Alexander Kossiakoff: His Life and Career, Part One

Ralph E. Gibson

Dr. Kossiakoff's retirement as Director of APL on 30 June 1980 marks an epoch in his long and distinguished career as scientist, administrator, and engineer. Having worked closely with him for nearly 40 years, I am grateful for the opportunity to record my affectionate appreciation of a trusted friend, a loyal colleague, and a dedicated man. I use the word "dedicated" advisedly, for Alexander Kossiakoff literally devoted all his energies to the Laboratory and the technical and administrative problems affecting its welfare. In times of crisis, Kossy stepped into the breach, organizing and leading groups to solve the problems, sometimes working day and night, regardless of his personal health or convenience.

THE EARLY YEARS

Alexander Ivanovitch Kossiakoff was born in St. Petersburg, Russia, on 26 June 1914, the only child of Ivan Timothy and Ludmilla (Brodskaya) Kossiakoff. When World War I was declared in August 1914, Ivan Kossiakoff, who had graduated second in his class at the Royal Military Academy, was given the choice of serving as an officer in the Imperial Army on the Eastern Front or on the Western front. He chose the Eastern Front and was stationed in Vladivostok. Then came the Bolshevik Revolution of 1917. The traditional monarchy was overthrown and liquidated by the Red Russians. Those who remained loyal to the old regime or supported a moderate one, the White Russians, fought nobly to defend their cause but it soon became evident that the odds against them were overwhelming. The Kossiakoffs were White Russians, and Ivan, recognizing that his family's position in St. Petersburg, now Petrograd, was becoming dangerous, made arrangements for them to join him in Vladivostok. Ludmilla, her 3-year-old son, and her mother embarked on a 7000-mile railroad journey, ruggedly uncomfortable at best and perilous at worst. They never reached Vladivostok but stopped in Irkutzk, a town near Lake Baikal in Siberia, after an arduous journey. Kossy had vivid memories of riding in a horsedrawn sleigh over the snow-covered steppes of Siberia, throwing scraps of food to the wolves that followed them. Even in the remote town of Irkutzk, the activities of the Reds made life unsafe for White Russians, and shortly the family

Adapted from an unpublished manuscript written by Dr. Gibson upon Kossy's retirement as APL Director in 1980.

sought refuge in China, in the town of Harbin, Manchuria. At that time, Harbin was filled with refugees from Russia so that the Kossiakoffs were not lonely. They stayed there for 3 years. When Kossy was 6 years old, the family moved to Hankow, his father working for the YMCA. Three years later they obtained visas to enter the United States, traveling aboard the Canadian liner *Empress of China* from Yokohama to Vancouver and Washington state.

On 31 July 1923, 9-year-old Alexander Kossiakoff and his parents first set foot on American soil after an odyssey extending 10,000 miles in space and 6 years in time.

Young Alexander continued his education in elementary and high schools in Seattle, having first learned to speak and write English from a private tutor. Apparently his 6 years of refugee life in China proved to be no handicap to his educational progress. Indeed, the opposite was the case, for at the age of 18 he was accepted as an undergraduate at the California Institute of Technology, his major interest being in chemistry.

The lot of an undergraduate at Cal Tech was not easy: the pace was fast, the information to be digested enormous, and the standards very high. However, Kossy not only survived, he excelled. When he left Cal Tech in 1935, he had already published one paper with A. A. Noyes and another was in press. Furthermore, in his junior year he had won a 4-year fellowship sponsored by the American Can Company, which enabled him to proceed at once with graduate studies at The Johns Hopkins University. By taking courses at the University of Washington in the summer of 1935, he fulfilled certain Cal Tech formal requirements and received a BS degree in 1936.

In the summer of 1938, after 3 years of graduate work, studying experimental kinetics under F. O. Rice and molecular structure under David Harker, Kossy received a Ph.D. from Johns Hopkins.

