*MY RECOLLECTIONS OF P. N. LEBEDEV**

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Usp. Fiz. Nauk 77, 571-582 (August, 1962)

INTRODUCTION

WHEN we read the biographies of representatives of the sciences, arts and literature, we are interested not only in the actual achievements of a given scientist, actor, painter or writer, but in his personality, his character, and his attitude towards society and his country. A great cultural leader interests us as an individual; we are concerned not only with his accomplishments in his particular field, but with him as a human being. If he was a man of stature, with broad views, with clear ideas on what culture should mean and be, desirous not only of making his personal contribution to the treasure-house of knowledge but of involving those around him in his investigations, enlisting the participation of the young and making them share his interests, inspiring them with the enthusiasm which is generated by association with a great man—then he deserves that we should carefully set down all we remember about him.

Many scientists are aware that association with the greatest representatives of an epoch leaves the strongest of impressions and acts as a stimulus throughout their working life. If we are fortunate enough to meet a man of genius, his influence will last our lifetime; we can therefore hardly overestimate the influence of a teacher on a school he has himself created.

There are, however, in the history of science instances of great men in whom genius was combined with pettiness, and who suffered from jealousy and from the fear that their students might surpass them. This human weakness was known even to the ancient world. Thus, according to the famous geometrist Pappus of Alexandria, Apollonius of Perga, the great creator of the mathematics of conic sections, despite all his attainments as a scientist was so afraid of competition that he is as much remembered for his jealousy as for his work.

Such men as P. N. Lebedev, who are remembered not only for their achievements, but for their personal influence on their associates and for their views of the world around them are therefore particularly attractive. It is a pleasure to consider the lifework of these gifted men who, having made an enormous contribution to science and, indeed, created an epoch of scientific development, were free of such petty human frailties as envy and malice. It is a joy to recollect instances of their deep human affection, their moral purity, their patriotism.

Reminiscences about great men and their biographies are of considerable educational value for the young. They furnish the stimuli which cause young men and women to choose the arts and sciences as their profession, and many a scientist and artist owed his choice of the career which later made him famous to reading a biography of, or reminiscences about, some outstanding practitioner in that particular field. But if reminiscences are to have an educational effect, if they are to influence the young, they should not be written down too soon after the death of the person concerned. Death lays its stamp on our attitude towards a man. A great deal recedes to the background, and we are moved to speak only of what was good or great in our subject. Yet personal recollections are valuable only when they portray a man in the round, so that what we have is not a funeral oration on the principle of "de mortuis aut bene aut nihil" but a clear and recognizable picture of an individual personality. This can be done only when we are able to view the man in some perspective, as a historical personage.

On the other hand, reminiscences should not be too long postponed. Human memory is fallible, and gradually many details are forgotten. I would say that 20—25 years is just about the right period, for it enables us to be both accurate and objective, to select what is most important from the total mass of recollection, and to evaluate the good and the bad alike.

It therefore seems to me particularly appropriate to set down at the present time my memories of my famous teacher and friend P. N. Lebedev, with whom during the last ten years of his life I maintained close personal as well as professional relations. In my reminiscences, I would like to describe Lebedev as professor, laboratory director, scientist and, lastly, as a man; in so doing, I will draw on the enormous factual material amassed during ten years of association with him.

LEBEDEV AS A UNIVERSITY TEACHER

In 1896, at the age of 17, I enrolled at the school of medicine of Moscow University. I was interested in physiology and planned to become a physiologist-physicist; the lectures on physics and chemistry given at the University naturally attracted my attention.

*From the book "Ocherki istorii russkoĭ nauki," (Outlines of the History of Russian Science), Moscow, AN SSSR, 1950, pp. 149-166.

From my sixth year at the secondary school I had begun to prepare for my physiology studies, and took up higher mathematics, chemistry (after Mendeleev) and physics. Once, at the University, I awaited the physics lectures impatiently, although I knew that the course offered to medical students was very elementary and that I would not learn much from it.

