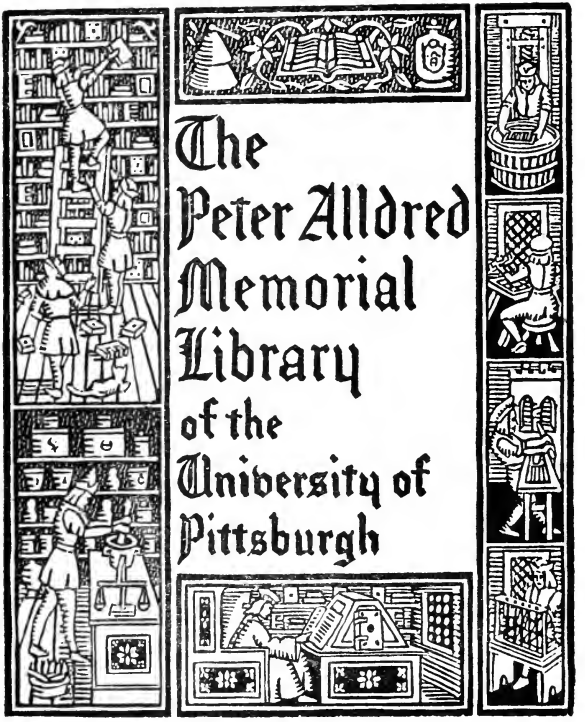
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This is the biography of a man who made his greatest contribution to science in his reorganization of the U. S. Coast Survey. Alexander Dallas Bache was appointed superintendent in 1843, and the Survey increased its scope and improved its methods in the study of winds, tides, currents and harbors under his charge.

Grandson of Benjamin Franklin, Bache was also active in education. Elected first president of Girard College when he was thirty, he visited European educational institutions in order to study their methods. And it may well be that, because of the admiration felt for his great ancestor, he was received in Europe with more attention than even his scholarship and personality merited. His survey of European educational institutions resulted in his monumental "Report on Education in Europe," which exerted a profound influence on educational methods in the United States.

At heart, however, Bache was primarily a scientist, and he became a significant figure in the development of American scientific institutions in general, and of Philadelphia in particular. An indefatigable worker, he also served as Superintendent of Weights and Measures of the United States, as a member of the Lighthouse Board, a regent of the Smithsonian Institution, and Secretary of the American Philosophical Society.

PENNSYLVANIA LIVES

ALEXANDER DALLAS BACHE

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ALEXANDER DALLAS BACHE

ALEXANDER DALLAS BACHE

Scientist and Educator

1806–1867

By

MERLE M. ODGERS

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FOREWORD

ALEXANDER DALLAS BACHE, great-grandson of Benjamin Franklin and grandson of Alexander J. Dallas, Secretary of the Treasury under Madison, began life during a challenging period in the history of our country. Although we had already passed what John Fiske has termed "the critical period in American history," grave political problems still faced the young nation. It was a period of growth coupled with uncertainty, and whether we were to remain strong and indivisible was not to be determined until several decades later. It was important for the Nation's survival that wise leaders emerge to direct the political future of the country; it was equally important that men of vision and strong personality emerge to guide the scientific thought of the Nation. Alexander Dallas Bache was one of those individuals who met that challenge.

During his lifetime Bache held many responsibilities, any one of which might have been considered the successful culmination of a life's work and ambition. His rise to positions of prominence in the fields of education and science was meteoric. As a West Point cadet he distinguished himself by his scholastic excellence, graduating at the head of his class at the age of nineteen. At twenty-two he was named to the faculty of the University of Pennsylvania as Professor of Natural Philosophy and Chemistry. In addition to his eight years at the University, his service to American education included the presidency of two of our foremost schools, Girard College and the Central High School of Philadelphia; the general superintendency of a city school system; and the publication of a monumental work on European education resulting from two years of intensive study abroad.

Bache began his career in Philadelphia, the then intellectual-scientific center of the country, and during much of his active career he lived in the Nation's capital. There he became the leading exponent of science, and associated with him were such leaders as George Davidson and James Lawson, who were his pupils; and Joseph Henry, Benjamin Gould, Julius Hilgard,

Benjamin Peirce, Henry Mitchell, and Louis Agassiz. Bache's interest in science on a broad national basis was exemplified by his activity in the establishment of the Smithsonian Institution, of which he was a Regent, and in the founding of the National Academy of Sciences, of which he was the first President.

Bache attained preëminence while serving as Superintendent of the United States Coast Survey, to which position he had been appointed in 1843. The selection of Professor Bache for this scientific and technical post was a tribute to the high esteem in which he was held at the time.

The gain to the country in his appointment, and particularly to the Survey, could be fully measured only in retrospect. Bache possessed by nature those qualities most conducive to success in the management of widely extended public interests. An orderly and scientific mind, combined with administrative ability of a high order, enabled him to cope successfully with the many organizational problems that faced his administration.

In original concept the plan for the survey of the coast was Hassler's, but Bache gave it form and direction. Under Bache's careful guidance and sympathetic understanding, the Coast Survey not only kept pace with the progress of art and science, but made many notable and original contributions in the fields of astronomy, geodesy, terrestrial magnetism, and physical hydrography.

Alexander Dallas Bache emerges as one of the great personalities of nineteenth-century America. Science and education have been enriched as a result of his impact on them. His life has become a part of our history. In this exhaustive research into early records and original papers, the author has given us the means for an understanding of that life.

LEO OTIS COLBERT

U.S. Coast and Geodetic Survey
Washington, D.C.
June 1947

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I

FRANKLIN'S MOST FAMOUS SCION

LIKE most of us, Benjamin Franklin did not care for salt on his strawberries. During the Revolutionary War, while Franklin was in France, his daughter Sarah wrote to him that she desired some clothes, and said that she would have great pride in wearing anything he thought was in good taste. Franklin replied that her longing exhibited a lack of patriotism and said that it

> . . . disgusted me as much as if you had put salt on my strawberries. . . . When I began to read your account of the high price of goods . . . I expected you would conclude with telling me, that everybody as well as yourself was grown frugal and industrious; and I could scarce believe my eyes, in reading forward, that there never was so much pleasure and dressing going on; and that you yourself wanted black pins and feathers from France, to appear, I suppose, in the mode! . . . The high taxes which are necessary to support the war may make our frugality necessary and, as I am always preaching that doctrine, I cannot, in conscience or in decency encourage the contrary by my example, in furnishing my children with foolish modes and luxuries.

But Sarah was no longer a youngster. She was thirty-four and she had been married to Richard Bache, a Yorkshireman, for eleven years. Nor was she unpatriotic; her work for the revolutionary cause was, in fact, outstanding. Her father, on the business of the colonies in France, might criticize her, but the Marquis de Chastelleux, who visited Philadelphia, wrote of her:

> If there are ladies in Europe who need a model of attachment to domestic duties and love to their country, Mrs. Bache may be pointed out to them as such. Simple in her manners, like her respectable father, she possesses his benevolence. She conducted us into a room filled with work, lately finished by the ladies of Philadelphia. The ladies bought the linen and made it into shirts

for the soldiers of Pennsylvania. On each shirt was the name of the married or unmarried lady who made it, and they amounted to twenty-two hundred.

It was no small task to supervise a large group of volunteer women workers in the period of the Revolution. Poorly clad men were grateful for such assistance. So were the soldiers in hospitals whose wounds she dressed and whose medicines she administered. Sally, as she was called, had been well brought up. Her mother, Deborah Franklin, a plain, sensible woman, who called Benjamin "Pappy," had instructed her in housekeeping and cookery. Sally's father had taught her to play the harmonica and had interested himself in her early efforts at sewing and buttonhole-making. Both had given her good health, good nature, and good sense. Watson's *Annals of Philadelphia,* a classic of a century ago, has the droll comment:

Franklin and his daughter Mrs. Bache were both very remarkable for their very large exhibition of the organ of "philoprogenitiveness"—or bumps upon the back of the head. In Franklin's time, when people spoke of it, they said it was a mark of wisdom; but now it goes for love of children, of which Dr. Franklin gave sufficient proofs in his care of his natural children.

Had her mother permitted, Sally would have been taken to Europe by her father instead of being left in Philadelphia to meet the man with whom she was to fall very much in love. Richard Bache, several years her senior, was the eighteenth child of William Bache, a collector of excise at the town of Settle, in the West Riding of Yorkshire, England. After coming as a young man to Philadelphia, he had acted as an agent in the underwriting of vessels and cargoes of his brother, Theophylact, who had preceded him as an immigrant. Theophylact was to be a loyalist during the Revolution, and was finally to attain the honor of reposing in a tomb in Trinity Churchyard next to that of Alexander Hamilton.

Sally and her mother had lost the head of their family even though affectionate letters were still exchanged and Pennsyl-

vania cakes and nuts were sent abroad in return for the Kashmir shawls, the Lyon silks, and the porcelains that they received. As a man of affairs and as a philosopher, Benjamin had stepped out of their world, for he spent only two of the eighteen years from 1757 to 1775 in America. His son-in-law, Richard Bache, was a business man, though not strikingly successful, and he stayed in Philadelphia. "Without needing to eat it, he resembled Franklin after a good dinner," says Bernard Faÿ. "He was a stout fellow, friendly and jovial, with nothing of a great man about him. He had a big mouth and a capacious smile, and he was given to making coarse jokes. He was a simple-minded man. You could depend on him." He was to Deborah's liking.

When Sally Franklin married Richard in November 1767, the vessels in the harbor ran up their flags in tribute to her absent father. Later Richard visited Franklin in England, ate and drank with him, and came home with three hundred pounds which his father-in-law had lent him. When Franklin resigned his position of Postmaster-General, he arranged to have Richard succeed him. Richard held this position from 1776 to 1782 with headquarters in Philadelphia. His salary, approximately a thousand dollars a year, was paid for administering a system that provided a change of riders every twenty-five miles. At the beginning of the Revolution Richard parted political company with his loyalist brother Theophylact and became President of the Republican Society of Philadelphia. We also encounter his name as a Commissioner of Bankruptcy for the Commonwealth of Pennsylvania in 1790.

Grandmother Sally Franklin Bache died in 1808 when Alexander Dallas Bache was only two years old. Her husband, Richard, died three years later. They left seven children. An eighth had died in infancy. The first-born of the seven was Benjamin Franklin Bache, whose education in France and Geneva was supervised by his illustrious grandfather, and whose short career has been so engagingly traced by Faÿ in *The Two Franklins*. He is best known as the first publisher and editor of the *Aurora*, a variety of journal that was yellow, to be

sure, but that has nevertheless helped to preserve our democracy. He opposed the Federalists and Washington, and the latter is reported to have remarked, "The publications in Freneau's and Bache's papers are outrages on common decency." Stephen Girard's correspondent in Baltimore had written him of Bache's paper: "Nous soupçonnons, que le gouvernement craint plus la libre circulation de cette Gazette que de toute autre." Bache had to refute Federalist charges that he was a paid agent of the French Directory, and Jefferson felt that the Sedition Bill of 1798 had been directed at Bache. In the same year he was arrested for libeling President Adams.

Benjamin Franklin Bache's newspaper was usually involved in some argument or other. Dr. William Currie had attacked Stephen Girard in connection with the latter's heroic part in the yellow fever epidemic. Girard wrote a letter to the editor of the *Aurora* replying to the attack, and Bache felt it necessary to comment upon it in a manner entirely unfavorable to Dr. Currie. It is interesting that there was this early connection between the Bache family and Stephen Girard, who founded the institution of which Alexander Dallas Bache was to be elected the first President. Benjamin Franklin Bache himself died in September 1798, as a twenty-nine-year-old victim of the yellow fever; he left four children, one of whom was Franklin Bache, later Professor of Chemistry in both the Philadelphia College of Pharmacy and the Jefferson Medical College, and co-author of Wood and Bache's *Dispensatory of the United States*.

Alexander had an uncle, Colonel Louis Bache, who commanded Marcus Hook during the War of 1812 when such posts were fortified along the Delaware River after the capture of Washington, in order to prevent the enemy from attacking Philadelphia. An aunt, Sarah, married Chief Justice Thomas Sergeant. Another aunt, Deborah, married William J. Duane, Secretary of the Treasury in Jackson's administration, and outdid her mother by having nine children. A third aunt, Eliza, was the mother of Admiral Allan A. Harwood.

Alexander's father, Richard Bache, was the seventh child of Franklin's daughter and her Yorkshireman husband, Richard. At twenty-one, in April 1805, he married Sophia B. Dallas, the daughter of Alexander J. Dallas, Secretary of the Treasury under Madison. Sophia Dallas' brother, George M. Dallas, was to distinguish himself as Vice-President of the United States in Polk's administration and later as minister to the Court of St. James's. The maternal grandfather, for whom Alexander Dallas Bache was named, served as Secretary of the Treasury from October 1814 to November 1816 during a troublesome financial period, and performed a notable service. The Coast Survey of the United States, which his grandson was to develop, was started as a division of the Treasury Department under Alexander J. Dallas' direction.

Sophia Dallas Bache and the younger Richard had nine children, of whom Alexander was the oldest. In her biography of Jefferson Davis, who was a devoted friend of Bache, Mrs. Jefferson Davis refers to the Bache family and to Alexander's eight brothers and sisters:

> The whole family of Baches were brilliant, well-educated, and thoroughly pleasant people. They had little of poor Richard's thrift, but much of their grandfather's shrewd wit and wisdom. . . . Mrs. Bache had many sons and daughters, who played more or less brilliant *rôles* in governmental society. Dallas Bache, of the Coast Survey, in his day one of the greatest savants the country had produced; George Bache, a brilliant naval officer, who gallantly gave up his life to save the passengers on his sinking ship, and with a sad smile took off his cap and bowed to them as his ship went down before the overladen boats; Richard Bache, also an officer of the Navy, drowned while making a survey of the coast; Mrs. Robert J. Walker, the wife of the Secretary of the Treasury and whilom Senator from Mississippi; Mrs. Irwin, wife of the former Minister to Sweden; Mrs. William H. Emory, whose husband was afterward a General in the United States Army, and who was herself a well-known wit; Mrs. Charles Abert; Mrs. Richard Wainright of the Navy, and Mrs. Allen McLane, a woman of marvelous wit, and strong, bright understanding.

Sophia Dallas' husband, Richard Bache, had to some extent followed in the footsteps of his distinguished grandfather and less distinguished father. Like both of them he was interested in the government mail service, and he became Postmaster of Philadelphia. He served in such public capacities as chairman in 1814 of the city committee of his "Democratic Fellow Citizens" to celebrate the Fourth of July with a big parade, exercises, and a dinner. His was a good name on a committee list. For example, he was one of a group to receive subscriptions and donations for the erection of a new Masonic hall.

But like his grandfather, Richard became a rover and left his family behind him in Philadelphia. His business affairs, unlike those of his grandfather, may not have been entirely successful. In 1818 he was refused a loan by Stephen Girard who found, "owing to the great application for money that it is not in my power to comply with your request." Whatever the circumstances may have been that caused him to leave his birthplace and his wife and nine children, he found another home in Texas, where he again became interested in public affairs about the time of the annexation of the Lone Star Republic by the United States. Though he was not, as has sometimes been stated, the only person in the Senate of Texas to vote against annexation and was, in fact, not even a member of that body at the time, he probably had little affection for his former home. There is no reason to think that Alexander ever saw his father after the latter left Philadelphia.

After the Congressional resolution passed in February 1845 had offered annexation to Texas, both Texas houses voted acceptance unanimously on June 23. On Independence Day "the convention called for the purpose met and passed an ordinance to that effect." The same historian of Texas records: "It is said that Richard Bache, a grandson of Benjamin Franklin, who was a delegate from Galveston, voted against the ordinance, but his name appears in the list of those who signed it."

There is a story that Alexander's father was an officer in Sam Houston's army at the battle of San Jacinto, and that when

Santa Anna was defeated the Mexican general, fearing for his life because of the intense hatred of which he knew himself to be the object, asked that his captors give him a guard of fellow Masons. Bache, according to the story, was appointed one of the guard. Like Franklin, Richard had aided in the building of a new republic.

Alexander Dallas Bache was born on July 19, 1806, in the Philadelphia home of the family at 74 Walnut Street. One can imagine that it was his mother rather than his father who kept the family together even in its early years and trained Alexander and his eight younger brothers and sisters in the way they should go. The Dallas family had had its share of administrators, and the mother of this large brood was a practical manager. Alexander, or Dallas, as his companions called him, felt the weight of responsibility as the oldest of the nine. In 1851, when a sister died, this childless man in his forties wrote to his friend Deloutte: "My sister was like a child to me. . . . My faith in the goodness of God is not shaken by his dispensations but human nature is weak and we must writhe in our sufferings." For his mother he had the tenderest feelings. When he was in Europe he welcomed letters from her; any account of her unhappiness affected him deeply. One of her letters, he wrote, contained "so much bad news that I came very near to feeling home-sick."

Alexander was by nature a shy, sober boy. His well-recognized sense of humor and his conviviality developed later. In his journal he tells us how an early friend one evening told his wife "a ridiculous story about my gravity at dancing school, and in quite a funny way: it was true to boot."

He was educated at a classical school in Philadelphia, probably Clermont Academy or Seminary, a school near Frankford. In an address before the alumni organization of the Central High School of Philadelphia in 1859, Bache refers to the fact that he had brought his "beloved preceptor," John Sanderson, to the faculty of that school. It would appear that Sanderson's only teaching positions were at Clermont and at the Central

High School, which was not in existence in Bache's boyhood. When Sanderson married the daughter of John T. Carré, the principal of Clermont, he became a partner in directing the school.

Sanderson was an ardent classicist. In 1826 he published "Remarks on the Plan of a College to Exclude the Latin and Greek Languages," upholding the cause of the classics. After Stephen Girard's death he advocated the teaching of Latin and Greek in Girard College in spite of Girard's mild condemnation of them. Bache did not agree with him, but when he wished to secure for the new school the services of a teacher with enthusiasm for his field, he turned to Sanderson. The latter already had a considerable reputation for his *Biography of the Signers of the Declaration of Independence*, a seven-volume work in which he collaborated with his brother, and for his *Sketches in Paris* and *The American in London*. Bache's "beloved preceptor" died in 1844. He doubtless trained Bache well in the classical subjects which his later scientific interests made him feel he could not wholeheartedly support. Bache's good diction was developed by Sanderson, however, and Bache did not forget it. Another young man who profited by Sanderson's instruction was Bache's lifelong friend, Frederick Fraley.

When Bache completed his earlier education in 1821 at the age of fifteen, he was certainly more mature intellectually than most boys of his time or our own. His was a great heritage. He was a great-grandson of one of America's greatest citizens, an unusual man who had been interested in starting a revolution at the age of seventy. Bache was to become that citizen's most distinguished descendant, to exhibit something of his versatility, and to furnish the professional complement to Franklin's amateur interest in science. Sally Franklin, his grandmother, and the Bache family into which she married were sturdy, vigorous people who loved movement and outdoor life. The Dallas family of his mother exhibited leadership and executive capacity.

There was nothing stodgy about such a heritage, nothing

that made Bache resemble some other Philadelphians who constituted, as some later wit phrased it, "Philadelphia's unburied dead." Bache himself seemed to recognize a Philadelphia type, at least among his older contemporaries. In 1854, on writing to Deloutte concerning some difficulties that Bishop Alonzo Potter was experiencing with the Faculty and his fellow Trustees of the University of Pennsylvania in connection with his plan to establish there the first graduate school in the United States, Bache said: "Indeed the Trustees are of the old Philad. stamp & the Bishop of the new New York, & he has not probably studied them as deeply as he has some other things & some other men." Bache always thought of Philadelphia as his real home, although his residence was in Washington for almost half of his life. But in his own mind he was not "of the old Philad. stamp."

II

WEST POINT AND THE ARMY

MANY of Alexander Dallas Bache's paternal and maternal relatives had served their country in some capacity. It was perhaps natural that his mother thought of his becoming a cadet by entering the United States Military Academy, which was only nineteen years old when he entered it in 1821.

The boy himself was only fifteen at admission. It was a day when youngsters were matriculated in higher institutions of learning at an age at which their descendants of the present time have scarcely entered secondary schools. Indeed, Bache was not quite fifteen when he was appointed to the Academy, and he is said to have been the youngest student on its rolls.