With 1 year of his fellowship left, Kossy returned to Cal Tech as a post-doctoral fellow. He studied with Linus Pauling, whose reputation as a leader in advanced thought in physical chemistry had reached international proportions. Incidentally, a few years later, Pauling told me that Kossiakoff was one of the most brilliant students he had encountered. In the middle of his post-doctoral year, Dr. Kossiakoff was appointed instructor in chemistry at The Catholic University of America, beginning in September 1939.

At Hopkins, Kossy had become well acquainted with Thomas Harrison Davies, a student in biochemistry at the University. Shortly after his return to Cal Tech, Kossy met Davies on a street in Pasadena and was introduced to his sister, Arabelle, a talented young artist who had studied sculpture at the Maryland Institute of Art. Events moved rapidly, for 3 months later, on 18 February 1939, Alexander Kossiakoff and Arabelle Knight Davies were married. Those who experienced the gracious hospitality of the Kossiakoffs and saw their two children, Tonya and Tony, progress through attractive childhood and adolescence to becoming well adjusted and successful adults with children of their own, realize how successful this marriage had been.

Such is the eventful story of the young man who, after interviews with Drs. R. C. Tolman, Chairman of

Division A (Armor Ordnance), and C. N. Hickman, Chairman of Section H (Rocket Development), was appointed to be Technical Aide of Section H, of the National Defense Research Committee (NDRC), by that time a branch of the Office of Scientific Research and Development (OSRD), headed by Dr. Vannevar Bush in the Office of Emergency Management. The Navy made available an old World War I "bomb proof" building at the Naval Powder Factory, Indian Head, Maryland, for experimental work.

THE WAR YEARS

I have never seen a job description of the position Technical Aide, but it must have covered the waterfront of duties, varying from handling the paperwork to assisting in the formulation of technical problems and making arrangements for their solution. Although he was proficient in his administrative duties, Kossy was more interested in the technical problems and soon made his presence felt.

In his early days with the NDRC, Kossy spent much time traveling between his office at the National Academy of Sciences and Indian Head. There he tracked the activities of the growing staff being recruited, mostly from universities, to support Dr. Hickman. The work on the 2000-lb armor-piercing bomb had proceeded largely through Hickman's personal efforts, supplemented by some members of the then existing American Rocket Society, whose enthusiasm far outran their understanding of physics, chemistry, and exact engineering principles. This understanding had to be provided by faculty members and students from universities, many recommended by Dr. J. O. Hirschfelder. In a year or so substantial research programs were in progress to investigate the properties of rocket propellants, the complex phenomena exhibited when propellants burn in rocket chambers (internal ballistics), aerodynamic behavior, the stabilization of rockets flying at transonic speeds (external ballistics), materials requirements for metal parts, etc., as well as engineering design studies to meet various applications. Kossy had a hand in directing much of this effort and in supervising the work of a number of contractors to the OSRD, whose services had been retained to assist the government in specialized areas.

By mid-1943, it became apparent that the primitive facilities in the damp bomb proofs at Indian Head were inadequate to support the work sponsored by Section H. Dr. Van Evera found a site of approximately 450 acres near Cumberland, Maryland, on which the Kelly-Springfield Corporation had built and operated a plant for loading and testing .50-caliber machine gun ammunition. Since there was now an excess of this ammunition in the country, the plant was being closed. With the addition of an office building, a machine shop, and a few minor structures, it seemed that this plant would make an ideal facility for rocket research and testing at a relatively low cost. Negotiations began, and the Army turned the plant over to the OSRD, who assigned to the George Washington University the contractual responsibility for its operation. It was given a somewhat uninformative name, the Allegany Ballistics Laboratory (ABL), since its work was highly classified. By January 1944, the laboratory was in operation.