My first year course was taught by Professor N. A. Umov and Instructor P. N. Lebedev. Umov lectured on mechanics, acoustics and optics and Lebedev on heat, electricity and magnetism. This was the first time that Lebedev, who was then still a slender, good-looking young man, gave a general course. Accordingly, both the advantages and the shortcomings of his inexperience made themselves clearly felt. Lebedev's lectures were brilliantly illustrated by experiment, all the experiments being eminently successful, although many of them were extremely complicated, and the students remembered them forever after. To give an idea of Lebedev's remarkable technique in the demonstrations which accompanied his lectures, I might mention that, beginning with the Congress of Natural Scientists and Physicians held in the 90s, Lebedev showed every year experiments involving electromagnetic waves, which was no mean feat at that time.

Among his shortcomings were the excessive use of experiments, which is characteristic for beginning teachers, and a tendency to present his material in too elementary a manner. The form in which his lectures were given was, however, impeccable; Lebedev was careful not to make an unnecessary movement or to say an unnecessary word, and always retained his poise. Only the high pitch of his voice occasionally betrayed his nervousness.

Lebedev's lectures on experimental physics contained absolutely no material on advanced mathematics, and this, it seems to me, made the course less serious and valuable than it might have been. Comparison with the carefully prepared course given by Umov, who was a very experienced lecturer, was not in Lebedev's favor, and many students preferred Umov's lectures to Lebedev's Nevertheless, Lebedev, too, had his partisans, who esteemed him very highly, and during the breaks between lectures students were forever arguing about which of the two physicists, Lebedev or Umov, was the better scientist and teacher. Although none of them really knew as yet what Umov had accomplished or what Lebedev was famous for, the arguments were very heated, and naturally, inconclusive.

In 1897 I took a course in the physiology of the sensory organs and the nervous and muscular system, given by A. F. Samoĭlov. Samoĭlov was a brilliant lecturer and possessed the gift of deeply interesting his students in physiology problems. Like Lebedev, he accompanied his lectures with demonstrations of extremely difficult experiments. For example, he once showed, in every detail, an experiment involving the propagation of stimuli in the nervous system. After the lectures, students usually engaged in long discussions with Samoĭlov about the experiments. On such occasions, he frequently praised Lebedev for his remarkable ability to illustrate lectures by experiments and stressed that one had to know a great deal to be able to appreciate Lebedev's demonstrations and the tremendous labor and ingenuity which went into them.

My acquaintance with Lebedev, whom I first met in 1896, later ripened into deep friendship, which continued until his death. My first impression, naturally, was so strong that I was not able to talk to him coherently. I was struck first of all by his cordiality and kindness, qualities very rarely encountered in teachers of the School of Medicine. When I first went to ask him a question about a matter which had nothing to do with his lectures, although it did have a bearing on physics, Lebedev not only told me everything I needed to know, but gave me a great many hints besides and asked me to come to see him whenever I thought necessary. In this regard, it is with deep gratitude that I remember Lebedev, and also another instructor, V. I. Vernadskiĭ, who was also very kind to me. As I recall, I even started certain investigations as a result of my talks with Lebedev and Vernadskiĭ. When I began my last year at the School of Medicine I was naturally unable to continue my relations with Lebedev, but I did occasionally drop in on his seminars.

I must say that the first such seminar I attended was a real revelation to me. I was being trained at the School of Medicine at Moscow University—a school which was of such excellence that when I was sent abroad by it later I was not particularly impressed by the foreign universities. I saw nothing there that we did not have in Moscow, although I did meet teachers of great experience and unusual gifts. Despite all this, I was extremely impressed by Lebedev's seminars. In addition to his enormous erudition, he had an extraordinary ability to deal even with beginners as with equals. I was struck by the patience with which Lebedev heard out young physicists, even when they defended an obviously incorrect position. This was a most attractive trait of his and won him the sympathy of the young. He became the center of a large group of young physicists, many of whom later distinguished themselves.

