ANNUAL REPORT OF THE SCHOOL OF PHYSICS FOR THE FISCAL YEAR 1947–48

Llewellyn G. Hoxton, Chairman, School of Physics, University of Virginia

March 25, 1948

Contents

*(**Note:** square parens,* [Page]*, denote pagination of the original typescript, a carbon copy on thin paper in UVa Special Collections. We (MFowler) thank Ricky Patterson for locating it, and some first attempts at copying, and Lou Bloomfield for the crucial transcription, with ChatGPT.)*

I HISTORICAL SUMMARY

Llewellyn G. Hoxton

1.1 INTRODUCTION

Since I, as the author of this report, have had acquaintance with the University for a long time and since this is my last report, also my first report to you, our new President, I am undertaking a short summary of the development of this school as I have known it. Also, I am aware that this is in compliance with your wishes. I hope it will be useful.

I have looked up the important things where necessary. Other things are drawn from memory, but I think there are no excessive deviations from fact.

My connection with the University dates from the fall of 1896, when I entered as a student, graduating in 1900. I came back on the Faculty in September 1906. Forty-six years of my life have been spent here.

Any attempt at an historical account must, of necessity, reflect the personal bias of its author. It may appear as you read on that mine springs from a certain conviction—a conviction of the supreme importance of productive scholarship, of research, in a university; a conviction, in fact, that no institution can lay claim to distinction, or even be called a university, unless productive scholarship is well known to thrive within its walls. Instruction of the undergraduate youth has its own importance, of course, and has to be carefully kept up and advanced, but the other was regarded as needing every effort for its establishment and promotion.

Productive scholarship is here understood to include not only the publishing of scholarly research, but the training of persons, graduate students chiefly, to carry on the torch. My own productiveness is not what I would wish. But at least I could play the modest role of seeing that the work could be done no matter by whom. [Page 2]

Nowadays the ideas just expressed might be classified as truisms but, unhappily, they were not current at the University of Virginia in the early years of my association therewith. They came to me from elsewhere during the interim of absence from the University (1900–1906). I gained them from association with physicists at the National Bureau of Standards in Washington and at the Johns Hopkins University. I must however acknowledge a debt to W. J. Humphreys, a Hopkins man, Instructor in Physics for two of the years while I was a student. Yet his help and encouragement came mostly later on.

In 1906 it did not take long to sense a certain attitude of indifference amounting to hostility toward research, particularly on the part of older and influential members of the faculty. Remarks were made such as: "Thomas Jefferson founded the University for the imparting of knowledge, not for its discovery" (!!) Scorn was expressed for "these Hopkins specialists". "Our business is to teach these boys and not to rush into print" and so on. This is not an uncommon type of phenomenon but it persisted here too long. Maybe some of it lingers.

While many of the men of those days were brilliant and cultured, their reputation was local in the main. A few shining examples stood out, however, such as John W. Mallet, FRS, professor of Chemistry, Wm. H. Echols in Mathematics and, I think, W. H. Fontaine in Geology. Tuttle in Biology upheld the ideals of research. Gildersleeve was a tradition. He had joined the first faculty of the Johns Hopkins. There he found that free rein was given to his creative urge. He is buried here. I heard him say once that he had been buried here for 20 years!

(Handwritten footnote on this page: *An alumnus, a physicist, once said to me: 'About 1872 a crust of self-satisfaction began to form.' Therein lies some explanation.*) [Page 3]

That this picture on the whole is correct I think is buttressed by the testimony of others such as W. J. Humphreys, already mentioned, a noted physicist, alumnus and always a friend of the University. Then Dr. Barringer once made the observation to me that Virginia has "always been a stepmother to Science". Again a colleague characterized the University as a "good college with professional schools attached", i.e., with no Department of Graduate Studies. It should not be a matter of surprise then that the building up of a department of physics was a slow process.

The first Professor of Natural Philosophy of whom I have acquired some knowledge was William Barton Rogers who was here from 1835 to 1853, a period of 18 years. His chair included what we now call physics, also astronomy and geology. He may have possibly taught chemistry, but of that I am not certain. He was a true investigator, mainly in the field of geology, an eloquent and inspiring teacher and a pioneer in the method of lecture demonstration. A member of the National Academy of Sciences, he was well known abroad as well as in the United States. (*Added handwritten: he was also President of NAS.*)

While here he was chosen to champion the cause of the University during a crisis in its early history when the Legislature of Virginia threatened to reduce its support. He left here and moved to Boston where he is still well-known as the founder of the Massachusetts Institute of Technology. He carried with him the idea of the elective system and introduced it there.

Although he found here an atmosphere of “mental asphyxiation” he was always fond of the University and acknowledged his debts to it. His widow bequeathed a $1000 bond to this School, the interest on which was to be used for books. We still use some of the apparatus he [Page 4] left in our lecture demonstrations. Much of interest about the University can be found in his “Life and Letters”.

He was succeeded by Francis H. Smith who retired in 1907. His connection with the University lasted somewhat longer than from 1853 to 1907—about 56 years. Long before his retirement, Astronomy and Geology had become separated from the School of Natural Philosophy and were incorporated into Schools of their own. This School retained its original name until 1916 when it was changed to the School of Physics.

Professor Smith was a master at the art of lecturing and giving demonstrations. He followed and kept up this phase of the tradition of Rogers. His interest centered around the lecture-room and, as far as I know, he published no scientific papers. He turned out two Ph.D.’s however, Henry Louis Smith, later president of Washington and Lee University, and J. H. C. Bagby who became Professor of Physics at Hampden-Sydney College.

Associated with Professor Smith was **W. J. Humphreys**, Ph.D. from Johns Hopkins, previously mentioned. He held only the rank of Instructor from 1897 to 1905. As may be readily imagined he encountered trying conditions, yet, he succeeded in completing and publishing fundamentally important investigations. By his own efforts he secured apparatus, raised money for its purchase, also enough money to install an excellent instrument shop for that day. He was well thought of outside of the University and inside by a man like Dr. Mallet. Yet, in the end, he accepted a call from the Weather Bureau. He is now one of our well known physicists.

(*Footnote: (MF): Humphries wrote in 1913 about volcanic atmospheric dust impacting climate. He became a member of the American Academy of Arts and Sciences. His textbook* Physics of the Air *was still being printed in 1940 -- and in fact it's still being reprinted to order, in 2026, I just bought one*.)

Thus there was a fruitful period for the advancement of knowledge [Page 5] in this School from 1838 to 1853. Then followed a long period of sterility with a brief flare-up from 1897 to 1905. After that followed a period of slow, almost stationary, growth until 1928. Then the General Education Board chose to stimulate science in the South. This enabled us to bring Professor Beams to our staff and so get over a sort of "hump". After that the growth and reputation of the School has been more rapid and something to be proud of as will appear later in this report.

