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TO: Dean Graham, College of Liberal Arts

FROM: Robert S. Cohen, Acting Chairman, Department of Physics

SUBJECT: Annual report for the Department of Physics, June, 1959

I wish to submit the following report for 1958-59.

I. Personnel

1. Professor F. Dow Smith resigned as chairman of the department and was replaced by R.S. Cohen as Acting Chairman. Dr. Smith generously continued as Research Professor without stipend and taught PY 207, 208, Optics-Sound, during this academic year. He will not be on the faculty next year.
2. Professor Max Janner, of the Department of Physics at the Hebrew University in Israel and Chairman of the Department of Physics of the Bar-Ilan University in Israel, served as Visiting Professor of Physics during 1958-59, teaching our general education course in Physical Sciences, PY 101, 102, and our senior course in Modern Physics, PY 301, 302.
3. Professor Armand Siegel returned from his Guggenheim Fellowship at the University of Michigan; he taught several graduate courses and several discussion sections of the elementary physics course. During 1959-60 Dr. Siegel will teach a senior CLA course, Heat and Thermodynamics, PY 311. During part of the Fall term, 1958, Dr. Siegel served as Acting Chairman of this Department.
4. The proportion of part time faculty has been reduced this year and we look forward to further reduction. Our general aim is to teach our Evening Division courses with regularly appointed faculty in CLA or the Graduate School, and where this is not possible to employ part-time faculty of the same professional rank as regular staff members.
5. During 1959-60 the course in Physical Optics, PY 207 (PY 208 has been dropped) will be taught by Dr. Willem Brouwer, who is presently a member of the Physical Research Laboratories of Itek Corporation. Dr. Brouwer holds the Doctorate in Optics from the University of Delft; his teaching services are not being donated by the Itek Corporation but are a matter of agreement between Dr. Brouwer and this Department. At the present time Dr. Brouwer is planning with Dr. Stipe the renewal and improvement of the optics laboratory teaching facilities.

6. Dr. Edward O'Neill has continued as a faculty member, nominally listed at 1/3 time, but actually carrying better than 2/3 of a normal teaching and student load. He has shared in the handling of discussion sections in elementary physics, taught several graduate courses, participated in a graduate seminar with Dr. Siegel, and continued his direction of the academic programs and research activities of 8 graduate students.
7. Dr. Robert Nesbet has continued to serve as chairman of the department's Committee on Graduate Studies with particular time devoted to the preparation of the Comprehensive Examinations for the Master's and Doctor's degrees. He has continued to teach several advanced theoretical courses in the Graduate School and to offer a graduate seminar. During 1959-60 Dr. Nesbet will teach the undergraduate senior course in Modern Physics, PY 301, 302.
8. Dr. Charles Willis, together with Dr. Siegel, reinstated the graduate physics colloquium this year. This colloquium is important in that it provides a scientific community of the faculty and graduate students, something which is quite fragmentary when left to the various courses. It now appears, from our experience this year, that a regular colloquium can be maintained at a substantial level of scholarship, with a regular, sizeable, and informed audience of our own staff, and students, and physicists from neighboring institutions. We are limited because of the lack of funds for travel expenses and/or honoraria and I hope the Graduate School can plan to make such funds available. Along with a departmental library and adequate space facilities, the Colloquia could be the most significant aspect of élan in our graduate education in physics.

Dr. Willis has continued to teach in the graduate program and also has taught sections of elementary physics. He also taught one of the experimental sections of TV physics. During 1959-60 Dr. Willis will initiate our new undergraduate course PY 308, Vibrations and Waves, which is considered as a supplement to the present junior level courses in Electricity and Magnetism, PY 205, 206, and Physical Mechanics, PY 204.

9. Dr. Edward Booth has continued his teaching in nuclear physics and in the elementary course sections. During the present year and during 1959-60, his senior-graduate course in Advanced Laboratory, PY 313, 314, will be completely revamped. We have dropped the laboratories which have been associated with the undergraduate courses in Mechanics and Heat, and Modern Physics; these courses revert to 3 hours credit per semester; in place of their laboratories, Dr. Booth's course is offered to our majors and incoming graduate students. We expect that the Spring semester of this course will be completely devoted to student

projects of a research nature. In this connection Dr. Hawkins will take certain students for radio-astronomical investigations.