One can imagine the concern that must have been felt by Bache's solicitous mother back in Philadelphia when this mere child entered Sylvanus Thayer's great training school that already had a reputation for high standards and insistence upon manly effort, hardihood, and self-mastery. As a small boy Bache had been quiet and sober, but quick-tempered. Even in later years, when he was known for his gentleness and even temper, he sometimes displayed fits of anger which, as a friend writes, "might have surprised those who only knew him in his usual state of calm deportment. These ebullitions were, however, of rare occurrence, and always of short duration."

Mrs. Bache used her pen during Dallas' four years at the Academy to continue the quiet but effective influence that she had exerted upon him while he was under her wing. One of his contemporaries who was permitted to read her letters written to him during these formative years says that "nothing could be more admirable than the way in which, amid pleasant gossip and family news, she would inspire her son with high sentiments and encourage him to persevering industry."

The mother possessed the secret of inculcating self-discipline,

and from his earliest days Bache gave ready response to her instruction and guidance. Self-control became his outstanding trait. At the same time he developed a heart and a sense of responsibility. Throughout his course he was aware that, as the eldest of his family, he would probably have to provide for his mother and his younger brothers and sisters. His mother and his own judgment impressed him with the obligation he was under for his education at the Academy. He felt that he must exert his best efforts there in return for the opportunity. Perhaps he felt that a special responsibility rested upon him as a descendant of Franklin, for there are those who know that wealth of background or pocket confers the necessity of observing the principle of *noblesse oblige* rather than seizing upon special privilege.

Yet Bache was no seraph. Benjamin Apthorp Gould and others are mistaken in recording that during his whole course at the Academy Bache "never incurred a single mark of demerit." Gould hastens to add: "And this is all the more to his credit, in that he was no demure and prematurely sedate youth, but possessed, in an eminent degree, that love of frolic and of jest which formed a prominent trait of his character in riper years." As a matter of fact, Bache was not free from penalty and actually incurred four demerits. The Academy building that contained most of its records and those of the Garrison of West Point, including the revolutionary papers, was burned in 1838. Bache's academic record is therefore lost, but there still exists the "conduct book" in which were entered "reports" against the conduct of cadets. It contains four reports against the Philadelphia cadet for minor neglects of duty, such as being "late at tattoo." "Bad police," which is recorded against Bache, probably meant that his room was not well cleaned.

Some years later, when he visited Heriot's Hospital, an endowed school for fatherless boys in Edinburgh, he criticized the fact that its boys did none of the menial work of the school and that servants made beds, shined shoes, brushed clothes, and cleaned the dormitories. He said:

In the only government school of our country, the Military Academy at West Point, where youths are received, whose parents are in all the various circumstances of life, an opposite plan is pursued in regard to the duties of the house and personal police; and I have reason to know, from personal experience and an extensive acquaintance with its graduates, that the independent habits thus produced are retained by many as among the most convenient results of their early training.

When he visited the Bruce Castle School at Tottenham, certain features of the school reminded him of West Point, and he commented on what must have aided in the formation of his own character.

Regularity is insured by aiming at exact punctuality. Each exercise of the school has its appointed time, and rigid conformity to this is required, without which time is lost both to the tardy pupil himself, and, through his negligence, to others. It is not uncommon in schools to allow deviation from exactness in the ringing of the bell, or other signals for exercise, but the effect is fatal to habits of punctuality. It appears to me, from observation, that the happiest results are produced by this rule, which requires the pupil to be in a particular place at a precise second, and that it is greatly preferable to that which allows a latitude of several minutes.

Bache distinguished himself as a student at West Point. In a class that started with sixty-five members and ended with thirty-six, he stood first during each of his four years and was graduated as its leader, though its youngest member. The records also show that he acted as Assistant Professor of Mathematics (Assistant in Mathematics in modern academic parlance) in his second class or junior year, and as Assistant Professor of Chemistry in his first class or senior year.

He must have surprised many of his teachers at the Academy by his application. Even as a boy he did not overestimate his own ability. He told his friend, Joseph Henry, concerning his entrance at West Point: "I knew that I had nothing like genius, but I thought I was capable by hard study of accomplishing something." It is uncertain whether or not Bache himself told Henry of his extraordinary study methods, but Henry says:

As an illustration of his persistency of purpose, it is related that, when a recitation of more than common length or difficulty was to be prepared for the morrow, it was no unusual practice of his to place himself on a seat of unstable equilibrium, which by giving way when volition was about to lose its power recalled his flagging attention to the allotted task.

We should be tempted by Henry's account to think Bache a "grind" and a "sissy" if we did not know of the respect that he commanded even in his youth, for Henry describes him as a paragon of academic virtue aided by his fellows to attain angelic heights:

[His] classmates, with instinctive deference to his scrupulous sense of propriety, forbore to solicit his participation in any amusement which in the slightest degree conflicted with the rules of the Academy. So far from this, they commended his course, and took pride to themselves, as members of his class, in his reputation for high standing and exemplary conduct. His room-mate, older by several years than he was, and by no means noted for regularity or studious habits, constituted himself, as it were, his guardian, and sedulously excluded all visitors or other interruptions to study during the prescribed hours. For this self-imposed service, gravely rendered as essential to the honor of the class, he was accustomed jocularly to claim immunity for his own delinquencies or shortcomings. But whatever protection others might require on account of youth and inexperience, young Bache needed no guardian to keep him in the line of duty.

Bache's was no ordinary West Point class. Two of its members were General Robert Anderson, of Fort Sumter, and Major General C. F. Smith, whose name is also associated with the Civil War. That the staff of the Academy recognized the ability of Bache and his group is indicated by the fact that four of the graduates were assigned to the engineer corps at a time when only one or two members of a class usually received this honor.

On July 1, 1825, when her son, still nineteen days from his nineteenth birthday, graduated from West Point at the head of his class, Mrs. Bache must have been a proud mother, and she must have felt that here was a young Philadelphian worthy

of distinguished forbears. Perhaps it was the memory of this lineage, as much as the recognition of rare ability, that led the Secretary of War, who sat in at young Bache's final examination, to write to his mother after the examination results became known in June. His letter is florid and rhetorical and characteristic of the period:

West Point, June 10th, 1825

My Dear Madam:—Upon any other occasion than the subject of the present letter, I should be obliged to admit that our very small acquaintance would rebuke me for addressing you. But, being a father, and knowing how exquisite is the pleasure arising from the well-doing of children, I am quite sure, from your amiable disposition, that you will forgive me, when you learn that my only purpose in writing is to state, as I do most sincerely, how greatly I was gratified at the evidences given by your son in his examination, of the excellence of his attainments. He ought to be, as I am sure he will be, a source of the greatest consolation. I know not whether it has been your lot to have your cup of life drugged in any degree with calamity. The draught must have been severe indeed if it is not sweetened by the blessing of your excellent son. I knew and loved your father —his great paternal ancestor I knew only by his works. I thought, or permitted myself to believe, that I saw the excellences of both branches about to be united in your son. I offer you my sincere congratulations.

Mrs. Sophia Bache James Barbour

Gould reminds us that Mrs. Bache's "cup of life was indeed bitterly drugged with calamity" and that her son's "accession to each successive place of influence or authority, did most effectively sweeten it, and cause it to run over with gladness."

In his recent book on the West Point tradition in American Life, *Where They Have Trod*, Colonel R. Ernest Dupuy recounts the great influence of the Academy on education and, among others, mentions Bache as well as Albert T. Bledsoe, '30, a distinguished mathematician; Benjamin S. Ewell, '32, the President of William and Mary College; James Clark, '29, the Jesuit mathematician, who became President of Gonzaga after teaching in Mount St. Mary's, Georgetown, and Holy Cross;

and Roswell Park, the head of the class of '31, who filled the same chair as Bache at the University of Pennsylvania and later became President of Racine. The Academy exerted a special influence in science. Henry Adams says that in West Point the federal government projected "the first systematic study of science in the United States." The first civilian scientific school, Rensselaer Polytechnic School, was not organized until 1824. When other engineering and technical schools were established later, they drew upon the West Point graduates of an earlier day to fill some of their important posts.

Bache himself recognized the influence of his alma mater upon other educational institutions. In 1856 he told an audience:

> . . . our National School at West Point has, by thorough training of its graduates in a course of exact science, caused a reaction upon the Colleges quite as useful in its results, as the direct influence of the institution in its more limited sphere. It has also, by its action on the popular will, raised up for itself a competitor in the Naval Academy, which will, in time, vie with the elder institution in its good work.

Moreover, Bache knew how he had been benefited by his work at the Academy. In Europe he met some men who had been trained in a very different manner and showed the effects of home education. Referring to one such scholar he wrote in his journal: "He was brought up privately & has never been at a public place of education for either classics or maths., while my West Point career produced the opposite effect."

Like so many young men of outstanding academic ability, Bache remained at his college after graduation. He stayed on for a year in the capacity of assistant to Professor Mahan in the Department of Engineering. Doubtless this year was valuable to him, for it introduced him to regular practice in teaching and to the formal aspects of education in which he was to make one of his careers. It also gave him another year of maturity before he threw himself into active army life.

A year after his graduation Lieutenant Bache was assigned to

Newport, Rhode Island, to assist Colonel J. G. Totten, who was in charge of the construction of Fort Adams. While at Newport Bache studied physics and chemistry, contributed to the *Mathematical Journal*, read both broadly and avariciously, and, as a recreation comparable to stamp-collecting, he gathered and labeled the shells of the region. Totten must have had a strong influence upon him, especially because of his scientific interests. A friendship began at Newport which came to its fruition in Washington when as General Totten, in charge of the Engineer Corps of the Army, and as Professor Bache, the Superintendent of the Coast Survey, the two men became intimates and scientific leaders at the seat of government. Under Totten the two years at Newport completed the ripening process of the post-graduate year at West Point.

What years they must have been for him! Much later, after he had spent an evening with some Irish army officers, he wrote in his journal: "The kind of fellowship existing among these officers quite reminded me of days 'long since vanished'!" They were years of growth; years to let his physical self and his social self catch up with his remarkable mind; years not too busily filled, in which he could browse in the West Point library or take out what books he wished. Records are still available to show what he read in his last student year and in his years as an officer and instructor. The open-shelf system was used in Bache's time, as at present, so that we do not know what books he used without withdrawing them, but among those he took out in his last year at the Academy and in the three subsequent years were several volumes of Voltaire, several volumes of Molière, two volumes of Hume's *England*, *Lettres de Mme. de Sévigné*, a volume of Montesquieu, several volumes on ancient history by Rollin, seven volumes of *Mémorial du Génie*, Gardener's *Anecdotes*, Landmann's *Field Engineer Vade Mecum* and his treatise on mines, two volumes on what was then modern Europe, two volumes of a work entitled *View of the World*, Fulton on canal navigation, a book on carpentry borrowed

twice, and a book entitled *Construction des ponts* borrowed three times.

Young army officers face the problem of how to discharge the social obligations that their position forces upon them. At Newport Bache met Miss Nancy Clarke Fowler, the daughter of one of its first citizens, and there opened before him a vision of what she might mean to him as a helpmate and companion, sharing his travels, preparing his manuscripts for publication, and, by her devotion and encouragement and capacity for making friends, increasing his opportunities for advancement and usefulness. The prospect of matrimony dismayed him when he thought of the limitations of a lieutenant's pay and of the provision that he must make for his mother and her children in Philadelphia.

One does not usually think of a college professorship as in any sense a bonanza. Yet to Bache the offer of such a professorship made all things possible. When he assumed his professorship at the University of Pennsylvania in October 1828, he was only twenty-two years of age; but he had entered and had left an honorable profession, he had taught a year, he had had two years of field experience, and he had begun his career as a researcher. On the strength of his new position he married.

III

A PROFESSORSHIP AT TWENTY-TWO

ALMOST a century before Bache became identified with it, the University of Pennsylvania had been founded, in part, by his great-grandfather, Benjamin Franklin. Circumstances had taken the boy to West Point and not to the University for his higher education, but other circumstances were to bring him home to Philadelphia and to his ancestor's institution.

The University possessed proud traditions but it had not fared well. Its greatness was still in the future, and Bache was one of those who were to build it. From 1791 to 1828 the institution suffered from what Professor Edward P. Cheyney in his authoritative history of the University calls "four decades of trouble." Income was poor, enrollment low, and discipline intolerable. Other American colleges and universities had similar difficulties. Cheyney says: "The early decades of the nineteenth century were a time of low water in academic life in America." The behavior of undergraduates was particularly bad.

Characteristic of the struggles between faculties and boards of control in our colleges over their problems were the appeal of the Faculty of the University of Pennsylvania to the Trustees for help in maintaining discipline and the answer that the Trustees gave it. The latter were convinced that the Provost and Professors were inadequate to their tasks, and they decided to reorganize the Faculty by dismissing everyone and appointing a committee to select a new staff. It was not a sweeping change, since the Faculty was small. The Provost, one professor, and the only tutor failed of reëlection. A recently elected professor was reëlected and became Vice-Provost. Vice-Provost Robert M. Patterson, who could have been reëlected, had already accepted a professorship in the University of Virginia. When Henry Vethake, an instructor at Dickinson College, declined the invitation to take Patterson's chair, the com-

mittee turned to a younger man. Indeed at the time Bache was younger than many college seniors today. It is interesting to note that Vethake later became a colleague of Bache by accepting the professorship in mathematics at the University. He served it as Vice-Provost from 1845 to 1854, and as Provost from 1854 to 1859.

A Scot named William Smith had come to the institution to teach "Logick, Rhetorick, Ethicks and Natural Philosophy" in May 1754, the year before a new charter made it the "College, Academy and Charitable School of Philadelphia in the Province of Pennsylvania." He is remembered as Provost Smith, the first of the name. It is likely that his teaching of natural philosophy, that is, physics, was confined to a period of a few weeks each spring. "Provost Smith," says Cheyney, "had no mean powers as a showman, and from the very beginning of his administration he took every occasion possible to exhibit to the admiring citizens of Philadelphia and visitors to the city the abilities of his students in oratory, debating, plays, and other means of entertaining an audience." He also placed himself before the public, even as a poet. But for neither his students nor himself was natural philosophy a medium in his early efforts at public relations. Yet he loved the subject, and his lectures in it were given even to America's first medical school students. His successor, Provost John Ewing, became Professor of Natural and Experimental Philosophy. His lectures in this field were published after his death under the title *Plain Elementary and Practical System of Natural Experimental Philosophy*. Like Provost Smith and many of their academic contemporaries, Provost Ewing was a polymath and, in addition to natural philosophy, he taught chemistry, natural history, agriculture, astronomy, and engineering. Thus the first and second provosts of the University of Pennsylvania had made Bache's subject one of their chief interests. They had established it in the institution as a subject of importance and had given prestige to the chair.

Bache was elected Professor of Natural Philosophy and

Chemistry by the University Trustees on September 16, 1828, and three days later he received his notification from Nicholas Biddle, the chairman of the Committee that was reorganizing the staff. His reply to Biddle is written in a more legible hand than his busy and more hurried later years permitted, many of his letters being almost undecipherable:

Newport, R.I., Sept. 19, 1828

DEAR SIR.

I have the honour to acknowledge the receipt of your letter of the 18th Sept, informing me of my election to the Professorship of Nat. Philosophy & Chemistry in the University of Penn. In accepting the appointment I cannot but express my sense of the high honour conferred upon me by the Trustees of the University of Pennsylvania, and my full determination to endeavour to merit their confidence.

The desire of the Board, as signified by you, that I should commence the duties of the Professorship as soon as possible, will govern my arrangements. I expect to be able to reach Philadelphia in the course of the second week of October, and trust that this delay requisite previous to my change of station will not be deemed unreasonable. For your personal interest in my affairs you have my warm thanks, the pleasure of receiving acceptable information is heightened by having a kind friend the channel of communication.

Respectfully,
Your Obt. serv't
ALEX. D. BACHE
Lt. Corps Engr.

N. BIDDLE, ESQ.
Chrm'n Committee of Nominations
University of Pennsylvania

The young professor worked fast. He obtained a six months' leave of absence from the army, made Nancy Fowler his bride, left Newport with her, and arrived in Philadelphia on October 11 to take up his University duties. In the spring of the following year, 1829, at the expiration of his leave, he resigned his army commission. He had found himself completely at home in academic life.

Things were moving for him. He was married and he was

near his mother, brothers, and sisters. He increased his circle of friends. He enjoyed his teaching and found increased opportunities for research. In April 1829 he was elected a member of the American Philosophical Society and the following month a member of the Franklin Institute. The first had been founded by his great-grandfather, the second had received his name. Both provided their new twenty-two-year-old member with stimulation for scientific research and the give and take of intellectual discussion. Moreover, the University itself was planning to erect a new building for its College at Ninth and Market Streets to replace the Fourth Street building.

Natural philosophy, as distinguished from moral philosophy, comprised the physical sciences. This Bache taught to sophomores, juniors, and seniors of sixteen to nineteen years of age in classes of twenty to thirty each. Lectures with demonstrations were given, but laboratory work for students was not to be introduced for many decades. Yet even this demonstration teaching needed considerable apparatus. Ernest Child's *The Tools of the Chemist* tells us that the inventory of the Chemical Laboratory of the University amounted to $693.14, as indicated by Bache's receipt for the material when he took charge in 1828. It did not include the apparatus of Robert Hare in the Medical Department, but only the apparatus left in 1826 by Professor William H. Keating, who, with Samuel Vaughan Merrick, had been responsible for founding the Franklin Institute two years earlier. In the academic year 1829–30 Bache requested a grant of $250 for materials necessary to carry on his work "with vigor and activity." The Trustees felt that the young man was asking for too much, but he evidently made a good case and was voted this amount annually. In 1835, when he overspent the amount, his own pocketbook made up the deficiency. The next year he also gave the College his own collection of mineral specimens.

Bache was the kind of broadly informed scientist who is needed today to give the science survey or orientation courses that have had their day of great popularity in colleges. To

sophomores he taught the elements of natural philosophy and chemistry, to juniors mechanics, inorganic chemistry, electricity, magnetism, and electro-magnetism (Oersted and Faraday, only in the previous decade, had shown that electricity and magnetism were related phenomena), and to seniors more advanced chemistry, astronomy, the steam engine, and optics as a branch of physics. His teaching also included a review of physical science and the elements of geology and mineralogy.

For the elementary work in physics and chemistry he used an English textbook by Edward Turner published in 1827. We know that he used Gummere's *Astronomy* with his seniors. Sir David Brewster's *Treatise on Optics*, which he used with the same group, was not entirely satisfactory, though it was "from the pen of a master," and Bache published a revision of it in Philadelphia in 1833 "to correct," he modestly says, "such errors as my comparatively limited knowledge of the subject assured me, would not have been passed over by the author in a second edition." It includes an appendix of ninety-five pages written by Bache, "containing such a discussion of the subjects of Reflexion and Refraction, as might adapt the work to use in those of our colleges in which considerable extension is given to the course of Natural Philosophy," and entitled *An Elementary View of the Application of Analysis to Reflexion and Refraction.* We may view somewhat critically his use of volumes from Lardner's *Library of Useful Knowledge* for his other courses, but we ought to recall that at the time there was not the present wealth of available texts.

In view of the fact that the difficulties of the University and of other American institutions were in no small part disciplinary, it is remarkable that, as Cheyney tells us, "on the minute book there is not a complaint emanating from Professor Bache's room." This impressed his contemporaries probably more than it impresses us of a calmer period of academic life when undergraduates are no longer guilty of so much childishness, insult, and arson. Henry claims that Bache's students "regarded him with affection as well as respect, and while in other class-rooms

of the university disorder and insubordination occasionally annoyed the teachers, nothing was to be witnessed in his, but earnest attention and gentlemanly deportment." He was that rare teacher who gets genuine fun from his work and whose fervor carries over to his classes. Cheyney says: "Even his successor had trouble with his students, so it can hardly have been the fascinations of the subjects of physics, chemistry and geology that kept the students orderly. It would seem to be possible to make teaching so interesting that students will not want to misbehave." Current opinion at the Philadelphia college is summed up in Henry's statement that Bache

> . . . was a zealous and successful teacher, to whom the imparting of knowledge was a source of unalloyed and inexhaustible pleasure. His pupils could not fail to be favorably impressed by his enthusiasm and influenced by his kindness. He always manifested an interest not only in their proficiency in study, but also in their general welfare. . . . His success as an instructor affords a striking confutation of the fallacy which has not unfrequently been advocated in certain quarters, that men devoted to original research and imbued with habits of mind which it generates are not well qualified for the office of instructors.