After I had become a university lecturer myself, I frequently had occasion to watch Lebedev prepare his lectures. I saw how carefully and thoroughly he planned his demonstrations, and how much thought he gave to new equipment to replace the old instruments which everyone took for granted. There are many who still vividly remember the Congress of Natural Scientists and Physicians held in Moscow in 1910. In addition to delivering scientific papers, Lebedev also presented a number of brilliant lecture demonstrations which could be given right in the lecture hall. These included

a demonstration of undamped electric oscillations with a wavelength of 10 cm (N. K. Shchodro), another of waves propagating on the surface of a liquid (E. V. Bogoslovskiĭ), etc. At this same Congress, Lebedev, who was anxious to introduce electronics into his physics course, demonstrated the basic photoelectric processes in the form in which they were first studied by Stoletov. His demonstration of discharges in gases was conducted on so large a scale and was so effective that it elicited tumultuous applause. Indeed, it has been my experience that whenever this experiment was shown it met with great interest and enthusiastic approval on the part of students.

Later, in 1908-1909, I was fortunate enough to attend a special course given by Lebedev for persons who worked in his laboratory. The course dealt with the latest achievements of physics, Lebedev gave it with extraordinary brilliance, and the students followed it with fascinated interest. As I was to discover, Lebedev sometimes made no preparations for a lecture, but even on such occasions, having thought about a topic for only a few minutes just before the lecture began, he was able to give a detailed and interesting presentation of the development of the particular branch of physics he had chosen to lecture about.

Lebedev's special lectures showed how remarkably well-read he was not only in his own field but even in fields which bore little relation to his work. I clearly remember one occasion when Lebedev dropped in on me shortly before the lecture and said he did not know what to lecture about. The newspapers just then were reporting a sizable earthquake. "I might, perhaps, lecture on progress in seismology," said Lebedev, thinking aloud. I supported this idea, saying that the people in his laboratory knew little about the subject and would certainly be interested. And that is what Lebedev did. In the course of the lecture he gave a fascinating description of seismological stations. He brought out so ably and clearly the ingenious construction of seismological instruments that I remember it to this day, down to the smallest detail. His presentation of the theoretical aspects of seismology, based on the work of B. B. Golitsyn and Lebedev's conversations with him, was no less interesting. Lebedev enjoyed these special lectures, where he found it easier to be himself—a research scientist—and he was at his best in them.

During the closing years of his life, the general courses were a great burden to Lebedev; he not only disliked them, he feared them. He had had several heart seizures while giving a lecture, and for that reason alone was afraid of large public gatherings. During the three years immediately preceding his death, in a physics course he gave for students of mathematics and the natural sciences, Lebedev introduced new material, which included the electromagnetic theory of light, electron theory and a number of other discoveries of contemporary physics.

In mentioning these lectures to me, Lebedev also told me how he prepared for them. Stopping by one evening (we were both living in the Physics Institute, next door to the University) I found Lebedev surrounded by reference books and periodicals of every conceivable kind. When I asked what he was doing, he replied: "I am preparing my first lecture for the spring semester." "What sort of lecture is this, which requires reference books and all these periodicals?" "Look here," said Lebedev, "and you will see what modern physics is and how much one must read in order to know it." And he handed me some closely written pages which recorded the work being done on physics all over the globe. First, he had listed all the periodicals in different countries which carried articles on physics; next, using the different branches of physics as subheads, Lebedev demonstrated statistically the variations in the numbers of papers on any given branch of physics published annually, showing how interest in that branch fluctuated from year to year. Lastly, having added up all the publications on physics which appeared in the course of a year, Lebedev proved that it was impossible to know all of physics, since anyone who wanted to keep abreast of the current work alone would have to read some ten to twelve items a day, including books as well as articles. So much material was produced by modern physicists that anyone who wished to study physics must renounce the idea of studying the subject as a whole. One could know well only separate narrow fields, and broad knowledge could be acquired only by persistent and thorough study of different fields. One must not only be ready to read the literature on a given branch of science, one must also learn to read it. Such information on the existing literature, given by Lebedev before he embarked on the supplementary part of his physics course, was naturally of great interest to students, while the amount of work done in the different countries led them to the logical conclusion that familiarity with foreign languages was indispensable for a thorough knowledge of physics.