As the ABL Director of Research, I selected Dr. Kossiakoff to be Deputy Director of Research, a choice that met with the approval of all the government and university officials concerned, and a decision that proved to be a happy one. Wholeheartedly, he plunged into the difficult task of creating an organization in which a heterogeneous bunch of scientists and engineers from universities and industry could work together with productive results. The Kossiakoff family pulled up their roots in Washington, DC, and moved to Cumberland so that Kossy could be on the job 7 days a week. Their son, Tony, was born in Cumberland.

Looking back, I often wonder how ABL achieved the success it did. None of us knew anything about the management of research (we found later that few people really did), and the technology of rocketry was still in its infancy. Yet Kossy seemed to have a flair, an intuition, for suggesting the right things to do, the right slots where the scientists and engineers could contribute most effectively, and the right projects to be undertaken, projects within the capability of ABL's resources and of real interest to Army and Navy sponsors. His integrity and intellectual ability won the respect of the many first-rate scientists and engineers who became associated with ABL. They accepted his leadership gracefully and willingly.

During the 2 years Kossy was Deputy Director of Research at ABL, its staff grew to some 700; the projects it undertook increased in number and diversity; the fundamental research in propellants, interior ballistics, and exterior ballistics of rockets began to give the technology a background of understanding; and the facilities for developing rocket technology grew to impressive proportions.

Kossy's World War II contributions were recognized by the Naval Ordnance Development Award and the Presidential Certificate of Merit, both of which he received in 1948.

V-J Day came and went. Hostilities ceased. Many thought the world was now at peace. Following his original plan, Dr. Bush began to disband the OSRD and turn over to the Army, the Navy, and other established government agencies such resources as it still retained. ABL had become a valuable national facility. The Navy, largely because of the influence of Commander (later Admiral) Levering Smith, decided to sponsor ABL as a Navy facility and contracted with the Hercules Powder Company to take over its operation from the George Washington University, which was reluctant to continue in peacetime a contract for weapons development.

TRANSITION TO APL

In 1945, the Applied Physics Laboratory, which had undertaken a comprehensive program to develop a rocket-launched, ramjet-propelled guided missile for the defense of Navy ships, consulted with ABL, especially Dr. Kossiakoff, about the development of rockets to boost guided missiles to cruising speed; and in early 1946, when the future of ABL was settled, Dr. Merle Tuve invited Drs. Kossiakoff, F. McClure, R. B. Kershner, and myself to join the staff of APL to help for a few months in planning and directing the development of such rocket boosters.

Subsequently, Kossy became supervisor of the Launching Group (BBL). Within a year or so, two revolutionary and far-reaching results came from the work of this group. The first was the "Talos Booster." Kossy & Co. realized that order-of-magnitude changes in the size of rockets and their propelling charges were becoming possible with the use of smokeless cast double-base powder. They determined that a rocket with a propellant charge weighing approximately 2000 lb would accelerate the proposed ramjet missile to cruising speed. Previously, the largest solid fuel rocket charge had never exceeded 200 lb. BBL planned and directed a program, implemented at ABL with the Aerojet Engineering Corporation as a backup, with such success that booster rockets with 800-lb propellant charges of double-base powder were tested in flight in the summer of 1947, and by the end of 1948, full-scale boosters, the largest solid fuel rockets made up to that time, performed as predicted in flight tests at Inyokern, California. This work led directly to the Terrier missile, which was sustained in velocity by a solid fuel motor. Smokeless powder, single tandem boosters were adopted by all U.S. guided missile programs.

The second contribution of the BBL was the concept of the "zero-length launcher" for guided missiles, which posited that a missile with a tandem booster, because of its large moment of inertia about the longitudinal axis and its high acceleration, would take off stably when the booster, attached to a trainable and elevatable launcher, ignited—even if it were suspended on the booster from rails no longer than a few inches. Despite the adverse criticism of many "authorities" on the subject, Kossy's studies had convinced him and his colleagues of the feasibility of this concept and he pushed it to a successful demonstration. The zero-length launcher has been used on all Navy ships, and indeed, the realization of this revolutionary concept, made possible relatively simple and compact shipborne missile installations.

