BULLETIN

OF THE

AMERICAN ASSOCIATION

OF

JESUIT SCIENTISTS

Eastern States Division

VOLUME 38 September, 1961 NUMBER 3

Bulletin of the American Association
of Jesuit Scientists

Eastern States Division

(FOUNDED IN 1922)

JAMES F. SMITH, *Editor*
CHARLES L. CURRIE, *News Editor*

Associate Editors

JAMES GAFFNEY FRANCIS A. GREENE FRANK R. HAIG

Editorial Office
Woodstock College
Woodstock, Maryland

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OFFICERS OF THE ASSOCIATION

Second-class postage paid at Woodstock, Maryland. Published quarterly at Woodstock College, Woodstock, Maryland, by the American Association of Jesuit Scientists (Eastern States Division).

Annual dues for members of the Association are $6.00. A subscription to the BULLETIN is included among the privileges of membership.

To our readers . . .

In the March number of the BULLETIN we recorded an interview with physicist William J. Thaler in which he observed that science programs in our graduate schools should expect and prepare to emphasize experimental research among their students. The reason he gave was that "only a small percentage of graduate students in the sciences . . . have a first-rate theoretical ability." Among graduate students in mathematics the same relative scarcity of creative theorists is commonly acknowledged. At the same time, however, the exclusively theoretical character of the subject has made the resultant problem a harder one to solve. It seems clear that the absence of an alternative to completing a creative thesis for the Ph.D. candidate in mathematics has had much to do with the growing disproportion between supply and demand of adequately trained college teachers.

Sensitive to this special factor aggravating an already severe shortage of mathematics teachers, American mathematicians have recently called attention to the possibility of introducing a supplementary kind of doctoral program: one that would exact the qualifications of scholarship necessary for a competent teacher of mathematics, but without demanding the virtuosity of a creative mathematician. Some large universities have already instituted such a doctoral program. An account of this proposal for the "Doctor of Arts" degree in mathematics, as set forth by Professor Edwin Moise of Harvard University, is reproduced in the pages that follow. We hope it may prove of interest not only to Jesuit mathematics teachers of the present or future, but to those of our scientific and general academic administrators for whom the shortage of available college mathematics teachers is an all too familiar problem.

Jesuits are not inclined to forget that in making a choice of ministries the Society, "other things being equal, should give men priority over women" (*Epit., n. 603*). In the same section of the *Epitome*, however, we find the fundamental principle that "we are to concern ourselves chiefly with those who are most in need of our help, and who most give promise of spiritual advantage that is significant, lasting, and far-reaching." In the light of this latter norm, it is suggested in the present issue of the BULLETIN that other things are not always equal, and that in the United States the number of women who contribute significantly to the sciences and other academic fields is growing daily. Important for their influence within this group, and especially for its current upward trend, are women

religious. In the following pages we present an interview with one of the most outstanding scientists among them, Sister Annette Walters, C.S.J. With a striking record of achievement that we could report but in brief, Sister Annette herself represents the sort of scientific and professional leadership among religious that should interest Jesuit scientists and educators. At the same time, in her official concern for the improved spiritual and intellectual training of American sisters, she is able to state the case of those among them who in their religious formation in general, and in scientific training in particular, are most in need of our help.

THE PROPOSED DOCTOR OF ARTS DEGREE

EDWIN MOISE

At the annual meetings in Washington, this January, the American Mathematical Society's Council and the Mathematical Association of America's Board of Governors voted to approve, in principle, a report which recommended the establishment of a new graduate degree in mathematics. The proposal was described to both of these bodies at the summer meetings in East Lansing, last August; and an *ad hoc* committee was asked to study the matter and report in January. The committee consisted of M. M. Day, P. R. Halmos, A. D. Wallace and the author.

The present article is an attempt to explain what the proposal is, and how it forms a response to the situation in which the mathematical world now finds itself. The case as I shall put it will be rather close to the spirit of the *ad hoc* committee's report, but it should be understood that in matters of detail I make no claim to speak for anyone but myself.

Policy for teaching personnel. It is plain that the mathematics departments of American colleges need to be staffed by people whose scholarly training makes them competent to teach undergraduate mathematics. There may, however, be considerable debate over what constitutes competence. The leading universities, in our generation, have taken the position that only a mathematician can teach mathematics; and the word *mathematician* has been interpreted to mean, at best, a currently active research

From the American Mathematical Society *Notices*, Vol. 8, no. 2 (April, 1961). Reprinted with permission of the author and of the American Mathematical Society, holder of the copyright.

worker, and, at least, a person who has written one research paper, under supervision, at some time in the past. This is the substance of the policy which demands that college mathematics teachers hold the Ph.D.

Plainly the goal of this policy is desirable. The trouble is that the goal is impossible to attain. For mathematical Ph.D.'s the supply and the demand differ by order of magnitude.