Having thus dealt with some of the earlier aspects of the history of the School and some of the conditions prevailing down to 1906, it will be convenient to take up its development from 1906 down to the present under the separate heads indicated on the title page. As already mentioned, the date, 1906, marks the point at which the author joined the faculty. It is hoped that the reader will come to a realization of how difficult has been the path and that our progress, gratifying as it has been in many respects, is yet only half way to a worthy goal. We are at the beginning of a new era in physics and much remains to be done. [Page 6]

1.2 THE STAFF

1906–7: F. H. Smith, Professor, L. G. Hoxton Adjunct Professor.

Professor Smith retired in 1907 leaving Hoxton, Adjunct Professor, in responsible charge of the School for the time being.

1907–8: Hoxton, Adj. Prof. **J. H. Cle** Instructor for that session. 2 students assisting in instruction and 1 for odd jobs.

1908 thru 1910: Hoxton Adj. later Assoc. Professor. **D. V. Guthrie** Instructor later Adj. Prof. Resigned 1911. 2 student assistants.

1911–1916: Hoxton, Assoc. Prof. **C. M. Sparrow**, Adj. Prof. The assistants rose from 2 to 3. Up to this point **Hoxton with a rank below that of professor had been in responsible charge of the department, i.e., for 10 years.** President Alderman had made attempts (in which Hoxton assisted) to induce physicists of established reputation to come here but without success.

* On one occasion Dr. Ames of the J. H. U. said to him, "What you seem to want is a combination of Lord Kelvin, J. J. Thomson and Saint Paul — all for $3000 a year!"

1916–1921: Hoxton Professor, **Sparrow** Adjunct Professor, later Associate (1918) and finally Professor (1921). The number of assistants rose to 6. From this point on my records do not show the number of student assistants in teaching. Already it has been shown how few they were and that is probably sufficient.

1921–1928: There were three on the staff of professorial rank.
[Page 7]

T. F. Hull was Assistant Professor for the first year. He was succeeded by **F. L. Brown** who joined the staff as Assistant Professor in **1922** and became Associate Professor in 1926.

In **1928** the professorial staff was raised to four by the addition of **J. W. Beams** as Associate Professor, becoming Professor in 1930.

In 1936 L. B. Snoddy was added as Assistant Professor bringing the staff up to its maximum, so far, of five; 3 Professors, 1 Associate Professor and 1 Assistant Professor. Brown was made Associate Professor in 1926 and Professor in 1940. Snoddy was made Associate Professor in 1940 and Professor in 1943.

In the meantime the staff was reduced to four by the death of Professor Sparrow on August 30, 1941. The vacancy was not filled until the spring of 1946 when **E. P. Ney** joined the staff and served for 1946–7 as Associate Professor. He resigned in the summer of 1947. During this session of 1947–48 we are most fortunate and privileged to have Dr. **C. J. Davisson**, Nobel Prize Laureate, on our staff as Visiting Professor and hope that we may have his stimulating presence here as long as possible. With Beams and Davisson on our faculty we have two members of the National Academy of Sciences, the only ones in the University at present (Mitchell, retired, is a member) and two of the very few in the South.

It would be appropriate here to add a few words about Dr. Sparrow. He had an extraordinary breadth of interest. In the words of an eminent scientific friend of his "His mind was not a kingdom, it was an empire." He was not interested in research*. His mind was critical, not inventive. He lacked the quality of a sustained persistent interest in a given problem which is the *sine qua non* for research work, [Page 8] and also for carrying out jobs that come up around a physical laboratory.

His lectures, when he chose to make the effort, could be wonderfully clear; but, on the whole his teaching was obscure—at least to the relatively immature minds of the students.

On the other hand, his technical articles, while not numerous, possessed sure qualities of clarity and finish. His outstanding characteristics were intellectual honesty, a lofty conception of scholarship and a high regard for the dignity of the human mind. His influence was salutary in upholding standards. Withal he had a quick wit and a keen sense of humor. A lover of the beautiful; thoughtful young colleagues were drawn to him for his learning, culture and the things of the spirit. [Page 9]

1.3 PRODUCTIVE SCHOLARSHIP

As already mentioned, productive scholarship is understood to include not only the publication of the results of research by the faculty, but also the initiation of young people in research methods and pursuit—training them for scientific careers.

To enumerate the papers emanating from this department since 1906 would be too great a task to undertake at this point. Moreover this would be unnecessary for the University has catalogued them in its more or less annual "Publications and Research". Some idea of what we do each year in peace time might be gained from the papers listed in Section IV. It should be borne in mind, however, that the war is too recent for these to be fully representative.

When it comes to those trained here and graduating with the degree of Ph.D. the matter is more readily understood and more easily presented. We feel that we can take justifiable pride in these graduates.

Before 1906 only two Ph.D.'s in Physics were granted in the history of the University. From 1906 to 1921 there were none. Since then there have been fifty-seven of whom 7 were graduated before 1929. About half of these Ph.D.'s have gone to colleges and Universities, at least six of whom are department heads. About one quarter have gone into the research laboratories of the government or of the foundations, while a few of these have gone to medical research laboratories. Finally a quarter are in industrial laboratories, two having set up independent establishments of their own. [Page 9a]

Thirty-two have been listed in "American Men of Science" and most of the remainder probably will be so listed when the next edition appears.

One of our graduates is a Professor of Physics at Harvard and two are Professors of Physics here, namely, Professors Beams and Snoddy. One, H. J. Workman, is President of the New Mexico School of Mines.

Beams from 1929 and both Beams and Snoddy separately and as a team have directed essentially all of the research done in this laboratory, and have made the University well known at home and abroad. It is a matter of particular pride to us at Virginia that our additions to knowledge are the fruits basically of homegrown ideas and not from ideas developed in other institutions such as Chicago, Hopkins and the like and then transplanted here. [Page 10]

1.4 DEPARTMENT BUDGETARY GROWTH

This section consists largely of Table I (below) which is intended to show a trend. There is no pretense of accuracy in the figures given but they show the orders of magnitude and that is sufficient for the purpose in hand. They show all the money available from appropriations and from student fees and expendable for salaries and for the laboratory, its apparatus, equipment, supplies, services etc.