Bache met his three classes each week-day, so that he had a schedule of eighteen teaching hours. There was a great deal of preparation for such a varied roster of courses. At the same time he carried on his private research and was one of the major participants in the affairs of the learned societies of which he was a member. When one examines his bibliography for these University years and the minutes of these societies, and reflects upon the complexity of his teaching assignments, he echoes the remark of Professor Edwin G. Conklin: "How he ever found time to do all of this important work in a 'horse and buggy era' is a constant surprise to us of the flying age." He did it, Henry says, "by a division of his time into separate periods, to each of which was allotted its special occupation. By a rigid adherence to this system he was always prompt in his engagements, was never hurried, and found time, moreover, to attend to the claims of friendship and society."

There is a current cliché that So-and-so is a good teacher because he teaches boys rather than his subject, human beings rather than subject-matter. This is a little ridiculous because the really good teacher teaches both, as Bache did. He knew his science and aided its progress with his research. He also knew his students and conveyed much of his enthusiasm to them. It is said that the Zelosophic Society at the University of Pennsylvania owed its creation to Bache, who was asked by some University students his opinion of Andrew Jackson's spoils system, about which they were arguing. He dodged the question but suggested a formal debate, and expressed his own willingness to serve as moderator. The Zelosophic grew out of this and subsequent debates. The portrait of Bache, which the Society had painted, now hangs in the office of the President of the University. One of his former students said of Bache at an alumni dinner in 1849: "No one who has the good fortune to have been a pupil of Professor Bache can forget the amiable simplicity of his character, his devotion to the cause of science, his true and loyal attachment to the University and his warm and abiding friendship."

In the fall of 1829, at the beginning of Bache's second year at the University, he was made Secretary of the Faculty. One can see him arranging the roster of classes with mathematical exactness, and writing in his small hand the many letters which today an administrative officer would dictate. There is, for example, the letter of September 18, 1835, inviting to the College commencement Governor George Wolf of Pennsylvania, an official whose friendship the University evidently wished to cultivate, for he was an ex-teacher still very much interested in education who had urged upon the legislature the changes in public education that were contained in the important School Act of 1836. Other extant letters invited other notables to commencement exercises in the old Hall of the Musical Fund Society. It was Bache's duty to keep minutes of the frequently held faculty meetings, to write communications addressed to the Board, and to keep in touch with parents. Under date of

November 30, 1829, he addressed a statement to the father or guardian of each student that is interesting to quote in part, even though it may not be entirely original with Bache, because it recalls to us some of the almost perennial difficulties of academic life:

SIR,

Your son having been admitted into the Collegiate Department of this University, it is proper that you should be made acquainted with some features of the institution to which he will be required to conform, and in regard to which your own influence and counsel may essentially aid his progress. . . .

He will be required to be punctual and regular in his attendance in the recitation rooms of the several Professors, both in the morning and in the afternoon. The college opens in the afternoon at 3 o'clock precisely.

He will be required to be diligent in preparing himself for his recitations. In case he should through indolence or defectiveness be incapable of keeping pace with his class, it will be necessary to employ a private tutor to assist him in preparing for his recitations, or he must, (in compliance with the statutes of the Board of Trustees,) be turned into a lower class, or leave the institution. Whenever such inattention or defectiveness is disclosed, you will be immediately informed of the fact.

He will be required to present written excuses, signed by his parent, (or guardian,) for all detentions from the duties or exercises of the College, immediately on his return to them. As the chain of recitation can in no case be broken without injury to the student, the Faculty trust that such absences will be restricted by you within the narrowest possible limits. . . .

Your son will be required to demean himself respectfully to the officers of the College at all times.

He will be required to abstain from injuring the buildings of the University by breaking, cutting, marking, or in any way defacing them; by a law of the Board of Trustees, parents, (or guardians,) are required to pay the expense incurred for the repairs of damage done by their sons, (or wards.)

He will be required to exhibit at all times a decorous and gentlemanly deportment while in the College or its vicinity.

The following promise has been formally subscribed by your son:—

"I solemnly promise and engage to observe all the laws and

regulations of this College, to pursue with diligence the studies assigned me, and to avoid all indecent and disorderly language and behaviour, all disrespectful conduct to the Faculty, or to any member thereof, and all combinations to resist their authority: as witness my hand."

In order that every student may be fully acquainted with the enactments of the Board of Trustees relating to the College, a copy of the laws is given him on his admission, with a second copy, which he is directed to hand to his parent, (or guardian,) for the information of the latter.

Very respectfully,
Yours,
ALEX. DALLAS BACHE,
Secretary of the Faculty of Arts.

Many of the short faculty meetings of which Bache made record were devoted to what would probably now be called "conduct cases." The Faculty was usually charitable, yet three pages of the minutes are given to a youth who made a shrill noise in Chapel that led to his dismissal from the institution. Three other pages are devoted to the problem of what students had brought eggs into the mathematics and English classrooms and whose egg had been thrown. Violators of the rules were frequently given the mild treatment of being referred to the Vice-Provost for counsel. This was the fate of Mr. Odenheimer, for example, who was "charged by the Janitor with being noisy in the entry this morning, during the Chapel exercises." This same officer had reported Messrs. Fleming and Dupont for "fighting on the premises." There had been an argument and Fleming had struck Dupont after the latter had called him, according to the minutes, "a dam fool." Disgrace was visited on both culprits. Fleming was suspended for a fortnight and the scion of the famous Delaware family, "for the use of improper language calculated to provoke a fellow student," was admonished by the presiding officer in the presence of the Faculty. It was indeed fitting that, at the beginning of the minutes of a Faculty meeting devoted to interviewing student offenders, Bache with humor that transcended the annoyances of the moment sketched in ink some very threatening storm clouds.

IV

A SCHOOL IN THE MAKING: GIRARD COLLEGE

PHILADELPHIANS have always regarded as blue ribbons memberships on boards that supervise activities of a worthwhile nature. Moreover, the better Philadelphians have always taken seriously the responsibilities that such board memberships impose. It was therefore natural that Dallas Bache, who was achieving recognition in the city in his twenties, would think of his election to the Board of Trustees of Girard College as another indication that he was getting along.

Bache had previously interested himself in civic affairs. For example, as a chemist he was naturally concerned with the current question as to the probable effect of the introduction of illuminating gas on the health and welfare of the population of the city. His friend Samuel V. Merrick, who was the leading figure in the gas study, examined gas manufactories in Great Britain, France, and Belgium in 1834 under a resolution passed by Councils in January of that year, and served as engineer in the work authorized by subsequent ordinances of Councils looking to the construction, protection, and extension of the Philadelphia Gas Works. But the appointment to the Girard College Board was the outstanding civic recognition that Bache received.

On the day after Christmas 1831, Stephen Girard died at the age of eighty-one. Though French by birth, he had become a citizen of Pennsylvania before the United States of America came into being, and he therefore boasted that he was as old a citizen of his country as any other man. In the War of 1812 he saved the credit of the nation. He was equally loyal to Philadelphia, his adopted city, where he had recklessly exposed his life through serving others in the yellow fever epidemic of 1793, and where he had built up the largest American fortune of his day in his career as mariner, merchant, and banker. In his

famous Will, planned by himself and written by a Philadelphia lawyer, William J. Duane, in such a way that it withstood Daniel Webster's attacks upon it before the United States Supreme Court, the childless humanitarian provided for the establishment of what was to become a great school for fatherless boys and the largest boarding school in the world.

It was, according to Girard's Will, to be

a permanent College . . . sufficiently spacious for the residence and accommodation of at least three hundred scholars. . . . They shall be instructed in the various branches of a sound education, comprehending reading, writing, grammar, arithmetic, geography, navigation, surveying, practical mathematics, astronomy, natural, chemical, and experimental philosophy, the French and Spanish languages . . . and such other learning and science, as the capacities of the several scholars may merit or warrant: I would have them taught facts and things, rather than words or signs: And especially I desire that, by every proper means, a pure attachment to our republican institutions, and to the sacred rights of conscience, as guaranteed by our happy constitutions, shall be formed and fostered in the minds of the scholars. . . .

In 1832 arrangements were made by the Philadelphia City Councils and the Legislature of Pennsylvania to carry out the provisions of the Will, and in February 1833 a Board of Trustees of fifteen members was elected by the Councils. It included some of Philadelphia's important citizens. Among them was the youthful Bache. Another was Nicholas Biddle, President of the Second Bank of the United States, whom the Board elected its president at its organization. Biddle had been chairman of the committee of the trustees of the University of Pennsylvania that had selected Bache for his professorship in 1828.

Biddle's influence in the city was unquestionably large, and he accomplished much for the public good. On the other hand, he was so much concerned with public affairs that whatever he touched was in danger of becoming involved in contemporary controversies and subjected to their tension. Only an act of

the Legislature in 1869 rescued Girard College from a long continuance of these difficulties by establishing the Board of Directors of City Trusts to replace the old board of control and to lift the College from that time out of what the historian of the College calls "the maelstrom of partisan politics." Nevertheless this early board strove earnestly to create the sort of first-rank school that Girard had in mind.

Immediately following Girard's death much interest was evidenced as to what was to be done with this munificent bequest. Without invitation David McClure issued in 1834 a pamphlet and later a book outlining a plan for the College. Dr. Francis Lieber, well known as a teacher and educational philosopher, happened to be living in Philadelphia at the time, and he was invited by the Board to propose a plan. In the middle of his printed report of almost three hundred pages Lieber says:

I have collected all the information I have been able to obtain in this country, and, within the proposed time, in Europe, and I have endeavored to make it serviceable to the great end before us; I have laid before you the results of my experience, and in some respects, the study of my whole life; yet even if you had made a much better choice, the necessity of a personal inspection of the most important European institutions . . . could not in my opinion, be dispensed with. . . .

Lieber fortified his suggestion of a tour with references to similar missions that had been successful. He attributed to "the enlightened spirit of the French government" such well-known French publications as "Cottu's famous work on the Judicial System of England, Dupin's excellent production on British Trade and Industry, Cousin's work on National Education in Prussia and other German States, Beaumont and Tocqueville's work on our Penitentiaries." These men had been sent "to observe with their own eyes." He continues:

There are now two English gentlemen, Mr. Crawford and Mr. Newman, sent by Lord Brougham, among us, to inquire into our Prisons; I knew here two millers, sent by the Prussian government to study the improved flour mills in the United

States. Persons have often been sent by various governments, the Russian not excepted, to inquire into the nature, organisation and operation of the *Ecole Polytechnique* in Paris; miners and engineers have frequently been sent to England and Germany—but enough of instances. I am convinced, that much valuable information might be obtained, if a gentleman, already generally acquainted with the education pursued in the institutions to be inspected, so that he knows to what points he has chiefly to direct his attention, were sent to Europe.

Perhaps it is worth noting here that this interchange of benefits between Europe and America was not one-sided. Bache's trip and the missions of other Americans to Europe were not a sign that provincial America was coming of age, throwing off its isolation, and identifying itself with world movements. Instead, Europe was looking to America as well as America to Europe. As the Provost of Trinity College, Dublin, told Bache: "You must be a model to us, not we to you."

Many a survey report and many a preliminary plan has been submitted by a writer who has either himself or one of his friends in mind as the person to do the work outlined and to accomplish the desired results. Even if we assume that Lieber did not desire to make the European survey, we must feel that he had in mind some person who was competent to make it. It would seem unlikely that that person was Bache.

I have become impressed [Lieber says] throughout the course of my labors, with the great advantage which, Gentlemen, you would derive from sending a proper and well-prepared person to Europe. . . . He ought to be well prepared for his mission, both as to a knowledge of the languages spoken in the countries to which his mission will extend, as without it he would be unable to study those details which will form a prominent object of his attention, and as to a sound knowledge of education, schools, &c. so as to be able to direct at once his attention to the most important and essential points. To learn the languages in those countries, or to *begin* a knowledge of the institutions on the spot would require too much time, and yet not lead to the desired and necessary result.

These two qualifications Bache did not possess. Bache's ac-

complishments as a linguist were not great. He indicated that he favored the modern languages over the ancient, to be sure, but his library withdrawal list at West Point includes only French books in addition to those in English. In the journal written while he was abroad Bache says that he spoke only English and French on the trip. Several French letters written by Bache are extant, but there is no evidence that he could even read German. Two years before he went to Europe Bache referred to a man whom he did not know as "probably one of those outlandish men who write in the unknown tongue—German." His later notes show that he used and referred to Sarah Austin's printed translation rather than the French original of Victor Cousin's *Report on the State of Public Instruction in Prussia*. His copy of the translation has interesting corrections in the margins. His notes on the Gymnasium at Pforta reveal that much was "abstracted from Dr. Kroger's translation of Cousin's *Journey through Germany*."

The mass of documentary material that Bache assembled contained a great deal in foreign languages, and this was translated by Theodore Trewendt, who accompanied him on at least the Teutonic part of his journey on the continent and acted as interpreter when educators whom he consulted could speak only German. Even if Bache's knowledge of French and German had been adequate, Lieber would probably have considered him unprepared for the work with only eight years of a university professorship as his experience, and that in a land which was just undergoing an educational revival. Bache's finances had not permitted a previous trip to Europe, he had not been a formal student of education, domestic or foreign, and it would surely appear to Lieber necessary for a man in Bache's position to spend much time in acquiring elementary information about the institutions to be studied.

The Board adopted Lieber's suggestions that a person be sent abroad to study education in Europe and that he bring back instruments, equipment, and books. But it acted independently in making its selection. After a three-year term as a member

of the Board, Bache, who had given the new project only the type of devoted service of which he was capable, was reëlected a trustee in February 1836, at a joint session of the Councils. When the Board decided to send a man to Europe, it concluded that it would be well to send the man who would be chosen president of the new institution, since the school would doubtless be opened soon after his return.

It is understandable that the Board turned to one of its own number who had distinguished himself in education, in research, and in the local learned societies, and who had Bache's rich Philadelphia heritage. Nor was its choice unwise. Bache's mind had hair-trigger qualities, yet it was accurate and logical in its treatment of data. His scientific attitude and caution insured a thoroughgoing investigation of whatever he made the object of his attention, but his quick assimilation of details, his ease in relating them, and the speed of his thought processes made it possible for him to overcome handicaps of the sort with which Lieber would have charged him.

Moreover, there were two sides to the picture. A well-informed, well-intentioned student of education of foreign extraction or with European training might make a very satisfactory survey across the Atlantic and, despite the advantage of a command of French and German in his travels abroad, fail miserably when he tried to translate his knowledge into terms of the American scene or to convince members of the Board of the value of his proposals. If the expert had a foreign accent, it might be a disadvantage, even though Girard himself, to be sure, had retained such an accent. A foreign accent might, indeed, have been a greater disadvantage in Philadelphia than would have been the inability to converse in German while abroad. Altogether, Bache had a mind and a background that made him well equipped for the task.

It was on his thirtieth birthday, July 19, 1836, that Bache was unanimously elected President of Girard College by his fellow trustees with what was then the generous salary of four thousand dollars per annum. The appointment was well received.

Even in Horace Greeley's *New-Yorker,* a weekly newspaper, the issue for July 23 stated:

Professor Alexander Dallas Bache, of the University of Pennsylvania, has received the appointment of the President of Girard College, with a suitable salary to enable him to travel for some time in Europe to examine the different systems of education, procure information, etc. The appointment gives general satisfaction.

Without doubt the event caused excitement at Bache's home on Chestnut Street near Schuylkill Sixth Street (that is, Sixth from the Schuylkill River, now Seventeenth Street), where Bache's mother was then making her home with her son and her daughter-in-law. Bache must have shared the delight of his wife and his mother, though his mother's joy was doubtless tempered by the fact that he was soon to leave for the survey of European institutions of learning. Bache himself must also have had some of the feelings that his friend Joseph Henry ascribes to him, for he had "become enamored with the pursuit of science, and it was with difficulty that he could bring himself to regard with favor a proposition which might tend to separate him from this favorite object. The consideration of a more extended field of usefulness at length prevailed, and he accepted, though not without some lingering regret, the proffered position."

It was an interesting coincidence that the chairman of the committee to reorganize the University of Pennsylvania faculty, who had notified Bache of his appointment to the faculty in 1828, and the man who, in his capacity as chairman of the Committee on Scholastic Education of the Board of Trustees of Girard College, gave him in 1836 the formal instructions concerning his visit abroad as President of Girard College, were the same Nicholas Biddle, a potent factor in Philadelphia affairs. This Committee on Scholastic Education, whose other members were J. C. Biddle, W. W. Haly, J. M. Keagy, W. M. Meredith, and S. V. Merrick, instructed Bache to make an unhurried trip to Europe to examine and report upon educational institu-

tions abroad in order that he might have "useful information" at hand in his organization of the new school.

Possibly because he may have written or helped to write his own instructions, the Board with rare comprehension of the problem asked Bache, as he visited each European school, to learn something of "its history, general administration, and the nature and extent of its funds," its staff organization, its admission requirements, its student body, its curricula and vocational and educational placement, its character education and religious instruction, its mechanical instruction, its disciplinary system, its recreation and amusement provisions, its domestic economy as related to diet and clothing, its health regulations and daily schedule, "the expenses of the school, including salaries and all incidents, with the average annual expense of each scholar," and its physical plant. What a boon it would be today to those engaged in educational surveys if they were able to follow out the instructions of Bache's Board "to domesticate yourself, if practicable, in these institutions"! It is hard to say what length of stay was in Bache's mind when he left Philadelphia in the latter part of September 1836, and sailed for Europe.

In his letter of September 19, 1836, conveying to Bache the instructions of the Board, Nicholas Biddle had set no time limit. He says:

> It is this anxiety that your investigation should be complete, which induces them not to fix at present any period for your return. How much time it may require cannot now be safely determined. They rely confidently on your diligence, and are sure that you will not prolong your absence without ample reason. While, therefore, they are very anxious to open the College with the least possible delay, they deem it so much more important to begin well than to begin soon, that they postpone naming any limit to your stay in Europe, until you are able to apprize them of your progress.

Little did either Biddle or Bache realize in the fall of 1836 that for a variety of reasons it would be over eleven years before Girard College could be opened.

Indeed, Biddle became a little impatient for some sort of conclusions or an interim report while Bache was still in Europe. On November 27, 1837, in Hamburg, Bache received a letter from the President of the Board that upset him. He wrote in his journal:

I received today a letter from Mr. Biddle, the first since leaving home, which bears a double interpretation, one that the Trustees of the College have not rec'd. my reports, the other that they think I ought to have exposed my views as I went along in regard to the organization of the College. I have adopted the first and answered immediately. The second if meant is a wrong view of the matter since my journey is one of inquiry, and to predict the results of inquiry is to be endowed with a prophetic spirit. If I could arrange the College now I should be glad to save my time and go home at once. There is I trust a useful field of inquiry still before me. Heaven knows I wish the journey were at an end.

His journal a little more than a month later contains the following:

January 1, 1838. Berlin. Monday. I had no idea that the New Year would find me at Berlin. The school vacations which have been so agreeable to all others have been an impediment to my progress. If pleasure were my object this capital presents resources of every sort and day after day passes agreeably, but every day increases my anxiety to go to work at home, and every day makes the perspective of that home more attractive.

Bache felt that it would be unwise to "expose his views" in an interim report and that educational theory should be measured by its fruits. One of the Europeans with whom he discussed Girard College, he says in his journal, "thought that after making up my mind upon a system for the College I ought to give an exposition of it by lecture. This I believe I satisfied him would be the way to excite opposition which might be highly injurious: while the practical working, if good, of the establishment would disarm all such opposition." Bache did not wish to "stick his neck out." After he had spent an evening

in Edinburgh reading a book on education by a member of Parliament he commented:

> It was anything but wise, so it seems to me, for a Chairman of a parliamentary committee on education, to write a book, except in the shape of a report. This book binds him to a theory, and may retard the good cause in which he is engaged by directing opposition not immediately to his measures which the critics only of the House of Commons could effectually attack, but thro' his book which all the critics in the land may lash as suits party or prejudice or fancy or sound judgment.

