs, including Tyros, Echo and a number of the Explorer series. He is also responsible for the operation of a vast world-wide network of twenty-nine tracking stations for observing and collecting data from satellites.

An NSF grant of $19,350 has been awarded to Holy Cross for an academic-year In-Service Institute for high school teachers. The institute will include courses in biology, the physical sciences, and mathematics. The mathematics department has been participating in such a program for a number of years. The biology department began this year; physics starts this coming September; chemistry will begin in September of 1963.

Fr. Thomas J. Smith, S.J., formerly head of the physics department, continues his active interest in civilian defense work. Having participated as a member of the monitoring team at the Nevada test site in 1957, he is at present a member of the state radiological advisory committee and a radiological officer for Area III in the civilian defense network. His radiological interests have spread to other departments on campus. The departments

of biology, chemistry and physics now have about fifteen scalers and auxiliary equipment for instruction in various phases of nuclear science.

Chemistry. Fr. Joseph A. Martus, S.J. represented the department at the spring meeting of the American Chemical Society on both the Committee of Professional Training and the Committee on Examinations. Professor Andrew Van Hook represented the Central Massachusetts section at the meeting of the Council at the same spring session of the American Chemical Society. He also delivered a paper entitled "The Shape of Sucrose Crystals."

Le Moyne College. Mr. Jack Yudell and Dr. Garrit J. Lugthart have recently joined the staff of the biology department. Mr. Yudell did his undergraduate and graduate work at the University of Oklahoma. His special interest lies in the production and control of "L-forms" in bacteria. Dr. Lugthart took his undergraduate training at Michigan State University and received his doctorate from the University of Wisconsin in 1958. His particular interest is the resistance of the housefly to chemicals and insecticides.

Dr. Louis De Gennaro, chairman of the biology department, is studying the differentiation of the glycogen body in the chick embryo. The project, supported by NSF grants, involves the use of radioactive tracers, chorioallantoic grafting and tissue culture. Some of his recent findings have been published in the *Biological Bulletin* and in the *American Zoologist.*

Loyola College. Loyola ranked in the top 10% of 389 colleges and universities in the rate at which it graduates earned science doctorates between 1946 and 1950. This information was disclosed in a study published by the United States Department of Health, Education, and Welfare, in *Public Health Monograph #66.*

According to the study, Loyola College's rate during these years was 8.7 science doctorates per 1000 graduates. This same report indicates that eighty-five graduates of the college received their medical degree between 1950 and 1959, and that Loyola outranked 60% of the 389 colleges and universities in the rate at which it produced male scholars during the period 1946–50.

St. Joseph's College. Dr. Paul C. Aebersold, director of the division of isotope development of the AEC, was a visiting lecturer in the physics department January 16–17. He visited under the auspices of the American Association of Physics Teachers and the American Institute of Physics as part of a broad nationwide program to stimulate interest in physics. The program is now in its fifth year and is supported by the NSF.

Dr. Aebersold lectured, held informal meetings with students, and assisted faculty members with curriculum and research problems. Arrange-

ments for his visit were made by Fr. John S. O'Conor, S.J., chairman of the department of physics.

In 1958 Dr. Aebersold was named to his present position, with the responsibility for stimulating the use of radioisotopes and applied radiation in industry, agriculture, and medicine, and for encouraging industrial production and distribution of radioisotopes and other radiation sources.

Wheeling College. Fr. Joseph A. Duke, S.J., chairman of the chemistry department, has been awarded a research participant's grant to work at the Oak Ridge National Laboratories again this summer. He will spend June, July, and August there working with the chemical protection group. Dr. David Doherty, the discoverer of an effective chemical inhibitor or preventive of the damage caused by radiation, is director of the group. Fr. Duke's research in the field of enzymes will continue last summer's study of the action of pepsin on synthetic substrates.

The spring lectures in the Chemistry for Industry program at Wheeling College were devoted to the theory and industrial application of gas chromatography. Lecturers for the program included Dr. Robert L. Grob of the college staff, Mr. Nate Brenner of the Perkin-Elmer Corporation, and Mr. J. R. Gilson of the Standard Oil Company's Toledo Refinery. The final portion of the program consisted of a display of equipment by Perkin-Elmer, Burrell, Fisher Scientific, and Greenbrier Instruments.

Dr. Grob attended the sessions of the Educational Committee for Qualitative Analysis Examinations at the spring meeting of the American Chemical Society. Fr. Duke represented the college on the Committee on Professional Training.