Supply and demand. At present, America produces about 250 mathematical Ph.D.'s per year. From 1948 to 1953, the number of new Ph.D.'s increased rather sharply, from 128 to 241, but since then the number has been approximately constant. (1959 was a local maximum, with 282.) Five men for every state of the union would represent a pitiful rate of recruitment, even if all of them went into teaching, but of course they don't: about half of them go into government and industry. In 1953, over a third of the new mathematics teachers held the Ph.D. By 1959, this proportion had fallen to less than one fifth. From time to time it is reported that the growth of college faculties is not keeping up with rising enrollments. But to say this in connection with mathematics is a misleadingly inadequate description of our troubles: it has recently been reported that the number of mathematics teachers with Ph.D.'s has declined in the past five years, not merely relative to enrollment but *absolutely*.

Meanwhile, the task of college mathematics departments has been growing in ways that are not as widely recognized as they deserve to be. The developments have been peculiar and there is evidence to indicate that people have not been keeping proper track of it. While total college enrollments have grown, enrollments in mathematics departments have grown much faster. And while the *size* of the mathematicians' job has grown, the *shape* of their job has also changed: the enrollment in advanced courses is a higher proportion of the total than it used to be. This, of course, is a very good thing for the physical scientists and engineers: they seem to be aware that they need mathematics and plenty of it. It means, however, that in the past decade the need for highly trained college mathematics teachers has increased even faster than the need for college mathematics teachers in general.

There seems to be no reason at all to believe that the demand for Ph.D.'s is going to decline; it appears, rather, that the demand will continue to rise for the foreseeable future. Meanwhile, annual recruitment of Ph.D.'s into the teaching profession has not even been enough to balance annual losses. Under these conditions, to speak of "holding the line," by insisting that college mathematics teachers hold the Ph.D., is utterly unrealistic. Indeed, this idea is so remote from the real possibilities that to speak in such terms amounts in effect to a refusal to face the problem. The problem is very real, and we can hardly regard it as beneath our notice.

Special difficulty of study in mathematics. It is rather easy, at present, to see why the demand for highly trained mathematicians is so large. It is not, however, quite so easy to see why the supply of Ph.D.'s is so small. The conditions of mathematical study are rather peculiar. One indication of this is the fact that in the period from 1948 to 1959, the number of B.A.'s in mathematics was about twice the number of B.A.'s in physics, while the number of Ph.D.'s in mathematics was only about half the number of Ph.D.'s in physics.

The Ph.D. is a research degree, and the conditions of research in mathematics are almost unique. In most of the natural sciences, group research work is not only possible but usual. For this reason, it was quite sensible for a government agency to offer stipends for undergraduate research assistants in science. The applications of this idea to mathematics, however, were unclear, and the government has been asked to give stipends to worthy undergraduate mathematics students on some other basis. It is true, of course, that mathematicians sometimes collaborate, usually in groups of two, as novelists sometimes collaborate; but essentially, creative work in mathematics is done by a man alone.

(The above remarks are not taken from the *ad hoc* committee's report.)

The number of people who can sit down alone and do creative work in mathematics is quite small. We might describe the situation by first saying that as a general rule, *nobody* can do bona fide mathematical research, and then admitting that there are scattered exceptions to the general rule. Moreover, it is hard, except in extreme cases one way or the other, to predict which individuals will turn out to be among the exceptions. For these reasons, doctoral study in mathematics is not only difficult but dangerous: a student who looks well-qualified may work well for years, and then find that he is a "Failed Ph.D." because he couldn't write a creative thesis. (Recently, someone at a large state university coined the phrase "Teaching Fellow Emeritus.")

Safe and dangerous degrees. The difference between dangerous degrees and merely difficult degrees is important; these two properties are largely independent of one another. For example, the Harvard B.A., while difficult, is "safe;" a freshman who has once been admitted is very likely to graduate in four years. The same is true of the M.D. at most of the best medical schools; and it seems even to be true of the Ph.D. in mathematics at Princeton, because the admission standards are so high. On the other hand, the B.A. at many state universities is dangerous without being difficult: the graduation standards are low, but the admission standards are so much lower that the mortality is heavy.

The dangerousness of the Ph.D. creates morale problems over and above the difficulties due to high intellectual standards. Soon, we shall discuss the idea of a "safe" degree for college mathematics teachers. The foregoing remarks are designed to make it plain that a "safe" degree need not involve—and, of course, should not involve—a collapse of intellectual standards. It ought to be a course of study which is difficult and demanding, in which success is, however, reasonably predictable for suitably qualified people.

Varying standards for the Ph.D. Basically, degrees are a form of language. The primary purpose in giving a person a degree is to communicate information, thereby, to various third parties. A scheme of degrees ought to be a language adequate to describe and classify, with at least rough justice, the class of people to whom the language might apply. The degree-language in mathematics, from this viewpoint, has serious shortcomings.

In the first place, the standards for the Ph.D. vary so much, from one university to another, and from one supervising professor to another, that the mere possession of the degree is not, in itself, a guarantee of anything in particular. This is not a serious problem because the number of people involved is—unfortunately—so small that personal correspondence can be used, and commonly is used, as the main source of information.