Bache was well aware that Girard had "intended no ordinary Orphan Asylum to be created with the immense fund which his liberality intrusted to the authorities of the city" and that the founder had furnished the trustees, to quote from the conclusion of the *Report on Education in Europe*, with "the means of establishing a series of model schools for moral, intellectual, and physical education, embracing the period of life from early youth almost to manhood, the importance of which to our city, and even to the country at large, can hardly be estimated." He did realize the heavy responsibilities that his assignment involved. Yet he was not going to be long-faced about it. There would be fun in it.

The day after he had been elected to the Girard presidency, he dashed off a note to his friend Henry at Princeton: "I have only time to say that the Trustees of the Girard College elected me President of the institution, to proceed to Europe in the autumn. I want much to see you. . . . Do come down if it is only for a day." Scientific problems, such as he wished to discuss with Henry, were always on his mind. They would go with him to Europe. They would impel him to seek out European leaders in scientific research. He would never cease to be an investigator even in the busiest periods of his life.

After his boat had slipped out of its harbor in September 1836, he stood on the deck, holding his wife's hand and watching the shore line, then without skyscrapers, grow thinner and less distinct. He thought back over his thirty years and what

they had brought him, and he thought ahead to his visits to the famous centers of the old world that he was to see for the first time. London, Paris, Berlin, Edinburgh, Amsterdam! Famous universities and schools! Distinguished scientists! Men with whom Franklin, who had died only forty-six years before, would have liked to talk! Then he hurried below to his cabin and examined his luggage. Yes, the few small pieces of apparatus for making magnetic observations that he had brought with him were securely packed and would hold up well on the trip. He could feel somewhat expansive. At the age of thirty he had attained recognition as a scientist. And now as an educator he was being sent abroad on a mission. He was at last crossing the Atlantic.

V

"MEN AND . . ."

1836. Saturday Dec. 17. . . . In the meantime applying myself to bringing up a journal always in arrears. So much does the labour of *jotting down* take from the pleasure of impressions that I believe really and truly that if I had no object other than a public one I would trust to frail memory for impressions of "men and things," the strong marks would remain and these are probably all that will be worth communicating to friends at home. Then why not leave out all but the public!

This was written at the beginning of a new volume of the journal. There are seven of these volumes constituting a diary of a considerable part of the European trip. With the notes for the *Report* they give an interesting picture of Europe in the 1830's and of an American's reactions to the picture.

The journal was too exacting. After omitting four days completely, Bache wrote:

I had determined to be exceedingly quiet today and occupy myself sedulously in bringing up the journal. The first was easy but the second less so. The excitement of the past few days has been followed by mental reaction and the riding outside of the coach yesterday has acted on the outer man and so the journal made but moderate progress. It can only be written satisfactorily when all one's powers are awake and the memory has full play and yet the sleepiest hours of the twenty-four or some day of languor from over action are its portion and it becomes a sour dose to which I always look with nausea.

We have no copies of the letters of introduction that he obtained both here and abroad before making his visits, but he pasted in the journal one of his calling cards reading "Professor A. D. Bache, of Philadelphia" that he presented to persons and schools. One Monday evening he wrote: "I determined this morning to bring up my journal before setting out to deliver any letters, but the spirit of forward motion made the task so

irksome that I was soon content to leave it." This is doubtless the "nervous impatience" to which he refers in another place, the "nervous impatience which belongs, I suppose, to all Americans." Despite his intellectual vigor, Bache was a man of movement, a man of the outdoors, not a sedentary diarist. Nevertheless, for the days that it covers completely, Bache's journal is the kind that all of us would like to write on a trip and that few of us do.

But the journal became more and more impossible, if not distasteful, because of the pressure of time. Long periods are covered only by scrappy notes of the sort that give later encouragement to recollection or even amplification in written form. They read: "Sunday. *March 4:* On road to Salzburg. Mountain scenery. . . . Austrian boundary. Shabby treatment. Disposition to receive money after search. . . . Call on Director Meier. Friendliness and simplicity. . . ." or "Thursday 20th. Christ's Hospital. Breakfast with Lord Mayer [sic.] Soup with children. Eve—Antiquarian Society. Royal Society. Capt. Sabine."

Autograph hunters of a century ago sought Bache's signature, but not because of the chirography, unless it were for a choice example of bad handwriting. His writing was never good and in the scrappy sections of the journal it becomes almost illegible and, of course, difficult to understand because of the lack of continuity. His close friend Frazer wrote to him on one occasion: "Your letter is extensively illegible & principally incomprehensible." When Bache expressed mild surprise, Frazer, who habitually addressed him as "A. D. Bache, LL.D. My dear Grandpa" or "My dear Chief" or "My dear Grandpa and Chief," wrote back: "My dear Grandpa: You are the pearl of grandpas and no mistake. Your temper is proof even against the impertinence of grand-chits. . . . But really some of your instructions I could not make out."

It is a pity that we have practically none of Bache's correspondence written during his trip. One entry in the journal reads: "I sat up until two o'clock to write letters for home."

These were doubtless welcome to his mother and his brothers and sisters. One raw March day he wrote: "We found here letters from home, and were brought in contact with those we love best. A reviving thing at all times and most refreshing when one droops. With these came applications for places not yet made in the Girard College. . . ."

It happened that the person he himself loved best was with him in Europe. Nancy Clarke Fowler, his Newport bride, had become Ency by the time she became a character in the journal. They brought with them as a sort of companion Ency's younger sister, Maria, about ten years old. The little girl evidently helped to keep up their spirits, if for no other reason than that they could not afford to let her know when they were blue. One Sunday morning the

. . . family overslept the church-hour . . . and thus passed a most quiet morning at home, for which we were probably none the worse. In the aft[n]. we attended St. Paul's (Episcopal) Church, but were surely little edified by the sermon. The prayers are always a rescue to fall back upon so that one can never be entirely defeated in attempting to worship in a church where the Liturgy is used. I felt thoro'ly *home-sick* to-day. . . . Our charge so readily catches "an emanation" and reflects it that much caution is required, in sayings and doings. The evening passed soberly away, without interruption.

His wife Ency was an ideal sort of feminine *fidus Achates* for her educational and scientific Aeneas on his wanderings. Bache took good care of both his ladies. Writing on a side-trip he noted: "This was the *first* time I had allowed myself to leave Ency and Maria to take care of themselves for a whole night and I was uncomfortable accordingly." He was solicitous for their comfort and was glad that on a channel steamer to Ireland the ladies' cabin was "not less than ten by ten. By the aid of Morpheus who came accommodatingly I escaped being sea sick, but Ency suffered more than in crossing the Atlantic." He damns with faint praise by stating that the steamer was better than an American ferry, and he notes: "There were but two passengers

beside myself in the gentlemen's cabin and Ency and Maria had the ladies' to themselves."

On a somewhat more crowded boat trip "Maria was much amused, not to speak of others, by an exhibition on board the steamer of pigs dancing to the sound of a clarionet." Juvenile companionship of a human sort for Maria was a problem, though the Baches seized every opportunity to provide it for her. Fortunately some of the authorities on whom he called had small children. One house offered the combination of music and a youngster. "After tea we had duets on the piano and harp—Mrs. M. performing on the latter. Her embonpoint prevents the exhibition from being a graceful one. They have an only son, a delicate looking boy of nine: full of vivacity and of intelligence. . . . Maria and he had a fine time of it."

Bache was fond of children; otherwise Maria would not have been taken on the trip. We can follow Bache when he takes the little girl out to buy a bonnet, or to the theatre, or for walks in the Tuileries during the school vacation periods when his visits to educational institutions were necessarily fewer. Children liked him. One Irish family he found especially kind, saying,

. . . their little flock [is] so interesting, that I am always glad to be there. The second from the youngest, about 3 years old has dubbed me with the title of Grandpapa and is a great admirer of "see-saw," "cock-horse" and all such elegant amusements, besides dancing with Grandpapa to the piano upon which by the bye Mrs. S. is a delightful performer. "And where is grandpapa" is her question, "Nurse told me he was here, Grandpapa has not been here this long week." This little Henrietta has entwined herself more in my affections than I had supposed a child could do in so short a time. Even the little brogue sounds sweetly from a child, indeed I have now learned to associate that brogue with such fine qualities of heart that I love to hear it.

Contact with other children increased the sense of responsibility of the childless couple for their little niece.

Monday Dec. 26. Mr. Stow called this morning with his little girl by the hand to leave as Maria's play-mate; quite an accept-

able comfort to the child. . . . So much has been said by kind friends about fears of the scarlet fever, measles, smallpox etc. that we watch the child with more anxiety than there is occasion for and feel our responsibility *very* deeply.

Maria became ill occasionally and Ency had to stay home while Dallas fulfilled their engagements alone. "This evening I dined at Sir Wm. Hooker's, Maria still too unwell to go out." And again: "On reaching home I found that my kind friend Mr. Stevenson had arranged to call for me to take me to his house to dinner and had induced his sister to join the party in the expectation that Ency would make one of it. This Maria's sickness (cold) rendered out of the question."

When Bache had engagements which involved only himself he sometimes provided a program for his ladies. For example: "Occupied part of the remainder of the morning in making visits, Ency was provided with an escort to the Botanic Garden . . . in old Mr. Hone, and returned home quite pleased with what she had seen, and with bunches of flowers collected on the excursion." Ency herself was not always well. When he had to attend a party without her, the other women there were likely to be compared unfavorably to her:

This evening I attended a party at Dr. Kennedy's. Ency had too bad a cold to venture out and Maria would not leave her sister's apron string. This was a tea party amusing itself just in the way that we should have done on a similar occasion at home. The company were all assembled before ten o'clock and began to disperse between twelve and one. . . . Tea and coffee were handed round in the beginning of the evening and cold meats, ices etc. were set out in a small room towards the close. In the meantime chatting, singing and dancing (waltzing inclusive) occupied the company. . . . Dancing and waltzing in (officer's) spurs must be something of an art. . . . A quartette . . . accompanied by the piano was really well sung: what an excellent family resource music is, how many otherwise listless hours may be filled up by it, and how pure a source of pleasure it is. The waters of such a fountain can hardly prove bitter.

I would not like to say how few pretty females or small hands

were present. . . . The dresses were not remarkable for taste or the reverse. . . .

Bache himself was not free from colds. The hours that he spent walking about in the Durham Cathedral with Maria had to be paid for "by severe colds and our sleeping room smokes so terribly that a fire cannot be made in it. So we shall go from bad to worse as long as our sojourn in Durham continues." A few days later: "My cold had become so bad that I was forced to turn to and nurse it and instead of delivering letters and seeing men and things in York I was reduced by headache and coughing to medicine and diet." Sick headaches plagued Bache all his life. Fatigue contributed to them. In Paris, he noted, "the attention necessary this morning brought on or aggravated an incipient sick headache. . . ." Even his pleasures had to be taken temperately. In the section of his journal in which only brief notes were made we read:

Vienna. Sunday. March 17. Sick headache fr. Steinbüchel's hospitality. . . . Disputatious folks. All talk at once. . . . People contented with government. Why books on Amer. not allowed because excite attention to politics. Mistake servant for master and shake his hand to his consternation.

In another place: "Fatigue of party. Reflexions on effects of visit to Europe." It is difficult to say what the last sentence means but it probably indicates that his spirits at the time were at low ebb. Fatigue and music on at least one occasion contributed to homesickness.

A lady with a very good voice sang . . . for us in the course of the evening, reminding me forcibly of Anna Gillespy and of course of home. The only times when I feel at all homesick are when the associations called up by music render me so, or when after continued excitement my spirits begin and continue decidedly to flag. . . . The physical man in this case reacting upon the mental. This has been a week of constant effort and mental fatigue, occasionally attended with bodily, from standing or walking. . . .

In addition to fatigue, which may easily have been induced by the pressure under which he felt he was working in Europe, Bache was subjected to the usual woes of a traveler of a century ago. There were, for example, the disagreeable traveling companions in a German diligence. Some of his medicines and a bottle of ink were stolen, but, he adds with perhaps dry humor, "the castor-oil was left." In Ireland he narrowly escaped a bad accident in a coach: "As I looked out of the window to see why we had stopped, a native opened the door—'get out for God's sake or you will all be kilt.' "

British servants were his greatest vexation. "See what a pretty tale a New England man might make of Old England, from a private journal. All this seen in good nature and recorded thus. What if ill humor had been allowed to pen the record. . . ." Menials were always seeking generous tips, and sometimes looking down their noses at American travelers. "Bought civility (servility)," as he terms it, was quite offensive to him. He felt that tips demoralized those who sought them. He grew

. . . sick of the constant rapacity which you are beset by . . . the waiter, the porter, the boots, the chambermaid, the hostler! . . . "Please remember the chambermaid m'am," please remember "the porter sir." . . . Your post chaise drives up, the landlord, waiter, boots, etc. are at the door, you are ushered in with ceremony. They see no servants, who can these be without servants,—certainly not gentlemen. The servility ceases, you ring twice, a waiter pops in, you issue your orders for tea as if they are to be obeyed and obey them he does, but if you expect promptness it must be by showing that you mean to have it. You go out the hostler touches his hat expecting his fee, your next post-boy touches *his* hat to propitiate you in regard to the extra fee for "driving smartish" which he intends to ask. . . . You are in truth in a conveyance above your station. An American gentleman . . . does not support by his retinue the style which is expected, he is not treated well enough when he comes or goes in a stage-coach, even if in the inside. He is shown the worst instead of the best room when there is a choice. . . .

Among the Welsh Bache felt that the quest of the vail or gratuity amounted to begging or worse. One little girl came up to him and told him a Welsh story: "the word penny was the only intelligible one in her address." In an inn at Chester "the maid servants . . . were strapping Welsh women who bade us servially 'good night' in a very unsophisticated way, but alas! this system of vails leaves nothing unsophisticated about an inn. . . ." To be sure, Bache's eye may have been scientific, but it was not blind to the charms of pretty women.

My coachy had generally a word of Welsh to say to the lasses, who indeed were generally so handsome as to deserve higher attention. . . . Their frames generally on the substantial order agreed with the robust expression of limbs and face. The older females seemed to me not to sustain this character for health. All that I met had strong lines of age and withered skins showed nothing of the bloom of their youth.

Naturally Bache encountered some mild sycophancy that he might have expected. At a quasi-Lancasterian school in Belfast the teacher, in anticipation of Bache's visit and wishing to please him, had planned to use Franklin's "Too Dear for the Whistle" as the story for the pupils' discussion: "he endeavoured to bring home the moral to them, and then they [were] interlocuted [on] Dr. Franklin's career." But Bache's descent from Franklin was not an open sesame everywhere, nor was it insurance against pain from the brusqueness or chronic bad manners of others. Not all of his hosts were agreeable. At one home he was "*disgusted* with the manners of this whilome great chemist and glad to escape early in the midst of a geological discussion, in which the ipse dixit was substituted for argument." He was disappointed in a well-known but ill-mannered Scotch philosopher. So impressed was Bache, who, we can be sure, was always gracious to ladies, by a story told about this philosopher, that he copied it in his journal:

The same philosopher was put into a carriage with two ladies in returning from a party. A long pause,—when one of the

ladies wishing to break the awkward silence looking out of the window observed "Dr. T. look what a pretty star that is"—"did you ever see an ugly one madam" was the courteous reply.

Perhaps the Scotch nature at home was not cordial. It had a chilling effect on Bache. When he had left Edinburgh he confided to his journal:

I employed the rest of the day in bidding goodby to some attentive and to some inattentive folks. The Professors of the University who, except Mr. Ramsay, may be said to have put themselves to the minimum of trouble I determined to part with in all good feeling.

But in general it was a friendly world that Bache met. Even at breakfast he was entertained extensively in the British Isles and once made the entry: "For a wonder I breakfasted at home this morning." Ency and Maria were present at many of these breakfasts. At the home of an Irish professor Maria found a good breakfast and plenty of young companions. Bache notes that he had "E. & M. in tow. Mrs. S. must have been a beautiful woman not long ago and is now almost so, seven children to the contrary notwithstanding." All in all, Bache viewed breakfast hospitality with some disfavor:

Edinburgh, 1837. February 6, 1837. Monday—My breakfastings abroad seem to have been comfortably got through with —indeed, I hope so, for of all the ways of being hospitable it certainly is that which most breaks into the valuable part of the time of both entertainer and entertained—Certes it cuts off one's *natural rest* sadly and exposes him contrary to hygiene on an empty stomach to the fogs and damp of the morning.

The list of those whom he visited is by no means complete either in his own journal or in any compilation that we might make. There were some interesting personalities among both his hosts and those he met casually. There was old Mrs. Grant, for example, who remembered Charleston

. . . which she saw at three years of age. Talked of Albany

before the Revolution as of a place in which the manners and customs of yesterday were described. She met with a great disappointment from a . . . General Cuyler who was an Ensign in the British Army in those days (a German). She remembered a prank of his in carrying off a dish of cookies from the table set in the vestibule for tea in the house of a Dutch lady: This the general remembered nothing of. Mrs. Grant is now eighty-two years, and has just recovered from an attack of this influenza which has carried off so many old persons. The old lady is a real tory.

He visited a Scotch school and

. . . in the evening was a small gathering of the teachers, and a clergyman, Mr. Walker, on a visit to St. Andrews. He is [a] specimen such as I have not seen before, in the established Church of Scotland. . . . He was full of temperance societies and as I understand much dedicated to the urging on of revivals. On the whole the impression made upon me was unpleasant, for he seemed to be naturally gay and yet he tried to be somber when there was but little occasion for it.

Two weeks later:

There was quite a small party and I left there early to go to Archdeacon Williams. This gentleman was good enough to give me letters to some of the masters of the English schools who were fellow graduates of Oxford. He thinks all for classics or the world is lost. Is fully persuaded that no country can live without an establishment and an aristocracy. Expects America to do just as the ancient republics did before her etc. He is an honest hearted man I should think but entirely filled with prejudices. In speech he has a remarkable peculiarity, hesitating and filling up sentences with "what d'ye call 'em."

One evening in Hamburg

Dr. Julius called in and we had a long talk about America and Americans; of both his reminiscences in general are agreeable. He took me to an awfully smoky café to read the newspapers and then kept me talking until our coffee was consumed, so that what was in the paper which I held in my hand remained a mystery.

In Berlin one evening "we made our first visit to Mr. Wheaton's. Mrs. W. reminds me much of Aunt Duane but has all her severity of appearance and manner without any of her playfulness."

With many of his new acquaintances Bache talked of education and science, and of recent developments in each. Bache also liked to talk about the great and the near-great toward whom he kept a balance between hero-worship and debunking. In one place he says: "Besides more serious subjects Dr. R. let me into some information of the gossiping kind which interested me exceedingly."

Of the great men whom Bache met abroad perhaps the most outstanding were Humboldt and Metternich: "*Dec. 5th. 1837. Berlin.* . . . This morning I went to see Baron Humboldt by appointment. And spent nearly two hours during which the variety of ideas and subjects was actually overwhelming and I left him with a swim head-ache." Over a score of years later, when Humboldt died in 1859 at the age of ninety, Bache delivered in tribute to his memory an address which was published in *The Pulpit and Rostrum.* Prince Metternich, who was destined to die the same year as Humboldt, was the powerful Austrian reactionary opponent of democratic nationalism, who, according to Thomas Mann, "would have been better to talk to than Hitler. For a real reactionary is always better to talk to than a fake revolutionary." But Bache's whole concept of things as they should be probably made him prejudiced against Metternich. When he left him his annoyance included the members of the Prince's family. Under his visit to Vienna he notes: "Reception by Metternich. . . . Introduced to Princess and mother. . . . *Vulgar* ways if one dare say so. Mother bids one remember her prediction that Girard College cannot go on without religious instruction of one sect."

Bache also encountered some who had had greatness thrust upon them. Such was Burns's "bonnie Leslie" in Scotland. Bache doubtless learned that the lady had been Miss Leslie Baillie of Mayfield in Ayrshire and that she had been Mrs. Cumming for

almost forty years. To the great woe of Scotia she had crossed the border in her youth, Burns tells us.

O, saw ye bonie Lesley,
As she gaed o'er the Border?
She's gane, like Alexander,
To spread her conquests farther!

To see her is to love her,
And love but her for ever;
For Nature made her what she is,
And never made anither! . . .

Return again, fair Lesley,
Return to Caledonie!
That we may brag we hae a lass,
There's nane again sae bonie.