Oldtimers in the missile business would never forgive me if I did not mention the Launching Panel, which, like all the other Bumblebee Panels, had a very powerful influence on the course and progress of APL's guided missile programs. The Launching Panel was organized by the BBL and consisted first of representatives of all the associate contractors active in the program. Later it included officers of the Navy who had operational as well as engineering responsibilities and subsequently contained representatives from nearly all the contractors engaged in missile development for all the services. In fact, invitations to the meetings of the Launching Panel, which were held at industrial and Navy sites all over the country, were eagerly sought. Beck Kvist organized the meetings to provide the technical programs laid out by Dr. Kossiakoff and his successors. The technical fare provided was broad in scope, rich in detail, and authentic in content. Furthermore, Kvist always saw to it that the evening sessions enabled the delegates to relax thoroughly in an atmosphere of delightful *gemütlichkeit*.

Dr. Kossiakoff's work at that time became well recognized in the United States. He was chairman from 1948 to 1951 of a Panel on Launching and Handling (of Missiles), an arm of the Research and Development Board of the DoD, and from 1954 to 1960 he served the government on the DoD Technical Advisory Panel on Aeronautics.

The success of the BBL at APL and of the Hercules Powder Company at ABL in fabricating large single-grain solid fuel rockets led to the development of a booster and

a single-grain sustainer motor for the test vehicle used by the Laboratory to explore the behavior of prototype guidance and control systems at supersonic speeds. As a result of successful flight tests of this vehicle (STV-3), the Navy expressed the strong opinion that the STV-3 was so much like a guided missile that perhaps the Laboratory could make the modifications needed to convert it into a short-range, rocket launched, rocket propelled, tactical guided missile. APL undertook to do so, with the help of the industrial contractors, Convair in San Diego and Bendix-Pacific in North Hollywood, California.

Early in the pilot production phases of Terrier, Kossy began to question the fundamental designs of Terrier and other missiles that were based on classical airplane production techniques wherein the various components were built into an airframe as convenience dictated, and quality control was mainly based on testing the complete assembly. After much discussion with Dr. Kershner, he proposed and promoted a fundamental design based on "interchangeable sectionalization," whereby each function of a missile (e.g., propulsion, roll control, receipt of information, power supplies, etc.) is built and tested as a separate package whose geometry, inputs, and outputs, expressible in exact measurable terms, are made compatible with the other functional packages. Thus quality control is assured by a series of definable tests made at the component and package level, and testing of the complete assembly with all its complications and uncertainties is reduced to a minimum. His ideas were extended and reduced to practice with outstanding success by his colleagues at APL during his sojourn in California.

In recognizing his contributions, the Navy presented Kossy with the highest honor it can give to a civilian, the Navy Distinguished Public Service Award, which read in part:

> Dr. Alexander Kossiakoff: "For his outstanding services to the Department of the Navy in the fields of scientific research and development. Dr. Kossiakoff played a predominant part in the development by The Johns Hopkins University Applied Physics Laboratory of the Terrier guided missile from an experimental test vehicle to a tactical weapon, which has been evaluated to be a significant improvement in naval air defense, and is now in service onboard fully operational units of the Fleet. His talents as a creative yet highly practical scientist, coupled with his brilliant engineering leadership, enabled the Laboratory to steer a true course through the uncharted sea of guided missile technology to bring Terrier successfully to the production phase. For his outstanding contribution to the air defense capability of the Navy, this award is approved this third day of December 1957.

When the problems encountered in the production of Terrier, Tartar (its smaller brother), and Talos (the giant of the family) were solved, the Navy, aided and abetted by the DoD, embarked on another massive production enterprise. Encouraged by the success of the Terrier installations on the USS *Boston* (CAG-l), commissioned in 1955, and the USS *Canberra* (CAG-2), commissioned in 1956, the Navy decided to fit a large number and variety of ships with Talos, Terrier, and Tartar systems. Destroyer escorts, destroyers, and frigates were built, and other ships, including light and heavy cruisers, were refitted. When the program was completed some 10 years later, there were 70 guided missile warships in the U.S. Fleet.

