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GEORGE BRAXTON PEGRAM

1876—1958

A Biographical Memoir by

LEE ANNA EMBREY

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October 24, 1876–August 12, 1958

BY LEE ANNA EMBREY

On January 9, 1912, George B. Pegram, associate professor of physics at Columbia University, wrote to Albert Einstein inviting him to visit the University as a special lecturer in physics. The choice of subject he left to Professor Einstein, noting, nevertheless, that "of course, we would want to hear something from you on the Relativity Principle and perhaps also on the theory of 'Energiequanten.' " Then he added: "Personally I have been very much interested in the Relativity Theory since my attention was first directed to it by Professor Lorentz, and I should be glad to see greater appreciation of it in America, where I confess our physicists have been rather slow to take it up."

Twenty-seven years later, on March 16, 1939, Pegram wrote Admiral S. C. Hooper, Chairman of the Naval Research Committee, as follows:

> Experiments in the physics laboratories at Columbia University reveal that conditions may be found under which the chemical element uranium may be able to liberate its large excess of atomic energy, and that this might mean the possibility that uranium might be used as an explosive that would liberate a million times as much energy per pound as any known explosive. My own feeling is that the probabilities are against this, but my colleagues and I think that the bare possibility should not be disregarded, and

I therefore telephoned . . . this morning chiefly to arrange a channel through which the results of our experiments might, if the occasion should arise, be transmitted to the proper authorities in the United States Navy.[1]

The years separating these two letters represent approximately one half of Pegram's extraordinary career at Columbia University and mark the transition to the new age of atomic power that he had almost subconsciously anticipated from his youth onwards.

Pegram came to Columbia in 1900 as a young assistant in physics and retired in 1956 as chairman of the Committee on Government-Aided Research two years before his death. It is awesome to contemplate that his tenure at Columbia spanned more than a quarter of the history of the 200-year-old institution. During these years as teacher, research investigator, and administrator he witnessed and played a key role in bringing about America's rise to greatness in the field of physics. At the outset of his career, like many another aspiring American student of science, he had gone to Europe to round out his education, and by the close of his long career, students from all over the world were beating new paths to the great centers of physics in the United States.

BACKGROUND AND EARLY LIFE

From Pegram's background one might easily have predicted the academic career that he was to pursue. He falls into the now familiar pattern, characteristic of so many scientists of his generation, in coming from a scholarly family in which higher education and a professional career were taken for granted as objectives for the children.

According to the genealogy handed down by his grandfather, George Washington Pegram, the Pegrams had come to Virginia

[1] Laura Fermi, *Atoms in the Family* (Chicago: University of Chicago Press, 1954), p. 162.

from England around the middle of the eighteenth century, and one branch of the family had moved south to North Carolina. George's father was William Howell Pegram, professor at Trinity College, now an integral part of Duke University. His mother was Emma Craven, daughter of Braxton Craven, founder and first president of Trinity College. Both his father and grandfather are honored on the Duke University campus by buildings named for them, and the elder Pegram is also honored in the William Howell Pegram Chair of Chemistry. George was honored in his own lifetime in the naming of the George B. Pegram Laboratory adjacent to the Pupin Physics Laboratory on the Columbia campus, a structure that houses the six-million-electron-volt Van de Graaf generator dedicated in November 1955. George and his two sisters and two brothers were all graduated from Trinity College; his sister Annie went on to teach mathematics for many years at Greensboro College. This remarkable family is a brilliant case in point for those who find a strong influence of heredity in families of noted achievers.

After receiving his A.B. degree from Trinity in 1895, young George Pegram taught secondary school in North Carolina for a few years before going to Columbia in 1900, where he pursued graduate studies. He received his Ph.D. in 1903; his dissertation, with its prophetic overtones for the events that dominated the latter part of his life, was on "Secondary Radioactivity in the Electrolysis of Thorium Solutions."

His files for that period contain a letter of December 12, 1906, from Ernest Rutherford, who was then at McGill University, evidently in response to a request from Pegram for confirmation of research results: "Send your radium along in a closed vessel (to allow emanations to collect) and we shall be glad to test it. Eve has everything in shape for an immediate comparison with our standard."

Professor Hermon W. Farwell, who retired from the Physics

Department of Columbia in 1949, recalls the early days of a fifty-three-year friendship with Pegram that began in the summer of 1905 when Pegram was employed by the Coast and Geodetic Survey in a periodic redetermination of the earth's magnetic elements at established stations. During the summer in question, his duties took him to Hanover, New Hampshire, where Farwell, then a young instructor, was teaching physics at Dartmouth. It was in the course of that summer work, Farwell recalls, that Pegram showed clearly some of the traits that characterized his actions in the years to come. The local "station" was on a knoll near the old observatory. Pegram was not satisfied with results of his measurements because they were not in agreement with earlier ones and seemed to be in disagreement with those that his observations on neighboring stations had led him to expect. Consequently, he spent additional time in determining the values of dip and declination at various points on all sides of this modest elevation. The results obtained showed definitely that the station had been built over a considerable amount of magnetic rock and was therefore unrepresentative of the surrounding area. He then directed his efforts to the establishment of a new station on the golf links, well away from that unusual feature. As Professor Farwell observes: "This was doing the job properly, not just following a routine."

THE TYNDALL YEAR

Pegram's abilities received early recognition at Columbia and in 1907-1908 he was awarded the Tyndall Fellowship for study abroad.

The Tyndall Fellowship, constituting, as it does, a milestone in the history of physics in the United States, deserves comment in passing. It honors the memory of John Tyndall, noted British physicist, colleague and contemporary of Faraday. In 1872, Joseph Henry, representing the National Academy of Sciences, and other distinguished American scientists including President Frederick A. P. Barnard of Columbia, invited Professor Tyndall to deliver a course of lectures in several American cities. The purpose of the lectures was "to show the uses of experiment in the cultivation of natural knowledge," in the hope that this "would materially promote scientific education in this country."

Tyndall gave six nontechnical lectures on light in the winter of 1872-1873, speaking in Boston, New York, Philadelphia, Baltimore, and Washington. The success of the lectures surpassed the most sanguine expectations. The crowds were large, the interest and discussion intense.

At a farewell dinner for Professor Tyndall, he and others spoke eloquently on the benefits of pure research, and Tyndall announced that he expected to give all the proceeds of his lecture tour (after deducting his expenses) to the education of young American philosophers in Germany. There was every reason why Tyndall's proposal should be both appropriate and welcome, for as Flexner was later to observe:

> The German university has for almost a century and a half fruitfully engaged in teaching and research. As long as those two tasks combine in fertile union, the German university, whatever its defects of detail, will retain its importance. It has stimulated university development in Great Britain; from it has sprung the graduate school of the new world; to it industry and health and every conceivable practical activity are infinitely indebted.[2]

By 1885 a fund was set up, the income of which was to be used for the Tyndall Fellowship to be available to one or more American pupils with demonstrated talent in physics who preferably intended "to devote their lives to the advancement of the theoretic sciences and original investigations in the department of learning." It was to be awarded to a Columbia student and the value was then $648.

[2] Abraham Flexner, *Universities* (New York-London-Toronto: Oxford University Press, 1930), p. 315.

Michael Pupin, then in Cambridge studying theoretical physics and mathematics, was chosen to be the first recipient. He went to see Tyndall and was most sympathetically received and wisely counseled in his desire to choose the best place for experimental work. Tyndall considered Helmholtz's Laboratory in Berlin to be the best possible place and gave Pupin a letter to Helmholtz.

The importance of Professor Tyndall's visit to this country and the subsequent development can scarcely be overestimated. His visit sparked an upsurge in interest and scholarly effort long overdue in a culture devoted up to that time almost entirely to commerce and industry.

Pegram was clearly one to appreciate fully the potentialities of the opportunity offered by the Tyndall Fellowship. Interestingly enough, the state of physics at about the time he was finishing his own graduate study was summarized many years later by Pegram himself in a chapter on "Physics" that he contributed to *A Quarter Century of Learning*.[3] In that chapter he noted:

> . . . we may briefly depict conditions at the boundaries of knowledge of physics in 1904 by stating seven questions that were uppermost in the minds of physicists in 1904. . . .
>
> 1. Why is it not possible to detect some effect of the motion of the planet earth through the ether?
> 2. Is all matter composed solely of electricity?
> 3. How can the photo-electric effect be explained?
> 4. What is the nature of X-rays?
> 5. What is the meaning and scope of the quantum hypothesis?
> 6. What gives rise to the peculiar sequence of frequencies in the lines of a spectrum?
> 7. What is the relation of gravitation to the rest of physics?

[3] *A Quarter Century of Learning, 1904-1929* (New York: Columbia University Press, 1931), pp. 297-98.

One may be sure that these and other questions that preoccupied the scholars of his day were uppermost in his own mind as he set off for centers of learning in Europe.

Pegram's plan of study, described in his own words, survives in a handwritten letter to President Nicholas Murray Butler, dated December 31, 1907.

Courbierestrasse 15, Berlin, Germany

. . . I have been matriculated as a student in the Berlin University, hearing lectures by Professors Planck, Nernst, and Slabry; the lectures by Professor Planck on electromagnetic theory being by far the most important ones. I have also attended the meetings of the Physikalisches Colloquium weekly.