Perhaps local jealousy, though four decades old, was responsible for the following brief note in the journal: "While walking we met Burns' bonnie Leslie, now quite a portly old dame and I understand never very beautiful. Robie made beauties of homely faces."

Some of those whom he met involved Bache in arguments. He was interested in their points of view. There was the opinionated bookseller, for example:

He declaims loudly against what he considers the narrow system of the University, by which young persons are not admitted to have Logic or Mathematics without Classics. He avows that "we shopkeepers" do not want Classics and will not have them taught to our sons and it is hard that we cannot get them taught to write a decent letter or to solve an equation without going thro' that channel. I suggested to him that perhaps Universities were not the places for less than a thorough education, a view which at first took, but when he reflected on the endowment he concluded that he had a right to the benefit of a share in this.

If he had his way, he would

entirely exclude classics from education except as a sort of extra luxury like music, and the other fine arts. On this point we could not come to an agreement. He thinks that the ancient

languages are not even useful in comparison with the sciences as cultivators of the mind and memory.

Like any American on his first European trip, Bache was fascinated by national differences and the antipathies they produced. He notes "general contempt of the Austrians for the Hungarians." A little later: "Evening a visit from Nagy. Different account of Hungary. Believes it nearly perfect & blames Austria for misgovernment." If Bache gave his mind to the Germans for their scientific and educational advances, he gave his heart to the Irish because they were themselves. To him they had "a sort of generous frankness & a touch of enthusiasm that is captivating." Of an Irish professor he wrote: "His manners are genuine Irish, by which I have learned to understand, frank, cordial, and warm hearted, unceremonious." He liked the humor of the Irish, their sense of "funning." One of his breakfast hosts put his feet on the table without shocking Bache: "The only man I ever saw (gentle) with his feet on a breakfast table was Professor I. R. Young: an awful statement surely, but he too was funning. The law of libel should be put in force against itinerant libellers." He ended one of his days in the company of two Irish clergymen with "the mountain dew bottle for hot whisky toddy."

He was amused at the enthusiastic applause of students "listening in" that repeatedly interrupted oral prize examinations in Ireland. He told one Irish driver who had got on the wrong road that he "was sure he had gone astray. 'Your honour, this is the *circular* road, but may be you'd like to go the shortest.' " In an Irish group "the gentlemen insisted upon it that either an Englishman or an Irishman would give up his place in the coach to a lady—they vouched especially for the latter insisting that if he did not get out to put the lady in his place he would at least take her on his knee! The lively rattle that was kept up amused me infinitely."

Bache enjoyed Irish wit. At a political meeting in Ireland he heard a speaker tell "the tale of the man who had made a compact with Satan, was offered the choice of three acts, to kill

his mother, to slay his father, to get drunk. He chose the last because the least, got drunk and killed both parents." He had visited the Irish Inns of Court. "Mr. Kelly showed me out remarking that tho' many a lawyer might be found to bring me into court, few would be so disinterested as to get me out again."

Bache sympathized with the difficulties of the Irish. He lamented their divisions through "political religion," the violence of relatively recent Irish history, the fact that "the spirit of nationalism is not fashionable," and the existence of an armed police. "An armed police, what volumes it speaks! . . . An armed police for rural districts." At an Irish home the company discussed slavery and "its probable results to our Union. . . . I should say that the gentlemen whom I have met here without indulging in the extravagance of some of my English radical friends, have a sincere esteem for our country." American slavery was becoming an issue already of great interest in Great Britain. The day after Washington's birthday Bache wrote in his journal:

We had quite a pleasant party. After dinner Washington's health was drunk, in compliment, and a most sincere admiration for his character expressed. Mr. C. [Cunningham] has announced his intention of emigrating and Mr. Simpson called upon me on Tuesday morning with an inquiry if a licentiate of the Church of Scotland were admissible to the Girard College. I thought not but Mr. Jno. Gadon tells me that a licentiate is not an ecclesiastic not being ordained. This is a matter for the trustees to settle. As in most conversations which I have here, the slavery question was brought in. The ladies are thoro'-going anti-slavery advocates. The gentlemen will generally concede the difficulties of the subject.

A half-century after the Revolutionary War Bache could drink Washington's health with British gentlemen. In fact, memories of the War were a bit vague. Much had happened in Europe since that time, events that were nearer and more important for Great Britain. It is small wonder, therefore, that an

excellent lady made what seemed to Bache a serious mistake about one of our national heroes.

She is a clever Quakeress, a widow, in delicate health, having no family as I believe, and giving up her time to doing good to her species. In the course of conversation she spoke to me of the celebrated *pirate* Paul Jones, and it was with some difficulty that I persuaded her that he was no more a pirate than other renowned land or water plunderers and indeed that his adopted countrymen owed him much for enterprise.

Equally erroneous were some ideas of later origin about the relations of Great Britain and the United States. Bache copied the words that appeared on a monument: " 'On the 12th of Septr. 1814 in an action which took place between the British and Americans, near Baltimore in which the former were conspicuously victorious,' i.e. in which the British were repulsed." The monument may have annoyed him but he was amused whenever the British discussed Americanisms. As in a later day, America had not always been well represented in Europe. After discussing people of his own city, Captain Hale of Edinburgh had talked about Americans with Bache: "The behavior of Cooper, the novelist, who had great pretension has he thinks produced a sort of feeling that Americans are disposed to assume which Irving's quietness did not do away." De Tocqueville's work, then enjoying a current popularity in Europe, irritated Bache, especially when liberals appeared to prefer what the Frenchman said about America to what he as a native could assert with greater truth. "It is hard to see liberal men like Mr. Combs and Mr. Chambers swallowing the misstatements of de Tocqueville about the United States and really tho' at first the latter was glad to hear them contradicted, they both seemed to join in trying to uphold them."

One European democrat, who expressed great admiration for Franklin, told Bache that he had "often *wondered* if we had coats of arms in America, and seemed quite sorry to hear that the harmless vanity (as I consider it) was to be found so commonly." Bache felt, however, that many of the less

privileged classes of Europe were far from admiring Americans or American democracy. After visiting a large estate, he notes: "In passing thro' the grounds the workmen whom we met all touched hats, a mark of respect (? servility) which our origin once known they would have been far from paying." Certainly any of the disagreeable characteristics of American democracy could be duplicated in Europe. When a driver in a gig pointed in passing to "the gentleman who owned a distillery," Bache felt sure that in America a traveler would have put down the title to the credit of "our sturdy republicanism." At the same time, Bache saw considerable evidence of interest in America among the people most likely to become emigrants. He visited a colliery where a sub-viewer served as his guide.

The sub-viewer knew that he was to have charge of an "American gentleman" and seemed desirous of knowing about wages etc., with us. He had heard el dorado accounts of our country: indeed the lower classes here might it seems to me be easily moved off by any inducement seeming fair. And I do not wonder at it. They are such mere machines for the exercise of capital. Their interests and improvement are so little looked to.

Bache himself was a true American democrat of his period, and the stratification of the upper classes and of people in general bothered him. In Dublin he was present at a social affair sponsored by the King and Queen's College of Physicians.

Distinction of rank never came so unpleasantly home to me as when Prof. D. observed, "there is the Archbishop of Dublin, you must be made acquainted with him, but I am not a sufficiently *great personage* to introduce you." The Provost made the introduction and a few minutes conversation were sufficient to make me grateful that it had been done.

On another occasion he was enjoying a visit to one of Great Britain's venerable piles. Enjoyment runs high at thirty years. So does social consciousness in men like Bache. The social consciousness served to cancel his enjoyment of the visit. He looked about him. "Then came the thoughts of this boundless wealth indicated by the hall, the gardens, the grounds, the dependents

being that of *one man*. And last I felt that Eaton Hall should be a *public institution*."

Karl Marx had not yet been heard of, and Bache was really a liberal, not a socialist. Nevertheless the phrase "public institution" was often in his mind after he returned to America.

VI

". . . THINGS"

It is fortunate that Bache did not "trust to frail memory for impressions of 'men and things,' " or we should have been without an entertaining journal that reveals the man himself no less than the work and play of his European mission. A great deal that Bache entered in his journal because he found it disturbing or amusing or unusual would have been taken for granted by Franklin, who was by nature more of a world-citizen. Bache wrote in Switzerland that he had been "*shaved by a woman*," and underlined the four words. His great-grandfather might even have omitted mention of it.

The scene in the journal changes as rapidly as in a fast-moving novel or motion picture. Operas, concerts, parties with hot toddy, scientific meetings, hours in classrooms and in officials' offices, building inspections, visits to industries, political banquets, evenings in the Bois de Boulogne, walks in the famous parks and along continental streets that one mentioned in Philadelphia with bated breath! There is an infinite variety of things to be remembered that he entrusts to his journal beyond the notes that were to be used in writing his report. He knew, as a poet of our own time phrased it, that

> the big things pass
> And the little things remain.

Though he recorded both, the little things in many instances had for him a more lasting interest.

There was, for example, somewhere in England "an extra flourish . . . in the shape of a bugle to call us to dinner, playing 'roast beef' most furiously." And the walk through the slums of Glasgow, famous for their low life, their dram shops, and sprawling drunks. And the links at St. Andrews which "are rolling hillocks with tufts of grass and here the game of golf is played to most advantage. The weather prevented me from wit-

nessing any specimen of this so-called grave and philosophic game." And the "exhilarating sight" for an outdoors man of officers exercising fine hunters in a Dublin park. And the peculiar echo that he could never forget. And the costumes and uniforms. "The costume of the highland soldiers while very beautiful is one that even yet I cannot reconcile myself to; the bare leg is certainly not adapted to the climate. . . . They are splendid looking men, all that I have seen."

And his mistakes that he could laugh over later. Hurrying back from a visit to a naval school at Versailles and hurrying off in the evening to attend a philosophical society meeting only to find "it had taken place the day before"! A *faux pas* committed at an Irish dinner party worried him needlessly.

In passing to the drawing room I committed a bull which was probably put down to the score of American manners but which in fact resulted from part Scotch and part a general failing. Miss Cleland had called with the Dr. upon Ency and I supposed her to be the head of the concern, and had not heard Mrs. Cleland's name. The young lady to whom I made up very kindly intimated to me that Mrs. Cleland was on the opposite side of the room.

There may have been some thought in Bache's mind that he should have ready on his return a fund of stories for after-dinner speeches. At times he seemed to be conscious of an obligation to his journal to record even trifling matters.

Mr. Kelly told a good story "for my journal" of a former illicit distiller of spirits in the North of Ireland who wrote to Lord M. . . . to remind his honor how he had come under his honor's notice before and been well looked upon by his honor, and how he should feel proud of a place in the excise, as he had determined to have nothing more to do with illicit distilling believing it very wrong to defraud so good a government.

At Durham he wrote:

To show that fellows in the colleges need not reside at them, a story was told of an "old fellow" who regularly drew his dividend who was *king* of some island or other on the coast of

North America, if I remember aright and tho' he did not marry to lose his fellowship kept a seraglio of squaws.

Over the phrase "some island or other" Bache wrote in parentheses "Passimoquoddy?"

Bache enjoyed the social hours that produced these stories. He gives the usual picture:

After dinner we retired to the great sitting room and there cracked jokes and nuts in a most easy, pleasant way. Mr. Chevalier is quite a wag and there being three Cambridge men there they had a regular talk about Alma Mater. For her they have unbounded veneration.

Bache even attended political dinners for the fun that was in them. At one mammoth political affair, a cold supper for 3,500 guests, "a capital speech was made by a conservative M.P. (from Liverpool?) Mr. Gladstone." He doubtless heard more of Mr. Gladstone later. Certainly he heard enough of Gladstone and other speakers on this occasion, for supper was served at five o'clock. Bache left at one the next morning after eight hours, and the speakers were still talking! British political methods were certainly no more admirable than those in America of the same period, for Bache asserts that some voters "are plied with drink until they are 'for' and then a ticket is handed to them to vote. . . . When Mr. Ewart was elected, he expended 70,000 £ and his opponent (unsuccessful) 40,000 £."

Bache suffered from fatigue on his trip because he filled his days too full. He carried a complete program of day visiting, and cultivated his scientific and social interests in addition. Late hours at night followed by breakfast engagements the next morning left too little room for sleep, and the day schedule permitted no opportunity for rest except at week-ends. Of one evening he writes: "The toddy to the contrary notwithstanding we got home before 12." After an evening with a British headmaster:

The ever-returning toddy-glass. . . . Indeed no evening in a certain rank have I spent without this making its appearance.

. . . I have already taken more of alcohol in this form since visiting the mother country than in all my previous life. The social dispositions if they exist come out over the bowl of toddy or negus and one is thus well established on friendly terms.

When Ency was with him and the party was mixed, he records the type of entertainment provided by the household and its guests. He describes, for example, an Irish dance in which a crossed shovel and tongs were used. Another in which the dancer held a cane in the hand, with "the other end resting on the floor," he calls the "stick dance" and draws some pictures to show how it was performed.

In England and Ireland and on the continent people were hospitable and cordial, but the Scots appeared to Bache to be dour in some cases and in other cases simply dull. When he left Ireland and went to Glasgow he was not made welcome, and he was depressed by the contrast. The first Scot whom he met on the trip, a Mr. Stevenson, had "all the peculiarities of tone, manner, and address of the genus. Neither of these require description, the dwelling on the r, the mouthing the y, the i pronounced as e long, and many other peculiarities are well known, the coolness of manner, stiffness of address. . . ." Scottish university professors were "inattentive." One can see the characteristic Scottish earnestness in the explanations that Bache says they added to their own funny stories or philosophical quips. An "old gentleman explained some of his Scotch stories and told others, one of which an epigram penciled upon the tomb of David Hume I remember.

> 'Within this *circular idea*, vulgarly called a tomb,
> Lies that bundle of ideas that constituted Hume.' "

Even the history of Scotland must have depressed him somewhat. After seeing everything of historical importance in Edinburgh, Bache makes the comment: "It is good to have the realities of a barbarous age forced upon one for comparison with the present, else one would be disgusted with what now exists. Fanaticism, ambition, cruelty, all are tempered down, rela-

tively." It is easy to imagine what he would say if he could have lived to see Germany a century later, especially since Bremen in 1837 impressed him as follows:

I have forgotten to record to the discredit of Bremen that Jews are not allowed to live in the town. But are compelled to reside in a village apart and only come in to transact business. The gates of the town too are closed early in the evening and comers in and goers out must pay to get through them.

Bache's attitude toward everything was tolerant, truth-seeking. scientific. He must have felt that the spirit of science suffered a blow when an Irish scientist told him that he believed "fully all the charges of secret incontinence and the like against the Romish priests. . . . I could but express my conviction that all these tales were humbug."

Bache was shocked by this, both because of the scientist's unscientific prejudice and because his own upbringing had taught him to respect those who devoted themselves to religion. As an adult Bache became interested in religious matters and in church affairs. He went to church regularly every Sunday while abroad, and found in many churches the same kind of good causes being advanced as at home. In one, funds were being collected to build a British and American chapel in St. Petersburg, Russia. Holidays also took him to church, for school visits were then impossible. On Christmas he went to church twice, and since it was Scotland heard two interesting discourses. He was not always so fortunate.

In the Chapel of Trinity College, Dublin, he amused himself by counting the red-haired students. It was a rather unprofitable way of spending his Sunday morning, but he went back on a subsequent Sunday. "The services did not improve upon acquaintance. . . . The attendance is so obviously a matter of formality as combined with the musical way of going through the service to obstruct on my part devotional feelings." Ironically enough it had to be in Scotland that he almost made a serious monetary error in connection with a Glasgow church collection. "I came very near being excessively liberal at church

today throwing a gold ten shilling piece into the offering instead of a shilling. The superintending vestryman saw my mistake and took the real simon pure in exchange for its yellow representation." Much more disturbing to him was his unhappy experience in Edinburgh.

This morning an occurrence of a most disagreeable nature befell us. We went to St. John's (Episcopal Church) at the end of Princess Street. I had been invited here by Professor Forbes, but being rather late and besides not knowing the extent of his accommodations I applied to a woman below stairs who was acting as beadle for seats. She directed us to the gallery. Ency, who entered first, had her hand upon the door of an empty pew when a woman beadle clapperclawed her and turning her around said there was no room. I observed to her that we were strangers and would like to have seats. There were no seats to be had was the reply. Surveying momentarily the lower floor I thought yet to correct this most rude proceeding by applying below stairs, but here again we were met by an uncivil device of accommodation, and actually obliged to leave the Church! Tell it not in Gath! What would an English traveler in America have said to such treatment, and how many chapters would he have devoted to the outrage? And this from a denomination who in the U.S. are considered among the most civil. How happy were we to return to a place for which *paying*, we had a right to occupy and where perhaps our service was even more acceptably rendered than if we had obtained access to the gorgeous temple, its gay painted windows and congregation serving to distract our minds. Such at least was the feeling of the moment.

The continental Sabbath seemed strange to Bache. "A Sunday in Berlin is unlike one in America, or one in Scotland. Indeed many shops are open all the day and in the afternoon amusement is the order of the whole population. The theatres and gardens etc. are all in extra full blast." It was all in contrast to the restful quiet of a Philadelphia Sunday.

Bache may not have been "of the old Philad. stamp" but he loved his native city and never completely dissociated himself from it. Years after he left it he would return for scientific meetings and social visits and the less pleasant duty of serving

as pallbearer at a funeral. On the trip to Europe in his early thirties it was only natural that when he visited a bluecoat school at Chester he should think as a Philadelphian of the costume in use there as "a long blue Quaker cut coat" and that in Berlin the *Unter den Linden* should be noted in his journal as "wider than Market Street."

While he was abroad Bache furthered the scientific studies that he had begun in Philadelphia at the University. His journal is full of German and other European advances in science. Meteorological phenomena are referred to as coming under his personal observation. He gathered much gossip about scientists and apparatus. One day in the school vacation period he was "out with Henry all day looking at instruments." Henry was doubtless of considerable assistance to Bache in purchasing instruments for Girard College, though concerned that his own allowance from Princeton for purchasing equipment was insufficient.

This was the American Joseph Henry of whom Bache saw much in the summer of 1837. Henry had arrived in London on St. Patrick's Day, and Bache had arrived just a week later, taking lodgings within a few steps of Henry, perhaps by prearrangement. As Henry says in his notebook, they resolved to see the "lions of the city" together. When Henry was leaving London in May he wrote to his wife: "I feel much regret in parting with the kind friends I have made in this place; with Bache and his good little wife." Two months later he rejoiced in the opportunity to show the Baches around Paris.

Henry, who became Bache's closest professional friend, was a man who possessed, as Jefferson Davis said, a "quiet, spirited way." Years later in a lecture before the Royal Institution of Great Britain, Oliver Lodge referred to "that excellent experimentalist, Joseph Henry, of Washington, a man not wholly unlike Faraday in his mode of work. . . ." At one time Henry had been interested in Bache's terrestrial magnetism. Bache shared his general interest in electricity. Even while in Europe

the two men spent one entire day discussing their researches in steam.

In Great Britain and on the continent they attended scientific lectures, demonstrations, and meetings together. At least some of these meetings were unpleasant to Bache, possibly because he was a stranger. At the Royal Society Club of Edinburgh he was not made to feel at home in the slightest. After one of their gatherings he wrote:

It seems to me that these meetings have something stiff and formal in them which makes them anything but agreeable. Every man seems to have some special object in view; to speak to this great man, shake hands with the other, etc. etc. In short I was glad to get away.

The meetings may have been equally dull for even titled members. His observations at one meeting in London led him to write: "Science seems to be too drowsy for nobility—Lord Burlington went to sleep (have seen him do the same thing before). . . ."

The more Bache saw of scientists in the British Isles the more respect he had for American scientists and their work.

The isolated condition of men of science here grows upon my perception more and more. Comparing the places where I have been and where I supposed men were closely linked together by common pursuits, with those whence I came on the other side of the Atlantic, I perceive our position to be relatively much better than I had supposed. Each man seems content with his own circle and in that he moves the center of a small or of a large one according to circumstances. Striving to enlarge his and to appearance never thinking of his neighbours, much less desiring to unite wave to wave that the crest may on the whole be higher.

The figures may be somewhat mixed, but this is a revealing passage.