At the end of two semesters, examinations were given on the ground already covered, and this placed a really heavy burden on the professors. I first saw Lebedev in his role as examiner back in 1897, when he and Umov examined first year medical students. After the first few questions, students ranked Lebedev as a "severe" examiner. As it happened, I was examined by him. After I had spoken on the subject indicated on my paper (calorimetry) Lebedev put to me a number of questions on the interference, diffraction and polarization of light. As I was to learn later, when I acted as his assistant during examinations, Lebedev asked nearly everyone these questions, taking it for granted that a student who was able to cope with such relatively complicated matters would have had no difficulty in replying to easier questions.

During the examination, my first at the university, I was very nervous; but seeing Lebedev's complete calm—he never corrected or flustered a student, but neither did he prompt or help him—I soon regained my poise and replied to all his questions correctly. I phrased my answers poorly; I had not yet learned to express my ideas with ease. Lebedev was not troubled by this shortcoming, however; he graded me A+ and thanked me for my efforts. In later years, Lebedev often recalled this examination. Lebedev remained a calm and controlled examiner throughout his career. During the last years of his life I examined jointly with him students of mathematics and the natural sciences and also medical students. He had a few favorite questions for the mathematicians and natural scientists. For the first part of the physics course, which included mechanics, acoustics and heat, he asked nearly every student questions relating to the second law of thermodynamics. For the second part of the physics course (optics, electricity and magnetism) his favorite questions related to the determination of the velocity and charge to mass ratio of cathode rays and the effects observed when a crystal plate is inserted between two crossed Nicols. Lebedev examined his students unhurriedly and in the last years of his life, when examinations were carried out throughout the year, he would find time to examine not more than ten students annually.

Whereas Lebedev regarded general lectures as a heavy burden, and enjoyed his special course, which was an extremely useful one, the weekly seminars, which I have already mentioned, were a source of tremendous pleasure both to him and to the young physicists who attended them. When Lebedev obtained his professorship and with it the possibility of conducting scientific investigations at first in Professor A. P. Sokolov's laboratory and then in a laboratory of his own, he immediately instituted the scientific seminar. The papers presented at the seminar were not selected systematically and related to every possible branch of physics. A new piece of research on the reflection of infrared rays from metals was succeeded by one on the electric conductivity of salt mixtures, and an inexperienced listener at these seminars was at first hardly able to follow. He heard words, some of which he recognized, but in many cases he was unable to see how they fitted together. Gradually, his capacity to understand the expositions increased, and after a while, as each paper was presented, he would get a clear idea of the reported phenomena. In this manner, a young man who had just embarked on research and was beginning to specialize in some one branch of physics was given an opportunity to watch developments in all its branches and learn of the most important discoveries. These seminars gradually became one of the permanent features of Lebedev's university activities.

I was a medical student, and because I had many evening classes I was unable at first to attend Lebedev's seminars regularly. I began to do so at the invitation of A. R. Kolli only after graduating from the School of Medicine, while continuing scientific work on the physiology of hearing at the Ear, Throat and Nose Clinic. I vividly remember my impression of the first Lebedev seminar I went to. Towards 7 o'clock, all the physicists who were then working with Lebedev (there were about ten of them) gathered at a large, round, oilcloth-covered table in a small room in the Stoletov Library of the old physics laboratory. The outsiders included A. R. Kolli, T. P. Kravets and myself. A little after 7, Lebedev emerged from his laboratory. I had not seen him for four years and was amazed by the change time had wrought. The slim, handsome young man had become stout and gray-haired and looked ill. His face and especially his eyes made an even greater impression on me than during our earlier meetings. He seemed to be looking off into space, and his face had acquired that peculiar, spiritual beauty which we all know from his last photographs.

Having become accustomed, in the Society of Natural Scientists and the Society for the Promotion of the Natural Sciences, to meetings being conducted in an orderly manner, I was immediately struck by the fact that the person presenting a paper was constantly interrupted both by Lebedev himself and by other participants at the seminar, who either asked for clarification or questioned some of the statements made. The discussions were natural and spontaneous; one forgot that one of the participants was the famous P. N. Lebedev, already widely known for his research on short electromagnetic waves and the pressure of light. There was no deference, no respect for rank, and Lebedev himself seemed to be pleased when he was opposed on good grounds. At my very first seminar I was struck by Lebedev's encyclopedic knowledge of experimental physics. There was never a subject brought up with which he was not familiar and on which he did not comment.