Much of my time has been spent in reading and study, especially of the journals of physics, in the libraries here, in connection with subjects which seem at present to be most open to investigation.

I have written a paper entitled "Heat developed by Thorium Oxide due to its Radioactivity," which gives the results of experiments made by Mr. Harold W. Webb and myself in the Phoenix Physical Laboratories at Columbia. We were able to measure the rate at which energy is continuously and spontaneously liberated in the form of heat in any mass of thorium oxide, as a result of its radioactivity.

A theoretical problem, in the mechanics of sound waves in air, referred to in my first report, occupied much of my attention for a few weeks. I regret to say that I have been unable to arrive at a solution.

It is my intention to go in March from Berlin to Cambridge, England.

In a much less formal letter, written to his colleague and department head, Professor William Hallock, he comments (in part):

Berlin, Courbierestrasse 15
(Ber Burkhart) Nov. 20, 1907

My *pension* is out in the western part of the city, over two miles from the University, in a section that suits me much better as a place to live than any section near the University, and not far from what is called the American Section. As to lectures, I am not hearing any very serious course except Prof. Planck's. I had hoped to find a good course on partial differential equations, etc., given here, but there is none. I talked with Prof. Planck about mathematical courses, and about all he could say was that the courses are all too *rein.* After hearing some of the lectures I agreed with him and haven't been to any more. Prof. Planck's own lectures are very fine. He speaks remarkably fast, but with great clearness, so that it is very easy to understand him. His subject is electromagnetic theory, treated in a deductive manner from the starting point of only four notions: proportionality of electric energy density to field strength squared, the same for magnetic energy, Poynting's law, and the "relaxation time." I have been reading Lorentz, and Cohn, and others along with the lectures.

Nernst, I hear in a short course on chemical thermodynamics, which goes along very nicely. Then I have been going to hear a number of other men just to try them. Van't Hoff is lecturing on the influence of the knowledge of radioactivity on chemical conceptions. His knowledge of chemical conceptions appears to be much more exact than his knowledge of radioactivity. But the amusing lectures are those of Prof. Slabry on wireless telegraphy. He started out by setting forth the result, deducible from Neumann's statement of the law of induction, for instance, that as a current is varied in a straight infinite conductor, the E.M.F. per unit length of a parallel conductor depends on the inverse *first* power of the distance between the conductors. Then he applied this at once to the case of induction between || conductors of *finite* length, saying that the coefficient of mutual induction depends on the inverse *first* power of the distance between them. So, he said, with pity for the poor physicist who has to cumber his brain with the complex notion of Maxwell's theory, and with pride in his own ability to see things clearly, anybody who had been clever enough to think of making a simple calculation according to Neumann's law, could have invented wireless telegraphy forty years ago! Then he paid his respect to Maxwell's theory, which he said had been of no use whatever to the technical man, though doubltless all right for the physicist. In fact he considers it a pity that wireless telegraphy was developed in such a round-about way through Maxwell and Hertz.

Of course everybody went next time to hear what was to come next. He spent an hour and a half getting a solution for the charge and current in an oscillatory condenser discharge, and because the results did not all by themselves come out in the form in which his technical mind had been accustomed to seeing them, said there was a big mistake in his work somewhere. —All of which goes to show that the ignorant, not to say stupid, self-sufficiency of the technical man, who thinks he can get along without any exact theory, is quite as prevalent as the proud abstraction of the theorist, who will not have anything to do with practical applications.

I go to the colloquium every Wednesday evening, to find it subject to the same faults and virtues as ours. For the most part the reviews are shorter than ours, which strikes me as a virtue, perhaps, but one man attempted to review a mathematical paper with just the usual effect—some went to sleep, and nobody paid any attention finally. Rubens held out bravely until near the end, after Planck had given up, but finally quit pretending to understand.

I have seen very little of the laboratory as yet, preferring to wait until I become better acquainted with the various men working there, so that I can see it thoroughly, though several have offered to guide me through it. Dr. Hahn took me over the chemical laboratory. He has a room over there in which he is continuing his investigation of mezzo-thorium, and is also working some with Boltwood's ionium.

I spend considerable time in the library in the Phys. Inst., which is pretty well supplied with periodicals and books and is a quiet place to work. There is also a library of theoretical physics in Prof. Planck's office, from which we can borrow books without restriction as to number or how long we keep them.

Americans are plentiful here, and are a constant temptation to me. I already have met forty or fifty on various occasions, and at the Thanksgiving Day dinner next week I expect to meet a good many more. Still, I talk a good deal of German during the day, and think I would make rapid progress learning it if I would take a little more time to study it, which I am almost certain not to do.

I spend an evening or two a week at the theater, opera, or concert. Amusements of that sort are certainly much cheaper here than at home, but the necessaries of life are not really a great deal cheaper here than at home—not as much cheaper as I had expected to find them.

In closing this letter, he comments:

You will probably turn this over to Mrs. Hallock to rtad also, and she will probably say—"Oh, what does he write so much about old lectures and laboratories for, why doesn't he say how he likes Berlin and what he thinks of it and the Germans?" Well, this time I just didn't get started in that direction. However, I like Berlin and the Germans pretty well and am likely to write more as to that later.

An aura of those far-off student days comes through an elegantly engraved little card, tucked away in Pegram's files of the Tyndall year, which translates as follows:

Grunewald, Wangenheimstr. 21
January 1908

Professor Dr. M. Planck and Mrs. Planck would be happy to see their young acquaintances and friends at a simple supper on Wednesday evenings, January 14, January 29, February 12, and February 26, from 8:30 to 11:00.

Of the second half of his Tyndall year, Pegram wrote formally to President Butler:

70 Regent St.
Cambridge, England
June 30, 1908

During the first quarter I have been in Cambridge, England, where I have heard lectures by Professor J. Larmor and have been engaged in the study of subjects of theoretical physics, namely, thermodynamics, kinetic theory of gases, and fundamental electromagnetic theory. So far my work here has not resulted in a completed research, as I had hoped it would, but at least I have gained a much better acquaintance with methods of approach of some questions, and I shall naturally continue working on them.

It may not be amiss for me to remark that so far as immediate output of results of investigation is concerned, I might well have been more productive as Tyndall fellow, had I spent the whole year in one laboratory and worked all the time on experimental investigation. In any case it seemed wiser to try to get from the best sources in Europe the acquaintance with European laboratories, schools of ideas, and physicists, which cannot be obtained in America and not to give my time to experimental labor, which could be better undertaken in our own laboratories at Columbia.

To that end I have visited twenty of the university and government physical laboratories of Europe; have made the acquaintance of and talked with many physicists in the universities, at the German Scientific Association meeting in Dresden, the Congress of Mathematicians in Rome, and elsewhere; have studied under Planck and Nernst in Berlin; and have studied under Larmor and come in touch with the Cambridge school of physicists. As a completed research I may mention the one (with Mr. Webb, my successor as Tyndall Fellow) on the heat generated by the radioactivity of thorium, published in the *Physical Review*, though most of the experimental labor was done before my incumbency of the Tyndall Fellowship began.

Again, on the lighter side, he wrote Professor Hallock in the closing days of his Tyndall Fellowship:

70 Regent St.
Cambridge
July 4, 1908

Fizz—bang!! There! that's my only firecracker to celebrate this glorious Fourth. I'm sure you'll allow me that.

I enclose my final report as Tyndall fellow, and relinquish that honorable title to my very worthy successor, to whom I wish all success. He may be able to show up more research completed at the end of his year, probably he will, but I am not greatly saddened when I think of what I have got out of this year, and I hope to still be in the research business for some time to come.

Toward the close of this largely personal letter, he notes:

> I am in no hurry to leave Cambridge, but as the time comes near I find myself getting fairly eager to get home, and I hope Fayerweather will not be too thinly populated when I arrive, for meeting men at other universities doesn't lessen one's appreciation of those at Columbia a bit, I can tell you.

MARRIAGE AND ADVANCEMENT

The Tyndall year proved to be a turning point in his life in more ways than one. On his way to Europe on the *Rheindam,* he met, on almost the last day out, a young Wellesley graduate, Miss Florence Bement of Philadelphia and Boston. Undoubtedly regretting the opportunity he had missed of getting to know her better on shipboard, he succeeded in coaxing from her aunt the itinerary of their trip. When they arrived at Lucerne, Pegram turned up there shortly thereafter, and the two young people climbed the Rigi together. Later he put in an appearance in Munich, where Miss Bement, her aunt, and a cousin were attending the performance of Wagner's Ring cycle. There they went hiking in the Bavarian woods. In her recollections Mrs. Pegram notes ruefully, "I should have recognized his propensity for catching trains by the least possible margin, or even missing them, which he did at the Munich depot, while we 'tooted' off to Herrenchiemsee."

Despite this mischance, Pegram managed to keep in touch with Miss Bement, and when the illness of her aunt made it necessary to cut short their trip and sail for home, he sent her a novel steamer letter consisting of a postcard for each day out. From that auspicious beginning sprang up a correspondence that lasted through the Tyndall year.