A more serious trouble is that the present degree-scheme divides former graduate students into only two classes: those who did creative dissertations and those who did not. Under the present scheme, there is no way to describe sound mathematical scholarship except in those cases where it is accompanied by creative talent.

The proposed solution. For approximately these reasons—with one exception, as noted—the Council and the Board of Governors approved a proposal for a new degree, tentatively called the Doctor of Arts. (The name of the degree is not part of the substance of the proposal.) The essential idea is that the new degree would represent scholarly achievement, but not necessarily creative talent.

Nobody has attempted to describe, with any exactitude, the sort of program that would lead to this degree. In the country at large there is no general agreement on exactly what the Ph.D. ought to mean, and there is no reason to suppose that the Doctor of Arts degree can be, or should be, standardized on a national basis.

The report, however, went on to clarify the spirit of the proposal with general remarks about courses and dissertations. In the first place, the idea was for the new degree to be granted only by institutions qualified to grant the Ph.D. Few, if any, new courses ought to be needed. In fact, the

report proposed that the course-work for the Ph.D. and the Doctor of Arts be essentially the same, so as to make it easy for a student to alter his intentions, one way or the other, at any stage short of the dissertation.

In the second place, the creative dissertation should be replaced by a scholarly dissertation which could be historical, critical or philosophical in nature. Here the idea of historical dissertations is intended by all means to include studies of recent mathematical developments. Whatever the thesis topic may be, the course-work should be adequate to enable the student to read current research literature.

Criticisms. This describes the spirit of the proposal. It may now be worthwhile to discuss various criticisms that have been made, and various alternative proposals that have been brought up.

1. I have heard the Doctor of Arts degree described as "the negation of the Ph.D." This, I think, is a misunderstanding: the new degree would negate merely the idea that the Ph.D. is the only sort of higher degree that is worth giving or receiving.

2. It has been proposed that the M.A. be upgraded as a degree for college teachers. But the idea of increasing the prestige of an old degree appears to be a psycho-political impossibility.

3. It has been said that most people who can pass preliminary examinations can also write dissertations. If this is true—and at most places, I suspect that it is not—then it means merely that the contribution made by the new degree would not be quantitatively as large as one might have hoped.

4. Some have expressed the fear that some institutions would reflect discredit on the Doctor of Arts degree by giving it to inferior students. In fact, this is surely going to happen. At any rate, it has already happened to the B.A., the M.A., and the Ph.D. No matter what the idea behind a degree may be, it is normal for the standard of performance to vary, in a wide range, from one institution to another.

5. It has been suggested that the Doctor of Arts degree may displace the Ph.D. as a degree for college teachers, to the detriment of both research and teaching. The present attitudes of the colleges, however, suggest exactly the opposite difficulty: the colleges are now seeking not simply Ph.D.'s as such, but prospective research mathematicians, with an eagerness bordering almost on desperation. There seems to be no reason to expect—either in fear or in hope—that these widely held attitudes will be turned upside down merely by some legal or administrative device. It seems, on the contrary, that considerable persuasion will be required to get the colleges to accept the Doctor of Arts degree as evidence of the sort of qualifications that it really would represent. (Some have proposed

that new journals be established, for publication of the sort of scholarship that would be involved.)

Non-creative mathematicians as students and teachers. Finally, it should be understood that the question whether college teachers should be creative mathematicians, and whether graduate students ought to have creative intellects, are not really issues in connection with this proposal. Non-creative people are already teaching in the colleges, not only in large numbers, but forming a large majority; and this will continue to be true unless and until a way is found to increase, by order of magnitude, the supply of creative mathematicians. Non-creative students are now studying in graduate mathematics departments, not only in large numbers, but also for periods which often seem interminable. The real question at issue is whether the best of the non-creative mathematicians should be encouraged to develop their own capacities in the ways that are possible, and rewarded and recognized for the very real and very useful intellectual achievements of which they are capable.

HARVARD UNIVERSITY

THE JESUIT'S ROLE IN THE SCIENTIFIC TRAINING OF SISTERS

SISTER ANNETTE WALTERS, C.S.J.

Sister Annette Walters, C.S.J., in addition to being a psychologist and educator of wide experience and notable achievement, is in her present office as Executive Secretary of the NCEA Sister Formation Conference probably America's most informed spokesman on the vocational problems and professional interests common to women religious. A convert from Lutheranism two years before her admission to the community of the Sisters of St. Joseph of Carondelet, Sister Annette graduated, Phi Beta Kappa, from the College of St. Catherine, earned a Ph.D. in psychology from the University of Minnesota, and pursued post-doctoral research at the University of Chicago and afterwards under a Fulbright Scholarship at Louvain. Listed in *American Men of Science* and *Who's Who of American Women*, Sister Annette is a fellow of the American Psychological Association and a member of the NSF's screening committee and the committee on television of the American Council on Education. She has served as professor, departmental chairman, and dean at the College of St. Catherine, has delivered countless lectures to popular and professional audiences throughout the country, and recently telecast two complete psychology courses subsidized respectively by the Quinlan and Ford Foundations. She is co-author of two books and contributor of articles to several other books and numerous journals.