As the seminars proceeded, interest in them increased, and they were attended not only by Lebedev's research workers but by all Moscow physicists. Over the ten-year period, during which I attended them, all the major problems of contemporary physics were taken up. Gas discharges, radioactivity, x rays, blackbody radiation and Nernst's heat theorem were all reported upon; and when Lebedev himself presented a paper, it was a major event. Usually he chose some problem of particular current interest, and more than half the seminar was devoted to it. His papers always gave rise to lively general discussions.

In the early days, when Lebedev's health permitted, all participants adjourned after the seminar to a small restaurant on Bolshaya Dmitrovka where the talk was often continued past midnight over a simple supper and a mug of beer. Lebedev was always the center of these gatherings. He not only liked to talk but was a good

talker, enjoyed being listened to and held his listeners spellbound.

Drawing on his wide acquaintance with foreigh physicists, Lebedev would paint a vivid picture of the development of contemporary science. Frequently, when telling us about some scientists whom he had happened to meet, say, in Switzerland, Lebedev would throw in a description of the Alps, the glaciers, climbs up snow-covered mountains and tourist life in general. Tourism was a favorite hobby of his and some doctors were of the opinion that the heart ailment from which he suffered during the last years of his life had been partly brought on by his excessive addiction to mountain climbing. Suffice it to say that, when he was still in secondary school and during his first year at the Moscow Higher Technical School, Lebedev with a friend made a number of non-stop boat trips along the Moscow River down to Oka, one of them rowing while the other slept.

The members of the seminars were fascinated by Lebedev's picturesque descriptions of nature, and many of his students also took up mountain climbing. Because of Lebedev's excellent knowledge of Switzerland and the Tyrol, many people, not necessarily students of his, called on him for assistance in planning a trip through the Alps. I remember that P. A. Shternberg, who at that time was an instructor at Moscow University, asked Lebedev for advice in planning an easy walking tour through the Tyrol and the Alps which was to last one month.

LEBEDEV AS DIRECTOR OF A SCIENTIFIC LABORATORY

In speaking of Lebedev's teaching activities, reference must be made to his supervision of the scientific investigations carried out in his laboratory, a function to which Lebedev himself attached the greatest importance.

Lebedev welcomed anything that might facilitate scientific work in the laboratory. He lavished time and effort on improving the scientific aspects of the laboratory's activities. For example, he not only frequently invented the equipment to be used by the student in his investigation, and worked out the main lines of the investigation, but also made detailed drawings of the equipment to be built in the shop. This took up a great deal of Lebedev's time and not unnaturally he sometimes wished he was free of these petty occupations and able to devote himself to the major problems which claimed his interest.

All those who were admitted to Lebedev's laboratory, even men of limited ability, could count on completing their projects with Lebedev's assistance, and usually the most important aspect of the project was thought out and formulated by Lebedev.

The laboratory was too poor to maintain a large shop where research equipment could be built. The shop boasted of only one mechanic, A. I. Akulov, who assembled all equipment from Lebedev's designs. When the number of research workers in the laboratory increased to the point where one mechanic would no longer suffice, Lebedev solved the problem by turning all the research workers into assistant mechanics.

Before entering Lebedev's laboratory, the future research man was required to work in the university shop, which was run by P. I. Gromov, as a locksmith and assistant mechanic and build some relatively uncomplicated piece of equipment. It was only after such training that he was admitted into the laboratory, where he would be able either on his own, or more often, following Lebedev's detailed drawings, to build the equipment which he would have to use. This greatly speeded up the work, and the success of the investigation was assured; there were no unsuccessful research projects in Lebedev's laboratory.

When I was admitted to Lebedev's laboratory in 1905, I had certain definite interests in the field of biophysics and had already carried out some physical-physiological investigations in the Ear, Nose and Throat Clinic. I naturally chose work bordering on physiology and physical chemistry and when, in 1908, Lebedev asked me to select projects for several research students and to guide them in their work, I chose physical chemistry subjects which were related to physiology and biophysics.