From the outset they were drawn together by a common interest in art and music. Florence, the daughter of Frank Bement and Grace Furbush, was born in "a huge house in

Philadelphia where there was one of the first of the privately owned art galleries in that city," a circumstance that undoubtedly contributed to her own interest in art. She attended private schools in the Philadelphia area and developed a fondness for such games as baseball, soccer, and relay events—games that she later passed on to her own sons.

Both her father and grandfather were in the business of machine tool manufacture. Her parents were divorced around 1900, and she notes with regret that the divorce separated her almost completely from the Bement side of the family. Her mother moved to Boston to live, and Florence entered Wellesley in September 1901. Carrying on a tradition of travel, she interrupted her studies at Wellesley in 1903-1904 for a year abroad.

It was during this trip, on which she was accompanied by her mother, that the two American ladies became acquainted in Rome with an English gentleman, William Cleverly Alexander, and two of his daughters. This was the beginning of a friendship during which Miss Bement and her mother were the guests of the Alexanders, in different years, both in their London home and in their country estate, Heathfield Park, near Tunbridge Wells. Mrs. Pegram recalls being met upon their arrival in London by a brougham, with coachman and footman, driven out to Kensington, and shown into a lovely Queen Anne house, next door to Holland House. Their hostess at afternoon tea was "Miss Alexander," now grown up, whose charm as a child had been captured by James McNeill Whistler in the portrait that hangs in the National Gallery, Millbank, London. Thus, when Miss Bement met Pegram in 1906, she was already a seasoned European traveler and able to share with him many of the things she had enjoyed earlier.

Pegram lost no time, after returning from the Tyndall year, in traveling to Boston to renew his friendship with Miss Bement, and in 1909 they became engaged. They were married on June 3, 1909, at her aunt's home in West Newton, Massachusetts. Eager to show his bride to family and colleagues in North Carolina, Pegram took her south on their honeymoon, and she recalls standing in line during the Commencement exercises at Trinity College! Later there was a trip through the mountains and visits to friends and relatives.

Returning to New York from their wedding trip, the young couple set up housekeeping in an apartment, loaned for the summer, at the corner of Morningside Drive and West 118th Street. During that summer, Florence Pegram met many of her husband's scientific colleagues at the small, old-fashioned house that was the Faculty Club.

The young physics instructor had an 18-foot sponson canoe, in which he used to sail and paddle with his friend Tufts, also of the Physics Department, around Manhattan Island. Mrs. Pegram relates that on moonlit nights she and her husband sometimes put comforters over the slats in the canoe, which was kept in the Columbia boathouse at 116th Street, and went for a moonlight ride up the Hudson. It was occasionally a struggle to pass the ferry at 125th Street, but after that they would cross the Hudson and paddle until sleepy. Then they would put a lantern in the bow and anchor just offshore. In the morning they would land at some beautiful estate by the river bank, where they would get water and prepare a breakfast of bread and butter, eggs, and coffee from provisions transported in a fireless cooker serving as an improvised refrigerator.

Mrs. Pegram recalls that another favorite jaunt of her husband's was over to Sheepshead Bay, where he liked to look at the early airplanes strung together of bamboo and wires and resembling Bleriot's. Her comment, "Only lack of money saved him then," implies that it was this one circumstance that prevented him from trying to fly one of the monsters.

Following two years in apartments near Columbia, the Pegrams moved to Fieldston (Riverdale-on-Hudson) and rented a house while they built their own large stone house. There they were both able to indulge their love of tennis. A colleague, commenting on Pegram's tall, well-built athletic figure, observes that he was good at tennis until well into his sixties, when he won a "cup," soldered together out of laboratory junk, for besting all other tennis players at a summer meeting of the American Physical Society. Mrs. Pegram recalls that for many years they followed the Davis Cup and other matches, first at West 238th Street, and later at Forest Hills. A fellow tennis enthusiast of the early days was Dr. H. H. Janeway, of Memorial Hospital, who frequently sought Pegram's help in developing early methods of radium therapy.

Settled in their new home in Fieldston, Mrs. Pegram began to entertain for her husband, inviting graduate students, visiting scientists, and others to tea. Later there were parties for the various departments housed in the new Physics Building. On other occasions, young married couples from the faculty were invited to dinner and then on to the Tennis Club for dancing afterwards.

A special interest of Pegram's in those days was the Riverdale Choral Society, under the direction of Howard Barlow. Barlow, who later became known to millions as conductor of the Columbia Broadcasting System orchestra, was studying at Columbia University in those days and worrying about "how to learn to be a conductor with nothing to conduct." Pegram had sung in the choir back at Trinity but had not kept up his singing when he moved to New York. It was not until the last years of his life that his wife realized how he had longed to sing and had even got around to taking lessons when it was too late.

In 1910 their first son, William, was born to the Pegrams, and six years later, the second son, John. In the meantime, Pegram was moving up the academic ladder rapidly, particularly for a period when academic advancement was not so frequent as it is in these competitive times. An assistant professor of physics in 1909, he was made an associate in 1912, and in 1918 full professor.

He was made acting dean of Columbia School of Mines, Engineering, and Chemistry in 1917, and dean in 1918, holding that post until 1930. The esteem in which he was held by his colleagues is evident in the letter that he received in March of 1917 from F. J. E. Woodbridge, who was then dean of the graduate faculties, on leave to the University of California at Berkeley. After expressing his pleasure in Pegram's appointment as acting dean, Woodbridge observed:

I should think everybody would have complete confidence in you. We need just such men in administrative positions, men who have the keenest appreciation of scientific scholarship and who are approachable and democratic. It would be a joy to work with you. You have seen, just as I have, that the success of Columbia does not depend on bringing in outsiders to help us out but on bringing about hearty cooperation among ourselves and a clear idea of what we ought to be doing. We have got to break down distrust and fault-finding and stimulate mutual confidence and enthusiasm. You are so clear-headed, so sane, so sincere—but I need not express compliments. Yet I want to express my happiness and my confidence. You will let me do that.

The details of Pegram's activities during World War I are interesting, not only intrinsically, but also because they forecast to some degree his great involvement in World War II, particularly in antisubmarine warfare devices. The use of scientists in World War I was on a much smaller scale than occurred during World War II; nevertheless, they were pressed into service in a variety of tasks. In a very brief curriculum vitae, drafted apparently many years later, Pegram noted that during World War I he was a "member of the Administrative Board, Student Army Training Corps, at Columbia University; dean, U.S. Army

Radio School, also at Columbia University; U.S. Army School of Photography; Ordnance Department, School of Explosives; director of research for Signal Corps, U.S. Army."

The armed forces were concerned, as always, with sight and photography under difficult conditions, principally in the dark. In the School of Photography research was carried on and instruction given in photography. Professor Pegram had a hand in acquiring workers for the research, was consulted on projected research, and received regular progress reports from the research people.

He played a very large part in the establishment of the Student Army Training Corps. Early in September 1918 the War Department called for mobilization of all the resources of the nation's universities and colleges. With so many members of the Columbia staff already engaged in urgent war work, further involvement seemed impossible. Under the leadership of President Nicholas Murray Butler, however, arrangements were made in a remarkably short time to house, educate, and drill officers for the United States Army. On October 1, 1918, the school was opened with 2,500 in the student body and 60 officers. The schedule of studies was prepared by Dean Hawkes (Columbia College) and Professor Pegram. A report on Columbia's war work states that the organization of the S.A.T.C. and this schedule of studies were adopted practically without change by the War Department for use in all the colleges of the country having S.A.T.C. units.

The work of the New York Committee of the National Research Council on submarine detection was carried on as might be expected without public notice. The committee had its origin in a group of New Yorkers who, anxious to serve the government in the matter of defense against enemy submarines, held several meetings to discuss how such assistance might be rendered. Dr. George E. Hale and Dr. Robert Millikan, chairman and vice chairman respectively of the NRC, and Commander Bridge of the British Navy attended one of the meetings at which it was arranged for the New York group to operate as a subcommittee of the NRC. The formal organization of the committee took place on May 25, 1917, with nine members, including President Butler, Professor Pegram, and Professor Michael I. Pupin. President Butler was elected chairman, and Professor Pegram executive secretary.

An interesting summary of many projected methods of coping with enemy submarines is contained in the records of the subcommittee. After the formation of the subcommittee further study of the more important of these types of detection or control was assigned to its various members. In the end, mainly because the Navy and other agencies had become engaged in many of the fields considered, the subcommittee decided to concentrate upon the topic assigned to Professor Pupin, namely, the use of sound waves for detecting and locating submarines. On May 30 and 31, Professors Pupin and Pegram attended an NRC conference of about forty physicists and engineers to hear reports on the state of the art of submarine detection by the British and French. As a result of this meeting, it seemed best for the New York subcommittee to undertake the problem of submarine detection by *echoes,* under the direction of Professor Pupin.

Experimental work was begun at once in the physics laboratories at Columbia with Professor A. P. Wills of the Physics Department added to the research group to work with Professor Pupin on designing apparatus for producing very high frequency sound waves. In a short time it was decided to confine the research to development of a quartz piezo-electric sound detector. Professor John H. Morecroft of the Columbia Department of Electrical Engineering joined the group to work on the circuits needed, and a little later Professor H. W. Farwell of the Physics Department took over the responsibility for searching out and acquiring suitable quartz.