10. Dr. Gerald Hawkins has continued his large course in elementary astronomy, AS 101, 102, and also the more sophisticated similar introductory course, AS 201, 202. He will institute a graduate seminar in radio astronomy during 1959-60.
11. Dr. Michael Rice has continued to develop our special course in general physics for majors in the physical sciences. Again it has been an expensive course to equip and it has taken his full time to teach it with one laboratory assistant. The course appears to be growing and we have added the students from CIT to it for 1959-60. We anticipate that Dr. Rice will teach a graduate course, probably in his special field of magnetic resonance, during 1960-61. At Dr. Rice's suggestion the department has organized a system of advisors so that each undergraduate physics major receives regular counseling, and a file concerning them is maintained in the department office. All members of the department faculty share this task which is similar to the advisory system for graduate students.
12. Dr. J. Gordon Stipe joined this department this year, coming from a position as Chairman of the Physics Department at Randolph-Macon Woman's College, Lynchburg, Virginia. He was presented with a very difficult situation with respect to existing standards in the elementary course, PY 103, 104, lack of adequate laboratory equipment in this course and in his other course, PY 205, 206, Electricity and Magnetism, and Electronics. I believe that Dr. Stipe has now transformed the standards of both these courses such that they are at the national average with respect to academic standards and only slightly below the national average with respect to teaching equipment in the laboratories. We have every reason to hope that he will improve these courses further, the national average being below a desirable professional standard. Dr. Stipe served as Acting Chairman of the department during part of the Fall, 1958, semester. He has also served informally as director of undergraduate studies. He has been heavily burdened this year, far more than is consistent with good teaching.
13. During 1958-59 Dr. Cohen spent the greater part of the first semester on medical leave. Dr. Jamner generously taught Dr. Cohen's course on Philosophical Foundations of Physics (PY 807); Dr. Willis taught Dr. Cohen's course in Thermodynamics (PY 311); and Dr. Marx Wartofsky of the Junior College faculty taught Dr. Cohen's course on the Philosophy of David Hume, (PH 401).

II. Research Activities

Each member of the department has engaged in scholarly work this year.

1. Dr. Booth has continued his work in low energy nuclear physics on a contract from the National Science Foundation. This continues the work which was previously supported by the Research Corporation. A considerable expansion of this work is in process; Dr. Booth will be assisted by three graduate students during Summer, 1959 and academic year 1959-60.
2. Dr. Hawkins has continued as director of the Harvard Project on Radio Astronomical Investigation of Meteor Showers. Instrumentation and construction should have been completed by early summer, 1959, and a large scale test of the various observation stations will be made before September 1959. Dr. Hawkins has received, in addition, a contract from the National Aeronautics and Space Administration for a study of tektites and a second contract from the Air Force Cambridge Research Center for meteor research. We anticipate that his research activities will involve B.U. graduate students to an increasing extent, as they advance beyond the first year graduate level; two of our graduate students will be engaged in such research during 1959-60.
3. Dr. Jammer has nearly completed his historical and philosophical study of Concepts of Mass, to be published by the Harvard University Press as a companion volume to his earlier Concepts of Space and Concepts of Force. In addition Dr. Jammer and Dr. Cohen are collaborating on an annotated source book on the historical evolution of concepts of time, which we anticipate completing during July, 1959.
4. Dr. Nesbet has continued his important series of papers on the quantum mechanics of molecular structure. His papers have recently appeared in the Physical Review and Annals of Physics. Two more will appear during Fall, 1959 and three others are in process of writing. Dr. Nesbet has a contract for this work from the National Science Foundation, the major expenditure being for computer time. During summer 1959 Dr. Nesbet will be working at the research laboratories of RIAS in Baltimore, Maryland, and he will also participate in the International Conference on Molecular Quantum Mechanics at Boulder, Colorado, June 21-27, 1959.
5. Dr. O'Neill has continued his research in optics and information theory as a member of the research laboratory of the Itek Corporation. By invitation he will present his most recent research to the International Congress of Optics in Stockholm, Sweden, during August, 1959. Four of our graduate students will be engaged in related research with Dr. O'Neill during 1959-60.