Those who knew Lebedev little were greatly surprised when my research students began to work on physical-chemical and physical-biological projects in Lebedev's physics laboratory. I, who knew him better, realized that he had been avoiding physical chemistry projects simply because he was little acquainted with that branch of science.

His prejudice against chemistry and mathematics stemmed from a very superficial acquaintance with them, for which his Strasbourg teacher, Professor Kundt, is to be blamed. Kundt held physics above all other sciences, and made slighting references to chemistry and mathematics in his lectures. Kundt's great gifts and his amusing attacks on chemistry resulted in his students developing a disdain for that science. I remember a case I heard of abroad, of a student of Kundt's maintaining with perfect seriousness that nickel and cobalt are alloys. Lebedev's prejudice against chemistry increased when, although he had not followed a general course of inorganic and organic chemistry, he was obliged, at the invitation of Kohlrausch, to prepare in the space of only two weeks for a doctorate examination on special aspects of organic chemistry.

Constant exposure at seminars to physical-chemical papers introduced by myself and other investigators gradually changed Lebedev's views on chemistry and in the end he not only became reconciled to it but even developed a strong interest in certain chemical problems and attempted to reduce them to problems in physics.

I clearly remember one occasion in 1905, when I first began to work with Lebedev. I was present when he told L. A. Chugaev about the research being done in his laboratory. To Chugaev's question why he did not set his people projects in molecular physics Lebedev replied that only in the physics of ether—as it was then called—could one work with complete purity, while in the physics of matter one could never be sure of the purity of the substance investigated.

Later still, Lebedev developed an interest not only in problems of physical chemistry but in the broad field of biophysics, which I took up when I was with him. While working under Lebedev, I proposed to carry out an old project of mine: to observe through an ophthalmoscope the decomposition of retinal red in a living eye. I had told A. A. Eĭkhenval'd about this plan back in 1903, and in 1907 I described it to Lebedev in detail, mentioning that the subject was connected with my photo-chemical work in his laboratory. Lebedev was so interested that he began to study writings of Helmholtz on physiological optics and I remember that Lebedev spoke to me about this remarkable work with admiration. In 1909, with my help, Lebedev constructed a unique ophthalmoscope, through which one could not only look into the eye without any reflex from the cornea but also watch a color image, such as a spectrum, at the back of the eye. I demonstrated this spectral ophthalmoscope at the Congress of Natural Scientists and Physicians in 1910, and was able to show a number of new effects in physiological optics by using that instrument.

In order to complete this description of Lebedev as the director of a laboratory and head of a school it must also be recorded that he took the view that a scientific project was more than a laboratory investigation, and that one should be able to finish the investigation in time or abandon it. Basically, no one project can exhaust a subject and Lebedev stressed that the physicist's maturity may be judged by the stage at which he abandons his work, deeming further research useless. The completed study must be published in such a form as to be readily understood by the scientific world.

Research students in Lebedev's laboratory usually spent a great deal of time on preparing a paper for publication. Lebedev insisted that no effort be spared in polishing the paper, and most of his people rewrote their drafts five or six times. It often happened in the end that Lebedev, dissatisfied with the presentation of his student's work, rewrote it himself.

After generalizing the theory of the excitation of the sensory organs, on which I reported at one of Lebedev's seminars, I sent him a draft of the article I had prepared for publication. Lebedev was then in Heidelberg. He replied on March 16, 1910, advising me to rewrite the article. "This article," Lebedev wrote, "is bound to become, not now, but later, a classic in physiology. You must therefore spare no effort to cast it in such perfect form that authors of future physiology textbooks should be able to quote it textually. The article must be readily comprehensible to physiologists, that is, the physical and mathematical aspects must be presented in an elementary and detailed manner, even as you would do if you were writing a physiology manual for beginners. You must foresee the questions such readers would naturally ask and provide clear, simple and detailed answers. This article must set a trend and its value, as I see it, lies not in the explanation of separate facts, but in the method used; in the fact that physiological processes are explained not only in qualitative, but in quantitative terms. This is the one swallow which is bound to make a summer."