In commenting on Table I it is significant to note how much money out of the amounts given was available for the laboratory, its apparatus, instruments, equipment, supplies, gas and various services. From 1907 up to 1928 this money came partly from student laboratory fees and partly from appropriation. It fluctuated from $750 to $2000. From then on to 1946 it remained at a maximum of $2000. So from a period of 40 years it did not go over $2000, an amount far too small and far under what laboratories of good Universities expended. But for the help of the General

Education Board and Government Contracts, we would have become static. In 1946–7 it was raised to $4000 and for the current session it is $8000. [Page 11]

1.5 TABLE I

Fiscal Year	Total Money Available	Remarks
1907-08	4600	Salaries, equipment, even janitor service included. Part of the money came from student laboratory fees. Enrollment about 60.
08-09	4700	
09-10	5030	
10-11	4600	
11-12	4800	Sparrow added to staff.
12-13	5700	
13-14	6000	
14-15	6100	
15-16	6900	
16-17	7100	
17-18	6210	
18-19	5150	
19-20	8240	

Fiscal Year	Total Money Available	Remarks
1920-21	16600	Enrollment 130, and going up. An instrument maker added. Laboratory fees and loan raised. Brown added to staff.

21-22	17700	
22-23	15600	
23-24	16710	
24-25	16960	
25-26	16760	
26-27	18150	
27-28	18150	

Fiscal Year	Total Money Available	Remarks
1928-29	29200	Help from the General Education Board begun. Beams added to staff. Secretary-Librarian added.
29-30	35210	
30-31	38110	
31-32	39310	
32-33	34605	Salaries being cut for several years due to the depression.
33-34	28900	
34-35	29593	
35-36	—	
36-37	33115	
37-38	36570	
38-39	37373	
39-40	37773	

40-41	38373	

Fiscal Year	Total Money Available	Remarks
41-42	32992*	Chief drop due to Dr. Sparrow's death (1941). Vacancy not filled for 5 years.
42-43	—	Enrollment jumped to about 780. Navy V-12 and Pre-Meteorology** Government contracts 1944 on.
43-44	42232*	
44-45	49120*	
45-46	51500*	Ney added 1946.
46-47	54968*	Ney resigned.
47-48	59466*	Dr. Davisson added. Enrollment 350.

* The University paid out less than this by the amounts contributed by the Government on salaries of mechanics and part of professors' salaries.

** Pre-Meteorology expenses were carried on a separate budget.

1.6 GENERAL EDUCATION BOARD AND RESEARCH APPROPRIATIONS

[Page 12]

The aid from this board put research in physics at the University of Virginia on its feet. Otherwise this department would have remained static for a time hard to estimate. *We were enabled to add Beams to our faculty and really get started* as mentioned elsewhere.

Sometime about 1927 a committee of the board without solicitation or notice, appeared at the University to investigate its possibilities as one of the places where research could be promoted in the South. The fields chosen were Physics, Chemistry and Biology. They had finished a program with Medicine and had just turned to these three fields as basic.

They were satisfied with our set-up as promising. The plan initially embarked upon contemplated a beginning contribution of $25,000 for all 3 sciences for the first year (1928-9) and $30,000 for the second. Then the University was to start contributing more and more, the Board less and less until, at the end of an eight-year period, the Board would bow itself out and the University would carry on with an annual appropriation of $45,000. The period was later extended and the amount reduced.

So far as physics is concerned the trend appears in Table II. The share of each science was determined internally, that for physics being 28%, for biology 32% and for chemistry 40%. If the original plan had been adhered to the allotment to physics would have risen to $12,600 (28% of $45,000) and kept there. The departures from this appear in the table.

1.7 TABLE II — GENERAL EDUCATION BOARD

[Page 13]

Year	Money for Physics Research	Contributed by G.E.B.	Contributed by U.Va.
1928-29	$7000	$7000	$0
29-30	8400	8400	0
30-31	9800	?	?
31-32	9800	?	?
32-33	8680	8400	280
33-34	5880	5600	280
34-35	4480	2800	1680
35-36	4900	2800	2100
36-37	5600	2800	2800
37-38	5600	2100	3500
38-39	5600	1400	4200
39-40	5600	700	4900
40-41	5600	0	5600
41-42	5600	0	5600
42-43	—	—	—
43-44	—	—	—
44-45	—	—	—
45-46	—	—	—
46-47	—	—	—
47-48	—	—	—

It will be noted that, with the war years, the contributions ceased. The recent augmentation of our laboratory appropriations, already mentioned, is part compensation. During the war years we were heavily engaged in war work and since the war, on a contract with the Navy. This was practically the only support that we have had for research. During the time of the G.E.B. support, unfortunately, we had to expend money on salaries. For example, this was the only way in which it was possible to add Dr. Snoddy to our staff. There is thus good reason why the University should go forward with support for research. [Page 14]

1.8 ENROLLMENT

Briefly there were about 50 undergraduate students in physics here in 1906-7, all in one class and one laboratory section, perhaps two. There were no graduate students or at most one or two taking Master's courses. Roughly it may be said that the number of student hours was under 200 per week.

At the present moment (2d semester) there are over 400 undergraduate students to be met in 7 lecture sections and 16 laboratory sections. The graduate enrollment is 27. These are met in six classes whose rolls aggregate 94. There are over 1500 student-hours in classes. If we add the student-hours in laboratory sections the total would become over 3000 student-hours or about 15 times that of 1906-7.

It will be noted that the number of graduate students now is about half the total number in 1906. Twenty-seven is more than our laboratory can accommodate. Some of them perhaps should be dropped.

Of course mere mention of the increase during the war to about 780 students (no graduate students) is sufficient, for that was temporary. The high enrollment now and the rapid increase in the number o f physics majors in the College seems in large part due to the role that physics has played in the winning of the war. Physics has been "sold" to the public as chemistry was to World War I, and people are beginning to realize the importance of trained physicists to the national security. [Page 15]

1.9 UNDERGRADUATE INSTRUCTION

Emphasis has so far been laid rather on graduate work and research. The undergraduate work also has undergone development.

When I came here as an undergraduate in 1896 the beginning class in physics (known as "Junior Natural") succeeded in covering mainly mechanics and some heat, leaving out sound, electricity and light although an "attempt" to give the elements of these subjects appeared in the catalogue. The laboratory work was confined to a few experiments and lasted only about two weeks.

In 1906-7 things were improved somewhat for Humphreys had instituted a laboratory course especially for the premedical students.

The following year the laboratory work was expanded and instruction was added in sound, electricity and light. In time it developed into Physics B1 with which you are familiar. It included at first both academic and engineering students. Soon after 1911 at Sparrow's suggestion (a good one) the engineers were put in a separate lecture section with different text books but essentially the same laboratory.

Physics B1 and its engineering counterpart required 3 hours a week in lectures and 6 hours a week in the laboratory and recitation sections. This seems all right for the engineers. But in time it appeared too hard for the academic students. In other universities, moreover, less time was required. Then here, students would not take physics until their third or fourth year chiefly. They were scared of it.