Scholasticates

Innsbruck. Fr. Robert J. Ratchford, S.J. (*N.O.*), after completing his fourth year of theology, will spend a year of research in solid-state electrochemistry at the Technische Hochschule in Karlsruhe. He has been offered a fellowship under Dr. Hans Rickert, with whom he has been working during previous summers at the Max Planck Institute for Physical Chemistry in Göttingen.

Fr. Ratchford's summer work at the institute will be written up in the *Zeitschrift für Elektrochemie* and is abstracted below.

> The first part of the research was an electrochemical investigation of the evaporation of selenium (Se) from solid silver selenide (Ag_2Se) as a function of the chemical potential of Se. This work complemented Dr. Rickert's previous studies on the evaporation of sulfur (S) from silver sulfide (AgS), and iodine (I) from silver iodide (AgI). The electrochemical cells used were "sandwiches" six millimeters in diameter, consisting of six millimeters of AgI between one-half millimeter of Ag_2Se and six millimeters of Ag. Platinum leads were at-

tached to the Ag_2Se and Ag layers as the positive and negative poles, respectively. The cell was thermostated at various temperatures between 250°–400°C. A cold finger outside the cell was kept at −196°C, and the entire system was maintained under vacuum.

Silver ions (Ag^+) migrate from the Ag_2Se layer through the AgI (an almost purely ionic conductor) to deposit on the Ag layer. As the Ag^+ ions leave the decomposing Ag_2Se, the Se atoms evaporate and are collected on the cold finger. A mechanism was presented to explain the rate of evaporation, as measured by the passage of current. Possible steps occurring on the crystal surface as the Se evaporates are:

$$Se^{-2}\ (\text{crystal}) \rightarrow Se\ (\text{adsorbed}) + 2e \quad (1)$$

$$xSe\ (\text{adsorbed}) \rightarrow Se_x\ (\text{adsorbed}) \quad (2)$$

$$Se_x\ (\text{adsorbed}) \rightarrow Se_x\ (\text{vapor}) \quad (3)$$

where $x = 1, 2, \text{ or } 6$.

The potential across the cell was measured and related to the rates of evaporation in the 250°–400°C range, and conclusions drawn concerning the rate-determining step.

The second part of the research was an extension into solid-state electrochemistry of the Knudsen emission cell for determining the vapor pressure of metals and alloys. The same type cell as described above was constructed, but with a glass cavity extending over the Ag_2Se end of the cell. A hole of less than one-half millimeter diameter was made in the top of the cavity so that it acted as an equilibrium chamber for the Se_x vapor diffusing through the hole to the cold finger. The equilibrium pressure was controlled by merely changing the current, i.e., removing more or less Ag^+ from the Ag_2Se. The potentials measured with this cell were more reproducible than in the case of the cell without the cavity, since thermodynamic equilibrium was involved instead of the complications of a surface reaction.

With this "electrochemical Knudsen cell" the vapor pressure of Se was determined, as well as the relative proportions of Se_2 and Se_6 in the vapor at the different temperatures studied.

Shrub Oak. Fr. James Fischer, S.J. will participate in the NSF summer institute for college teachers at Bowdoin College, Maine. While taking other courses he will be tutoring students in the course on algebraic structures.

Mr. Peter C. McNamee, S.J. (*N.Y.*) has received both an NSF and a Woodrow Wilson fellowship for studies in physics. Mr. Robert Yankevitch, S.J. (*Md.*) received honorable mention in both competitions.

Weston College. Fr. Walter Feeney, S.J., professor of cosmology and mathematics, has been awarded an NSF science faculty fellowship, which will allow him to spend the coming academic year at the University of California at Berkeley. His studies will be concentrated in the field of mathematical logic, but he plans to do work in geometry as well, in preparation for a course he will be giving at Boston College.

Science Colloquium. The colloquium sponsored a domestic dialogue on the relation between philosophy and science. The panelists were Fr. Paul Lucey, S.J. and Fr. Walter Feeney, S.J. of the philosophy faculty, and Fr. Edward MacKinnon, S.J. (*N.E.*) and Mr. David M. Clarke, S.J. (*Ore.*), theologians with degrees in theoretical physics and physical chemistry, respectively. The central themes of the discussion were the lack of adequate communication between philosophers and scientists and the peculiar difficulties generated by the outmoded aspects of the scholastic tradition. A supplementary bibliography was circulated to stimulate further reading and research.

Professor Cecil E. Hall of the biology department at the Massachusetts Institute of Technology addressed the colloquium in January on the subject of "Electron Microscopy of Biological Molecules." Professor Hall, one of the pioneers in the field of electron microscopy, discussed the principles involved in the operation of the electron microscope, and presented a survey of the applications that have been made of the instrument. His talk was chiefly concerned, however, with the use of electron microscopy in discerning the structure and properties of proteins, nucleic acids, and viruses. The talk was illustrated with numerous electron micrographs taken in Dr. Hall's laboratory.