Being very exacting as regards form, Lebedev insisted that his students' papers be drafted with great precision and clarity, particularly if they were to be presented at a congress. If the paper was to be accompanied by demonstrations, Lebedev would first go over them together with the author, then carry them out in the presence of a number of people, and lastly have the report submitted at a seminar, where it was sometimes repeated (with revisions and alterations) two or three times. "We must prepare everything exactly as the Art Theatre does," Lebedev often said. He was very fond of the Art Theatre and had many friends among the actors. The report and the lecture must be impeccable, and Lebedev, who himself had prepared thoroughly for his early public appearances, demanded a similar effort from his students.

I will not attempt to evaluate Lebedev's scientific achievements. Much has been written on the subject both in Russia and abroad. I should like to bring out only a few facts which are not generally known.

Lebedev produced only a small number of original works—22 in all. His creative activity continued from 1889 to 1911, or over the space of 22 years; consequently, he published on the average one study a year. Dividing the time from 1891 to 1911 into five-year periods, we shall see that during each of the first three Lebedev published six studies, and during the last period only four studies. This drop is explained, on the one hand, by the difficulty of the subjects chosen, and on the other, by Lebedev's increasing ill health. If we compare the number of studies completed by Lebedev with the number of printed contributions of other scientists who died young, we get the following figures: Riemann (died at 39) left 18 studies, Hertz (died at 37) 25 studies, and Foucault (died at 47) 66 studies. There have been scientists who have left only two or three works behind—Galois is one of them—whose names will live forever in the history of science. We therefore see that the number of studies as such gives no indication of a scientist's importance.

It may seem surprising that Lebedev, who spent entire days in the laboratory, should have printed so little, but this is explained by the enormous technical

difficulty of the problems he sought to solve. His investigations of the pressure of light on solids required some eight years of work, while his research on the pressure of light on gases took even longer—about 10 years. If we review Lebedev's different experiments and all the control checks and tests he carried out we shall certainly agree with Wien, who wrote to V. A. Mikhel'son that Lebedev "was the greatest master of the art of experimentation of our day."

As may be seen from these statistics of the work of great scientists, the number and importance of their contribution usually increase with age, reaching the maximum level around the age of 35—40 years, and then gradually decline. In the case of a few scientists, including Helmholtz, productivity continues for a very long time. We may thus say that Lebedev died in his very prime, and that if it had not been for the disease that killed him, he would have made a number of most valuable contributions, both through his personal efforts and through those of his students.

LEBEDEV AS A PERSON

I have often heard it said that personal acquaintance with outstanding practitioners of the arts, literature and science often robs them of the glamor conferred on them by their profession. Work of talent and even of genius has often been produced by a man who himself does not make much of an impression. Buckle's comment on Darwin is a case in point: Buckle said that Darwin's books were more interesting than Darwin himself. Lebedev's work and his personality, however, were on the same level and if his contributions were brilliant and exciting, so was he himself. In this brief sketch I can hardly hope to give a complete picture of Lebedev; I will therefore mention only a few of his individual characteristics.

By the time Lebedev had reached the age of 35—40 years—which is when I began to see him frequently—he had developed some definite tastes and habits, and I should like to record them briefly. During the last two years of his life, because of his heart condition which was growing progressively worse, Lebedev had to renounce such cultural pursuits as attending plays and concerts. He found it quite unbearable to stay in an airless theatre hall and any such attempt on his part resulted in a heart seizure.

Speaking of his friends and acquaintances, who were few in number, Lebedev would note with special regret that he was unable to take advantage, as they did, of the opportunities offered by so great a cultural center as Moscow. During the last years of his life Lebedev barely left the Physics Institute of the University, where he lived. He walked only from his apartment to his laboratory and back again. Even a short stroll, particularly in cold weather, would bring on a heart seizure a few hours later, and Lebedev did his best to avoid such unpleasantness.

When Lebedev, together with other professors, left Moscow University in 1911 and was forced to look for a private apartment, he so arranged matters that his new lodgings and his temporary laboratory were in the same house.