College Topics one September in its guide for new students printed "Like the peace of God it passeth all understanding. Good for mental masochists". So students, being afraid, often unduly, [Page 16], would not come in contact with physics until too late, i.e., too late to go on with it even if they had the talent to become physicists. Thus we were failing to train physics majors or to feed the Graduate Department.

The result was that in September 1942, the course was cut down for the college students with a credit value of 10 semester hours—in line with the practice at other good institutions. The laboratory and quiz work was reduced to one period of 3 hours per week, or when the schedule did not permit this to 2 periods of 2 hrs. each per week. The course is now called Physics 1-2. Except for a period during the war, when the engineering and college students were put in Physics 1-2, the engineering course has kept to the original schedule of Physics B1. Physics majors may take this Engineering course, listed as Physics 3-4 in the College Catalogue. There are now two lecture sections, each course and 16 laboratory sections in all.

The new course Physics 1-2 permits college students to take up Physics earlier than formerly—as freshmen, in fact, if they come well prepared. Physics 1-2 is followed by four half-year courses (Physics 31, 34, 35 and 38) on the undergraduate level. This enables them to preserve their contact with the subject, to major in physics, and to acquire the calculus which is indispensable for majoring and for graduate study. These “30-courses” have no laboratory work. There is not the building space nor the staff required adequate to carry this out, at present.

The future course of undergraduate instruction I shall not undertake to specify leaving that to those that come after. A statement of its needs by Professor Brown was included in last year's report pp. 15-18, a summary of which is: [Page 17]

1.10: IMMEDIATE NEEDS

1. Remodeling of Room 6 and additional services there and elsewhere in Mechanical Laboratory and Optics Lab. of R. P. L.

2. Apparatus to equip intermediate laboratories.

3. Full time technician and/or instructor to devote major effort to undergraduate laboratory and lecture equipment supervision of them.

Longer View but also needed now.

1. A new and adequate Physics Laboratory.

2. Equipment to give adequate laboratory and lecture instruction to undergraduate as well as graduate students.

3. Staff to operate it including two technicians and two full time instructors or assistant professors in addition to all other staff requirements. [Page 18]

1.11 WAR WORK AND GOVERNMENT CONTRACTS

World War I has been characterized as a chemist's war,* World War II as a physicist's war. Nevertheless this laboratory contributed to the effort of World War I in a small way. Sparrow was on leave of absence, 1918–19, and served as Captain in the Air Service in its Division of Science and Research. Hoxton undertook some investigations on aviation gasoline under the heat division of the National Bureau of Standards. They were carried out partly in Washington and partly here.

In World War II we contributed in two ways; in the teaching field, training the Army Premeteorological units and the Navy V-12, V-5 etc. and in the field of research.

In the field of research some investigations, called defense work at that time, began more than a year before Pearl Harbor, but from then on they assumed proportions that taxed our available space so that some extra outside space had to be created.

The magnitude of these undertakings is suggested by the bare list of the contracts as given in last year's report and repeated here with the addition of recent contract extension.

```
Frankford Arsenal                $  6,000.00

Naval Research Laboratory        $ 10,000.00

O.S.R.D. Contracts Other:
  Nos. 398 and 440           $193,500
  No. 598                    $  9,000
  No. 1052                   $140,000

Naval Bureau of Ordnance
  (NOrd-7873)                $420,000

Laboratory Building of the
  Naval Bureau of Ordnance       $122,000
                        ----------
                        $900,500
```

* Conant of Harvard, a chemist.

[Page 19] The credit for bringing our potentialities to the attention of Washington and then the organization and directing the work belongs to Professors J. W. Beams and L. B. Snoddy, neither of whom received any extra compensation. A great deal of outside technical and scientific talent had to be secured as well as labor. The graduate students then in the laboratory changed their status to scientific assistants while the rest of us on the faculty helped where we could.

The Frankford Arsenal Contract dealt with the development of a quick test for flaws in shells. It obviated the necessity for the usual shooting tests and made it possible quickly to find out if anything went wrong with the process of manufacture.

The contract with the Naval Research Laboratory dealt with the early stages of the development of the Atomic Bomb. The specific problem was on the separation of Uranium isotopes.

The O.S.R.D. Contracts dealt with a number of different projects. The principal ones were as follows:

(1) The Uranium Separation Problem as related to the atomic bomb. It was part of the work which later became the Manhattan District Project of the Army.

(2) Research on the development of a very high velocity projectile for anti-tank guns.

(3) Research and development of gun directors (radar tracking) for anti-aircraft defense of ships.

(4) Research and development of Guided Missiles. Both research on the propulsion and guidance of these missiles was carried out.

The contracts with the Navy Bureau of Ordnance included work on fire control and guided missiles. [Page 20]

The fact that the agencies of the government always insisted on renewal or extension of the contracts and, in addition wanted us to take on more work if our facilities would permit, is sufficient evidence of their satisfaction and trust in the work done at the University of Va. in physics. The fact that the contract for both pure and applied research with the Navy Bureau of Ordnance continues in force is a further attestation to this fact.

Further a money benefit to the University of no inconsiderable proportion should not go unnoticed. In part this came to the University as "overhead". The computation of this would be too laborious and complicated to attempt here. Another part came in the saving to the University of salary money of professors who were serving part-time. Both fluctuated. Yet, at one time we made a rough computation showing that the School of Physics was more than being floated by contracts, i.e., was not only no expense to the University but was bringing in money.

A historical note: these pages are quite remarkable. Hoxton is documenting, only a few years after WWII, that UVA Physics participated in uranium-isotope separation work that became part of the Manhattan Project, as well as radar fire-control and guided-

missile research. That's a significant piece of UVA physics history.
[Page 21]

1 12 INSTRUMENT SHOP

A separate, though brief, section is devoted to this because it has always been uppermost in the minds of those concerned with the possibility of having a research laboratory here. In their minds, and in the minds of physicists generally, a shop is a *sine qua non*. To the lay mind the perspective may be different. Without a shop a modern physics laboratory is helpless. This applies to instruction also, but chiefly to research.

Yet our laboratory was without the adequate use of a shop for many years and it was not without a struggle that one was got going. *In 1906 a shop had been installed by W. J. Humphreys* and what equipment it had was good. This was an outstanding contribution, a bequest for which the University should always be grateful. He raised the money for it. His idea was that it would be potent for research. Professor Smith's idea that it was “ancillary to the lecture room”. *That is an illustration of conflicting views of that day in the University.*

The shop was here but there was no one to work in it. It was not until 1920, a period of 14 years, that an instrument maker, Mr. A. J. Weed was secured, supported at first from laboratory fees and it was not until 1922 that his salary was put on the budget.