The following interview, reported by James F. Smith, S.J., presents Sister Annette's reflections on some of the problems confronting sisters who study or teach the sciences, and some of the ways in which Jesuit scientists might help towards solving them.

Do you think that the cause of sister training is of any relevance to Jesuit scientists?

Definitely. It seems to me that the aims and needs of sister training answer very well to the principles, as I understand them, on which your order bases its choice of apostolic works. Furthermore, I am convinced that for a number of reasons the Jesuit Fathers are in a singularly favorable position to respond to this important need of the Church. This is true in regard to many areas of sister formation; science is just one of them, but it has its own special problems.

You must have observed that traditionally we have worked exclusively with boys and men in our educational apostolate. Why do you think that a part in the training of sisters would be appropriate for us?

Jesuits claim an interest in educating students for influential positions in society. The present-day American scene sees women assuming such

roles of influence in academic, professional, and political life. In the first two of these spheres, some sisters have been able to attain far-reaching results, and their numbers and influence for good will increase as their training improves.

Unfortunately, many of the clergy have not caught up to the changes in the social and cultural status of women. The best-trained priests often work exclusively with lay apostles. This is certainly an excellent and necessary ministry in the Church, but we must remember that a well educated sister, like the priest himself, stands ready to devote herself wholly to the needs of the Church. An investment in her training will surely pay a high dividend. On the other hand, the negative attitude of many priests towards sisters not only discourages vocations to the religious life; it has in some instances almost led to anticlericalism on the part of the sisters. I have known some very gifted sisters who have felt constrained to leave their community because they saw that external clerical pressures precluded the possibility of their acquiring and applying an intelligent approach to scholarship and the religious life. They concluded that with such a situation existing in their institute, they could better employ their ability for the Church's service in an atmosphere free of such stifling strictures. These sisters were not unwilling to obey; rather, they saw that the given framework of obedience, as brought about by unreasonable demands from without, was unacceptable to them.

The proof that Jesuits as a group recognize the signs of the times in this matter lies in the number of Jesuit colleges and universities that plan creatively, and often at great sacrifice, to assist sisters in a variety of ways. Several of these universities have been very cooperative in the work of sister formation, too, and in faculty exchanges with sisters. In fact, for two summers I was a visiting lecturer myself in the Marquette University graduate school.

Your claim, then, that Jesuits are needed for the cause of sister formation is based on the fact that many of our American colleges have effectively recognized the importance of training women for academic and professional leadership. Is that right?

That's only part of the reason. The rest lies in the order's special qualification to fulfill the two fundamental principles of the Sister Formation Movement.

What are these principles?

The first is the principle of excellence: that everything done for the training of sisters will be top-level. The second is the principle of integration: that the spiritual, intellectual, and professional training of sisters

will be carried out in such a way as to provide for a fusion of these aspects of their religious life.

How do you plan to attain these goals?

Mainly by setting up sister formation colleges as parts of existing Catholic universities. Seattle University has such a college at present. It has its own dean, a sister, who presents student sisters to the university for degrees. These sisters attend classes exclusively in their own religious houses during the postulancy. After the canonical year, however, they attend the university, but return daily to the juniorate for spiritual instruction as well. A like arrangement obtains for the faculty sisters: their main work is in the sister formation college, but they also teach courses in other schools of the university. And all of them are strictly required to have the doctorate—unless, of course, they are in a field where this degree is normally not demanded, as in art and nursing education.

You think, then, that sister formation colleges should solve the problem of the academic training, as well as spiritual formation, of teaching sisters?

To the extent that they can be instituted, they should make qualified teachers of the younger professed. But they cannot suffice to solve the problem of sisters who for some time have been teaching with obsolete or otherwise inadequate preparation.

It would seem that science and mathematics are fields where training once considered sufficient is now likely to be out-of-date.

That's quite true, these fields are advancing so rapidly. Of course, some sisters are very well trained in science. But others are not, and there will have to be some sort of in-service training for them. The NSF goes a long way in supplying this, but it doesn't cover all the needs of the schools. Many older sisters cannot obtain grants because of age. Others lack necessary background courses or suffer defects in their religious and educational background which make it morally impossible to undertake such a venture. A number of campuses are ruled out because of unsuitable living accommodations for sisters.

What can be done for these sisters who need remedial and refresher training in science?

It seems to me that the individual priest-scientist, if he were willing to make a special contribution to the Church's needs in this area, could accomplish a great deal. We do want sister formation colleges to be set up —but they are the ideal. It would be foolish to overlook whatever prac-

tical steps could be taken in the meantime, both for the older sisters I have mentioned, and for those younger sisters whose communities do not yet benefit from such ideally organized training. Besides, the establishment of new centers and programs of training is ultimately a matter for superiors and deans; much could be done right now on the level of the individual priest-scientist teaching in college or high school.