Drs. Gibson and Kossiakoff surveying the property that would eventually become APL's home in Howard County.

Test and evaluation of the performance of these shipborne systems soon began to uncover many discrepancies and problems, which were compounded by the heterogeneity of the equipment used for detecting and tracking targets and the launching, guidance, and control of the missiles. The Navy turned to APL for assistance, for the first time extending the Laboratory's authority for technical direction to include the whole missile system and not just the missiles. This new responsibility was regarded as a personal challenge by Dr. Kossiakoff who, in 1965, consolidated all the Laboratory's resources that bore on missile systems into the Surface Missiles Systems Department, of which he became head, and added to his already heavy duties as Associate Director of the Laboratory. Within a few years, the complex problems of shipborne missile systems were well under control. As in the days of the Convair Terrier crisis, Kossy not only focused on the overall problems of organization and leadership, but also dug down into technical details which his intuition told him might be significant. He made personal contributions to the solution of many problems, some apparently small, but all actually critical to the engineering operation of the systems.

Many of the problems that plagued the shipborne missile systems involved computer technology, and these excited in Kossy an interest in computer hardware and software that grew broader and deeper as the years went by. He had already been very active in promoting the use of digital data processing in the Typhon System, but now he decided that a more detailed knowledge of the subject was necessary if APL were to contribute innovatively to the concept and design of much-improved shipboard systems. His approach was typical of him: First learn all there is to know about the subject, then teach others so they can help, then apply the knowledge to the solution of significant practical problems, as he did in the development of the SYS-1 shipboard fire control system. To develop a grasp of the subject, he started by learning the details of computer programming and then applied his knowledge to the design of a computer program for the automatic detection and tracking of aircraft by a 3-D radar. However, his inquiring mind did not stop here—he started to look for the basic problems that added to the enormous expense and complexity of the use of computer technology in the control and operation of engineering systems. His management experience soon made him aware of a fundamental communications gap between engineers and programmers, i.e., the absence of a clear means of representing the costs of implementing engineering requirements in terms of computer time and machine capacity. In other words, no simple means existed whereby the engineer and the computer programmer could make "tradeoffs" between requirements and program expense. In two papers, "Graphical Automatic Programming" and "A Programming Language for Real Time Systems." Kossy explored the use of computer graphics and a symbolism taken from engineering circuit design to facilitate the development of an efficient system for real-time data processing by making visible to the engineer the core use and the running time of each section of the program. The general results may be expressed by his own words: "An entire computer program can be designed, documented, and managed through the use of data circuit language by the direct interaction between a systems engineer and the graphics terminal."

A related class of problems that claimed Dr. Kossiakoff's attention fell under the general heading of software management. The increasing use of digital computers in the operation of electromechanical systems such as modern weapons systems requires the preparation of many programs, which must fit together precisely at many interfaces. Since these software packages frequently came from different sources (for reasons not unrelated to politics), a difficult problem in management existed. By drawing on his long practical experience in, and understanding of, the modular design, construction, and evaluation of systems, Kossy made very significant contributions to the practice of software management, con tributions recognized in the DoD by invitations to serve as chair or member of committees organized to face the chaotic problems of supplying software for the systems under the jurisdiction of the armed services.

APL LEADERSHIP

Dr. Kossiakoff took over the Directorship of the Applied Physics Laboratory in 1969 at a time when administrative problems arising from external sources were increasing extensively and intensively. Some arose from doing business with the government, some from misunderstandings, and still others from the pressures of Congress on government agencies to exert tighter

Drs. Kossiakoff and Gibson conversing with Milton S. Eisenhower, President of The Johns Hopkins University from 1956 to 1967.

control on the expenditure of public funds, unfortunately with no understanding of the real value received from those expenditures. Contract regulators and auditors began to supersede technically oriented Navy project officers in controlling the Laboratory's resources. It required great patience and skill on Kossy's part to minimize the diversion of money and manpower from creative technical effort to mere "bookkeeping."