In the meantime the only help we could get were students working at 25 cents an hour and others when obtainable. Three outside men were tried at different times; one turned up with an incurable disease and had to leave, a second got on sprees and was forced to leave Albemarle County, while a third, fairly capable, had qualities of probity and honesty but with those qualities of eccentricity and obstinacy abetted by deafness! Of the students, one was outstanding,

[Page 22]

M. A. Fitzhugh, now the engineer in charge of the shore equipment of the Newport News Shipbuilding and Dry Dock Co. In the last 3 years he has made gifts of equipment and money amounting to $573.30.

In 1933 Mr. Linke was added. Mr. Weed died in 1936 and Mr. Somner replaced him that year. At present we have two men in the shop. During the war, when we were on contract with the government, there were several others.

1.13 BUILDINGS

Before the Rotunda fire in October 1895 the work in physics was carried on in the Rotunda Annex. It seems that a good part of the apparatus was salvaged. Practically all of it was for purposes of instruction. The lecture apparatus was an unusually rich collection for that day containing also a number of pieces of historical interest. Some was for advanced work particularly in light.

Promptly after the fire a small wooden temporary building was thrown up across the road from West Range. It was called "the School House" and had two lecture rooms, one of which was used for physics. ***Note:*** *Later, the School House was moved to the lower end of Dawson's Row and used as a residence—the one recently vacated by Professor Speidel.* [Page 23]

In the meantime the new buildings at the foot of the Lawn were under construction. Some time in the session of 1897–8 the Rouss Physical Laboratory was finished and occupied. It cost about $60,000, of which, the blind Charles Broadway Rouss, head of a New York department store, contributed $10,000 (and a marble bust of himself, now in the Bayly-Tiffany Museum). His name was put on the front in the hope that this would stimulate further gifts—but he failed to perform.

In 1906 the work in physics had not grown sufficiently to use all of the available space in the building. Furthermore, the building was not designed with much of an eye on the needs of research. It was a good deal of a shell in the two wings. As time wore on, our activities began to fill the building and when the G.E.B. money came in, some of it, unfortunately, had to be used in subdividing the basement of the wings into smaller individual laboratories for research. About this time also the building had to be rewired on account of the fire hazard. Also the electrical supply for research was improved.

By 1935 the building had long been taxed to its capacity to provide for the needs of instruction and of research. Fortunately the Department of Engineering had acquired a new building, Thornton Hall, and the School of Physics secured the use of the basement of the old Mechanical Laboratory.

In September 1935 all of the undergraduate laboratory work was moved across the Lawn. All lecture work except that in general undergraduate physics was likewise moved. This released some valuable space. Considerable fitting up of the basement of the north wing was carried out. Yet it was not subdivided sufficiently.

Subdivision was asked for and drawings were made, but the plans were not carried out until the war. Then the needs of instruction became so imperative that we could not operate until this job was done.

1.14 NEW BUILDING

At the present time a new building is the most urgent need of the School of Physics and what it stands for as a vital component of the University. The facilities here, in spite of the improvements already listed are far too meager and antiquated as modern establishments go. [Page 24]

The Rouss Physical Laboratory is still a fire trap with its wooden floors of inflammable pine. A fire once started could quickly get utterly beyond control and fire risks in laboratories are at their worst. In the Rouss Physical Laboratory is a collection of books and apparatus accumulated through the years. A great deal of it is irreplaceable. A big fire would mean a loss to the University of a precious heritage.

Further, two fires at least, one on a Sunday and the other at night, have already occurred but fortunately someone was on hand to stop them before they gained headway. The building has long been under attack by termites in woodwork supporting stairways through three stories and supporting adjacent floors.

In the winter of 1946 an extremely dangerous condition was discovered. The ceiling of the main lecture room had been slowly letting down with the imminent danger of collapse. The lecture room was used more than 9 times a week with about 100 students each time. The ceiling was lifted and buttressed by the Department of Buildings and Grounds with success.

The roof of the building has always leaked in rainy spells in spite of the frequent efforts that have been made to patch it up. To make a long story short the Rouss Physical Laboratory has been condemned.

But even if the buildings used for physics were up to date, they do not begin to furnish the space required either for research nor for instruction. Our undergraduate instruction beyond the beginning courses would not bear close scrutiny by present day standards. In that we are stymied until an adequate new building is put up.

Our research is even more handicapped. We need space for equipment facilities and for the students who want to come here for graduate study. [Page 25]

Without a new building we must face a decline and even disintegration of what has been painfully built up through the years. The University will become conspicuous for its lack of support of a basic science whose importance for its cultural value and national security is universally recognized.

Attention is directed to the fact that physics has received less support from the University than other natural sciences, some of it justly on account of larger registration in other schools, and yet, I submit, as far as outside recognition for research is concerned, it stands out in front. I should be willing to have a visiting board sit on that question. Our earlier requests were relatively modest. It seemed better to wait till things got done. Things have got done and the time has come to demand attention. Physics should stop trailing. It is not trailing elsewhere. Since I have been here I have seen a chemistry building go up, have known of the biology expansion at Blandy Farm and Mountain Lake and have seen two new Law buildings go up. It looks something like our turn now.

Attention is again directed to the fact that in the last ten years or so, the research accomplished was carried out not so much through State support as from support from without. Government support has already been mentioned, but before that, through the alertness, energy and enterprise of Professors Beams and Snoddy, special grants were secured from the foundations. For two years past research here has been entirely supported by the Navy, although this year that is only partly true.

All of this comes back to the new building. In October 1943, the physics faculty submitted an outline of requirements for a proposed physics laboratory. It came to 1,020,000 cubic feet, over 400,000 cubic feet less than the “cubage” of Thornton Hall, about 3 times that of the Rouss Laboratory and slightly over that of the Cobb Chemical Laboratory. [Page 26]

$611,000 was estimated as the cost at that time at 55 cents a cubic foot plus equipment. Duke University has had bids on a physics laboratory and the cost comes to about $1.40 per cubic foot. At this rate, we would get 22% less space than what we now have in the two buildings.

It would seem therefore, far better to postpone construction of a new building until money from some source can be added to the $611,000. It is said that it is easier to raise money for an organized project. Ours is patently a going concern. We ought to have on hand at least $1,000,000 before a building should be started. A shell of a building would be a poor asset, if not a liability.

The question is—can the University afford to lose any of its eminence in the South and elsewhere, and can it afford not to do its part in training the sort of men the country needs? The School of Physics should be so strong that should a question of regional education be agitated there would be no doubt where the physics center in the South should be located.

1.15 FUTURE PLANS

In this I shall be very brief. I have the greatest confidence in my colleagues and feel that their ideals are high and that their judgment is to be trusted. Only a new and adequate building I urge. We all in physics agree upon that. With that a reality I could cheerfully chant a *nunc dimittis*.