Why do you specify priest-scientists, rather than, say, Catholic scientists in general?

As I remarked earlier, what all sisters need very urgently in their education is integration, the fusion of the spiritual, scholarly, and professional aspects of their vocation into one unified religious life. Sisters who are science teachers not only need up-to-date instruction in their field, if it is lacking, but they also need to be shown how science correlates with sound philosophy and the teachings of faith. This must be done *explicitly*—for instance, by a good course in the philosophy of science—and also *implicitly*, by the example of priests and other religious who are expert scientists and science teachers. The sisters need to see clearly that the laity have no monopoly on research and scholarly teaching. The late Holy Father, Pius XII, again and again emphasized that sisters must be taught that the apostolate *is* the religious life. Jesuits are in a position to bring home this lesson.

Why do you single out Jesuits for this integration of science and faith?

There are several reasons. First of all, there are more Jesuits active in science and science teaching than perhaps any other group of priests or religious. And your course of study lays great stress on philosophy and theology. You are consequently in a position to synthesize these areas of knowledge on the *intellectual* level. But there is something more. The insights of your founder in his Spiritual Exercises and Constitutions provide for a harmonious union of science and religious life on the *spiritual* level. Jesuit Fathers should be well equipped to convey, at least through their example, the notion of sanctity through study. I say that they "should be" equipped for this, because the results are not automatic. "You're not here to be good teachers, but to be good religious"—how many sisters have heard this from one or another Jesuit retreat master! Such a statement is at very best misleading. Clearly, it could easily be taken as advising that divorce of the religious and intellectual life decried by Pius XII. To be a good religious, the teaching sister must strive to be a good teacher; she must even strive for the utmost excellence in her teaching field. I think Jesuits are trained according to this principle, isn't that right?

Yes, it is. But it would seem that if you believe sisters would benefit from Jesuit education, you would advocate the solution of sending them to our universities for courses.

Unfortunately, it's not as simple as that. Apart from the instance of those sisters who can obtain grants for study, the almost universal obstacle to formal education is money. In some places, a teaching sister has a daily sustenance of less than two dollars—and the tax for the juniorate and for elderly sisters, as well as medical expenses, must come from this. If a sister is getting a salary of 600 dollars a year, or even somewhat higher, how can she afford a summer course or an in-service training program?

This is an added reason, on a different level, why sisters could use the help of Jesuit scientists. If they are in need of scientific training, and unable to afford it, they can only rely on the charity and zeal of someone who is able and willing to undertake a personal sacrifice to assist them.

What form might this assistance take? Is it something that an individual science teacher could organize on his own, as distinguished from an official university program?

There are a number of possibilities for summer institutes, even brief ones, and for in-service training of sisters on a non-credit basis. Admittedly, these are stop-gap measures, but they could nevertheless have far-reaching results. And the fact that they are non-credit projects should enable the individual faculty member to organize them informally at the expense of his own time, which is the sacrifice he would make. Perhaps in some cases several of the faculty might be willing to collaborate. Admission to the course or institute would be by invitation, and a fee could be charged for overhead, if this should seem advisable.

A summer or school-year program for sisters teaching science might be run in several ways. The most obvious, perhaps, would be in the form of courses on contemporary developments in, say, physical sciences or biological sciences or mathematics. Perhaps a discussion group could be organized; this should be particularly effective for handling problems of curricula and teaching, such as the use of class and laboratory materials, science fairs, science libraries, and field trips. Laboratory sessions, problem sessions—these, too, could be very profitable. But I still think that considerable time should be given, especially in discussions, to fundamental problems of science and their relationship to faith and philosophy. Take evolution, for instance—even sisters teaching in grammar school are asked about this. They need priest-scientists who can give them the proper attitude and understanding of such matters, not merely a pat answer.

There seems to be considerable scope here for Jesuit scientists in our colleges. But what about our high schools—do you think that Jesuits teaching high school science could do something of this sort? Presumably the sisters themselves would be high school or junior high school teachers.

I think that the same type of thing could be done here, too, though some changes would be called for. Perhaps the most profitable type of project would be a discussion group or seminar made up of Catholic high school science teachers. In a group such as this, priest-scientists would have a special contribution to make, as we have seen. But it would be possible in most cities to include in the seminar some sisters who are themselves expert teachers of high school science. These sisters could draw on their scientific knowledge and experience. It is true that they would not have the theological and philosophical knowledge of a priest, but they would obviously be in the very best position to exemplify for the other sisters a successfully integrated religious-scientific apostolate. The resulting increase in their understanding of their apostolic vocation should help these other sisters to strive for more effective science teaching, too.

Of course, there is one obstacle to this mutual assistance among Catholic teachers on the same level, and that is competition between schools and religious communities. There is a place for some competition—it does help to improve standards. But it can go too far. I suppose that is why our present Holy Father, looking to the good of the Church as a whole, urged religious to do away with unworthy competition among various institutes and to practice greater cooperation; he stated that religious communities must not look with disdain on other communities and their works.