In the late 1960s, the DoD, influenced by Congress and following the current trend toward "neat" administrative packages and labels, put together into one category labeled "Federal Con tractResearch Centers" (FCRC) a number of research and development organizations that differed largely in sponsorship and methods of operation. I believe the National Science Foundation first used the name. Certain general regulations were applied to FCRCs as a class, one being a ceiling on funds allocated annually by the DoD to any one FCRC, regardless of the work the agencies might justifiably want the FCRC to do.

Part of the motivation behind these regulations was an attempt to slow down the rapid expansion of some of the FCRCs. Although APL had established a voluntary upper limit to the size of its staff in 1962, it was for many years classed as an FCRC and subject to this funding restriction, which was particularly distressing since the ceiling on funding was initially set lower than the going rate because of a misunderstanding in the Secretary of the Navy's Office.

Kossy devoted much effort, first to living with this problem and finally to solving it. In 1977, with the strong support of the Navy, APL was removed from the list of FCRCs. Kossy's patience, integrity, and skillful perseverance had won out. It is now generally acknowledged that APL in the future as in the past stands or falls on the importance and quality of its ideas and practical achievements, unfettered by arbitrary limitations.

Another set of problems came from a Baltimore-based group of anti-war, anti-nuclear activists, among them some students and faculty members of The Johns Hopkins University. While one could not but sympathize with the high-minded but misguided motives of many members of this group, there was a segment that had shown a tendency to promote their missionary efforts by violence. The bombing incident at the University of Wisconsin, although the work of another party, served as a warning. The Baltimore group's avowed intent was to eliminate all projects sponsored by the DoD at the Laboratory and even close down the Laboratory itself. Kossy met with the activist leaders on several occasions, patiently explaining the Laboratory's program and the methods of operation, but making it perfectly clear that APL was not about to deviate from its traditional course, especially under threats of violence. He was strongly supported by the President of the University and by the whole staff of the Laboratory. Indeed, he devoted much time and effort to providing APL buildings with passive protection from damage and particularly to avoiding clashes between members of the Laboratory staff and activist pickets, events that might have been physically disastrous to the latter.

Despite his preoccupation with these and other worrisome administrative problems, Dr. Kossiakoff devoted the major portion of his time and energy to directing and strengthening the multifaceted scientific and engineering work of the Laboratory. I have already mentioned his keen interest in modern computing techniques and their applications in the processing of information vital to naval fire control systems. The SYS-1 missile control system, developed at the Laboratory and deployed by the Navy, owes much of its success to Kossy's basic ideas for the automatic detection of relevant signals in the presence of massive background noise.

Kossy also spent a great deal of his time and thought on a critical study of the results of the Laboratory's investigations of the physics and chemistry of the oceans, particularly in areas of significance in undersea warfare. The scope of these investigations was enormous; the scientific problems complex and elusive. Solutions to these problems, and indeed the very existence of the phenomena giving rise to these problems, could only be validated by experiments at sea involving the deployment of batteries of instruments and the coordinated maneuvers of many ships. Analysis and interpretation of the results, which taxed to the utmost the resources of the Laboratory and its associate contractors, was the area to which Kossy gave greatest attention and in which the clarifying effects of his scientific mind were felt. I could cite many more examples of Kossy's personal involvement in the Laboratory's technical work, but must be content with one. His interest was excited by the potential of new and relatively inexpensive microprocessors. He encouraged the widespread use of these versatile devices throughout the Laboratory and personally promoted their applications to new objectives in education and aid to the handicapped.