In retrospect may I be permitted a few observations—not without their bearing on the future of the University as a whole. One is this. Early in my tenure here it became apparent that hard work, good work and even outstanding work did not receive any especial or discriminating evaluation. If the evaluation was made, voluntary action thereon was a rarity. [Page 27] Only agitation for one's interests seemed to have any effect. This may be the way of the world, but in a University it does not seem to be exactly fitting.

Perhaps I should not have made this observation, but for a confirmation made by a corporation official who has happened to stay here a good deal.

Another suggestion, coming from the same source, is that in the matter of professors' salaries relatively more stress should be made on the entering man and the retiring man. This would seem to have a beneficial effect in attracting good men to the University.

Another observation: In this age of science is the University putting itself in the best light before the world by giving too little emphasis to science, and to physics in particular, in its long range plans as recently stated in the Development Fund prospectus? [Page 28]

II BUDGET FOR 1948–49

(The superscripts 1, 2, etc. refer to explanatory notes following the table.)

Salaries	Allowed 1947–48	Requested 1948–49
Prof. L. G. Hoxton[1]	$7,500.00	—
Prof. J. W. Beams[2]	7,500.00	7,500.00+
Prof. F. L. Brown[3]	6,075.00	6,500.00+
Prof. L. B. Snoddy[3]	6,075.00	6,550.00+
Visiting Prof. C. J. Davisson	5,600.00	5,600.00
Assoc. Prof. to fill vacancy[1]	—	4,400.00
Instrument Maker Phillip Somner[4]	3,141.82	4,140.00
Instrument Maker Fritz Linke[4]	3,975.60	4,275.00
Steno-Clerk G, Miss Annie G. Lipscomb[5]	2,025.60	2,325.60

Total Salaries: $41,893.02

Other Items	Allowed 1947–48	Requested 1948–49
Laboratory Appropriation, including Rogers Bequest for Books[6]	8,000.00	10,000.00
Student Teaching Assistants[7]	8,853.00	9,000.00
Temp. Lab. Worker (Instruction, Apparatus)[8]	720.00	720.00

Grand Total: $59,466.02

Less salaries of Linke & Somner paid by Navy: –$7,117.42 (1947–48), –$8,415.00 (1948–49 requested)

Net Total: $50,898.60

Explanatory Notes

1. Professor Hoxton is due to retire in June 1948 leaving a vacancy to be filled.

2. **The author of this report on his own responsibility urges that some sort of a distinguished professorship be provided for Professor Beams.** The salary he (the author) is unable to specify but

it should be more than the normal maximum for academic professors. Beams should be free of the necessity of having to get employment in the summers and to devote his efforts more toward the development of pure research at the University. His eminence and distinction are already known to you [Page 29] and are indicated in the historical summary. Of course, he often gets offers to move elsewhere. He always takes a high ground in considering these offers and has a loyal attitude toward this country and to the University. The University would do well to give him the recognition, and through him a recognition for the work in physics done here to parallel that given by the outside world of science.

3. **Concerning Professors Brown and Snoddy,** I would first make reference to the revision of personnel regulations regarding merit increases effective January 1, 1948. As will appear below in the table appended for your reference, it seems that they will have served in the second stage of promotion as professors for 24 months and are therefore due for an increase of one “step”.

The salary corresponding to this has been put down. But further, it is my belief that this step is overdue on account of their services to the University. Professor Brown served the University as Assistant Professor 4 years; as Associate Professor 14 years; in the minimum rank as Professor 5 years, and in his present rank 2 years. His position is a responsible one for he administers the undergraduate laboratory in the College and Engineering and is a key man. He was born October 23, 1890.

Professor Snoddy (born March 4, 1908) was Assistant Professor 4 years, Associate 2 years and Professor 5 years. He is a gifted person, a good chemist, a good mathematician and a good physicist, theoretical and experimental, as well as a musician who once considered the concert stage. He was a tower of strength on the war projects, was and still is our liaison officer with Washington.

For example, our work at the University on Contract OEMsr-1062 was [Page 30] part of a large development program and his job in Washington was to secure proper equipment and to see that our program was properly integrated with the development of the program as a whole. By August 1944 the University of Virginia had progressed so rapidly that one particular part of the program depended entirely upon the developments in our laboratory. In order to simplify administration in the central laboratory at Silver Spring, he was made Assistant Unit Supervisor (from U. Va.) and placed in administrative charge of the central laboratory program on this particular problem. This involved the supervision of several groups who were constructing pre-production models of apparatus using the equipment developed in our laboratory, the coordination of the industrial construction with our testing work, etc. On the basis of tests in our laboratory the equipment was accepted by the Navy and production orders placed.

Owing to service in World War II Professor Snoddy was delayed in getting started in his profession, or else he would be well ahead of where he is now. He and Beams make a first class team for the further development of the department and the conduction of research so that I do not hesitate in urging his advancement beyond that indicated by one "step". [Page 31]

Table concerning Professors Brown and Snoddy

Brown	Salary	Intervals	Snoddy	Salary
Assistant Prof.	$2250	1922–24		
	2500	24–26		
Associate	3000	26–28		
	3200	28–29		
	4000	29–30		
	4250	30–32		
	(Less due to depression)	32–33		
		36–37	Assistant Prof.	$2660
	4250	37–38		2800
		38–39		3000
		39–40		3400
Professor	4500	40–41	Associate	3750
	4500	41–42		3750
	4500	42–43		3750
Twelve months teaching begins	6000	43–44	Professor	6000
	6000	44–45		6000
	6000	45–46		6000
	6912	46–47½		6912
Nine month's teaching returns	6075	47–48		6075

From this it appears that each will have been in the second stage of promotion as professor for 24 months.

4. The figures given for **Linke and Somner** do not represent an expenditure on the part of the University. Their salaries are being **paid by the Navy** at present. Somner's salary moreover is $3840. This figure is based on an old arrangement between the Schools of Physics and Chemistry, not now in force, whereby the School of Physics would pay 7/11 or $3141.82 and the School of Chemistry would pay 2/11 or $698.18 making the total $3840. The writer has suggested an increase of $300 for each, since they are working here for less than what they have been offered elsewhere, and the scale of their compensation is less than in the run of good universities. They have been asking for increases and there are indications that these figures would [Page 32] satisfy them. The money should be in reserve pending the day when they go off the Naval payroll. I do not have on hand a copy of the steps appropriate to their classification and must refer you to the Personnel Division of the Office of the Bursar.