The work was pursued with great vigor. Professor Pegram, of course, was acquainted with all the problems of the research and was constantly in the counsel of the workers. His functions were to provide working space and people to assist the work, to locate and purchase materials, to manage the finances, and to keep the records as secretary.

By early February 1918 the apparatus was tried out at Key West with sufficient success that further work at Columbia was pursued with the close cooperation of the Navy Experimental Station at New London. By September 1918 research results seemed sufficiently promising for the Naval Experimental Station to take over the work and to finance it. With this step mention of the work ceased in the Columbia papers.

Until the spring of 1918 the work had been financed by two members of the New York subcommittee, one a member of the three-man finance committee of the subcommittee who made cash contributions, the other a Columbia professor who, beginning in October 1917, turned back his salary to Columbia. In the spring of 1918 a manufacturer of machinery established a credit to cover the cost of apparatus if furnished by his company to the committee. A most important equivalent source of funds was the research facilities of the Columbia Physics Department put without stint at the disposal of the submarine research. All the persons and amounts concerned in this financing appear in Professor Pegram's reports.

In 1917 and 1918 the subcommittee financed also a small research project to test the concealment of ships by clouds of fine spray sent out from high-pressure nozzles suitably distributed over the vessel. This was suggested by H. P. Quick, an engineer not connected with Columbia. The Navy advanced several cogent objections to his scheme, but it was decided to go ahead with a test, which was performed in the summer of 1918. Professor Pegram's part here seems to have been the procurement of materials and the payment of bills. The test showed that this method of spray camouflage was not very promising and the project was abandoned.

Following the "flu" epidemic of 1918, the Pegrams' older son William kept having recurrences; so after consulting doctors and his school, Mrs. Pegram took the two boys to Europe. Hoping that the climate along the Riviera would be conducive to William's full recovery, she enrolled them in a boys' school at Théoule, across the bay from Cannes, where the two youngsters learned French very naturally from hearing it constantly spoken.

ADMINISTRATIVE RESPONSIBILITIES

Shortly after the death of Professor Hallock in 1913, Pegram had become executive officer of the Physics Department and served continuously until 1945, carrying the responsibilities of that post along with other heavy administrative duties. Despite his obvious talents for administration and the effectiveness with which he performed as dean, he had little taste for the duties of the deanship, however, and longed to devote full time to his work in physics, which he so much enjoyed. His correspondence indicates that from 1925 on he had sought to persuade President Butler to relieve him of the deanship; finally, in January of 1930, he was permitted to resign. In his letter of resignation as dean, he noted that his term of office had not only exceeded his own expectations but had lasted longer than that of any of his five predecessors except one.

"As you know," he wrote President Butler, "my professorship of physics, in a department that has large responsibilities, can well absorb all my effort. It is my hope that I may thus serve the University more, rather than less, effectively by now resigning the deanship."

President Butler not only wrote him a warm personal letter on that occasion, but five months later, on June 4, 1930, in a memorandum addressed to the members of the Faculty of Engineering, commented:

Absence from the University at the time of the last meeting of the Faculty of Engineering for the present academic year deprived me of the pleasure of recording formally at that time, in the presence of the Faculty, my appreciation of the work which has been done for us by Professor George B. Pegram during his thirteen years of service as Dean, and my admiration for his mind, his character, and his unselfish devotion to the University's highest interests. At a time of change and development, with many perplexing problems to face and with new adjustments of teaching and research work to be made, Professor Pegram has guided us with large intelligence, with an open mind, and with unceasing diligence. At his own request he lays aside administrative duties in order that he may concentrate his efforts for years to come upon his own special field of advanced teaching and research in the Department of Physics. He carried with him to that work our grateful thanks for his years of service to the Faculty of Engineering and our confident prediction that new success and new distinction await him.

Karl K. Darrow, who has so ably summarized Pegram's life and work in a Biographical Memoir for the American Philosophical Society, has the following comment on the six-year intermission between Pegram's resignation of the deanship of the Faculty of Engineering and his assumption of the duties as dean of the Graduate Faculties:

During that period Pegram went back to the laboratory and associated himself with several brilliant young students. The neutron had just been discovered, and to use a colloquialism, Pegram and his group were "in on the ground floor." Their experiments were the first to reveal some of the major properties of neutrons and their interactions with matter, and Columbia University became one of the world centers of neutron research, a rank which it has never lost though it has many rivals now. By no means did he put his name always first in the by-lines of the papers which originated from his work. Those who shared it with him remember him as a partner who normally came in very late in the evening, after more than a normal day's work in executive and other tasks, and continued sometimes into the small hours. After Pegram re-entered deanship [1936] there were no longer hours enough in the day and the night.[4]

INTEREST IN RADIOACTIVITY

Pegram maintained an interest in the field of radioactivity throughout his life, but efforts to reconstruct what led him into this field originally have been unsuccessful. Perhaps he was influenced to some extent by the intellectual interests of his father. In 1911 the elder Pegram's presidential address to the North Carolina Academy of Science was entitled "The Problem of the Constitution of Matter." In closing paragraphs of that address, Professor Pegram observed:

> The spontaneous disintegration of matter in the field of radioactivity reveals the atom as a reservoir of energy. The measurements of Curie and Labord show that the disintegration of one gram of radium produces 300,000 times as much energy as is produced by combustion of one gram of coal. Thompson estimates that enough energy is stored within the atoms of one gram of hydrogen to raise a million tons through a hundred yards. This enormous supply of energy found within the atom has been used to account for the sun's heat, and to greatly modify our opinion as to the age of the earth. Probably the most important problem before the physicist today is that of making this enormous energy available in the world's work.[5]

Professor Lucy J. Hayner of the Department of Physics at Columbia, and a long-time colleague of Dean Pegram's, notes:

[4] *Year Book of the American Philosophical Society*, 1961, pp. 154-55.

[5] William Baskerville Hamilton, *Fifty Years of the South Atlantic Quarterly* (Durham, N.C.: Duke University Press, 1952), pp. 146-47.

During all his life from his days doing radioactive research at Columbia, Professor Pegram had a keen and active interest in the use of radium and other radioactive substances for medical purposes, principally, of course, in the treatment of cancer. He became acquainted with men who were prospecting for radioactive minerals—mainly in the west, in those who were refining the products, and, of course, was very closely associated with doctors who were trying to develop radiation treatment for their patients.

He was in constant touch with the staff of the Memorial Hospital—where there was one of the early large supplies of radium—and had an unofficial influence on their methods of treatment and research. He was a close associate of Dr. Francis Carter Wood, who was engaged in cancer research for many years at St. Luke's Hospital and who later headed the Crocker Institute for Cancer Research at Columbia where X-rays were being used in the treatment of cancer. I think that his interest in these topics never abated, but his activity was greatest in the very early years.

As far as I can discover there was the most intense interest among medical men in radioactive materials, but very little information as to scientific methods of measurement. Dean Pegram and several other members of the Columbia Physics Department carried on a brisk business in measuring the strengths of radioactive samples submitted by doctors who had purchased radium, and in testing all sorts of materials sent in to him from far and wide in the hope that they might prove radioactive. Mineral water of various types was one of the most common types of substances on which tests were desired. The whole subject of radioactivity and its biological effects was of course a great mystery to the general public which was inclined to be hopeful for a panacea for all sorts of ills. Professor Pegram established standards and methods of measurement. In this Professor Ernest Rutherford of McGill University was cordial and helpful.

On several occasions Professor Pegram received some prominence in the newspapers when he was able to find radium that had been mislaid or thrown away inadvertently. He enjoyed all this activity very much, since it had scientific meaning and at the same time involved people. This was the pattern of his interests, always.

Professor Farwell recalls one incident from the early period:

There must have been some solution containing a relatively small amount of radium (perhaps large for those days) which was accidentally spilled somewhere on the carpet in a large room. No one could find where it was until Pegram laid down photographic plates all around and soon located the exact area. I don't know what happened next, but I do know that it was big news, and not many years later I heard directly from one of the reporters who "covered the story" how fortunate he was to have the assignment, and what a gold mine it was for him.

Mrs. Pegram remembers that during the height of public interest in radium she was awakened at odd hours of the night by telephone calls from reporters and she felt she had to be "careful not to say the wrong thing."

In view of Pegram's prominence on the faculty and his deep personal interest in the phenomenon of radioactivity, it is not surprising that he should have been named to serve as Mme Curie's personal escort when she received the degree of Doctor of Science Honoris Causa at the Columbia Commencement, June 1, 1921. In Eve Curie's book about her mother, *Madame Curie,* Pegram is pictured walking beside her, his tall figure in academic gown towering above her tiny one.

Farwell's comment (in relation to the status of the Physics Department in the decade following the University's move uptown to 116th Street in 1897) that "Pegram continued his work in radioactivity, but to graduate students it did not seem to be a promising field," is an interesting footnote to history.