6. Dr. Rice received a grant administered through the Boston University Medical School, the Rebekah Rice Grant, for research in the application of nuclear physical methods to biological systems. We anticipate that he will set up a small research laboratory at Boston University for nuclear magnetic resonance measurements, and thereby transfer all his activities from Harvard to Boston University.
7. Dr. Siegel has continued to devote his efforts to (a) foundations of quantum mechanics, and (b) new methods for the statistical mechanics associated with Brownian motion and related problems. He will be joined during 1959-60, by terms of his new Air Force contract, by a Research Associate at the post-doctoral level. We have been fortunate to have a student of Professor Julian Schwinger accept this post as Dr. Siegel's Associate.
8. Dr. Stipe has received a contract from the McGraw-Hill Book Co. to complete his manuscript of a text book of introductory physics. An interesting feature of the manuscript arises from Dr. Stipe's view that the virtues of the recent general education courses in physical science (mainly an attention to the historical, cultural, and philosophical elements in the scientific enterprise) can be brought into the elementary course for science majors and pre-medical students. Dr. Stipe expects to complete this manuscript by Fall, 1959.
9. Dr. Willis has continued his research in statistical mechanical problems of transport phenomena and plasma physics. During summer 1958 he was supported by Air Force Cambridge Research Center and during the summer 1959 he will be working with Dr. E.P. Cross under a grant administered by Brandeis University; he will also be associated with the Brandeis University Summer Institute of Theoretical Physics.

III. Curriculum

A. Undergraduate

In the two years previous to 1958-59, the graduate programs leading to the M.A. and Ph.D. degrees were fundamentally reconsidered and during 1958-59 this process was continued with reference to the undergraduate major program and also with reference to the introductory courses. The results appear in the CLA catalog for 1959-60.

One principal difficulty has been the inadequate equipment and low standards which have characterized the laboratory portions of various courses. Our attempt to rectify this situation by fairly extensive purchasing of university level equipment has been complicated by the substantial increase in enrollment. At this time I

can summarize our situation with regard to undergraduate laboratory facilities as follows: (1) The two introductory courses which require laboratory are about 80% up to a suitable standard and in each case, a few major purchases of equipment will bring them to a position where only minor replacements will be necessary for some years to come. (2) The course in Electricity and Magnetism is now comparable to the average liberal arts college course, but the equipment for the second semester of this course, Electronics, is by no means up to this level. Even less so is the course in Intermediate Electronics. (3) Despite the major interest in optics at S.U. over the past 15 years, we have been faced with a serious deficiency in equipment for laboratory instruction in this field. Only extensive purchases can improve this; requisitions which have recently been submitted should bring this course up to a minimum professional standard. (4) We have instituted the special course in Advanced Laboratory techniques to be offered for undergraduate and graduate credit. Equipping of such a course is always expensive but a good start has been made this past year.

We have also initiated a special Physics-Astronomy major to begin in 1959-60.

B. Graduate

The new graduate curriculum is now producing its first set of students and we were gratified by their showing in the department's comprehensive examinations this spring. There is still a shortage of courses at the advanced graduate level, and also a shortage of research opportunities for these new advanced graduate students.

The continued concentration of able graduate students at the large major universities poses a serious problem for us. We cannot obtain students to study with our faculty unless we offer some reason for them to come here rather than to the prestige universities. Our limited number of teaching fellowships and research assistantships seems likely to assure us of a minimum of a dozen competent graduate students; we have some appeal for students from foreign countries, especially from India and Japan, and it appears that the process of soliciting foreign students is more independent of the American graduate school's prestige order than the solicitation of students from this country; finally we have the possibility of a considerably expanded enrollment of degree candidates and non-degree students in the graduate program from industrial and scientific laboratories in the metropolitan Boston area, through the Evening Division. If our present negotiations with Raytheon Manufacturing Company succeed, they may bring as many as a dozen such students through the doctorate each decade and they may serve as a model for negotiations with other firms and institutions.