5. A raise of $300 is urged for **Miss Lipscomb** even if a reclassification is necessary. In view of her responsibilities and of experience acquired with us, the writer thinks this recognition is well merited. I do not have a copy of the steps appropriate to her classification and must refer you to the Personnel Division of the Office of the Bursar.

6. The amount asked for last year was $10,000, a figure arrived at by Professors Beams, Snoddy and myself. Attention is called to the facts stated in the Historical Summary. (1) that research support from the G.E.B. in 1931–32 amounted to $9800 and that the University laboratory appropriation was $2000 additional. (2) that just before the war the research appropriation was $5600 and the laboratory appropriation was still $2000 making a total of $7600. (3) that from then on until 1945–6 all research support was discontinued. Only by getting outside aid was research supported.

7. The $8853 is necessary just to operate this year and is carefully calculated. At present we are operating just under this estimate. The matter was fully outlined in a letter to Mr. Shea as of November 29, 1947. A little margin for next year would make us feel safe. We hope to operate for a figure a little under this and return the balance. It should be added that in competition with other universities we are beginning to get behind. Universities comparable to ours pay $100 per month which is more than the maximum here. The subject will bear study.

8. The student laboratory worker is the continuation of a job already allowed effective from 4/7/47 to 8/31/47 at $1.25 per hour for 12 to 15 hours per week [Page 33] in repairing and making apparatus. This work has proved so valuable that its continuance is asked for. $60 per month for 12 months would about cover this. It was continued this year. [Page 34]

III LECTURE, LABORATORY AND OTHER WORK BORNE BY MEMBERS OF THE STAFF

For many years the letter from the President has requested that we

"(c) set forth briefly the exact amount of lecture and laboratory work now borne by you and other members in your department and the exact number of students to whom instruction is being given by each".

To get a proper picture of the activities and the load carried by a department in experimental science, certainly in physics, the above questions are inadequate, and cannot be answered except in part. For formal stated class meetings it is relatively simple (but even there one cannot be "exact" about the number of students unless a specific date is specified).

In advanced graduate work the matter is not simple. There are 27 students of whom 17 are working on dissertations and theses. Two are doing research on the Navy Projects. The supervision of the research is carried on by three professors. The times and durations of conferences are not fixed and occur when feasible, that is, at odd times. Further, two or more professors often cooperate in directing one student. Hence in the table below "supervising research" is included but the exact number of students and hours are not attempted.

A similar disposition is made of administrative work, the various sorts of which fall on more than one man.

The whole staff also participates in the weekly Journal Meetings, which are attended by all the graduate students and frequently by staff members of other departments, chiefly Astronomy.

In general it may be remarked that the professors are on duty one way or another all day long: 8 and 9 a.m. to 5:30 or 6 p.m. and sometimes at night. It is pertinent to note that there are 480 to 520 students to be met in 11 and 12 classes and 16 laboratory sections, whereas in 1941–2, there were about 190 students to be met in 8 classes and about 6 laboratory sections. The professional staff is the same [Page 35] for both. The only difference is in the number of student assistants. The table already referred to follows. Note that courses numbered 200 and up are for graduates only, 100 and up for graduates and advanced undergraduates and those below 100 are for undergraduate credit only.

Professor Davisson:

Physics 31, 1st semester, lectures 3 hrs. weekly, 19 students

Physics 35, 2d semester, lectures 3 hrs. weekly, approximately 40 students

Physics 215–16, lectures 3 hrs. weekly, 12 students and 6 auditors

Journal Meeting, 1 hr. weekly. See Introduction, this head.

Directing research.

Professor Snoddy:

Physics 111–12, lectures 3 hrs. weekly, 17 students

Physics 217–18, lectures 3 hrs. weekly, 12 students

Journal Meeting, 1 hour weekly. See Introduction, this head.

Directing research.

Navy Project.

Professor Beams:

Physics 113, lectures 3 hrs. weekly, 7 students

Physics 115–16 (also Engineering 401–2), lectures 3 hrs. weekly, 26 students

Physics 223–4, lectures 3 hrs. weekly, 7 students

Journal Meeting. See Introduction, this head.

Directing research.

Navy Project.

[Page 36]

Professor Brown:

Physics 201–2 (Engineering) and 3–4 College

Lecture Section 1, 3 hrs. weekly, 63 students

Lecture Section 3, 3 hrs. weekly, 77 students

Physics 34, 2d semester, 3 hrs. weekly, 12–20 students

Journal Meeting — 1 hr. weekly. See Introduction, this head.

Directing and supervising 16 laboratory sections of 354 undergraduates, College and Engineering, meeting at various times from 8 a.m. Monday, Wednesday, Friday to 6 p.m. Tuesday, Wednesday, Thursday.

Meeting with all instructors 2 hrs. Fridays to set up apparatus and plan work for week ahead. Tuesday nights make up sections.

Related Administrative duties — See Introduction, this head.

Professor Hoxton:

Physics 1–2

Lecture Section 2, 3 hrs. weekly, 106 students

Lecture Section 4, 4 hrs. weekly, 108 students

Physics 107–8, lectures 3 hrs. weekly, 26 students

Journal Meeting, 1 hr. weekly. See Introduction, this head.

Administrative work — See Introduction, this head. [Page 37]

IV PRODUCTIVE SCHOLARLY WORK — BIBLIOGRAPHY

During the war all research done in this laboratory, being secret, was withheld from publication. This included a large number of classified reports to Manhattan District, Navy Bureau of Ordnance, Naval Research Laboratory, Frankford Arsenal, etc. Professors Beams and Snoddy (the leaders), Hoxton and assistants taken from the ranks of the graduate students.

Since V-J Day the laboratory has, under the able leadership of Professors Beams and Snoddy, gotten into production on problems in fundamental physics. The recent addition to our staff of Visiting Professor Davisson is a powerful stimulus in productive scholarship.

The bibliography covering the period from February 14, 1947 to February 14, 1948 is given below falling naturally under the four heads indicated. The names of authors who are graduate students now or who have, as graduate students, done their work here, are underscored.

Articles Published in Scientific Journals of National Scope

Alfred O. Nier, Edward P. Ney and Mark G. Inghram,
"Method for the Comparison of Two Ion Currents in a Mass Spectrometer," *The Review of Scientific Instruments*, Vol. 18, pp. 294–297, May 1947.

Ney was on our staff; the others at the University of Minnesota.

J. W. Beams,
"High Centrifugal Fields," *Journal of the Washington Academy of Science*, Vol. 37, No. 7, July 15, 1947. The 16th Joseph Henry Lecture of the Philosophical Society of Washington. Delivered Washington, D.C., Feb. 15, 1947.