TALENTS AS AN ADMINISTRATOR

One thread running through Farwell's reminiscences is his strong admiration of Pegram's ability for planning and administration. On one occasion he suggested to Dr. Pegram, as executive officer of the department, that his budget request to the Trustees include provision for two instructors in addition to the usual number of teaching assistants. He recalls his own surprise when authorization was granted. Pegram's response was that the need was plain and that Farwell had been fully justified in his request. "However," he added, "don't imagine that the authorities are unaware of a common practice of asking for much more than is needed."

The conscientious and scrupulous care with which Pegram carried out his administrative duties is undoubtedly one of the traits that earned for him the lasting respect and confidence of President Butler at a time when faculties of science were still something of a novelty in the American university. Professor Hayner saw him as "the one who managed things, the one who fought for money—very tight in those early days—and the one who was truly interested in the frontiers of research."

Professor Farwell notes that, as an administrator, Pegram sometimes found himself in difficult situations in relation to older men on the staff who were resistant to change. In response to a query as to why he did not exercise the authority of his office and remove some of these reactionaries, Pegram replied, "As long as men with such violent opposition to change remain on the campus, I can know what they are doing."

In another situation the department was strongly in need of a top-ranking man in theoretical physics, at a time when a number of well-trained men seemed to be available. Some of his colleagues could not understand Pegram's hesitation in recruiting one of them. His response was that there were numerous directions in their activities, some of which naturally would ultimately be shown by experience to be quite unacceptable. "The trouble is," he said, "that some men have gotten so far out on a limb that they will find it difficult or impossible to get back to the main trunk."

When a new building (Pupin) was being considered for the Physics Department, he concerned himself intimately with its structural details. Long before there was definite assurance of such a building, in fact, Pegram had appointed a committee to lay out plans based on what the men of the department considered essential for the needs of a growing research group and an active teaching staff. His basic idea was for a structure with features borrowed from warehouse design, that is, regular framing throughout, no special internal features, rooms adjustable to whatever size was needed, because inside walls were not to be load-bearing walls.

The decision to have the largest lecture room occupy two floors, in order to have the seats arranged in ascending rows, shocked the architects, who pointed out that, in order to support the columns for the floors above the lecture room, an 8-foot plate girder would have to be placed squarely across the middle of the space in front of the demonstration table. Pegram's response was to draw a rough sketch for them to show that, by building a truss on each side of the corridor of the floor immediately above the lecture room, the necessary columns could be amply supported, and by suitable design of the trusses the available space on the next floor would not be seriously reduced. Years later, an architect for a midwestern university called at Columbia University to say that he had been directed to visit the Pupin Physics Laboratory, although he frankly could not see why he should study a building built in 1926 when so many more modern buildings were available as models. After he had studied Pupin he understood. He saw the two-floor lecture room that had been called an architectural impossibility by the original planners until Dean Pegram showed them how to do it. He departed with the comment that Pupin was better adapted for physics than most buildings he had seen.

If Pegram could be faulted at all as an administrator, it was probably in his reluctance to delegate authority and in his tendency to absorb himself in details when the load might well have been shared by someone else. During one period of particular involvement, his friend Farwell was prompted to inquire whether he remembered the 18th chapter of Exodus. "He probably did," observed Farwell, "but it was part of his nature to deal directly with his problems."

The lasting impact of the Tyndall year is evident in the care that he took to expose his students at Columbia to as many as possible of the great minds to which he himself had been exposed in his year in Germany and England. Although Einstein had been unable to accept the invitation tendered by the young associate professor, those who did arrive over the years included such great names as Lorentz, Larmor, Planck, and Born.

Pegram retained his own interest in Einstein and his theory through the years. Mrs. Pegram recalls that once in the early days of their marriage, when he was to lecture about the Einstein theory at the New York Museum of Natural History, he awoke her at midnight, read his paper to her, and asked if it meant anything to her. When she replied that she had noted two or three ideas, he appeared satisfied, saying, "That is all I can expect from the public."

THE YEARS OF WORLD WAR II

The period during which he was free of the burdens of the deanship was short lived. In 1936, shortly before the June commencement, Howard Lee McBain, dean of the Graduate Faculties, died very suddenly. This unexpected loss at a crucial time in the academic year created a near panic among the staff. It was obvious that something would have to be done immediately and equally apparent that Pegram was the only man who could step into the job and assume its burdens. It was in this manner, then, that he took over administration of Columbia's great and influential graduate school on the eve of World War II.

If it is true, as Pasteur is quoted as saying, that "Fortune favors the prepared mind," there is every reason why the science faculties of Columbia, under Pegram's leadership, should have been off to a head start in the application of science to the defense of the nation. In 1929 he had brought into the Physics Department as assistant a young graduate student from Nebraska Wesleyan University, John R. Dunning. Dunning was interested in the application of electronics to nuclear physics. He built the linear amplifier, so that Columbia was ready when Chadwick discovered the neutron in 1932.

When Pegram had learned, in the late thirties, of Enrico Fermi's desire to bring his family to the United States in order to remove them from the political climate of wartime Italy, he invited Fermi to join the staff at Columbia. The significance of this move is graphically described by Samuel K. Allison in his Biographical Memoir of Fermi:

> Two weeks after Fermi's arrival at Columbia University in January, 1939, Professor Niels Bohr landed from Copenhagen, bringing the news of the discovery of the fission of uranium under neutron bombardment. If it could be demonstrated that, in turn, neutrons were a fission product, the possibility for release of energy in macroscopic amounts was open. Many physicists at once attempted to detect neutrons from fission, and Fermi, with the group forming around him at Columbia, soon demonstrated their presence, which was also announced, practically simultaneously, from many other laboratories.
>
> Fermi's new group, at first consisting of Herbert L. Anderson, Leo Szilard, and Walter H. Zinn, soon demonstrated, with the help of a trace of separated U^{235}, prepared by A. O. Nier of the University of Minnesota, that as Bohr had predicted, the rare isotope U^{235} was the thermally fissionable isotope of natural uranium.[6]

[6] National Academy of Sciences, *Biographical Memoirs,* XXX (New York: Columbia University Press, 1957), 130-31.

It was the success of their early experiments that had prompted Dean Pegram's letter to Admiral Hooper, a copy of which Mrs. Fermi found among the family papers more than ten years after it was written. Mrs. Fermi comments:

Professor Pegram's attitude was due to his cautious judgment that warned him against jumping to premature conclusions. His skepticism about the outcome of the work in his own laboratories was shared by many other scientists and was probably caused by a hope that nuclear weapons should prove unfeasible. And Enrico himself, when talking to Admiral Hooper, doubted the relevance of his predictions.[7]

The device used by the Columbia group consisted of a lattice structure or "pile" described by Smyth as follows:

About July 1941 the first lattice structure of graphite and uranium was set up at Columbia. It was a graphite cube about 8 feet on an edge, and contained about 7 tons of uranium oxide in iron containers distributed at equal intervals throughout the graphite.[8]

In a speech at the University in January 1954, Fermi recalled some of the problems associated with the construction of the pile:

This graphite "pile" was expanded, he disclosed, until it grew too large for space it occupied in Columbia's Pupin Physics Laboratories. "We went to Dean Pegram," said Dr. Fermi, "who was then the man who could carry out magic around the University, and we explained to him that we needed a big room. He scouted around the campus and we went with him to dark corridors and under various heating pipes and so on, to visit possible sites for this experiment and eventually a big room was discovered in Schermerhorn Hall." By July 1941, he said, this pile had grown to eight feet square by eight feet high and weighed about seven tons. The physicists handling the graphite material, a black substance, "started looking like coal miners and the wives to whom

[7] Fermi, *Atoms in the Family*, pp. 164-65.
[8] Henry D. Smyth, *Atomic Energy for Military Purposes* (Princeton: Princeton University Press, 1946), pp. 59-60.

these physicists came back tired at night were wondering what was happening," Dr. Fermi revealed. He added that to handle the heavy graphite bricks made "people very black and required strong people" to accomplish the task. He said that Dr. Pegram suggested that the scientists use a dozen husky members of the Columbia football squad to work on the graphite. "It was a marvelous idea," Dr. Fermi continued, "and it was really a pleasure for once to direct the work of these husky boys, canning uranium —just shoving it in—handling packs of 50 or 100 pounds with the same ease as another person would have handled three or four pounds."[9]

Pegram's connection with the atomic project was twofold in nature. First, as the person at Columbia University who had assembled and coordinated the team of physicists performing those early crucial experiments in nuclear fission, he had operating responsibility for Columbia's role as a major center of atomic research. As has been noted, he was the very first person to make contact, through his letter to Admiral Hooper, with the United States government on the possibilities of atomic power. Secondly, Pegram was an active participating member in the series of advisory groups that were established beginning in 1939 and the early 1940s and that continued until the project was a going operation and was turned over to the Manhattan District of the Army Corps of Engineers.