On 27 June 1980, some senior members of the staff surprised Dr. Kossiakoff after he had presented the customary plaques to those retiring from the Laboratory by giving him a unique plaque marking "The completion of his tenure as Director of the Applied Physics Laboratory." The inscription bore words that I wish I had written myself, and which I quote without apology as a prelude to the conclusion of this paper:

> Serving successively as Assistant, Associate, and Deputy Director, and for the past 11 years as Director, his leadership was a major factor in establishing the Laboratory as a unique national resource. He earned the confidence and unswerving support of The Johns Hopkins University and the Navy through his unfailing integrity. He provided essential soundness and stability in difficult times, and illuminated our happy moments with good humor and good taste—always with a touch of elegance.

MOVING ON

By nature, Alexander Kossiakoff was a reserved and modest man. He did not wear his heart on his sleeve but his affections for his family, a circle of intimate friends, the Laboratory, and his adopted country were deep and enduring. He kept his own counsel; only a few of his closest friends knew what really went on in his mind. Being one who shared his thoughts for years, I can say that selfish considerations or personal gain never entered into them; they were entirely focused on how he could do an excellent and honest job in fulfilling the responsibilities he had undertaken. He never sought personal publicity and more often than not allowed the credit for his own achievements to go to others. An interesting example of his modesty was found by a group of his colleagues compiling a volume of photographs to be presented to him at the Principal Staff banquet honoring him on his retirement as Director of the Laboratory. The group had the greatest difficulty in finding photographs featuring Dr. Kossiakoff among the many thousands on file at APL, even though he had played a key role in all the Laboratory's major events for more than 30 years.

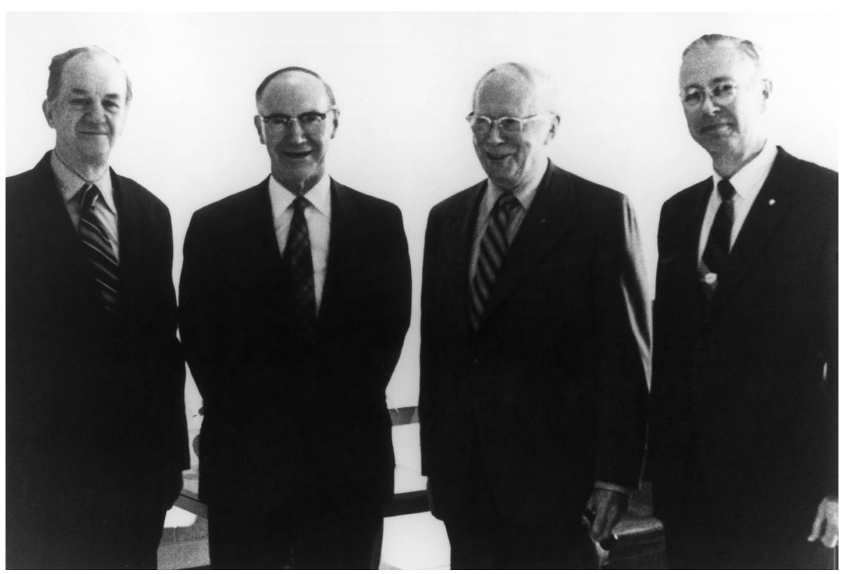
If you asked Dr. Kossiakoff what he considered to be his favorite professional activity, I think he would immediately reply, "problem solving"; he was a problem solver par excellence. He had the judgment to choose the right problems, problems that might be difficult but whose solutions would be significant; the imagination to conceive innovative solutions; the knowledge and skill to implement these concepts and obtain consensus on their validity; and the energy, will, and determination to carry them through to practical solutions. Throughout his career, he addressed problems in many fields—basic science, engineering, administration, etc.—and in all succeeded in finding sound, innovative, and frequently fundamental solutions.