J. W. Beams, A. R. Kuhlthau, A. C. Lansley, J. H. McQueen, L. B. Snoddy and W. D. Whitehead, Jr.,
"Spark Light Source of Short Duration," *Journal of the Optical Society of America*, Vol. 37, pp. 866–70, October 1947.

Frank L. Hereford, Jr.,
"Acceleration of Electrons by a Resonant Cavity," *Journal of Applied Physics*, Vol. 18, pp. 956–960, Nov. 1947. [Page 38]

F. H. Mitchell and L. B. Snoddy,
"Ionization Processes in a Long Discharge Tube with Application to Lightning Mechanism," *The Physical Review*, Vol. 72, pp. 1202–03, December 1947.

A. B. Cullen, Jr., and J. H. Greig,
"Resonant Cavity Linear Accelerator," *Journal of Applied Physics*, Vol. 19, pp. 47–50, January 1948.

Letters to the Editor

These are "brief reports of important discoveries in physics" and are usually followed by fuller papers later. They are important in establishing priorities. The quotation is from *The Physical Review*, Journal of the American Physical Society.

E. P. Ney and E. P. Nier,
"The Determination of the Self-Diffusion Coefficient of Methane," *The Physical Review*, Vol. 72, July 2, pp. 77–78.

J. W. Beams,
"The Radial Density Variation of Gases and Vapors in a Centrifugal Field," *The Physical Review*, Vol. 72, pp. 433–4, 1947.

J. W. Beams,
"Rotors Driven by Light Pressure," *The Physical Review*, Vol. 72, pp. 987–88, Nov. 15, 1947. This made news for *Science News Letter*, a publication of Science Service, Inc., Washington, D.C.

D. K. Coles, E. S. Elyash and J. G. Gorman,
"Microwave Absorption Spectra of H_2O," *The Physical Review*, Vol. 72, p. 973, Nov. 15, 1947. Work done at the Westinghouse Research Laboratories during the summer 1947.

A. C. Lansley, L. B. Snoddy and J. W. Beams,
"The Use of a Cavity Oscillator for a Kerr Electro-Optical Light Shutter," *Journal of Applied Physics*, Vol. 19, pp. 111–112, January 1948.

J. H. McQueen, J. W. Beams and L. B. Snoddy,
"Light Scattering in Supersonic Streams," *The Physical Review*, Vol. 73, p. 260, Feb. 1, 1948.

Papers Presented Before the National Scientific Societies and Abstracted in their Journals

J. W. Beams and J. L. Young, III,
"The Production of Constant High Rotational Speed." Given before the Southeastern Section of the American Physical Society, Salisbury, N.C., April, 1947. Abstracted in *The Physical Review*, Vol. 71, p. 835, June 1947.

E. P. Ney and A. K. Mann,
"Mass Measurement with a Single Field Mass Spectrometer." Given before the Southeastern Section of the American Physical Society, April, 1947. Abstracted in *The Physical Review*, Vol. 71, p. 835, June 1947.

Frank L. Hereford, Jr.,
"Acceleration of Electrons by a Single Resonant Cavity." Paper given before the Washington Meeting of the American Physical Society,

May 1947. Abstracted in *The Physical Review*, Vol. 72, pp. 157–60, July 1947.

M. L. Randolph,
"The Balancing of Sedimentation by Electrophoresis." Given before the meeting of the American Physical Society, Dallas, Texas, Nov. 1947. Reference not available now. [Page 39]

Papers Presented at the Annual Meeting of the Virginia Academy of Science, University of Virginia, May 8–10, 1947 and Abstracted in its Proceedings for 1946–47

Ney, E. P. and Fontaine C. Armistead,
"The Self-Diffusion Coefficients of Uranium Hexafluoride."

A. K. Mann and E. P. Ney,
"Mass Measurement in a Single Field Mass Spectrometer."

J. T. Griffin,
"The Spreading of an Ion Beam in a Vacuum."

J. W. Beams,
"An Investigation of the Change in Vapor Pressure in a Centrifugal Field."

M. L. Randolph,
"The Balancing of Sedimentation by Electrophoresis in an Ultracentrifuge."

I. G. Foster,
"The Use of an Interferometer for Observing Sedimentation in the Analytical Ultracentrifuge."

J. W. Beams and Wm. G. Likolli,
"The Precise Measurement of Distances by an Interferometer-Photocell-Counting Circuit Arrangement."

Lecture Demonstrations:
(a) Interference Pattern of Beats
(b) Focal Length of a Lens in Water
— L. G. Hoxton

E. P. Ney and L. B. Snoddy and J. L. Young, III,
"Cosmic Ray Studies in Endless Caverns near Bristol, Virginia."

Frank L. Hereford, Jr.,
"A Single Cavity Resonator Electron Accelerator."

J. H. Greig and A. B. Cullen,
"A Three-Section Resonant Cavity Electron Accelerator."

Mouse Trap Model of Atomic Bomb (Demonstration) — E. P. Ney

Direct-Current Generator and Motor Combination (Demonstration) — L. G. Hoxton

Richard W. Mitchell and Forrest F. Cleveland,
"Raman Spectrum of Hexamethylethane." [Page 40]

GRADUATE DEGREES CONFERRED

June 16, 1947

Master's Degrees

ANDREWS, William Johns, B.A., Princeton
Thesis: *Breakdown Times in Geiger Muller Counters.*

VENABLE, Douglas, B.S., Hampden-Sydney College
Thesis: *Electrification of Carnauba Wax in High Centrifugal Fields.*

WEHR, Edward Barriere, B.S.E.E., University of South Carolina
Thesis: *Determination of the Self-Diffusion Coefficient of Methane.*

GRIFFIN, John Tyler, B.A., Princeton
Thesis: *The Spreading of an Ion Beam in a Vacuum.*

Doctors of Philosophy

CULLEN, Abbey Boyd, Jr., B.A., M.S., University of Mississippi
Dissertation: *A Three-Stage Resonant Cavity Accelerator.*

GREIG, John Henry, B.A., Cornell University
Dissertation: *3000 Megacycle Cavity Resonators as Linear Electron Accelerators.*

HEREFORD, Frank Loucks, Jr., B.A., U. Va.
Dissertation: *The Application of a Resonant Cavity to the Single and Double Stage Acceleration of Electrons.*

LAPSLEY, Alvyn Cowles, B.E.E., M.S., U. Va.
Dissertation: *Kerr Effect with High Frequency Fields.*

MANN, Alfred Kenneth, B.A., M.S., U. Va.
Dissertation: *The Thermal Diffusion Coefficient of Nitrogen.*

RANDOLPH, Malcolm Logan, B.A., M.S., U. Va.
Dissertation: *Balancing of Sedimentation by Electrophoresis.*

Respectfully submitted,

L. G. Hoxton
Professor of Physics in Charge