I can see the need to eliminate such excessive competition among Catholic teachers on the same level. And I also realize that if Jesuit scientists are to share their views and experience with sisters who might be helped by them, they must make some personal sacrifice of time and effort. But I should think that ultimately such cooperation with the needs of the sisters would benefit the Jesuit's own school or college.

It would. What happens—though if you aim at it, you don't always get it—is that sisters teaching in high school urge their graduates to go to the college whose faculty has been generous to them. This is only to be expected. The same thing naturally happens when sisters who teach in junior high school advise their pupils on selection of a high school. Even the grade school sister holds this position of influence!

But the sister's influence is best felt in the quality of the student she trains. It stands to reason that if she is a good science teacher, she will turn out good science students. I know of one Jesuit Father who teaches

college physics in a city where most of the Catholic high school students are taught by sisters. Not satisfied with the number or quality of students in his course, he invited several high school seniors to take a Saturday course in mathematics from him, free of charge. No doubt his physics program benefited from such a measure. But I wonder if the result might not be more extensive and permanent if he were to do something similar for the sisters who teach these high school students. I don't mean the same type of program, of course, but one of the sort we discussed earlier.

You are convinced, then, that much good can be accomplished by help given to sisters in science education.

Yes. Some sisters could use whatever remedial and refresher training is made available to them, provided it is of high quality. Others are thoroughly up-to-date in their teaching field and get remarkable results. Both groups can usually profit from exchanges of ideas, and from assistance in understanding scientific questions touching revelation and other areas of knowledge. This I believe Jesuit scientists can give them; perhaps the permanence and extensiveness of the results of such an effort may prove an attraction to a number of you.

NATIONAL CATHOLIC EDUCATIONAL ASSOCIATION
WASHINGTON, D.C.

REPORTS OF SCIENTIFIC ACTIVITY

High Schools

Fordham Prep. Five juniors from the science honors program attended the NSF-sponsored summer institutes for talented secondary school students. All tuition costs and up to fifty per cent of the subsistence and travel costs were underwritten by the NSF.

The students and their institutes were: Richard Lepre, Manhattan College (physics and mathematics); John Fiscella, St. John's University (physics); John Connor, American Museum-Hayden Planetarium (astronomy and space science); John Conway, Assumption College (mathematics); and Richard McCarthy, University of Utah (geology). The award to the last student was partly the result of his fine work during the fifteen-week Saturday course in geology, mineralogy, and crystallography at the American Museum of Natural History.

The junior chemistry section took the 1960 American Chemical Society general chemistry examination instead of the usual province examination. Half the class achieved percentiles of 65 or better.

St. Joseph's Prep. Fr. Stephen Garber, S.J. is directing a group of six students in a research project supported by a grant from the Heart Association of Southeastern Pennsylvania. The grant provides $200 for equipment and $600 for personal use. The group will investigate the solvent and ionizing powers of N,N′ dimethylformamide.

Colleges and Universities

Fairfield University. The NSF granted the university $10,230 for an in-service institute for secondary school teachers of science and mathematics. Dr. John A. Barone of the chemistry department directs this program, which is a cooperative effort of the university's science departments and the graduate department of education.

Chemistry. The National Cancer Institute has supplemented Dr. Barone's two-year grant of $8,346 with an additional $4,739, to further his study of the synthesis and properties of trifluorinated pyrimidines and purines, which are potential anti-cancer agents.

Under Dr. Barone's direction the department has received a three-year grant of $7,590 from the NSF in support of its undergraduate research participation program. This program also concerns the study of potential

anti-metabolites, but in this case the compounds under investigation are related to B-vitamins.

Fordham University. George Maass, senior chemistry major, shared first prize for his research paper, "Transitions in solid solutions," presented April 29 before the inorganic and physical chemistry section of the meeting-in-miniature of the New York Chemistry Students Association. The work was supported by the NSF and directed by Dr. Norman Smith of the chemistry department. This is the second consecutive year that a Fordham physical chemistry major has won first prize at this annual meeting.

Holy Cross College. The departments of biology, chemistry, and physics have received an AEC grant of $10,000 for undergraduate nuclear science instruction in the principal courses in each of the three departments. A few laboratory experiments will supplement the appropriate lectures and demonstrations. Fr. John W. Flavin, S.J., of the biology department, will direct the program.

Science departments at the college conducted an NSF-sponsored summer institute for high school teachers in biology, chemistry, and physics. The institute was so designed that any two of the three fields could be studied. Fr. Flavin was general director of the institute as well as director of the biology section. Fr. Joseph A. Martus, S.J. and Fr. Thomas J. Smith, S.J. directed the chemistry and physics sections, respectively. Among those assisting in the instruction were Fr. James P. McCaffrey, S.J., of Boston College High School, and Fr. Robert B. MacDonnell, S.J., of Holy Cross.