The administrative history of the atomic project is admirably set forth in the Smyth report. Pegram's role may be summarized somewhat as follows: In the spring of 1939, following the announcement of the hypothesis of fission, a small group of foreign-born scientists in the United States undertook to impose voluntary self-censorship of papers in the field, for fear the idea might be exploited for military purposes. According to Smyth, American-born scientists were so unaccustomed to the idea of their science being used for such purposes that they hardly

[9] Columbia University Files.

realized what needed to be done. But the idea gained momentum, and in the spring of 1940 the Division of Physical Sciences of the National Research Council took action that led to the appointment of the "Reference Committee" to control publication policy in *all* fields of potential military interest. The chairman of the committee was L. P. Eisenhart, and Pegram was a member both of the main committee and of the subcommittee on uranium fission. Editors of journals submitted prospective manuscripts to the committee, which advised them as to whether or not publication of the paper in question was in the national interest. Smyth found that this voluntary nongovernmental arrangement worked very well; it continued throughout the war, obviously with modification in the light of government security regulations.

The first *official* advisory body was the Advisory Committee on Uranium, appointed by President Roosevelt in July 1939. The only members of this group were L. J. Briggs, director of the National Bureau of Standards; Colonel K. F. Adamson, of Army Ordnance; and Commander G. C. Hoover, of the Navy Bureau of Ordnance. A number of scientists, including Dean Pegram, met with the Advisory Committee on Uranium from time to time. A special advisory group, called together by Briggs at the National Bureau of Standards on June 15, 1940, recommended to the Uranium Committee

"that funds should be sought to support research on the uranium-carbon experiment along two lines:

"(A) further measurements of the nuclear constants involved in the proposed type of reaction;

"(B) experiments with amounts of uranium and carbon equal to about one fifth to one quarter of the amount that could be estimated as the minimum in which a chain reaction would sustain itself.

"It was estimated that about $40,000 would be necessary for further measurements of the fundamental constants and that approximately $100,000 worth of metallic uranium and pure graphite would be needed for the intermediate experiment." (Quotations from memorandum of Pegram to Briggs, dated August 14, 1940)[10]

The next major organizational step was the establishment of the National Defense Research Committee in June 1940 and an order from the President placing the Uranium Committee under Vannevar Bush as chairman of the NDRC. When the committee was reconstituted by Bush, Dean Pegram was among the scientists who were added to its membership. The very first contract recommended by this group went to Columbia University for work along the lines recommended in the Pegram memorandum cited above.

In the summer of 1941, the NDRC itself was absorbed into a new and larger governmental organization for wartime research, the Office of Scientific Research and Development, with Vannevar Bush as director. The Advisory Committee on Uranium now became the Uranium Section (Section S-1 of the NDRC) and Pegram became vice chairman of the committee as a whole and chairman of the subsection on power production.

Meanwhile, cautious and unofficial interchange of information on atomic developments had been going on between the Americans and the British, and the first official British report of July 15, 1941, was transmitted to James B. Conant as chairman of NDRC on October 3, 1941. On the strength of the earlier reports, Pegram and Harold Urey were sent to England in the fall of 1941 to get firsthand information on what the British were doing. Smyth notes that this was the first time that any Americans had been to England specifically in connection with the uranium problem. Their report, strengthened by a series of reports by a special committee of the National Academy of Sciences appointed to review the uranium problem, rein-

[10] Smyth, *Atomic Energy*, pp. 48-49.

forced Bush's determination to pursue the uranium work even more vigorously.

MISSION TO ENGLAND

It might be noted parenthetically that, at the time he undertook this special mission to England, Pegram was sixty-five years old, the age conventionally associated with retirement, or at the very least, a slacking off of activity. Yet his important and vigorous leadership of Columbia's wartime research program lay still largely before him.

The decision to launch an all-out effort in the atomic field, accompanied by further reorganization of the S-1 group, was announced by Conant at an S-1 Section meeting on December 6, 1941, the day before Pearl Harbor. Pegram was again made vice chairman of the reconstituted group and served in that capacity until May 1942, when Bush terminated the S-1 Section and replaced it with an executive committee. This action preceded by only a few months the establishment by the Army of the Manhattan District to take over and administer the engineering aspects of the atomic project. A year later, in May 1943, all the OSRD S-1 contracts were formally transferred to the Manhattan District.

Dean Pegram's wartime activities at Columbia were by no means limited to the atomic project. Throughout the war he headed Columbia's Committee on War Research, which directed a variety of projects, of which those connected with undersea warfare were second in importance only to the atomic project. The contract with the United States Navy Underwater Sound Laboratory at New London, Connecticut, was the largest of Columbia's contracts not concerned with atomic energy. In 1941 a group of scientists, organized by Columbia, began its part of the secret project that led to the invention and development of the magnetic airborne detector (MAD), which played a tremendous role in clearing the Atlantic of Nazi submarines. The Airborne Instruments Laboratory, established by Columbia at Mineola, Long Island, was a focal point for much of the work on MAD.

When the war ended and Columbia contracts with the government were no longer limited to military problems, Dean Pegram was made chairman of Columbia University's Committee on Government-Aided Research, serving in that capacity from 1945 to 1950 and again in 1951 through 1956. He served from 1949 to 1950 as vice president of the University, becoming vice president emeritus and special adviser to the President in 1950.

SERVICE TO SCIENCE

In much that has been written and said of him, Pegram is described as "the physicists' physicist,"[11] a description that undoubtedly stems not only from his activities as teacher, mentor, and advocate, but also from his tireless services to the cause of organized physics. It is clear from the record that, despite his arduous labors at Columbia, he devoted much of what should have been his free time to the American Physical Society and later to the American Institute of Physics.

With respect to the Physical Society, Darrow has the following comment:

> He never quite got over his regret at having missed, through some absurd mischance or quite uncharacteristic negligence, the convening of some forty-five (the exact number is unknown) American physicists from which sprang the American Physical Society. This occurred in a small room of Fayerweather Hall of Columbia University in May of 1899. Pegram did attend the first of the meetings of the new Society in October of that year, and

[11] In his informal recollections, *At Ease* (New York: Doubleday, 1967, p. 346) Dwight Eisenhower notes, "George Pegram, a scientists' scientist, occupied an office immediately above mine and was always ready to drop in to chat about anything from common fractions to nuclear fission and fusion."

fifty-six years later he was still attending them. He was Treasurer of the Society for thirty-nine years (1918-1957), the longest term of service ever given to the Society by any individual. On the other hand his term as President of the Society was the shortest on record, and this was for a reason that was characteristic of him. In the middle of what should have been Pegram's year of presidency, the Vice-President who in the normal course of events should have succeeded him announced that he would not accept the nomination for the year to come, because of serious illness in his family. Pegram instantly resigned the presidency, and the Vice-President was forthwith appointed to that rank to fill out the year, so that his name follows that of Pegram in the roster of the Presidents. Pegram always said that he had resigned because he was so busy, but we all knew the truth.

It would be impossible to overstate the influence of George Pegram on the evolution of the American Physical Society. Already in the middle thirties when I first sat upon its Council, he was the elder statesman whose opinion was always sought, who was a reservoir of knowledge on the history and practices of the Society, and whose judgment was always held in great respect.[12]

John Van Vleck recalls that once during the early fifties, when scientists were frequently traveling between New York and Boston on the New Haven's night sleeper, the Owl, Pegram missed the Owl on a trip to Boston. In order not to be late for the meeting of the Physical Society the next morning, he caught the next train (all coaches) and sat up all night. When one recalls that he was in his seventies at that time, the depth of his devotion to the Physical Society becomes apparent.

Together with the late Karl T. Compton, then president of M.I.T., Pegram played a leading role in the development of the American Institute of Physics in the thirties. Henry A. Barton, first director of the Institute (now retired), who was closely associated with the two men, has related to the author of this

[12] Karl K. Darrow, *Year Book of the American Philosophical Society*, 1961, p. 157.

memoir the circumstances under which the concept of the AIP developed.

A number of independent societies had been or were about to be formed, specializing in certain subfields or aspects—the teaching of physics, for example—so that the organizational unity of the profession, theretofore provided by the American Physical Society, was in danger of being lost. It became obvious that some sort of all-inclusive federation was needed to unite the strength of all these groups for the aim that they had in common, namely, the advancement of physics.

The *Physical Review* was alarmingly short of funds for the publication of the results of all good research, and the situation in the post-depression years offered no hope of improvement short of drastic measures. Money for physics could come from the economy only if industry, government, and the public could be made aware of the importance of the subject; and physics at that time was generally regarded as a rather academic field of endeavor. Therefore some different mechanism was needed to assure continuing financial support for the journal.

Compton and Pegram presented the proposed American Institute of Physics to the five original societies: the American Physical Society, the Optical Society of America, the Acoustical Society of America, the Society of Rheology, and the fledgling American Association of Physics Teachers. From the Chemical Foundation they had received a promise to underwrite the initial expense of the new Institute, and Dr. Barton opened his office as director on October 1, 1931, in a room provided by that Foundation. The AIP had formally existed since May 3, 1931, as a joint board of representatives of the founder societies.

At first, the AIP had legal status as a "voluntary association," but a few months or so later it sought status as a membership corporation under the statutes of the State of New York. Dr. Barton recalls:

I will not forget a memorable hour in which Pegram *dictated* to me without notes a "Constitution and By-Laws" which with few changes was subsequently adopted by the Governing Board and by the Councils of the Societies. This was done slowly so I could get it down longhand and with pauses for comment and discussion to which I had little to contribute. It was a kind of master-student session! He was able to perform this remarkable feat because he had a lawyer's ability to read and grasp the legal language of the pertinent statutes and he had an intimate knowledge of the constitutions of various other organizations. That of the Engineering Foundation was the model most nearly appropriate to our purpose. Years later the AIP Constitution was used liberally as a model for federations of societies in other major scientific areas. A far-reaching precedent was thus established.