C. Summer Session

In the Summer Sessions we continue to offer General Physics regularly. Furthermore we plan to alternate two of our intermediate level courses, Electricity and Magnetism, and Modern Physics, in successive summers. The enrollment just barely justifies this latter but it seems wise to offer the intermediate courses for the benefit of the many undergraduate physics majors who are part-time students and pressed for time.

This summer we have offered, in the evening, a formal graduate course for the first time in recent years, PY 303E,S, Mathematical Physics (Theoretical Physics I). In order to avoid the pressure and frequently lowered standards of summer courses we have set this course to run throughout the two summer sessions for the normal 3 hours of Graduate School credit. The course is in every way up to our normal standard. The registration, at 19, has exceeded our expectations. It appears that we should continue to offer graduate courses in the summer.

D. College and University Services

There are three introductory courses in this department: PY 101, 102 for those who are not majoring in a science, and who are not satisfying either a laboratory science distribution requirement or a pre-medical requirement; PY 103, 104, introductory physics without use of the calculus, intended for those students who are majoring in other sciences, for pre-medical students and for students who wish this course to satisfy the distribution requirements in a laboratory science; PY 201, 202, an introductory general physics course using calculus, intended for physics majors, increasingly demanded by chemistry and mathematics majors, and by those pre-medical students of higher mathematical aptitude, and as a special physics course for the aeronautics majors at CIT.

The courses in Physical Sciences (PY 101, 102) is cultural as well as scientific in nature, stressing philosophical and historical aspects of science. It will be taken by students from Sargent College and the School of Education during 1959-60, and hence it will be necessary, a year from now to review the purposes of this course. It has no laboratory and the students from Sargent College, who do require a laboratory in physical sciences, will take a special section of the PY 103, 104 laboratory. The students from the School of Education and from Sargent College also apparently, will satisfy certain distribution requirements in science and we are not clear that those requirements are entirely of a general education nature; these two schools may in fact want a technical course. Moreover the two respective faculties have not clarified their needs with respect to one- or two-semester physics courses. I do not

believe that a general education course should be less rigorous than a technical course in the sciences, although liberal arts students may welcome the reduced amount of mathematical techniques in the general education course. If the other colleges wish a technical course at somewhat lower standards than PY 103, 104, we shall have to reconsider the suitability of our general education course, PY 101, 102 for that purpose. Our own view in this department is to recommend that those students with professional needs in physics should take PY 103, 104 at the same standard as CIA students, and that those students with a general education need in the physical sciences should take our culturally-oriented course, PY 101, 102.

Four notes are in order:

(1) Dr. Stipe's work with PY 103, 104 is benefiting from his own experience in the Harvard General Education Program and hence this pre-professional course can also be considered as a general education course; there is little doubt to my mind that science majors and pre-medical students have as much need for education in the larger aspects and implications of science as have liberal arts majors.

(2) The physical sciences course at OGH is comparable in its aims and pedagogical techniques with our PY 101, 102.

(3) The situation with respect to a special course for the projected new Liberal Arts-Medical curriculum is unclear. We do not think that the recent recommendations of the faculty committee on this curriculum (for teaching mathematical ideas in the physics course) can be carried out. The physics faculty is divided on the question, whether a special physics course should be devised for pre-medical students? We know of successful courses of this sort elsewhere but we are not clear that the customary course at a sufficiently rigorous level is not best for prospective medical students. The injection of special medical problems and examples is always a possibility but hardly of great pedagogical significance. On the other hand a course which stresses those parts of physics which are presently known to be of medical and biological significance could be a qualitatively distinct course, but here the further problem arises, which aspects of fundamental and pure physics will be of such significance in the future? We think it best to offer the orthodox course at present.

(4) The introductory course in descriptive astronomy has been of wide appeal to non-science majors and we anticipate that it will continue to be. During 1959-60 we shall try some cooperative teaching with the new planetarium at the science museum.