Chemistry. Three new members have been added to the chemistry faculty in the past year. Richard B. Bishop, private consultant and holder of many patents in the field of high polymers, joined the staff in September of 1960. He will direct graduate and undergraduate research. Dr. Robert W. Ricci, a graduate of Boston College and the University of New Hampshire, with postdoctoral work at the latter, will begin teaching quantitative analysis and advanced physical chemistry in September, 1961. Bringing the present staff total to nine will be Dr. Paul D. McMaster, another September 1961 addition. Dr. McMaster, who graduated from Holy Cross and Clark University, will work in organic chemistry at the graduate and undergraduate levels.

During the past summer Fr. Bernard A. Fiekers, S.J. taught quantitative analysis at Gonzaga University in Spokane, Washington.

Termination of the staff's extra-curricular activities include: Fr. Fiekers, as editor of this BULLETIN; Fr. Martus, as secretary of the New England Association of Chemistry Teachers; Professor Andrew Van Hook, as member of the executive council of the American Chemical Society's Central

Massachusetts Section. Professor Bishop and Fr. Fiekers are still members of this council, the former as the new secretary-treasurer, the latter as national councilor in the society. (Fr. Arthur L. McNeil, S.J., of Gonzaga University, is another Jesuit member of the national council and represents the Inland Empire Section. ACS President Arthur C. Cope recently appointed him to the council's Committee on Chemical Education.)

During the Easter holidays the college was host to the Society of Plastics Engineers for its Injection Molding Workshop. The society has granted the department $1500 for equipment to be used in polymer studies.

St. Joseph's College. Mr. James Spratt, a 1956 graduate in electronics-physics and currently a research scientist at the Philco Corporation, was co-discoverer of a new solid state device which may replace the transistor in many electronic circuits. At the dedication of the Philco Research Center at Blue Bell, Philco President James M. Skinner spoke of the work done by Mr. Spratt and his co-workers as follows:

> Last month [April, 1961] in a letter to the editor of the *Physical Review*, Mr. James Spratt, Dr. Ruth Schwarz, and Mr. Walter M. Kane of the Philco Research Division announced the discovery of a new device for amplification of electronic signals. We call this the Metal Interface Amplifier, or MIA. Basically, it consists of a tripledecker sandwich of thin metal and insulating films which can be arranged to control the behavior of energetic or "hot" electrons, as contrasted with transistors which are made of semi-conductors, and current is transferred by "minority carriers." While this device is still very much a new-born baby, and a great deal of hard research and development lies ahead before it takes its place in the hierarchy of electronic amplifiers, nevertheless, our analytical studies to date indicate that this new invention should be completely competitive with, and outclass the transistor in all respects. It should, in theory at least, have a higher speed capability, a greater temperature range, be less subject to radiation damage, have greater power capability, and be more compatible with microminiature circuits. Whether these promises are realized, of course, only the future will tell—but we have high hopes.
>
> Interestingly enough, from a size point of view, the working dimension of these devices is only a few atoms thick. This is a very small fraction of a wave length of light. Consequently, there is no possible way that one can ever see the actual working structure, no matter how powerful a microscope is used. However, the working structure is there—and can be controlled and reproduced—and it does work.
>
> The device which cut the ribbon dedicating the new Philco Research Laboratories was actuated by a signal generated by one of the first of these MIA's, used as an oscillator.

Wheeling College. The chemistry department announces the appointment of Dr. Jack Pincus as Assistant Professor. Dr. Pincus received his doctorate from the University of Southern California and worked as a postdoctoral fellow at the State University of Gronigen, in the Netherlands.

For the past several years he has been teaching and doing research at the University of Pittsburgh.

Fr. Joseph A. Duke, S.J. has been elected secretary of the West Virginia Academy of Science for a three-year term, and has been asked to serve on the Committee of Talent Search and Grants.

The chemistry department has recently acquired a pH stat and conductivity apparatus which will be used in Fr. Duke's research on nucleotides sponsored by the National Institutes of Health.

Graduate Studies and Research

Manila Observatory. The laying of the cornerstone at the new site of the famed observatory, and a highly successful TV physics course by one of the staff members, have focused attention on Jesuit contributions to expanding scientific education and research in the Philippines.

New site. The Manila Observatory has been operating in Baguio City since 1952, when Fr. Charles Deppermann, S.J. built a replacement for the original observatory destroyed in Manila during World War II. Fr. James J. Hennessey, S.J. has directed the expanding activities of the observatory since Fr. Deppermann's death in 1957. At the same time he has been conducting ionospheric research. Fr. Richard Miller, S.J. and Fr. Bernard Doucette, S.J. direct the solar and seismic research, respectively.

The Baguio site has been exceptionally good for solar studies and the seismic foundation on solid limestone is second to none in the Philippines. However, lack of space has limited the research opportunities, and has necessitated the refusal of many contracts.