Pegram was one of the six signers of the Articles of Incorporation, adopted May 20, 1932; and from the actual founding of the Institute in May 1931 until 1955 he served in a series of offices including the key posts of secretary and later that of treasurer. Dr. Barton observes:

Of the several original protagonists of the AIP, Pegram was the one who, first as secretary and later also as treasurer, contributed the most time and thought to its operation and policies. His levelheadedness was essential in compromising the sometimes divergent views which inevitably arise in a federation of autonomous groups.

I think I must have phoned, written, or visited him at least a thousand times. I remember not one instance of impatience nor ever a difficulty of access except under conditions obviously beyond his control. It gave me a great feeling of confidence when he supported my course of action and when, on the other hand, he talked me out of proposals, he did it without any discouraging effect. In those years I sometimes thought his approach to things was conservative but certainly he had no lack of independent enterprise in the face of unprecedented situations.

We all learned much from him. I recall an APS Council meeting when a particularly puzzling problem was under discussion. Finally, Professor G. W. Stewart of the University of Iowa said, "Pegram, you know everything. What shall we do?" There and elsewhere it often came to that.

For his long-time service he was twice honored by the AIP—in 1956 by special resolution, and in 1957, as hereinafter noted, by the award of the first Karl Taylor Compton Medal.

ORGANIZATIONAL ACTIVITIES

In addition to his work with the American Physical Society and the American Institute of Physics, Pegram was a member of many other organizations—in a number of instances over long periods of time—including the Academy of Political Sciences; Acoustical Society of America; American Association for the Advancement of Science (Fellow; Vice President, 1938); American Association for Physics Teachers; American Institute of Radio Engineers; American Philosophical Society; American Society of Mechanical Engineers; Association of University Professors (President, 1930); Federation of American Scientists; Institute of Aeronautical Sciences; National Education Association; New York Academy of Sciences (Recording Secretary and Vice President, 1948-1950; President, 1952); Sigma Xi (Treasurer from 1917 to 1949; President, 1925). He was a member of the Board of Trustees of both Associated Universities, Inc., and the Oak Ridge Institute of Nuclear Studies. He was chairman of the Anglo-American-Hellenic Bureau of Education.

There is nothing in the recollections of friends and associates or in the written record to suggest that George Pegram had more than an ordinary interest in politics, but—as illustrated by several incidents in his life—on issues that mattered to him he was there to be counted.

IDENTIFICATION WITH CAUSES

Both Pegrams, father and son, were closely identified with a celebrated case involving academic freedom at Trinity College shortly after the turn of the century—the elder Pegram as senior member of the faculty, and George as a promising young alumnus engaged in graduate work at Columbia University. The issue involved the *South Atlantic Quarterly,* a new and broadly liberal journal set to grapple with the multitudinous social and economic problems that beset the South. As recounted by William Baskerville Hamilton, "The young men of Trinity College who launched the *South Atlantic Quarterly* represented almost the first generation of postgraduate scholars trained in the United States. . . . Everything was possible to them. They were filled with the anticipatory excitement of Poggio about to enter some great unexplored monastic library or of a physicist opening his laboratory in the middle of the twentieth century."[13]

The moving spirit and first editor of the *Quarterly* was John Spencer Bassett, an alumnus of Trinity College and The Johns Hopkins University, who leaped into print with provocative editorials that quickly brought a storm down on his head. An editorial article entitled "Stirring Up the Fires of Race Antipathy" in the issue of October 1903 precipitated a controversy that threatened the College itself, and Bassett offered to resign in order to protect Trinity. Both alumni and faculty quickly rallied to his support and challenged the Board of Trustees to defend his rights and those of the College. In a memorial from the faculty presented to the Board of Trustees, December 1, 1903, the faculty made it clear that they neither supported nor endorsed Bassett's views but that a far greater principle was at stake. Their statement declared in part:

> If American colleges are to be the home of seekers after truth, their atmosphere must be favorable to the free expression of opinion. It is the duty of a college professor, as of every other citizen, to consider well all his opinions and the form of their expression. If he err, he is subject to criticism, to rebuke, to

[13] Hamilton, *Fifty Years of the South Atlantic Quarterly,* p. 31.

refutation, equally with all others. The principle of academic freedom, as we understand it, merely requires that while the public hold him to his duty as it holds other men, it shall not invade his rights, which are not less than other men's.[14]

William Howell Pegram led the list of signatories, which included every member of the faculty except one who happened to be out of town; the faculty members had already decided among themselves to resign in a body if the Board rejected their position. George was one of a group of alumni, including Walter Hines Page, later United States Ambassador to Great Britain, and Bruce R. Payne, later President of Peabody, that urged the Board of Trustees to stand firm.

The Board debated the issue through the night of December 1 and into the early hours of the following day. Finally, between two and three o'clock in the morning of December 3, the college bell rang out summoning the students to a victory celebration.

Following World War II and the demonstration by the United States of the power of the atomic bomb as an ultimate weapon, the technical problems that had preoccupied the nation's physicists for so long gave way to moral questions of overriding concern. One of the phenomena of the immediate postwar period was the tremendous political activity on the part of the scientific community to ensure civilian control of atomic energy and the bomb. The movement was spearheaded by the Federation of Atomic Scientists—groups of scientists who had worked on the Manhattan Project in various parts of the country and who had organized themselves into political units to lobby for wise legislation in the field of atomic energy. When victory had been secured in this country, they turned their attention to the problem of international controls.

Alice Kimball Smith, wife of Cyril Smith, director of metal-

[14] *Ibid.*, p. 65.

lurgy at Los Alamos, and herself assistant editor of the *Bulletin of the Atomic Scientists* from 1946 to 1948, has fully documented these efforts in her book, *A Peril and a Hope*.

Pegram was a member of the Federation, and although he was not active in the movement, Mrs. Smith points out that when the struggle moved into the international area and the question of banning the bomb was seriously raised, "it was not by the younger element in the federation but by senior faculty members at Columbia University, representing science, law, history, sociology, and economics, who recommended that the President declare a bomb holiday so that discussion in the newly established UNAEC might proceed in 'an atmosphere of full good faith and of confidence in their successful outcome for international peace.' Of the five scientists who framed this proposal in a letter to the New York *Times*—Selig Hecht, Edgar Miller, George B. Pegram, I. I. Rabi, and Jan Schilt—only Hecht was an active supporter of the FAS."[15]

RECOGNITION AND HONORS

George B. Pegram's work, his selfless leadership, his qualities of mind and spirit were well appreciated in his lifetime. He was the recipient of many honors. On one such occasion he was the New York *Times* "Man of the News" and was described in its headlines as "Much Honored Physicist." He was honored by both a king and a prince—King Paul of Greece and Prince Philip, Duke of Edinburgh.

From King Paul he received the Gold Cross of the Commander, Royal Greek Order of the Phoenix, for his work on behalf of the Anglo-American-Hellenic Bureau of Education. This is an organization with headquarters in New York, whose purpose is to enable Greek students of ability and character

[15] Alice Kimball Smith, *A Peril and a Hope: The Scientists' Movement in America, 1945-47* (Chicago and London: University of Chicago Press, 1965), p. 448.

to be educated in American colleges and universities and to return to Greece to pursue their careers. More than 200 American colleges and universities and a number of preparatory schools and hospitals participate in this effort. Dean Pegram was associated with it soon after its inception in 1941 and served as Chairman of the Board from 1944 to 1954, when he stepped down from the active chairmanship and assumed honorary status because of failing health.

At a special convocation of the Permanent Greek Delegation to the United Nations on October 26, 1956, His Excellency, Christian X. Palamas, Greek Ambassador to the UN, bestowed the Gold Cross on Dean Pegram in the name of the King.

The following year, Prince Philip, who was in New York at the time, conferred upon him the first Karl Taylor Compton Gold Medal for Distinguished Service in the Advancement of Physics, awarded by the American Institute of Physics. On that occasion, too, he received a congratulatory message from President Eisenhower, which read in part:

> As the first recipient of the Karl Taylor Compton Gold Medal, Dr. Pegram personifies the highest standards of scholarship, character and service. His distinguished career has brought strength to your society and his confident plans will forever be an inspiration to those who use this new building. Moreover, I have a personal gratification because of the deep friendship I have felt toward Dr. Pegram ever since I first met him at Columbia.[16]

It is quite possible, however, that even more than these formal words of the President, he cherished the comments of General Eisenhower when in 1948, as president-designate of Columbia, he addressed the annual commencement luncheon of the Columbia Alumni Federation. Dean Pegram was the guest of honor, and General Eisenhower, speaking on that occasion, remarked "that no freshman ever had been more in terror than

[16] New York *Times*, Oct. 22, 1957.

he was as a 'freshman college president' and that no freshman ever had been more grateful for a 'friendly face than he had been for Dean Pegram's kindness to him in his first days at Columbia.' "[17]

The National Academy of Sciences elected Pegram to membership at its annual meeting in the spring of 1949. When his friend Jesse Beams, professor of physics at the University of Virginia, wrote to welcome him to the Section of Physics of the Academy, Pegram responded with typical modesty:

10 May 1949

Dear Beams:

Your kind note of May 4 is very much appreciated, both because it comes from you as a friend and from you as Chairman of the Physics Section of the National Academy of Sciences. Since so large a part of my active life has been spent in University administration and only a smaller part in direct scientific accomplishment, I really had never entertained any aspirations to membership in the National Academy. Election to it is probably all the more gratifying because it was so unexpected.