E. Special Problems

We are particularly weak in experimental physics; we have a quite inadequate library; we have too few undergraduate majors of high capabilities, either as experimentalists or theoreticians; we are unable to attract a sufficiently large number of applications for graduate study to enable us to make a selection, and, related to this, we are dependent upon the granting of teaching fellowships to maintain a core of capable entering graduate students. These seem to be quite normal problems for a physics department which is in transition from mainly undergraduate teaching to a full range of curricula, degree offerings, and research activities. It is especially necessary to recognize that stimulating and successful teaching at every level from the general education course to the graduate seminar depends upon teachers who are actively engaged in scholarly research. This is one standard that we meet successfully and it should make us reasonably optimistic about the future. Not one of these problems could not be solved by sufficient space and money.

Robert S. Cohen

RSC/b

BOSTON UNIVERSITY

March 27, 1957

To: Dean E. K. Graham, Dean D. E. Macdonald

From: F. Dow Smith

Subject: Physics Department Staff, 1957-58

This memorandum presents in summary fashion ^{justification for} the addition of physics staff for 1957-58. In this connection it is advisable to review the history of the department over recent years. In the spring of 1956 President March authorized a total staff of ten full-time teaching appointments. (Ref.: "Some Remarks on Physics at Boston University" by D.E. Macdonald, April 1954, page 50.) As the table below shows, this level has never been achieved. Indeed it has been extremely difficult to maintain the lower current level. Concerted attempts to hire qualified people from 1952-53 to until about a year ago were generally unsuccessful because of the unattractive salary situation. A marked improvement late in 1956-57 enabled us to add two new men although we had three refusals of essentially finalized offers prior to that. At the present time we can compete very well on the basis of salaries as recommended. It is so late in the year, however, that we run a great risk and may lose the men currently under informal negotiation unless immediate authorization to proceed is forthcoming.

Total budget level is a poor index of departmental activity because of salary increases. For example in 1951-52 the average base rate for junior faculty was \$4100 (Instructors and Assistant Professors) and in 1956-57 (Assistant Professors). The average teaching experience of the second group is actually less than that of the first group. (Their total qualifications are in general, however, higher.) This indicates an accumulated increase in rate of nearly 40% for men of comparable experience. The shift from instructors to assistant professors over the years is an established trend and we are now quite unable to interest any qualified Ph.D. applicant in anything less than an Assistant Professorship. Moreover supervision of work in the graduate program has been more direct. On the one hand, the total number of graduate students has been reduced (many part-time students were maintaining registration, but not working seriously toward a degree). On the other hand, faculty time devoted to supervision of active students has increased. This is essential for the graduate program but means that a smaller portion of the individual's total load is made up through teaching of lecture courses. #5666.

We can thus anticipate that in terms of a given number of credit hours in lecture courses the cost of physics staff in terms of salary has gone up something over 50% in the last five years. The bulk of this increase occurred this year and additional increases can be expected as necessary further increases in salary are introduced. This increase has not been reflected in the total departmental budget because the level of manpower available has dropped steadily.

BOSTON UNIVERSITY

To: Dean Graham, Dean MacDonald

From: F. Dow Smith

Subject: Page Two

The best index of need for additional strength is given by reference to courses for next year.

Additional Courses for 1957-58

| | |
|----------------------------------------|----------------|
| CIT Section of General Physics Courses | 5 credit hours |
| Sectioning of CIT Intermediate Physics | 6 " " |

Basic Courses Taught by Part-Time (1956-57)

| | |
|--------------------------------------------|-------|
| CIA: PY 201-2, General Physics | 8 " " |
| PY 203-4, Mechanics-Heat | 6 " " |
| GRAD: PY 709E-710E, Electromagnetic Theory | 6 " " |
| PY 305E, Solid State Physics | 3 " " |
| PY 706E, Theory of the Solid State | 3 " " |
| PY 707E, Statistical Mechanics | 3 " " |

40 credit hours

The basic courses listed above are an essential part of the regular program and should unquestionably be taught by regular faculty. Some of these are in the evening and additionally serve a broad area in community service. For this reason, too, our best feet should be put forward. In addition we give in the evening some 13 hours of undergraduate work (General Physics and one intermediate course) which are taken primarily by people wanting CIA credit. These courses are duplicates of day courses and are in steady demand. We should move toward teaching these with regular faculty. Over and above this we offer certain peripheral evening courses: electronics, high vacuum techniques, etc., which can be given effectively by part-time people. There will be no need to build faculty to cover these cases.