The annual Ahearn-Quigley lecture was given by Dr. J. Wallace Joyce, special assistant to the director of the NSF. Dr. Joyce's talk, entitled "Science and Human Values," discussed the positive contributions made by the natural sciences to human society. He emphasized the need for providing a solid grounding in the natural sciences in order to develop a sound technology, especially in underdeveloped countries.

Woodstock College. Woodstock was cited as one of the three Catholic colleges or universities to have a winner of an NSF postdoctoral fellowship in the most recent competition. The award went to Fr. Frank R. Haig, S.J., who has just completed tertianship at Port Townsend, Washington. Fr. Haig will spend a year at the University of Rochester continuing his research in theoretical nuclear physics.

Mr. G. Harry Hock, S.J. was awarded an NSF grant to attend an eight-week summer institute at the University of California at Los Angeles. At this institute for college teachers of mathematics, the physical sciences, and engineering, Mr. Hock will study numerical analysis.

Chemistry Seminar. The theologians who taught chemistry in high school and/or who have graduate degrees in chemistry held a weekly seminar during the past year. The participants discussed their particular fields of interest. Since the group was heterogeneous in interest the talks were of a rather general nature, but it is hoped that future discussions will

be able to consider more detailed topics, in order to increase the profit from sharing ideas on various branches of chemistry.

Educational topics have included the CBA and CHEM high school chemistry programs, and a comparison of teaching chemistry in high school and in college. Research topics have included inorganic polymers, solutions of alkali metals in liquid ammonia, the stereochemistry and reactions of some of the boranes, an introduction to gas kinetic studies, chemical reactions in a shock tube, X-ray crystallography, and valence theory.

Mathematics Seminar. A different type of seminar was the semi-weekly meeting of the mathematicians with graduate degrees. A more homogeneous group than the chemists, they have been working out the historic examples in Lie group theory. A collection of these examples with proof more or less sketched out, is found in Ponrjagin's *Topologische Gruppen* (a German translation of the second Russian edition). The members of the seminar group have thus been able to increase their active reserve of examples in their particular fields as well as to exchange ideas among these various fields.

Graduate Studies and Research

Catholic University. Mr. James F. Gilroy, S.J. (*Wisc.*) recently completed work for his master's degree in mathematics. His thesis in the field of statistical inference is entitled, "Methods for estimating parameters in certain truncated distributions." An abstract follows.

> The object of many statistical investigations is to estimate by means of a sample from the population under consideration one or more unknown parameters that appear in the distribution function of this population. The estimation problem becomes much more complex if it happens that sample values are unobtainable from some parts of the population. In particular, it often happens that sample values above or below a certain value cannot be obtained. Methods of obtaining estimates in this situation, as obtained by various authors, are presented in a unified form. In particular, the normal distribution and the Poisson distribution are treated for a variety of cases of truncation and censoring. The negative binomial distribution is treated for the specific case in which the zero class alone is missing. The estimating equations are given for all cases considered, and numerical examples are worked out for selected cases.

Fordham University. Mr. Thomas E. Murray, S.J. (*Buff.*) has won an NSF pre-doctoral fellowship in his first year of studying physics at Fordham. He will continue his studies for the doctorate at Syracuse University starting in September.

Johns Hopkins University. Mr. Anthony P. Mahowald, S.J. (*Wisc.*) is completing work on his dissertation entitled "Electron microsocopy of early embryogenesis in *Drosophila melanogaster*." An abstract follows.

The changes in fine structure of the *Drosophila* embryo have been followed during early embryogenesis. A search was undertaken for evidences of mosaicism at the ultrastructural level but with the exception of the pole cells no distinguishable regions were found. The pole cells have, besides the polar granules with a structure similar to the nucleolus, a distinctive endoplasmic reticulum and spherical nucleolus.

Special emphasis has been given to the transition period between the syncytial blastema and cellular blastoderm stages. The new cell membranes form from the inward growth of one of the multiple folds in the plasma membrane. These folds occur principally in the regions between the nuclei of the blastema. The base of the cell membrane furrow bears a fibrous material that extends into the cytoplasm for about 500Å in a helical configuration. This fibrous material is absent above the vesicle at the base of the furrow. At the same time as the membranes are moving inward, the nuclei are elongating in a radial direction. Many small vesicles and tubules become associated with the tip of the furrow. Serial sections show that at least some of these are tubular extensions of the outer nuclear membrane. However, they do not appear to aid in cell membrane formation.