For this and other reasons it was thought wise to move the observatory back to Manila, to the campus of the Ateneo de Manila (Quezon City). This change of site gives the observatory twenty acres for expanding its facilities, and the presence of its staff on the university campus, along with the staff's interest in teaching, will help both the observatory and the science departments of the university.

The new observatory will comprise four units. The largest, the main building, will include laboratories, classrooms, a large museum, a large library, and, on the third floor, residence quarters for the Jesuits on the staff. The other three units will be the ionosphere station, the seismic vault, and the solar building. Work is in progress and is scheduled for completion early in 1962.

The public blessing of the cornerstone and site took place April 16, 1961, with Rufino Cardinal Santos, Archbishop of Manila, officiating. Three short addresses preceded the blessing. Fr. Francisco Araneta, S.J., Rector of the Ateneo, welcomed the observatory on its return to the campus

of the school and expressed hope of great results from the cooperation of both institutions in the field of science. Rev. Fr. Francis X. Clark, S.J., Provincial of the Philippines, recalled the missionary scientists of the Far East in the distant past, and the Spanish and American Fathers who directed the observatory over the past hundred years.

Fr. James J. Hennessey, S.J., present director of the observatory, explained briefly the research being done at the observatory in the field of geophysics. He explained how this work will be helped by being on the campus, and by the faculty's present opportunity to teach at the university. Fr. Francis Glover, S.J., as Master of Ceremonies, introduced Cardinal Santos.

TV College Physics Course. Fr. Glover, attached to the observatory as a Fulbright research professor, recently presented a TV college course in physics, the first such course in the Philippines. Sponsored by the National Science Development Board (NSDB), in cooperation with the Department of Education and the United States Educational Foundation, "Physics for the Atomic Age" ran for six weeks, Monday through Friday, 8:00–8:30 A.M., starting in April.

A general college physics course, it was designed to help improve the quality of physics instruction in the schools. It included a study of kinematics and mechanics, point charges at rest and in motion, wave motion with application to sound and light, and selected topics from modern physics. Suggested textbook references were: L. Paul Elliot and Wm. F. Wilcox, *Physics, a Modern Approach* (New York: Macmillan); and R. L. Wever, M. W. White, and K. V. Manning, *College Physics* (New York: McGraw-Hill).

Qualified college students were able to take the course for credit recognized by more than fifteen colleges and universities in the Philippines. Many secondary school teachers participated informally in the course in order to evaluate themselves as teachers. Junior and senior high school students also participated.

Fr. Glover, as a Fulbright professor, has been assigned to the NSDB as an advisor, to the Far Eastern University for teaching, and to the Manila Observatory for research. At the NSDB he has been giving lectures on atomic physics to the staff and its agencies, the Philippine Atomic Energy Commission and the National Institute of Science and Technology.

The enthusiastic response to Fr. Glover's TV course is reflected in a letter received by Fr. Hennessey, director of the observatory, from Dr Paulino J. Garcia, chairman of the NSDB. The letter reads in part:

> We could not have found a more effective lecturer. Reports on the TV project that reached me even when I was in the States recounted the unprecedented enthusiastic response of the TV viewers especially to the TV lecturer. The

questionnaires that have come in and the testimonies of high school teachers, college professors, science supervisors, the science superintendent, and our own top officials at NSDB give such glowing accounts of Fr. Glover's effective presentation of his lectures.

We wish, indeed, to congratulate you for having Fr. Glover on your staff. It should make the Jesuit Community happy to know that Fr. Glover has earned the distinction from among his peers at the University of the Philippines, the University of Sto. Tomas, Far Eastern University, Mapua Institute, etc., as the most effective physics professor in the Philippines.

Needless to say, the NSDB is greatly honored in having "discovered" Fr. Glover and in having been able to define NSDB's standard of excellent teaching through Fr. Glover's performance.

University of Maryland. Mr. James M. Schecher, S.J. (*N.E.*) recently completed work for his master's degree in physics. Under the direction of Professor Joannes M. Burgers, his thesis was entitled, "The use of a T-tube to produce shock-heated plasmas in an X-band waveguide." An abstract of the research follows.

The shock wave produced by a T-tube with a sidearm expansion tube of 10 mm. square cross section was investigated as a possible means of producing shock-heated plasmas in an X-band waveguide. Only shocks of Mach number less than 15 in argon at ambient pressures of from 0.12 mm. to 2 mm. Hg were studied.

The investigation had two aspects. The theoretical and experimental results obtained by previous studies of strong shocks in T-tubes were applied to this tube where possible. Experimental studies were also made on the tube. At Mach numbers less than 16 the velocity of the shock front was found to vary as the inverse square root of the initial pressure and as the square of the applied voltage. The maximum volume of the shock-heated test plasma was found by theoretical considerations to be less than 1.2 cc. Drum camera pictures revealed the presence of additional fronts which move slightly faster than the shock front itself. Finally, a summary was given of the thermodynamic variables of the test gas behind the shock front, obtainable from drum camera photographs. It appeared that the important parameters of electron temperature and density cannot be obtained by this means.

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