To be sure, almost everything but social engagements, concerts, and some sight-seeing that Bache did on his European trip was related to the ambitious concept of Girard College

that his Board and Bache himself entertained. The journal contains long architectural descriptions of cathedrals and other massive structures. Like the Irish themselves, their chief city impressed him favorably: "Dublin seems to me a city eminently worthy to be the metropolis of a flourishing nation, not of a province. Its ample and beautiful public buildings are too ample and too costly for the part which they now have to play." Architecture was evidently a well-developed interest, but Bache also had constantly in mind the school that was to be built and conducted under his supervision. He even had with him drawings of the proposed buildings of Girard College. These aroused a great deal of comment, and one London painter showed him an idealistic representation in oils that he had done from them. At one university Bache made note of some architectural changes. To the rooms of their new building "they made an addition in rear, removing the dome over the former lecture room to the new. Thus they had a lecture room with so charming an echo that the Lecturer could not be heard. They cut off a dome part therefore for a museum." Bache did not anticipate the similar acoustic difficulties that Founder's Hall, the main building of Girard College, later presented. Neither did the gifted College architect, Thomas U. Walter, who met Bache in England and visited with him a school at Clapton and Christ's Hospital, which at that time was in London.

Whenever he discussed Girard College on his trip he found responsive listeners. There was even interest in Stephen Girard, who was already little more than a myth abroad. In Scotland

Dr. Muir insisted upon it that Girard was a Scot and had relatives in Edinburgh: he called him G*e*rard and said he had been told of his visiting here claiming relationship, a few years since, not being well rec'd and going back leaving 2,000,000$ to found a college, more to build houses etc. The whole was so involved that he would scarcely be satisfied that he was totally wrong as to our founder.

At Grätz Bache met an archduke of "liberal ideas and easy manners" who expressed admiration for Girard. The archduke may

have considered the Frenchman's ban on the admission of clergymen to the Girard campus a mark of liberalism.

This provision of the Girard Will was not so generally known in the 1830's as it is today. A Scot who may have had it in mind to apply for a position in the new school had to be informed of the ban.

He cannot bear the turmoil into which the opposition to established principles of education thrust him, and tho' a licentiate of the Church of Scotland he cannot view the intolerance which surrounds him, without discomfort. In candour I was obliged to state to him the exclusion of ecclesiastics from the Girard College.

Just as it seemed years later that everyone whom Bache knew, and many on Boston's Boylston Street and elsewhere whom he did not know, had some man to recommend for service in the Coast Survey, so on the European mission a candidate for a Girard teaching position or a relative of one turned up everywhere he went, and letters from home often brought applications by mail.

Mr. Maginis formerly a teacher in Philad. has found me out. His son was in the University classes and was considered very clever. The father is a grand flourish and now wishes a place in the Girard College, notwithstanding that he has just re-emigrated a second time to Ireland. I returned his visit with Dr. B. who drew me out on the subject of slavery, on which he says I am not orthodox. I.E. I hold that ultra agitation by the non slave holding states does harm not good to the ultimate abolition result. I believe that these agitators have circulated incendiary pamphlets, and are responsible for the reaction which their violence has caused.

Bache's trip gave him many minor sidelights on European education. In one institution he found what we might call "daylight-wasting": "The college clock is kept ten minutes in arrears of the town time . . . tho' no doubt is calculated upon by the students." In Berlin he first discovered an old guidance technique which at that time was not uncommon on the con-

tinent: "Just now the characters of all the boys are sketched by the masters from their note books and reported to the parents." Bache did not know that such a teacher's report had been written about Napoleon in the previous century and that its accuracy as a prophecy is almost uncanny. Educational needs that he noted abroad could be interpreted in terms of such needs in Philadelphia. After visiting a school he wrote: "On the playground there now lies 7½ inches of snow and I see plainly that provision ought to be made in this climate . . . for a covered playground to be used in winter or in bad weather in summer."

There are many educational observations in the journal that do not appear in the *Report*. School attendance in one part of Ireland was poor: "Attendance is represented as irregular just now, partly on account of the bad weather, but more because the potato crop is getting in." Bache could not avoid associating in his mind social conditions and education, and thinking about the effect of one upon the other. He liked the Irish, but despaired of the living conditions among many of them:

The miserable cabins crowd together by the roadside, and their miserable tenants made a most unhappy impression. . . . The cabins which we visited were of exceeding different grades. One of a year old settler was still of the turf. A ditch surrounded it to keep it dry. A hole in the somewhat conical roof served to carry off the smoke. The door was used for light. In this place a family of two or more children were huddled about the fire. The father was away but the mother appeared cheerful and full of hope for the coming year. If the year had not been so uncommon bad they would have been much better off etc.

It was a day when both students and staff members in a boarding school were harshly treated. Students were required to do no work in most boarding schools, but the rod or cane was not spared. Long hours were required of the masters, but they had some pleasant perquisites. At Heriot's in Edinburgh, for example, "allowances of tea, wine, porter, whiskey, etc. are furnished to the masters."

Bache thought that the education of the abnormal revealed methods applicable to the instruction of normal children. Hence his interest in visiting a school for the deaf and dumb where he was astonished to learn that "the temperature of the deaf and dumb is lower than that of ordinary persons in the same class of life." He was naturally interested in all that was novel in European education. His *Report* shows his interest in Pestalozzi's system, and his own notes discuss this system at considerably greater length, weighing its merits and faults.

His love of music carried over into the educational field, where he felt that music deserved a place not as a frill but as a subject to be pursued seriously. One can imagine the slight aural pain that he felt on his visit to the Liverpool Blue Coat School from his comment: "The singing respectable but not scientific." In a Swiss normal school

> the rector was good enough to have a singing lesson for us. . . . One of the songs moved me . . . the German words were level to my comprehension and the music was so touching. Such songs form no aristocrats. The director insists much upon the fact that since these songs have been introduced the loose songs of the tavern have disappeared. He considers them a most powerful means of civilizing and moralizing a people.

Reference to Switzerland recalls Bache's lecture on that country published in the General Appendix of the *Smithsonian Report* for 1870 and apparently never printed prior to his death. It was based on notes he made in Switzerland. In his journal and notes, to be sure, we glimpse pictures of several countries, pictures that prove his habit of careful observation. The journal is a fascinating series of changing scenes. Visits to a slate quarry, an iron works, a dye works, a gas works, a carpet manufactory, and a mine! The last was two and a half miles northwest of Newcastle.

> I found the sub-viewer in miner's dress waiting for me. The first operation was to doff every thing but stockings and drawers and to don a full miner's suit, flannel shirt, pants and roundabout and crash shoes. Then armed with a stick I followed the

guide to the mouth of the pit. He arranged me in the basket and after many cautions how to hold obviously preparing himself for an attack upon my nerves, he got into the other side and giving a signal we began to descend. Making the excuse that I should see better for it on landing he advised me to shut my eyes, but curiosity would open them now and then. After a short time the sensation became that of ascending and I could not believe until my guide struck the sides with his stick to convince me that we were going down. I felt very sensibly the undue pressure of air upon my ears' membranes. There was very little if any sensation of danger in this descent. The basket was carefully kept from the sides by my guide, and there was no twisting or at least but a very slight twisting the rope being a flat one. The depth of this colliery is 181 fathoms and our time of descent was nearly two minutes. When about ¾ths. of the way down there was a jerking or jarring from irregular motion which was unpleasant.

Visits to the docks and warehouses of Amsterdam! A coach trip through a part of Holland!

Tho' we hurried and took but a hasty meal on the way, night caught us just after leaving the high road and on such a road! as we have not before seen in Europe. A mean strip of earth between two paths of water, the wheels sinking into the soft soil and the horses hoofs splashing in the mud. An upset in such a place would have presented a choice of evils—on mud or water. We floundered safely thro'. . . . In passing along this road we had a fair specimen of the drowned lands of this part of the country. The fields were for miles entirely under water and to this inundation they say the ground owes its fertility and if it fails the fields fail also.

A little later in a diligence: "We were now, plainly, leaving Holland. The land became more and more dry."

A visit to the Giants' Causeway in Ireland on a Saturday turns "to good account" what "is a most unprofitable school visiting day." Then an Irish castle brings the comment:

An Irish castle is no very striking affair if this is a specimen. Outwardly it looks like a collection of barns or barracks with high peaked roofs surrounded by a wall. . . . The legend tells how poor McQuillan was ousted by a canny Scot McDonald

and then come treacheries innumerable by which it was taken and retaken by various sets of rogues having different names and titles.

By contrast a Welsh castle that he had seen earlier had "a new look." Bache did not know who the original lord and lady were, "but if there is any truth in instinct their pictures show them to have been vulgarians, the lady strikingly so."

The journal and notes are frequently scrappy, and because of the haste in which they were written they are sometimes ungrammatical. But the lecture on Switzerland previously mentioned shows Bache's power in writing at its best. It was a happy theme that greatly appealed to him, "the only federated republic of Europe," a republican state "with the disadvantages of being hemmed in on all sides by monarchies." Arthur E. Morgan, in referring to these Swiss freemen who by keeping alive the ancient tradition of democratic life "may have had more enduring influence than the heads of the Holy Roman Empire," reminds us that "excellence may be more significant than bigness." Bache was interested in Switzerland for a variety of reasons. Its democracy was, to be sure, "a beacon light to the modern world." It was the land that had given American science Agassiz, Guyot, Hassler, and Lesquereux. It was a land of educational experimentation and reform. Let the lecture on Switzerland speak in part for itself.

On the eastern side of the town the bank of the Aar is quite precipitous, and from the parapet which crowns it a glimpse is had into that fairy-land, the Oberland of Berne. The peaks of its snow-clad hills, with their bold outline, cut sharply against the sky, presenting, in the course of a clear day, a beautiful variety of aspect, from the dark shadows cast by the rising sun, and the brilliancy of mid-day, to the delicate hues at sunset, and the ashy and almost ghastly paleness of the evening. One of the few things which cannot disappoint is a visit to the Bernese Alps. Nature presents itself not only upon a grand scale, but in unusual and varied forms. Lofty and precipitous mountains, rugged with rocks, and ice, and snow; glaciers pushing their way from the steep mountain sides into the valleys; avalanches tumbling headlong from the heights, and with a roar like dis-

tant thunder burying their ice and snow in the deep gorges; cascades pouring from precipices so lofty that the water is dispersed in dust-like spray, in mid-air, or tumbling from rock to rock in foaming sheets; pine-clad hills, and valleys green with grass; all these, in turn, rejoice the sight, while the unaccustomed modes of Alpine traveling invigorate the frame, and the spirits rise until they create a world of enjoyment of their own. The works of man lend themselves to nature, to add to the picturesque character of these regions; for the Swiss cottage, with its roof weighted with stones, its projecting eaves and out-door galleries, is unlike a farmhouse elsewhere, and the chalet, with its stable, dwelling, and dairy, all under one roof, yet separated with scrupulous regard to neatness, is as unlike a peasant's hut. The costume of the people, too, puts them to the eye of a stranger in constant masquerade, and the vocal music, with its curious falsetto tones, and the instrumental upon the wooden tube, or Alpine horn, are unlike what is to be heard in other countries.

The valley of Grindelwald is itself more than three thousand feet above the level of the sea, and from it the Faulhorn rises three thousand more. The ascent of this mountain is by winding paths, along the base or on the brink of high rocks, by the side of ponds formed by the melting snow, through the snows themselves, to the very apex. Then the whole district of the lakes of Brientz and Thun is stretched out before and far below you, the lake of Lucerne and its mountains, the valleys of Lauterbrunnen and Grindelwald, the Alpine heights of the Eiger, the Monk, the Jungfrau, and others of this chain, far across to the mountains where the Rhine and the Rhone both have their sources. Above the region where the white hill-clouds of summer are formed and rest, when *they* occur spreading a deep shade over the valleys below, the top of the Faulhorn is in the full blaze of the sun, and the eye ranges from it upon the expanse of the tops of the white clouds, as over a vast plain of snow thrown into ridges by the wind, a mimic ocean of snow with the forms of waves without their motion. Life in a chalet upon such a mountain is very little like that in an inn down in the valley. The whole mountaintop will hardly give elbow-room to the twenty or thirty people who come up on a fine summer's day, much less will the chalet give room for exclusiveness in eating, drinking, or sleeping. Then, further, to break down reserve, the sunset is to be seen by all, and then the moon,

at rising or setting, puts the whole sleeping household in motion, and again all are out to see the sun rise over the distant Alps.

There are some traits by which one may infallibly recognize our countrymen, and in this chalet with us was an undoubted American. He talked to every one who could speak his vernacular, and spoke to every one who would give his broken French an answer. His meals were bolted down in haste. He fidgeted lest he should lose anything of the moon or sun rise, and actually turned out to witness the former in regular Kickapoo style, wrapped in a blanket. He was restless to an excess, and talked all the time that others were absorbed in sentiment; forgetting his unpresentable condition, he even addressed some young English ladies, who had certainly offered no special encouragement to the approach of any fellow-traveler, even in full costume. He was off among the first in the morning, and after the day's journey we met him in the evening at Meyringen, still talkative as ever, and his tones certifying that he came from the east of the Hudson; so far, the very beau-ideal of the American figured by tourists. Here, however, he piqued my curiosity by the very un-American act of abusing the supper, as well as by some peculiarity of expression; and, entering into further conversation with him, I found that this *undoubted* American was last from Thread and Needle Street, had been born and bred in the old country, and had not even trodden our republican soil. So much for national characteristics, which, like family peculiarities, may sometimes lead us to mistake the father for the son. . . .

Bache is not unmindful of the fact that he had first seen Switzerland while engaged in an educational mission. So he pays tribute to

the great reformer in education, Pestalozzi. At Yverdon, on the shores of Lake Neufchatel, in a castle erected for war, but turned to purposes of peace, he terminated his active, beneficent, but stormy life. He was the Bacon of education. Adhering rigidly to the laws of induction, he changed the very basis of the sciences. He combined those extraordinary qualities of the German character, simplicity, enthusiasm, rationalism, and its opposite, mysticism. As a practical teacher he has been surpassed by many of his followers, but he was undoubtedly the founder of a new school in education. Restless, and always

dissatisfied with the results of his efforts, he began many times afresh, and to the last, with renewed hope of entire success. . . .

One of the first steps of the new government was to reorganize and renovate public instruction. A visit to the normal school established by them must inspire bright anticipations of future improvement for the country. Patriotism, religious and moral feeling, and intelligence, are developed by precept and example in those who are hereafter to have the training of the Bernese youth. The industrious life of these future teachers, eleven hours being spent in the school-room in receiving or imparting instruction, their frugal fare, meat of any kind being placed before them but twice in each week, and their coarse clothing, are all shared with them by the director of the institution. Severe exercise in the open air, through the gymnastics so popular in Germany and Switzerland, counteracts, in a degree, the effect of this sedentary life upon their health. In addition to the branches usually cultivated in our schools, music is made a part of the teacher's education, that he may, in turn, give instruction in it to all his pupils. The effect produced by the deep toned and well tuned voices of the young teachers in this normal school, engaged in singing, *con amore*, some of the patriotic songs of their country, was one of the most moving that I ever experienced. What a fine material for republicans! was the remark of the counsellor of state who accompanied me, the echo of the very feeling which was thrilling through me. Close by this school is Hofwyl, the celebrated institution of Emmanuel Fellenberg. But to venture within its precincts would occupy you far longer than I am privileged to do. The system of this establishment, for it is not one school, but is composed of several schools of different grades, has served, in a degree, as a model for that of the canton, and has exerted a greater influence in and out of Switzerland than any other single institution in the world.

A century ago, if one had been asked to select a small part of the world where a federated republic would best succeed, he might easily have passed up the Swiss cantons as ripe for union. In the national chamber, Bache tells us,

members do not rise when addressing the chair, which has an awkward effect, and must be embarrassing to the lively delegates of the Italian and French cantons; but all minor embarrassments yield to that of the use of three different languages.

the French, German, and Italian, by members from the different cantons, while a majority of the deputies understand but one. A glance at these representatives will illustrate the difficulties of forming a Swiss union. What has the man of Tessin really in common with him of Geneva? The one is a Roman Catholic, the other a Calvinist; the one a republican of the most democratic shool, the other an aristocrat by principle, and perhaps by birth; the one is from a rough pastoral or agricultural district, the other from a city where the more refined mechanic arts flourish; the one from a small community, all the members of which are nearly equal in the means of life and education, the other from a town where wealth and education are very unequally distributed; the one in speech an Italian, the other a Frenchman. Again, what has the educated and polished professor of Lausanne, or the merchant and banker of Basle, in common with the peasant of Appenzele or the shepherd of Uri? With all these diversities they are brought together in part by a sentiment—the love of liberty; in part by a necessity —that of mutual defense. The progress of the cantons in education and the arts of life will doubtless draw their bonds gradually closer, and to have attempted a union in 1832 is to have laid the basis for it at some other time. Meanwhile the confederation, if it does not directly aid the cantons in their career of improvement, at least goes far to guarantee the continuation of that peace which is essential to progress. . . .

In the distance which separates us from them the minuter shades of character are lost. We do not discern the men of Geneva, of Vaud, of Berne, and of Zurich, but the men of Switzerland. Standing out from the picture, like the lofty summits of their own mountain chains, are the prominent characteristics of the people. Frugality, perseverance, hardy enterprise, high moral and religious feeling, lofty patriotism; these are the characteristics of the Swiss nation.

How far these noble qualities are the result of their political institutions, or whether the institutions owe their origin to these very qualities of the people, it is needless to inquire, since what greater praise can be awarded than the truth, that the institutions of Switzerland are in harmony with the free spirit of the people, and the spirit of the people with their noble republican institutions.

VII

AN ENVOY'S REPORT

It is difficult to sketch the state of American education in the eighteen-thirties, and this is not the place to attempt it. Suffice it to say that America was undergoing an educational revival or renaissance. It was trying to do its own tasks better, and it set itself to studying the educational institutions of the older lands in order to benefit by their experience.

Americans were eager for educational "plans." As early as 1796 the American Philosophical Society had offered a premium for the best essay on education in the new republic. The topic was "The Best System of Liberal Education and Literary Instruction, Adapted to the Genius of the Government of the United States." In December 1797 the award was given jointly to Samuel Knox of Bladensburg, Maryland, and Samuel Harrison Smith of Philadelphia. Both essays were published before the close of the century. They were comprehensive plans that called for a considerable degree of national control of education.

Three decades passed before active interest was taken in the work of European institutions. Especially influential then were reports by Victor Cousin, the French philosopher, on public instruction in Germany, and particularly in Prussia. Of these Bache had copies. An English translation of Cousin's report on education in Prussia was widely circulated in the United States. Another report that appeared in the thirties was an account of the Fellenberg plan in operation at Hofwyl in Switzerland by William C. Woodbridge, who had taught at Hofwyl for a year. Woodbridge is well known for his *Annals of Education.* Just after Bache had gone to Europe, Calvin E. Stowe made a report on the Prussian school system to the Ohio legislature, which several other state legislatures republished. Stowe also wrote a *Report on Elementary Education in Europe.* Prior to the 1830's, American educators' contacts with Europe had given

no marked results. Among others, Mrs. Emma Hart Willard, who became a leader in women's education, and Professor John Griscom, of New York, who published *A Year in Europe* in 1819, had visited European schools, but their reports left America unimpressed. Even Woodbridge's presentation of Pestalozzi to American readers in the third decade of the century had failed to create the interest that one would expect.

Some of these inspections and reports may, to be sure, have been much more superficial than Bache's. One student of education whom Bache visited had "an excellent collection of reports etc., and books in German, on education." Among them, according to the journal, was "a translation of M. Cousin's celebrated report with notes pointing out its errors and handling it sometimes without gloves." He spoke "in terms of high indignation of the mode of getting up this [Cousin's] report. Visiting a school—very well—any reports—the printed documents pocketed and off he goes. Thus in six weeks is Prussia run through and . . . the state of education there. Quel génie!"

The 1830's, Willard S. Elsbree reminds us in *The American Teacher,* represented

a period of agitation which, in America at least, seemed necessary for the launching of any important change in educational practice. Europe had experimented with teacher training for a century or more but the people of the United States were not alert to the importance of developing a specialized profession of teaching comparable to that of law, medicine, or the clergy. It was first necessary for some educational evangelists to spread the gospel.