The endoplasmic reticulum proliferates in the region above the nuclei after the cell membranes have separated the nuclei into individual cells. The origin of the new membranes are Golgi-like regions. Ribosomes become attached to the membranes as soon as they are produced, and they frequently show the typical helical patterns. The strong basophilia in general, however, is produced by the numerous free ribosomes in the cytoplasm.

University of Pennsylvania. Both Mr. Michael Bielefeld, S.J. (*Wisc.*) and Mr. Roger Phillips, S.J. (*N.E.*) were awarded NSF cooperative fellowships for 1962–63. Mr. Bielefeld is studying physical chemistry and has completed his first year at the university. Mr. Phillips, also in physical chemistry, has completed his second year of graduate studies.

Weston Observatory. Fr. Daniel Linehan, S.J., director of the Weston Observatory, is continuing his work with UNESCO for the aid and evaluation of seismic conditions and instrumentation in countries subject to major seismic disturbance. Fr. Linehan is a member of a team of internationally known seismologists appointed by the United Nations and member governments. This team has as its function to inspect areas where earthquake or volcanic damage is prevalent, to recommend methods of detection for these phenomena, and to help in the establishment or alteration of building codes in seismically-disturbed areas. Four areas have been inspected with attendant evaluation and recommendation: Southeast Asia, South America, the Mediterranean, and the Near East.

The space magnetic research group has finished another nose cone instrument package for high altitude magnetic measurements. After several months' work, Mr. Joseph Pomeroy, S.J. has completed the ground receiver recorder for the flight. Ground equipment is mounted in a small aluminum house trailer with self-contained heating, cooling, and power

supply equipment. Signals are received from the flight telemetry package, recorded on dual Mincom data tape recorders, and simultaneously analyzed in their frequency spectrum for visual monitoring purposes during flight. The instrumentation of the nose cone, done at Weston by Mr. Jerome Kelliher of the Air Force Cambridge Research Laboratories, involved the preparation of altitude sensors as well as a Varian rubidium magnetometer, an optical pumping instrument. The vehicle is a Astrobee 200 with a vertical probe of 150 km., in a trajectory approximately perpendicular to the magnetic field of the earth. The taped results of this flight will be analyzed at Weston in a newly-equipped data reduction facility.

In March, the design and construction of a network of seismic stations were officially begun by Mr. David M. Clarke, S.J., under the sponsorship of the Air Force Cambridge Research Center. The network is composed of five seismic stations, each operating three short-period Benioff seismometers. Weston Observatory is the principal station. Three stations are located in Maine: one in the vicinity of Caribou, another at Millinocket, and a third at Mechias. A fourth station is in Berlin, New Hampshire.

The four unattended stations will have frequency-modulated transmitters in continuous operation for seismic data transmission over leased telephone lines. The receiving and recording equipment for these signals, as well as reproducing and analysis instruments, will all be located in the Weston Observatory data reduction facility.

The above-mentioned data reduction facility is a joint effort on the part of the observatory staff, the seismic net project, and the space magnetic project. The facility, when finished to the extent of a first operational stage, will have three systems, each with two record/reproducers, two eighteen-channel Consolidated Electrodynamics recording oscillographs (one direct write and one wet process), one three-channel helical recording galvanometer, and an assortment of strip-chart recording equipment. Provisions have been made for complete frequency analysis through discrimination, filtering, tape speed compensation counters, and printers. The facility will have the capability for data phones when it is desired to transmit data for computer analysis. Final development of the facility will be determined after evaluation of the first operational stage in its actual performance.

A separate outside structure has been erected at Weston Observatory to provide additional seismic pier space. In connection with a program for testing new models of seismometers, this structure was erected as a constant temperature enclosure, having its own stage thermal transfer apparatus to assure temperature control within one degree centigrade with

minimum air motion in the enclosure. Underground conduits bring data lines to the recording piers in the main observatory building.

Mr. Richard J. Holt, of Weston Geophysical Research, Inc., in cooperation with Mr. Clarke and Mr. Pomeroy, has set up earth potential sensors at the observatory and has monitored the DC potential continuously for several months. The correlation of the earth potential, due to telluric currents, with magnetic storms and with atmospheric electrical disturbances, is more than sufficient to warrant a full investigation of the electrical, magnetic, and seismic interaction.

OFFICIAL REPORTS AND NOTICES

Notice of Annual Meeting

The thirty-seventh annual meeting of the American Association of Jesuit Scientists (Eastern States Division) will be held at the University of Scranton, August 28–30, 1962.

JAMES L. HARLEY, S.J., *President*

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