The 40 credit hours listed above would require an additional four or five people. We need not move this quickly, but it is clear that we will be seriously handicapped with less than three. This would bring our total physics staff to nine, the same as in 1951-52.

BOSTON UNIVERSITY

To: Dean Graham, Dean MacDonald

From: F. Dow Smith

Subject: Page Three

It should be emphasized that approval to appoint three new people for 1957-58 involves at this time only one new commitment. In August 1956 I was authorized to negotiate with W. Salove for an Associate Professorship. My offer to him was turned down; had it been accepted and Prof. Ajsenberg-Salove stayed B.U., our strength for 1957-58 would have been eight without further additions.

The size of Physics Faculty is shown in the following table over the last five years.

| 1951-52 | 1952-53 | 1953-54 | 1954-55 | 1955-56 | 1956-57 | 1957-58 |
|---------------------------------------------------|-----------------------------|----------------------------------|------------------------------------------|-----------------------------|-----------------------------|---------|
| 1 Prof 5500* | 1 Prof 5725 | 1 Prof 5755 | 1 Prof 5775 | 1 Prof 6175 | 1 Prof 6800 | 1 Prof |
| 1 Assoc —** | 1 Assoc — | | | 2 Assoc — 4600 | 2 Assoc — 5750 | 4 Ass |
| 2 Asst 4000 3850 | 3 Asst 4400 4000 4000 | 4 Asst — 4550 4000 3800 | 5 Asst — 4700 4200 4200 3900 | 3 Asst 4700 4200 4100 | 3 Asst 6500 5900 5250 | 4 Ass |
| 5 Inst 3900 3850 3800 3600 3600 | | | | 1 Inst *** | | |
| 9 32,100 | 5 18,125 | 5 18,105 | 6 22,575 | 7 23,775 | 6 29,500 | 9 |
| GIA credit 7,750 (still excluding chairman) | 3,200 | 2,950 | 2,800 | 1,000 | 4,000 | |
| Lecturers *** (basic courses only) | | | | | 4,985 | 50 |

* All rates are base academic rates.

** Dept. Chairman's salary not included.

*** O'Neill-no budget item

NOTE: The figures for 1957-58 differ slightly from those submitted in the February 18 Budget since they include the hiring of Prof. Robert S. Cohen.

BOSTON UNIVERSITY

To: Dean Graham, Dean Macdonald

From: F. Dow Smith

Subject: Page Four

SUMMARY

The Physics Department is at low strength:

- 1.) on the basis of the 1950 authorization by President Marsh,
- 2.) on the basis of a level implied by authorizations through September 1957,
- 3.) by comparison of our instructor-student ratio with other departments having comparable size and enrollment, (cf: Annual report to Grad. Dean, June 1956),
- 4.) by consideration of our too heavy dependence on part-time instructors for courses central to our program.

Authorization to hire a total of 3 new people for 1957-58 is urgently requested. One of these should be an experimental physicist at a senior level if at all possible.

BOSTON UNIVERSITY

April 8, 1957

To: Dean E. K. Graham

From: F. Dow Smith

Subject: Supplemental information to memorandum dated March 27, 1957.

ADDITION TO CHART ON PAGE 3

| Year | 1951-2 | 1952-3 | 1953-4 | 1954-5 | 1955-6 | 1956-7 | 1957-8 |
|---------------------------------|--------|--------|--------|--------|--------|--------|--------|
| # of Regular Personnel Listed * | 9 | 5 | 5 | 6 | 7 | 6 | 9 |
| Full-time equivalents * | 7 | 4½ | 4½ | 5½ | 6-3/4 | 5½ | 8½ |

* To provide a more consistent picture the departmental chairman's salary has not been included. Data is not complete and academic base rate is uncertain in some cases. Budget charge to CIA ranges from \$2500 (1951-2) to \$3300 (1956-7) and has not varied much from this range to my knowledge.