The subject of teacher training interested Bache. He saw that the task was being performed well in much of Europe, and inadequately in the States. Among the evangelists for teacher training who preceded him were the Reverend Samuel R. Hall, Denison Olmstead, James T. Kingsley, the Reverend Thomas Gallaudet, and James G. Carter, all of New England. The principal of the Germantown Academy in Philadelphia, Walter

Johnson, urged such "professional seminaries" in a pamphlet published in 1825, Henry E. Wright in 1829 described his visits to teacher-training schools in northern Germany, William C. Woodbridge described the Prussian normal schools in 1831, and Henry Barnard and the Reverend Charles Brooks also studied them. Professor Robert Cunningham of Lafayette College published in 1839 a lecture in which he developed a plan for a normal school on the Prussian and European models. Indeed, the first normal school in America was launched in 1839. Bache's report of the same year showed that after his inspection of European schools he was a vigorous proponent of their teacher-training programs, and his position aroused much discussion in America.

In England, as elsewhere, Bache found much admiration for German education. While in England Bache wrote in his journal: "The learning of the British Universities was rated far below that of the German & in fact it was asserted that there (in Germany) the student reads in the Gymnasium what he reads at the Eng. Univ." There is now general recognition of the strong influence of the German universities on American higher education in the last century, and at the same time too little appreciation of the influence exerted in the past by German education in general. In *The Making of Our Middle Schools*, Elmer E. Brown tells us:

> The German example influenced our elementary schools, not so much in those days (the 1830's and 1840's) by any infusion of German methods, as by the suggestions of German organization and of the German provision for universality of instruction. In our secondary education, too, there was very little direct imitation of German models, but the stimulus of German excellence began to prick the American spirit of emulation.

Bache admired the German schools of a century ago. He liked their well-developed interest in scientific study, their program and methods of instruction, their disciplinary systems, their thoroughness and high standards, and their toleration that per-

mitted such dissimilar establishments as the *gymnasia* and the "real schools" to grow up side by side. The *gymnasia* were apparently not strongly regimented, and the supposed defects of their teachers are interestingly enough the defects that are charged today against American college and university teachers. He observes that the teaching methods employed by the English master in the Glasgow High School were among the best that he saw abroad and says that this teacher, who had traveled on the continent, had "especially studied the secret of the great success in the more modern German schools" and had followed out their methods. Bache agreed with other observers that Prussia was "decidedly in advance of the other larger German States in the education of the people," and he asserted that compared to the French the German secondary schools presented "a better matured and more finished system," but as a deterrent to making all wide-awake educators Germanophiles he made the important statement: "The means for supplying teachers for secondary instruction must, I think, be admitted, so far as the normal school is concerned, to be superior in France to those of Prussia."

European education probably had never had so young an American examine it with so thoroughgoing and so scientific an approach. He had carefully devised a set of questions to propound at each school and college which he visited, and he was also prepared to modify these questions "to suit the particular establishment." He assembled printed information useful for his visits, and this he read carefully, for he found even the authority Cousin wrong in a number of instances. Again and again, both in his *Report* and in his notes, he gives precise, analytical evaluations of the instruction that he saw in the classes which he visited. He employed somewhat mathematical, scientific means of measuring work, such as the hour of instruction which, despite criticism, is still a fairly good measure. The many corrections in his own manuscript, the re-draft in his own writing of many of his notes, and the numerous corrections in the notes of his amanuenses indicate his careful re-

view of the results of his visits. The attention given to business methods and purchasing procedures, greater in his notes than in his report, showed his interest in basically sound management in educational institutions.

Bache's eye from 1836 to 1838 was always upon the Girard College of the future with the thought that "we must raise our system upon the basis of the successful experiments of others, unless we would encounter the vexations incident to the acquisition of experience by our own failures." Bache must have talked about Girard College with the educational specialists whom he met in Europe. His notes say, for example, that Mr. de Fellenberg, the wealthy founder of the schools at Hofwyl, agreed "fully in the idea that the Girard School should be made a great industrial and agricultural school but inclines more to agriculture than to industry tho' he admits my reasons for the reverse."

Many of the Europeans whom he visited were already familiar with the Girard bequest and sometimes held contrasting opinions about it, as the journal reveals. An Irish Presbyterian, who was evidently opposed to large families as well as child-caring institutions and boarding schools, said that he was against

taking children from their parents and guardians to train them up in communities being of the opinion that in the bosom of their family or with foster parents they will do much better than when so pent up. Thinks that heaven ordained men to live in families; a few in each. A large number prevents the strong ties of love. . . . He promised me a pamphlet of his own on this subject.

At another extreme was an advanced student of education whom Bache went to see.

I visited Mr. Simpson this afternoon and received from him a written critique upon McClure's plan of education for the Girard College. He is quite severe upon it, sometimes unjustly as I explained to him because "the will" provides for just what McClure follows. Such as the admission of children at six years; which Simpson denounces. There must be *infant training*, or the institution can do no good.

An advocate of co-education to at least the age of fourteen was irritated by the exclusion of girls.

The non-existence of such an admixture and the age of admission into the Girard College he considers both serious obstacles to the training in it effectually. He would even have, if possible, girls supported at it by voluntary subscriptions, and infant schools subsidiary to it on the same footing.

The Provost of Trinity College, Professor Lloyd, who possessed what Bache calls "a genuine Hibernian face" and whom Ency called "Light and Vision and Mechanics Lloyd" because of his interests and reputation, was quite sure of what the new school should attempt.

Lloyd made some remarks to me tonight which must sink deep, coming from a learned, an aged, & experienced man. Do not trammel yourself with antiquated forms, we have too many with us. What did very well a generation since is antiquated now. You must have a splendid institution meeting the wants of the age.—If we can get good models,—You must be a model to us not we to you.

A few days later the Provost "repeated his good advice on the subject of not trammeling the Girard College."

Another expert whom he visited expressed the hope that

they will make it a splendid model institution not aiming to support the greatest number of children but to give the best possible education to those whom they do support. To pay the teachers well & get first rate ones. To make of it a great normal school, which all I could assure him were in *full* contemplation.

To be sure, each person saw the Girard plan in the light of his own experience and philosophy. Bache talked with some Scotch divines. "They all are pleased with the idea that 'the bible' is to be made the basis of inculcating the 'principles of pure morality' in the Girard College and yet how few would agree with me when I come to administer it. I fear so."

Visits to some schools exemplified for him what he wished to avoid. One such was an orphan colony in Holland.

Our visit to this establishment was a cursory one, but it was easy to see that its object was totally different from that which will direct our establishment and I did not feel warranted in stopping longer. The children are treated on the wholesale plan and the greatest number are to be educated at the least possible expense.

When Bache left America in September 1836 on his mission, he had already acquainted himself with the reports of those who had broken the ground. To Cousin he was especially indebted. Before his return in October 1838, Bache studied more than 278 schools in the British Isles, France, Switzerland, Belgium, Holland, Italy, and the several German states, including Austria. His stops were very brief at some and occupied several days at others. He visited even a school for the deaf and dumb, as Horace Mann did a few years later, and he says in his notes: "The result of this visit has confirmed the impression which I had that from the efforts necessary in the instruction of those deprived of some one or more senses many valuable hints for the teaching those who have all might be derived."

He brought back his journals, rough notes and more carefully prepared notes for his report, books on education, textbooks, scientific apparatus and instruments, models of machines, and a large mass of documents. In the Appendix to the *Report* he lists 530 such documents, including items on educational legislation, school organization and administration, lists of textbooks, courses of study, school regulations, educational philosophy, examination questions, institutional prospectuses, institutional reports, catalogues of school staffs and students, catalogues of alumni with their occupations, professorial lectures, subject methods, school histories, school schedules, specimens of students' work, and educational statistics. In writing his report it was necessary for him to omit reference to many of the schools that he visited and to make "a very close selection" from his material in order to confine it "within any reasonable limits." Nevertheless, when he finished in the winter of 1838–39 the monumental *Report on Education in Europe* which was

published the following spring, it was a document that required an octavo volume of 666 pages. No one could have made the study of European education under more favorable circumstances. The resulting report was the most complete thing of its kind, a masterpiece of educational research and compilation.

Yet one would seek in it in vain for Bache's plan for Girard College. The report was to "enable the Trustees of the Girard College to examine, by the light of experience, the plan which it has been made my duty, at a future time, to present to them for that institution." As a matter of fact, Bache believed in "the gradual organization of an institution" and in "the propriety of leaving the regulations relating to details to be tried in the actual circumstances of the establishment before enacting them into laws." "The wish to begin an institution," he says, "on a scale commensurate with its future entire organization, is a natural one, but it should yield to the lessons of experience, which have everywhere shown that a small beginning is preferable." This does not mean that Bache did not bring energy and enthusiasm to his plan-making. "The trustees of the College," he comments, "have appealed to the experience of Europe to furnish data necessarily wanting in a new country, and it remains for them to apply the experimental deductions thus obtained from the old world with the vigour characteristic of the new."

Such is Bache's interpretation of the task to which he addressed himself. In this *Report on Education in Europe* and in several smaller documents, including those related to the work of the public schools, he reveals his sympathies and conclusions in the field of education. By nature Bache was forward-looking and interested in educational experiments and new methods. For his time, he paid unusual attention to some neglected features of education, such as the playground that he calls the "uncovered school." Yet he recognized "the odium usually attaching to innovation" and resented the fact "that what is an established system in one country, should by many be considered as an innovation of doubtful expediency" in another. Moreover,

he knew that education, like medicine, could have a great deal of sham and bluff in it. In his journal he referred to a school of somewhat advanced type as "an experiment and so far quite a successful one. How much quackery and how much of good is in it I know not. . . ."

Like Quintilian and many other educators through the centuries, Bache made a strong point of individual differences and felt that differentiated curricula should be provided, that "different trains of instruction" should be pursued according to the students' "mental development and probable pursuits in after life," and that "different kinds of education are suited to different objects in life." Along with others he anticipated questions of guidance, the phase of education in which the individual approach is emphasized. He favored as a substitute for the formal report to parents a written statement of progress and conduct of the "anecdotal report" type that he found in a school in Berlin. He noted some things in European schools that we now take for granted, such as natural history societies. He thought that the test by which schools are judged on the college success of their graduates was "essentially defective" and also opposed the measurement of a school's worth by the conspicuous success of a few distinguished alumni.

Since Bache was interested in the individual approach he would, of course, oppose the system of mass education or mutual instruction associated with the names "Lancasterian," "Bell," and "Madras," and he considered this type of instruction "a very unadvanced grade of public education" that was inexpensive but desirable only where nothing better was possible. He thought monitorial systems were doomed to have only limited success, and he also opposed advanced forms of student self-government, though he felt that boys must be made to assume responsibility within reasonable limits and strongly endorsed the performance of chores by students, sometimes called in our day the self-help plan.

The inescapable problem of discipline challenged his attention, to be sure. His notes reveal that he witnessed a strong re-

proof administered by the head of a Parisian institution of higher learning to a refractory student. "His manner in truth was somewhat stern, & he expressed to me the opinion that mild means would not always regulate especially as society is now constituted. . . ." This is written in 1837, not many decades after the French Revolution and the period of Napoleon. He made an interesting note on instruction at Belfast Academy that he doubtless thought applied also to the administration of discipline.

The old system assumes that children are wild beasts; the new one supposes them to be men; the system of the Academy takes them up as what they really are—children,—beings who possess rational faculties, but in whom those faculties are not yet fully developed—who can reason, but need as yet the guidance of those more experienced than themselves to teach them how to reason correctly, and to shew them their mistakes when they reason erroneously.

Bache himself thought that discipline ought to be based on "the Christian law of love . . . in school, if we would have it practised in society." He disapproved of fagging and any demerit system, used "mild" as a word of commendation in relation to discipline, and disliked useless regimentation. In his *Report to the Committee of Controllers of the Public Schools on the Organization of a High School for Girls*, he sums up his attitude toward discipline:

The authority of the teacher being a portion of that of the parent, and delegated for the time being to him, the parental relation should, as far as possible, exist in a school. This relation should form the basis of moral discipline, and in proportion as it is recognised by both teacher and pupil, the task of each is lightened. . . . When rightly applied, it no more leads to loose discipline, than does the exercise of a kindly affection in the family relations. The necessity of a rigid adherence to the rules enacted for the general welfare, is easily seen by a child, even before reaching the age of a pupil in the High School. The strictest discipline is, in my opinion, consistent with kindness of feeling and mildness of action. Punishments are, no doubt, necessary in a school; and the good sense of a community of

young people recognises, at once, when punishment is applied as a means of correcting bad habits and propensities; or when administered in the spirit of revenge.

It is interesting to note that Bache favored male supervision for older boys and such a division of labor among the educational staff as the present unique provision for separate school faculties and household officers at Girard College.

Bache's ideas of moral education were also in line with those expressed in the Will of Stephen Girard and with the later program carried out by Girard College. Here and in the more formal biblical instruction Bache searched for whatever might be adapted to Girard College. In Holland he found "an important experiment in communicating religious without sectarian instruction" which he would doubtless have employed had circumstances permitted, since the Girard Will excludes clergymen from the campus.

For classroom instruction Bache favored the inductive rather than the routine method. He says:

The inductive method applied to any branch of knowledge requires time, patience, and some skill on the part of the teacher. The routine method, or positive teaching, is much easier to the instructor. The former at every step unfolds the mind, the latter frequently overburthens it. If the positive knowledge acquired by the first is entirely lost, the habit of thinking remains, while, if acquired by the second there is nothing left unless some improvement of memory, and general development of the reasoning powers.

He becomes more definite in discussing a school in Berlin:

The methods of instruction in this school are, in general, most excellent, and I was particularly struck with the small number of text-books employed. This is not peculiar, however, to this establishment, but is a feature in every good school in Germany. The master is expected to be so fully imbued with his subject, and expert in his art, as to be able to impart knowledge principally orally to his pupils, and in such a way as to adapt it to each individual; hence books are chiefly required for study at home, and individual training is possible to an extent which no routine system with books would permit.

As a good teacher Bache believed in the importance of good organization in a school. Referring in his *Report* to an institution in Hamburg, he says: "An efficient teacher may supply many deficiencies in a plan, but there are some cases, of which this is one, in which a defective organization places the remedy beyond the teacher's reach." Such an observation as this is based characteristically upon much detailed study. It would appear that Bache, despite his experience in the immediate past as a university teacher, was capable of giving unusual attention to detail when he went on his educational mission, though the foreign schools that he examined were on the elementary and secondary levels. Occasionally the details are so full as to be humorous, as when he mentions the fact that at one school the nine female servants have as one of their tasks "washing the feet of all the boys once a week."

Although he personally knew little about the training of young children, Bache found great interest in "infant schools," the best of which were at Glasgow, Edinburgh, and London, and in elementary schools. Schools of the last type in Great Britain were inferior, he thought, to those in Germany and elsewhere. At all events, Bache realized the importance of elementary education, he was aware of the forces at work in this field, especially Pestalozzi, and he sought up-to-date elementary methods. At Bayreuth, a north Bavarian city now associated in our minds with Wagner Festivals, he visited Dr. Graser, who had introduced in some of the German elementary schools a system of education not unlike the modern American system of elementary instruction.

It is interesting to note how Bache used his European observations in his appraisal of American elementary education. After examining the public schools of Lancaster, Pennsylvania, in 1840, he wrote to Henry Barnard:

The attainments which are most attractive to parents, because they can best enter into their merits, or because *they* were so taught, have caused proficiency in reading to be the main object aimed at in these, as in many other, primary schools, and

hence the admirable *training of the senses* so important and well adapted to pupils of the age of these, is hardly practised, and lessons on objects, as part of this training, are omitted.

Lancaster had some women teachers, and of this recent innovation Bache said: "This employment of females as teachers is of the utmost importance to our country, & I am not aware that the experiment has failed in any case when it has been fairly tried." The school board of Lancaster followed an expert's recommendations, and this led Bache to observe:

Education is one of the few subjects in regard to which men do not yet resort for advice to those who make it their study and profession. Few persons claiming to be enlightened go to those unlearned in medicine for advice; & still fewer do not resort to the lawyer when litigation is to be commenced or avoided, but every one erects himself into a judge of what may be taught in schools & how it must be taught, though education affects both the temporal & eternal interests of the recipient.

So far as Latin and Greek and higher mathematics as the core of all secondary education were concerned, Bache was skeptical, saying:

I am far from being one of those who undervalue classical culture, but I am convinced that to be at all effective it must be thorough, that it cannot be thorough when the instruction is terminated at an early age, and that there are certain minds very little or not at all improvable by language, as there are others similarly related to mathematical studies.

He thought "the amount of intellectual culture to be gained by the exercises of arithmetic and algebra . . . to be undervalued," but the aptitude and the future of the student had to be studied before he should enter higher mathematical studies. In believing that a modernized classical course was needed, and that "the exclusion of all, or nearly all, that characterizes modern civilization, brings discredit upon the system, and the worst foes of the legitimate use of classical culture are those who profess to be its best friends"—in believing this, he saw eye to eye with Thomas Arnold of Rugby, which was, Bache held, superior to

Harrow. In the appendix to his report he quoted Arnold at length on the study of classics and of history, and he even speculated on the making of a series of liberally illustrated textbooks according to Arnold's plans. Even this admiration for Arnold did not cause him to forget his initial resentment when he visited Rugby and discovered that he would not be admitted to any classes, a prohibition which he found existed at other public schools in England.

When Bache thought it over, he saw ample reasons why the English temperament would discourage educational intruders. Yet somehow the prohibition spoiled his educational grand tour, for these so-called "public schools" like Rugby were already well known. It hurt his pride in the missionary nature of his trip that he could not take back to America something of the classroom experiences of these English schools. He knew that American educators were avid for just this sort of information.

Probably the reviewer of the *Report* in the Journal of Bache's own Franklin Institute reflected the sentiment of some American students of education when he wrote:

> In particular sections of the United States the most laudable efforts are unquestionably in operation to elevate the standard of common schools and academies to the highest point of philanthropic ambition; but whoever reads attentively the volume before us must make the acknowledgment, however painful to his *amor patriae*, that in no part of our favoured land is the science of education fully understood, and its precepts carried into practical operation. The main reason is that little or nothing has been done to educate those who are to become the educators of the people. . . .
>
> This subject we know is beginning to claim attention in several of the States, and we regard it as the earnest of a spirit of higher importance to the welfare of the country, than any thing within the whole range of politics, trade, or other matters relating to mere physical improvement. It is in this point of view especially, that we could wish the Report of President Bache placed in the hands of every teacher and manager of schools throughout the country. It will show them at what an

unimagined distance we are still behind, in spirit and advancement, the educational institutions of some parts of Europe; and yet with what an accelerated motion, with the means and appliances in our possession, we may follow on in the track of a noble rivalship, and the acquirement of a distinction as flattering to the moral strength of the nation as its ships, factories, and railroads are to its intellectual and physical energies.

That American education has acquired something of the distinction that was wished for it is due in no small part to Bache and the other pioneers of a century ago.

The immediate effects of Bache's study of European education are to be seen in Philadelphia, to be sure, but he also made a considerable contribution to the movement then current that was brought to a focus in the famous *Seventh Annual Report* written by Horace Mann in his capacity of Secretary of the Massachusetts Board of Education. Paul Monroe calls Mann "an ardent patriot, an experienced politician and public administrator, a keen observer, an energetic reformer, and the wielder of a trenchant pen." Monroe's summary of Mann's influence recalls much for which Bache himself stood:

His forceful statement was followed up by yet more forceful practical endeavour. The abolition of corporal punishment, the introduction of an enriched curriculum, the training of teachers, the adoption of methods based on a scientific knowledge of the human mind, the proper classification of school children, the elaboration of the public school system to include many if not all of the quasi-public organizations so numerous in America—these were his demands. The effect of all of the efforts to borrow lessons from European, particularly German, experience was thoroughly in evidence.

This seventh of the twelve annual reports of Mann gave an account of his educational tour of Europe which required six months in 1843. This was four years after the publication of Bache's *Report,* which Mann probably read with great thoroughness in preparation for his own journey. Like Bache, Mann took his wife with him, for he had married a teacher in the spring and the subsequent trip was in the nature of a wedding

journey. This *Report* for 1843 also dealt with Mann's ideas about corporal punishment and the harm of excessive cultivation of the verbal memory. The *Report* for 1844 also dealt with several topics that had been discussed by Bache, including women teachers, normal schools, and the study of vocal music. In 1845 he followed Pestalozzi and Bache in asking for the substitution of induction for deduction in teaching. It is to be noted that Mann subscribed to Bache's admiration for German education. He even earned a nickname, "the Prussian."