In 1953 he was honored with a special citation by the Consular Law Society, an organization whose objective in its own words is "to promote a knowledge of international law and diplomacy, thereby contributing to international understanding." The citation read:

First, as Dean of Columbia's School of Mines, Engineering, and Chemistry; then, as Dean of the Graduate Faculties; and later, as Vice-President of the University, he has striven to strengthen the University as a national and international force for the promotion of intellectual emancipation and cooperation. Through numerous societies, including the American Physical Society and the New York Academy of Sciences (whose hospitality we accept today), he has exerted a constructive influence wherever men of science collaborate in search of truth.[18]

[17] News Office, Columbia University, November 1955.

[18] 10th Anniversary Report, 1943-1953.

Pegram was one of five incorporating trustees of Associated Universities, Inc., the consortium of nine eastern universities that operates the Brookhaven National Laboratory on behalf of the U.S. Atomic Energy Commission. His role in the establishment of AUI, and the subsequent creation of Brookhaven, have been described by Norman F. Ramsey,[19] who himself was one of the prime movers in this project.

Ramsey relates how in the fall of 1945 he and I. I. Rabi discussed ways and means of making a nuclear reactor available to Columbia. They were also concerned with similar problems pertaining to high-energy accelerators. When it became clear that this objective could not be achieved within the resources of the Physics Department, they discussed with members of the department and Dean Pegram the possibility of interesting other educational institutions in the New York area in cooperating in the construction of such a facility. Dean Pegram called a meeting of twenty-one major research institutions, which was held on January 16, 1946.

As a result of this meeting a committee, headed by Dean Pegram, was instructed to prepare a proposal for transmittal to General Leslie R. Groves, head of the Manhattan District Corps of Engineers. The proposal stressed the need for a regional laboratory in the nuclear sciences in the New York area. The Manhattan District was definitely interested, but since a Massachusetts group with similar interests was also making a bid for a regional laboratory at that time, the two groups were told by the Manhattan District that they would have to cooperate in order to achieve a single facility.

The two groups, in a series of discussions, managed to achieve a remarkable degree of unanimity, and out of these discussions and negotiations nine universities—Columbia, Cornell, Har-

[19] "Early History of Associated Universities and Brookhaven National Laboratory," Brookhaven Lecture Series No. 55, March 31, 1966. BNL 992 (TO421).

vard, Johns Hopkins, Massachusetts Institute of Technology, University of Pennsylvania, Princeton, University of Rochester, and Yale—came together to form the consortium that ultimately became AUI. Pegram served as a member of the Board of Trustees from July 1946 to October 1956, and was briefly Chairman of the Board in 1951.

At the time of his death, the Board of Trustees adopted a Memorial Resolution setting forth his intimate relationship with the organization and administration of AUI. It reads in part:

> To the governing body of Associated Universities, Inc., Dr. Pegram brought not only his broad experience as a scientist, a teacher, and a university administrator, but also unfailing common sense in the consideration of the wide variety of problems on which the Board of Trustees acts, or, more often, gives advice. All who were associated with him will vividly recall the clear reasoning and succinct expression of his opinions and recommendations, whether given formally, sometimes in the report of an ad hoc committee, or informally in the course of general discussion. . . .
>
> In the words of Dr. Leland J. Haworth, Director of Brookhaven National Laboratory, "he will always remain the inspiring leader and devoted friend who more than any other individual brought to fruition the original organizing activities and who in the succeeding years has unceasingly and unstintingly contributed his wisdom and his counsel to our affairs."

Just prior to his death in August 1958, the Board of Trustees initiated in his honor the annual George B. Pegram Lectureship at Brookhaven National Laboratory. The lectureship is supported by the corporation through an annual appropriation and is expected to be continued indefinitely. Among the distinguished lecturers who have participated in the series are Lee Alvin DuBridge, René J. Dubos, Barbara Ward, and Louis S. B. Leakey.

Seven universities conferred honorary degrees upon him, including Columbia University, which awarded him the degree of Doctor of Science in 1929 on the occasion of the 175th anniversary of the issuance of the original charter of King's College. The extent to which he was moved by this particular honor is evident in the handwritten draft of his reply to President Butler, obviously worked and reworked with great care and emotion and scratched through many times. Finally, with characteristic dignity and simplicity, he appears to have satisfied himself with the following:

> Your letter of June 4 advising me that the Trustees have placed my name on the list of faculty members upon whom the degree of Doctor *honoris causa* is to be conferred on October 31, next, has so overwhelmed me that I have not yet discovered how to make appropriate reply. Simply to say as I really feel that my efforts are not deserving of such high honor, would not compliment those who have the responsibility for doing this. My feeling is one of grateful wonder at the most kindly and generous judgment of yourself, of my other colleagues, and of the Trustees who placed my name on the list of those to be honored at the celebration of the 175th anniversary of the chartering of the University. I think no one could receive this honor with more sense of modesty of feeling than mine.
>
> With deepest appreciation and with cordial regard, I remain

RETIREMENT AND DEATH

In 1950 Pegram retired as professor of physics and as vice president of the University. (He had resigned as executive secretary of the Physics Department in 1945.) He then became vice president emeritus and special adviser to the president of the University. In the meantime he had been continuously associated since 1939 with Columbia's research on behalf of the war effort, serving as chairman of the Columbia Committee on War Research from its inception. After the war, the Committee was renamed (1946) the Committee on Government-Aided Research. Pegram remained chairman until June 1950, and after a brief hiatus of a year resumed the chairmanship in 1951 and continued until June 1956.

Earlier, when he had begun to face the fact of impending retirement, he had cast about for some means of escaping the heavy burden of New York state taxes. A close friend of Pegram's and a trustee of Columbia, Marcellus Hartley Dodge, who was living in Madison, New Jersey, suggested that the Pegrams look around for a place there. They found a small house that pleased them, and since the location seemed to offer a number of advantages for retirement, they purchased it in 1950 intending to live there temporarily. In the meantime, however, Pegram had committed himself to continue on as chairman of the Committee on Government-Aided Research, without remembering to tell Mrs. Pegram until after arrangements for the New Jersey home had been consummated.

By then it was too late to reverse the contemplated move; and since it was out of the question for Pegram to commute daily between Madison and Columbia, he arranged for accommodations at Butler Hall, an apartment-hotel, traveling to Madison on weekends. His health, which was failing, deteriorated steadily through the early 1950s. Early in 1958, he developed a mild case of pneumonia and was hospitalized in St. Luke's Hospital until January 26, 1958, when his elder son William took him out of the hospital and back home with him to Swarthmore. In the meantime, Mrs. Pegram rented an apartment in Swarthmore so that her husband could be near William and his family and also to gratify his own desire to be near the Franklin Institute in Philadelphia. The younger Pegrams found nurses for him, and his last days were spent in the apartment that in effect constituted his own little private sanitarium. He died August 12, 1958. His body was cremated and his ashes were taken back to his native North Carolina for burial.

ACKNOWLEDGMENTS

The biographical memoir of George B. Pegram represents the combined contributions of a number of his colleagues and long-time friends. Lucy J. Hayner, Professor Emeritus of Physics and Special Lecturer in Physics, Columbia University, researched Dean Pegram's voluminous files, selecting the correspondence that is so basic to the memoir, and in addition made valuable contributions to the text. Hermon Farwell, Professor Emeritus of Physics, Columbia University, who had known Dean Pegram from the beginning of his career at Columbia, was most gracious in setting down the reminiscences of a lifelong friendship.

Helpful leads to the background of the Pegram family in Durham, North Carolina, and its associations with Trinity College and Duke University were furnished by Paul Gross, William Howell Pegram Professor Emeritus of Chemistry, Duke University.

Henry Barton, retired president, American Institute of Physics, was kind enough to supply perceptive insights regarding Dean Pegram as a "physicists' physicist" and particularly of his association with the beginnings of the Institute.

Among those who read the manuscript and contributed helpful comments were John Van Vleck, Professor of Physics, Harvard University; Norman F. Ramsey, Professor of Physics, Harvard University; Joseph C. Boyce and the late Alan T. Waterman of the Academy staff.

The willingness of Mrs. George B. Pegram* to recall the circumstances of her meeting with her future husband, her marriage, and her life with him has helped to round out the memoir of Dean Pegram as husband and father, as well as scientist and administrator.

* Deceased June 21, 1969.

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Atti Accad. Naz. Lincei Rend. Classe Sci. Fis. Mat. Natr. = Atti della Accademia Nazionale dei Lincei, Rendiconti, Classe di Scienze Fisiche, Matematiche e Naturali

Phys. Rev. = Physical Review

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