In his youth Lebedev had been fond of the theatre and concerts and had been a constant attendant. He loved music all his life, and when he received in the evenings somebody was always singing or playing a musical instrument.

Lebedev had a great love for literature, and all his life delighted in Tolstoi's works. He was particularly impressed and fascinated by Tolstoi's novel "War and Peace." Re-reading time and again this work of the great Russian writer, Lebedev never failed to be amazed at Tolstoi's ability to transpose the reader into the historical past and so to describe a bygone way of life that the reader could not help feeling that Tolstoi had himself seen and taken part in all the events which he described so clearly and simply. Lebedev also admired in Tolstoi that vigor, that love for mankind, that avidity for life which Lebedev himself was beginning to lose as a result of his illness and which he envied in others.

The persistent attempts of the obscurantists of the Czarist regime to stifle all progressive ideas among university professors distressed Lebedev greatly and at times in conversations with his superiors he forgot to be properly deferential. Once after a talk with the head of the Warsaw educational district Lebedev, extremely upset and indignant, dropped in to see me. When I asked him what had happened, Lebedev told me that the district head had come to consult him on a professorship in physical chemistry and had mentioned a fairly well-known Moscow man. Lebedev had recommended this scientist highly, praising his teaching ability and his services to science. All this, however, was apparently not enough. "Is he by any chance a Red?" The district head had asked. "What did you reply," I inquired. "I picked up a spectroscope and said, 'If you are interested in the color take a look in this instrument.'"

The smashing of Moscow University by Minister Kasso in 1911 greatly distressed Lebedev. He was one of the few professors who did not have a second employment and when he lost his professorship at the university he found himself out in the street. Where other professors lost a great deal, Lebedev lost everything.

The considerable private income which Lebedev had enjoyed in his youth had by then greatly dwindled. He could hardly have lived on it, and since he also had no access to a laboratory his scientific life had been wrecked. The Ledentsov Society and the Shanyavskiĭ City University came to Lebedev's assistance and set up a small laboratory for him. At the same time, N. E. Egorov, head of the Central Department of Weights and Measures, and Academician D. P. Kono-

valov began negotiations regarding the transfer of Lebedev and myself to that Department. Lastly, at about that time, S. Arrhenius, director of the Nobel Institute, invited Lebedev to join the Institute and emigrate to Sweden.

Lebedev, who went abroad in 1911, reacted very painfully to the attacks on education launched by the Czarist government. In late summer of 1911 he wrote to me from Heidelberg: "I avoid reading Russian newspapers. The story of the 1500 women medical students who were expelled is a nightmare."

On August 5, 1911, informing me of his plans regarding the new laboratory, Lebedev wrote, "Today I received a very kind letter from Arrhenius. He seems to insist on my moving to Stockholm. I nevertheless think that we ought to choose the Department of Weights and Measures; we will be together and it may all work out."

During the last months of Lebedev's stay abroad the installation of the laboratory in Mertvy Pereulok [literally, Dead Alley] No. 20 where Lebedev had his apartment was completed and I so informed him in early August. Lebedev replied on August 16, 1911. This last letter he ever wrote to me ends with the words: "In a few days I will be in Moscow and will be delighted to see for myself that you and I together will indeed be doing living work in Dead Alley."

Lebedev returned to Russia in September 1911, having somewhat recovered from the nightmare months which had followed the smashing of Moscow University. Until his very death, which occurred on March 1, 1912, Lebedev watched with great bitterness the further disintegration of the University and the unworthy conduct of many of the professors who had remained and who now occupied the chairs formerly held by professors who had chosen to resign. He realized that the work he had begun with so much enthusiasm was being progressively destroyed and he saw no way of arresting that destruction. This had an adverse effect on his health and certainly accelerated the disease which carried him away before his time.

P. N. Lebedev was one of the greatest men of the pre-revolutionary epoch; he had an ardent love for Russian science and devoted his entire life to it. His example ought to inspire modern physicists and prompt them to follow in the footsteps of our unforgettable teacher.

Translated by Mrs. Valentine S. Rosen