However, the teacher, the man who could organize his knowledge and expound it to others in clear, precise, and interesting terms, was always dominant in Kossy's intellectual makeup, even though sometimes he wouldn't admit it. Anyone who saw him pull together on a blackboard the details of a complicated subject and arrange them in a comprehensible, aesthetic pattern could not but recognize the earmarks of the superb teacher. He knew the meaning of words and his written expositions even surpassed his spoken ones in clarity and precision. For many years, Kossy and I reviewed each other's manuscripts prior to circulation. I could always count on him to read mine carefully and critically. Seldom did mine return without a number of critical suggestions, most of which I was glad to accept since they clarified to the reader what I really meant to say. I should add that almost always he accepted my suggestions gracefully.

Dr. Kossiakoff eventually devoted more and more of his time to educational problems, to the use of microprocessors and other computing devices in assisting various specialized educational activities, and more particularly to preparing, arranging, and teaching systematic courses in the organization and management of research and development, first for the benefit of the technical staff of the Laboratory and later for wider student audiences at the University. The subject was a complicated mixture of art and science confused by a great deal of pedantic dogmatism from lecturers and writers whose experience has been limited. Kossiakoff the teacher brought to this task not only his long experience as an administrator, but also the imagination, discipline, and pragmatism of Kossiakoff the systems engineer.

Dr. Kossiakoff passed on to his successor, Dr. Carl Bostrom, an organization that had never been more vital and productive. Its relations with the University, the Navy, the DoD, NASA, NIH, and other government agencies were at an all-time high. Its tasks were challenging and its output of new ideas continues to increase. Its staff has gone on record that the Laboratory is a "darned good place" in which to work. If Kossy were inordinately proud of this legacy, who could blame him?

In his new capacity as Chief Scientist of the Laboratory, Kossy looked forward enthusiastically to new outlets for his undiminished energy, curiosity, and imagination. At least he would doubtless dig more deeply into problems in education such as I have just



Dr. Kossiakoff (right) with past Directors (from left) Drs. Merle Tuve, Lawrence Hafstad, and R. E. Gibson.

outlined, and at the same time extend his knowledge of and experience with computers in attempting to find fundamental answers to questions arising in systems engineering. Beyond this, I could not predict, but assert that whatever he did was of use to his fellows, inspired by a love of the Laboratory he did so much to build, and love of his adopted country.

ACKNOWLEDGMENTS: David Silver wishes to thank Alvin Eaton for his advice on extraction of material from Dr. Gibson's manuscript and Linda Maier-Tyler for editorial assistance. Dr. Gibson's unpublished manuscript has remained in the APL archives until now.

THE AUTHOR

Ralph E. Gibson

Ralph Edward Gibson received the B.Sc. (1922) and Ph.D. (1924) degrees in chemistry from the University of Edinburgh. He was a physical chemist at the Carnegie Institution of Washington (1924–1941) and a faculty member of The George Washington University (1929–1945). During 1944–1946, he was the first Director of Research of the Allegany Ballistics Laboratory. Dr. Gibson joined APL in 1946 as head of the Contracts Group. He became Acting Director in 1947 and Director in 1948. After his retirement in 1969, he became Director Emeritus of APL and Professor of biomedical engineering at The Johns Hopkins University School of Medicine. He published 90 papers in the fields of physical chemistry, solid propellants, missile systems R&D, space technology, and research administration. Among his many honors were the Hillebrand Prize of the Chemical Society of Washington, the President's Certificate of Merit (World War II), appointment as Honorary Commander of the Most Excellent Order of the British Empire, the DoD Medal for Distinguished Public Service, and the M.D. (*Honoris Causa*) from The Johns Hopkins University (1972). Dr. Gibson served as President of the Chemical Society of Washington, the Philosophical Society, the Washington Academy of Sciences, and the Cosmos Club. When Dr. Gibson died in 1983, Dr. Kossiakoff wrote a memorial vignette that appeared in the *Johns Hopkins APL Tech. Dig.* **4**(1), 42–44 (1983).