Bache's *Report* was well received. One man who read it from cover to cover, and who took a trip in 1845 similar to those of Bache and Mann, was Henry Barnard, who has been called the Horace Mann of Connecticut. Barnard is remembered as the editor of the *American Journal of Education* which claimed a good portion of his life and his private fortune, and in whose monumental thirty-one volumes, each of more than eight hundred pages, were preserved rich material that would otherwise have been lost.

When Barnard and others wrote enthusiastically of the *Report,* Bache was even tempted to issue it in abridged form for wider consumption. He wrote to Barnard in 1840:

> The labor of preparing it would have been more than compensated by the remarks which it has elicited from those engaged in the cause of education. Soon after the first distribution of the Report I was advised to put it in a more popular form for general circulation, and had intended as soon as the present monetary embarrassments which oppress me had ceased in any degree to propose to one of our booksellers to undertake the publication.

One would expect Bache's friend Joseph Henry to be somewhat prejudiced, of course, but he tells us after Bache's death that in his opinion Bache's *Report on Education in Europe* "has done more, perhaps, to improve the theory and art of education in this country than any other work ever published; and it has effected this not alone by the statement of facts derived from

observation, but also by the inferences and suggestions with which it abounds."

Bache knew that his *Report* could have a large usefulness. "If this account," he says, "should further contribute to awaken attention in our schools to improvements which have been introduced abroad, I am sure that the trustees of the Girard College will feel gratified at this useful result of their measures." But "the personal experience gained by my tour will," he says in the Introduction, "as far as the Girard College is concerned, be its most important result." Analogies to the Girard College to be established under the Girard Will must have suggested themselves: the avowed purpose of a school in Berlin that "not mere words should be taught to the pupils, but realities, explanations being made to them from nature, from models and plans, and of subjects calculated to be useful in after life" must have recalled to Bache the words of Girard: "I would have them taught facts and things, rather than words or signs."

VIII

THE PHILADELPHIA CENTRAL HIGH SCHOOL

In the notes which he used in writing his *Report on Education in Europe* Bache mentioned his visit to George Watson's Hospital in Edinburgh. "The headmaster," he said, "is quite a young man probably not more than 27." Bache was looking at this gentleman from the vantage of the next decade, for he was thirty! His election to the presidency of Girard College on his thirtieth birthday had saved him from whatever embarrassment might have arisen from his being a school head in his twenties.

Bache was young, to be sure, but no older man of his day could have employed a more scientific approach to his task. His training and experience had been scientific. The Girard College that was to be, and for which he was making these elaborate preparations, would to no small degree be a technical school. He wanted to supply concrete, mathematical information; he desired to make analyses that were quantitative and not merely qualitative. He even had some genuinely scientific objectives, for he had been instructed to bring back "models, drawings, and such philosophical instruments as may be necessary or useful in opening the College."

It was this quest for instruments, oddly enough, that first gave him the information about the new Central High School that was to be opened in Philadelphia. Bache tells us:

I visited at Munich the great workshops for astronomical instruments established there by Fraunhofer and continued at that time by Merz & Mahler. Mr. Merz inquired if I knew the Justice of the Philadelphia High School who had ordered a large class equatorial telescope and other instruments for the observatory of the institution. Here was truly a surprise. A new institution had sprung up since my departure from home, and with a policy worthy of our city an observatory had been established in connection with it which was to be supplied with instruments of a

high grade. The days of Rittenhouse and Lukens and Owen Biddle were to be reinaugurated in connection with a public school. This "Justice" whom the worthy artist supposed to be some high functionary of the school was George M. Justice, one of the Committee of the High School and a leader in this truly commendable enterprise.

The very month that Bache arrived home, October 1838, the Central High School of Philadelphia, the first public high school outside the New England states, was opened. It was on the east side of Juniper Street below Market Street on part of the site on which the John Wanamaker store now stands. Its beautiful Ionic portico looked out on Centre Square where City Hall was to be built. People considered the building one of the ornaments of the city. It and the school that it housed were certainly modern, and Philadelphia had for them high hopes that were fortunately to be realized.

The beginning was small, for the school opened with only four professors, as they were then called, and sixty-three students. More surprising was the fact that the institution ran for its entire first year without a head. Here Bache saw his opportunity to be of service and to organize a school according to the principles that his trip had so recently enabled him to formulate. The buildings at Girard College were far from being ready and, though his salary was continued, he had but little work to do as President. By accepting the headship of the new high school he could try out his ideas, and at the same time discharge his obligation to the city to which Girard had left his bequest.

It happened that the High School Committee of the Controllers of Public Schools needed help. The Committee, of which George M. Justice was a member, made the following report to the Controllers, indicating that they sought the assistance of Bache as the Philadelphian best qualified to render it:

After the experience of one year in attending to the duties devolving on the Committee since the School was opened, they

have unanimously concluded that an improvement in the system of education, as at present pursued there, may be made. In this view the Professors also concur. To perfect this, as far as circumstances would permit, and still further to add to the usefulness of the school, your Committee sought a conference with our fellow-citizen, Alexander Dallas Bache, President of the Girard College, for the purpose of gaining such information as he might be disposed to impart to them on the subject.

The Committee feel gratified in stating that he promptly responded to their application, with the offer of his personal services in carrying out a system which might be agreed upon by himself and the Committee, under the direction of this Board, should the application of the Committee be sanctioned, but with this express understanding, that all his services would be rendered as President of the Girard College, and under the approbation and permission of the Board of Trustees of that institution. This permission has been officially communicated to your Committee, and now only waits for the sanction of the Controllers to complete the arrangement.

The unexpected offer of Professor Bache's personal aid, so far as it does not interfere with his duties at the Girard College, and the highly honourable ground of declining to receive a compensation for any services he may render to this Board, inasmuch as he is already employed and paid by the citizens of Philadelphia, cannot but be, your Committee think, acceptable to the Controllers; and they trust the usefulness and popularity of the School will be increased by calling in the aid of one who has been selected for so important a station as that of President of the Girard College, whilst at the same time the Controllers will have the satisfaction of knowing they have secured to the Public School System of the City and County, the talents of one so well calculated to promote and extend its usefulness. Your Committee, therefore, offer the following resolution:

Resolved, That the Committee on the High School be authorized to accept the services of Professor Alexander D. Bache, in introducing such change of the system of education, now in use there, as he and the Committee may deem expedient, and that the Committee have full power to convey to Alexander D. Bache all needful authority in the premises.

In November 1839 Bache was made the first head of the Central High School. Losing no time, he submitted on Decem-

ber 10, 1839, to the High School Committee a report on the reorganization of the High School containing long extracts from his *Report on Education in Europe* which had been published earlier in the year. The educational philosophy is in accord with that which Bache had developed at greater length in the earlier document.

Again he turned to Prussia, and praised its system of secondary instruction. His plan was to have the Central High School combine in its curriculum both the Prussian *gymnasium* and the *realschule*. In Prussia, he said, boys

intended for the learned professions, or to whose pursuits parents wish to give such a direction, are appropriately educated in the thorough classical courses of the gymnasia, while those intended for occupations connected with the mechanic arts, manufactures, or commerce, pass the corresponding period in the study of science and the modern languages, in the institutions called "real schools." This system has found much favour, and the real schools are on the increase in Germany, and are spreading into other countries. It is no new experiment, having originated as early as 1747, and made its way slowly into favour among a people not addicted to change. It is remarkable that a plan, founded upon the same leading idea which gave rise to the establishment of "real schools," was proposed by Dr. Franklin, as the basis of the Philadelphia Academy.

Several years ago Dr. John L. Haney, then President of the High School, remarked:

Those not familiar with Central High School are apt to look upon it as a kind of rigorous classical academy which for nearly a century has prepared young men for college by drilling them exclusively in Latin, Greek, mathematics and kindred subjects. It was never that, not in the days of Alexander Dallas Bache, who drew up the first plan for the operation of the school, nor in the brilliant administration of John Seely Hart, his accomplished successor.

Hart had been a Professor of Languages at the institution that later became Princeton University, and Bache did not have complete confidence in him. Doubtless he felt that Hart was

not sufficiently progressive, and on one occasion he wrote of him to a friend: "He mistakes I think his true course & the true dignity of the High School & its mission. And he will one day find this out."

At all events, the fact has been overlooked that the Middle Atlantic States possessed two educational institutions that in their beginnings represented marked advances in American education. Both were in Philadelphia. The University of Pennsylvania, founded two centuries ago by Benjamin Franklin, though shaped by Provost William Smith, and the Central High School of Philadelphia, given character less than a century later by Franklin's great-grandson, Alexander Dallas Bache, were institutions that were departures from tradition, more utilitarian than their neighbors, more interested in training students in the mother tongue, more concerned with what we now think of as the sciences and the social studies, and, of course, freed from the restricting influences of theology and sectarianism.

School libraries of the sort that we now know are of relatively recent growth. In this connection a paragraph from Bache's report to the High School Committee is significant:

> The creation of a select library for the use of the teachers, as well as of the pupils, is a most important object. Every institution should furnish, from motives of interest as well as of justice to the teachers connected with it, the means of improvement in the science and art of instruction, and in the branches to which they are devoted, the expense of works connected with which is often a serious obstacle to furnishing them for a private library. It is particularly important in the High-school, also, to establish a library for the pupils, a large proportion of whom will otherwise be without this important means of acquiring information, and of cultivating a taste for reading.

A unique copy of the catalogue of the Central High School for 1841, now in the Library of Congress, shows that in his administration Bache had built up a school library of over one thousand volumes, certainly one of the earliest and largest

school libraries of a century ago. Bache had previously built up for Girard College a library of about the same size. It was probably inferior to the book collection at the High School as a school library but superior as a pedagogical and as a technological library since it contained the books that Bache had brought back from Europe. Including journals, but eliminating duplications and its many pamphlets, we find that the Girard College Library had more than 550 volumes in English, more than 600 in German, and approximately 300 in French and Italian. It was naturally scientific and mathematical, but it contained a surprisingly large number of books on the ancient languages and civilizations.

The three courses that Bache recommended for the high school were a principal course of four years without classical languages, a classical course of four years, and an elementary or English course of two years for those who could spend only that length of time. The proposal probably represented a compromise. "It was not so much what he wanted," says Dr. Robert Ellis Thompson, "as what he saw he could get." In any case, the Controllers approved his proposals at once, and directed that they should be effective on January 3, 1840, immediately after the Christmas vacation.

In their annual report the School Controllers said:

Early in the year . . . the Board was favoured by the co-operation of a powerful and highly gifted auxiliary. Alexander Dallas Bache, President of the Girard College, whilst awaiting the period of more active duties in that institution, with the concurrence of the Trustees of the College, volunteered his services as Acting Principal of the High School, without compensation. For more than a year past, this gentleman, whose distinguished qualifications and high attainments are too familiar to his fellow-citizens to require or permit notice or eulogy here, has devoted himself, with unwearied industry, to the organization and improvement of the new institution in which he has taken so deep an interest. To his assiduity, his clear and practical views, and to his close familiarity with the best models of this and other countries, the Controllers are indebted for the present improved condition of the High School.

Bache's interest in physical education and in the playground as the "uncovered school" is reflected in the following paragraph from the same report of the Controllers:

Under the recommendation of Professor Bache, a valuable addition has been made to the comfort and health, as well as to the amusement of the pupils, in the establishment of an extensive play-ground for gymnastic exercises. For this purpose, a spacious lot, adjacent to the High School, has been leased for a term of years.

A controversy arose between the City Councils and the Trustees of Girard College, who were appointed at that time by the Councils, concerning the management of the affairs of the College. Money was a natural bone of contention. Among other grievances the Councils criticized Bache's traveling expenses totaling $7,219.66 for his journey of twenty-six months, and his expenditure of $5,278.51 for books, models, scientific apparatus, and other equipment. Bache had tried to keep down these expenditures. In the first few months of his trip he wrote in his journal: "It is hard for persons who at home think little about money matters to turn regular recorders of shillings but I feel all the time that my personal expenses are coming out of the Girard fund & I hate to spend."

On the other hand, the city had been dipping into the estate of Stephen Girard, and the words of a critic, probably Nicholas Biddle himself, present the situation: "Unhappily the city, pressed by its wants, or misapprehending its duty, used the income all for the purposes of the city, instead of accumulating it for the benefit of the College—a great injustice which the city should hereafter be compelled to repair." A depression had followed the Panic of 1837. It was a bad financial period for the city. A letter of Bache to Thomas Dunlap, President of the School Controllers, dated November 16, 1840, shows that the city still owed him $1,500.

The Trustees had planned to open Girard College on Bache's return in October 1838, before the completion of the buildings. Legal opinion intervened, however, with a ruling that the

school could not be opened before the completion of its buildings according to the provisions of the Will. In 1840 the Councils pointed out that the services of President Bache, who had already interested himself in the public schools, would not be needed at the College for several years. A year and a half later the Councils abolished the Board of Trustees and the presidency of the College. But Bache had anticipated their action and had already been engaged in public school work for almost a year when on September 16, 1840, he wrote a letter resigning from a position which he had never really filled, but for which he had made unusually complete preparations. In the autumn of 1840 he terminated his official relations with the College, gave even more of his time to the work assigned him by the Philadelphia School Controllers, who, of course, depended on the Councils for funds, and began to receive a salary directly from them.

Despite the apparent acrimony of the controversy Bache was highly regarded by everyone involved. The Councils expressed by resolution their appreciation of his "important services to education as president of the College," and requested him to continue in charge of the equipment and books which he had gathered together, much of it in Europe, for the use of the College. This arrangement permitted him to supervise the work of the Magnetic Observatory and to continue its operation even after he made Washington his home. The salary from the Controllers of the public schools was a considerably lower salary than he had been receiving, and Bache's financial position was not such that he could neglect this mundane matter entirely.

Bache was doubtless in demand for addresses when he returned to Philadelphia, but our records of his activities are far from complete. He renewed his connections with the American Philosophical Society and other scientific organizations, to be sure. We know that in 1839 he undertook some lectures in old Musical Fund Hall for the Athenian Institute and that he also participated in the National Convention for the Promotion of

Popular Education held in Philadelphia. But we know also that the affairs of the High School kept him busy. It was a school that was attracting attention. Horace Mann and Henry Barnard were among the distinguished visitors who came to see what it was doing.

So pleased were the Controllers with the help that Bache had given them with the new High School that they insisted upon his assuming in 1841 the general superintendency of the city schools. In this capacity he served for one year. He had already been obliged to present a report on the *Organization of a High School for Girls, and Seminary for Female Teachers* to which he had attached extracts from his *Report on Education in Europe* dealing with normal schools. His recommendations were not immediately adopted, but they later led to the establishment of the well-known Philadelphia High School for Girls and the but recently discontinued Philadelphia Normal School, which served the city well during a period when it was much needed.

A surprising feature of his plan for the high school for girls was that it excluded foreign languages. Again, as in his main *Report* and in the *Report on the Reorganization of the Central High School,* he stressed the importance of training in vocal music. "There are several grounds upon which I would recommend the introduction of Vocal Music," he says.

First, as a part of physical education, calculated to strengthen the lungs, throat, etc., and to give flexibility to the organs of voice. Second; on account of its moral influence *in the school* from the effects of harmony and the associations of the feelings produced by it with the sentiments conveyed in appropriately selected words. Third; from the tendency *out of school* to substitute proper for improper songs. Singing will be practised, whether taught at school or not; and it is important to improve the taste beyond the point at which vulgar melodies, and coarse words, will give pleasure.

Musical education has, of course, traveled a long way since Bache engaged in this pioneering.

Bache spent three years in the public schools of Philadelphia, most of his time being devoted to the Central High School and its complete organization or reorganization. As was to be expected, its curricula emphasized the sciences and training in the vernacular. Expensive scientific equipment was purchased, especially for the astronomical observatory. Several years ago Dr. Cheesman A. Herrick, who wrote the *History of Girard College* while serving as its president, said: "While Bache did not work out in detail the educational scheme for Girard College, we may accept the plan which he did work out for the Central High School as an indication of what he would have done, had he actually begun the work at the College." We may assume this from what Bache himself says, despite a confusion of dates. Answering the question of a correspondent in Philadelphia, he wrote in 1857:

I returned from Europe in 1838 having spent two years there in examining the schools. . . . The results are given in my report on Education in Europe, printed by the Board of Trustees and formed the basis of the organization of the Central High School of Philadelphia of which I was principal, while President of the Girard College in 1840 and 1841.

Dr. Robert Ellis Thompson, President of the Central High School from 1894 to 1920, stated in an unpublished history of the school that Bache gave it character. "His influence upon the school," observes Dr. Thompson, "corresponded to his hearty, cheerful, courageous English temperament. . . . He illustrated the qualities he sought to foster." Dr. Thompson had not known Bache, of course, but a man who wrote engagingly about the school in a Philadelphia newspaper in 1859 under the nom de plume "Alumnus" said of its first head:

There hung about the motions of his large body a smooth and persuading courage, which made him the acknowledged master of his professors and pupils the moment he appeared. He was a healthy and hearty lover of life, and the constant cheerfulness with which he moved through the dull routine of the roster, coupled with the broad, perpetual humor in his

countenance, indicated that he was a natural lover of his kind, and that he was of the true stamp to be a beloved leader of the young.

The first head of the High School was interested in his boys and tried to help many of them. One of them sat in his office and talked with him about books and his love of books. The conversation revealed that the boy lacked money to buy his lunch. The Library Company of Philadelphia came to Bache's mind, so he turned to his desk and penned a note to John J. Smith, Jr., whom he addressed as "Librarian, City Library":

Allow me to introduce to you my young friend Joseph Ruth a very deserving pupil of our High School: he is very desirous to obtain some place as assistant in a Library, that he may be *among books* and receive a small stipend. If any such is in your gift or within the scope of your influence will you aid my young friend?

This "young friend," Joseph T. W. Ruth, and other Central High School graduates were later appointed by Bache to the Coast Survey and won distinction in it. Among them were Alexander M. Harrisson, James S. Lawson, George S. McMurtrie, and the outstanding member of the group, George Davidson.

Bache succeeded as a "leader of the young" by illustrating "the qualities he sought to foster in them." Students remembered him. It was not his fault that his feet could be heard and that, as revealed by Zephaniah Hopper, a member of the second class of the school, and one of its teachers for fifty-nine years from 1854 to 1913,

whenever he thought it necessary to visit the class-rooms, many of which were situated on the upper floors, students had ample warning of his approach; as we all could hear his footsteps as he rapidly ascended the staircase, and we prepared to receive him with the most exemplary behavior.

Dr. Thompson refers to his training:

He was loyal to West Point, and tried to convey to the School what good he had found there. He would have her graduates loyal to the Central High School, and advised them to form an

association of her alumni, to keep her spirit alive in them by yearly meetings and addresses.

Bache's last official appearance as head of the school was at its first commencement on July 14, 1842, over which he presided. The commencement was held in the school building, and twenty-five young men who had completed the full course and one who had finished a partial course received certificates. Zephaniah Hopper was really a member of the second class, but he and several of his classmates were graduated with the first class. Bache addressed the class, and at the conclusion of the exercises the graduates immediately formed an alumni organization. For some years Bache Institute of Philadelphia, an organization of alumni origin which was incorporated in Pennsylvania in 1851, commemorated his name. Many years later the Associated Alumni of the High School, recalling Bache's position in science, endowed the Alexander Dallas Bache Physics Prize, which consists of a substantial sum awarded to the member of each graduating class "whose average in physics shall be the highest."

The *Report* of 1839 to the Trustees of Girard College had drawn an interesting picture of European education. It also reveals what American education was and serves to remind us what great changes in curricula and subject syllabi a fast-moving century has brought about. This can be traced in the history of the Central High School, though only the matter of choice of courses need be mentioned. Bache had given Central a choice of three courses, and even this arrangement probably represented a compromise of his plans, as Dr. Thompson says. The latter states that in succeeding presidencies the school sank "into a uniformity of curriculum which compelled every student to take the same course." This uniformity ended with Dr. Thompson's predecessor, Henry Clark Johnson, who was President from 1888 to 1893. Johnson's plan gave five choices. This liberality of selection was doubtless the main reason why Johnson's administration was "regarded as a period of sweeping innovations, which threatened the historical identity of

the School. As a matter of fact the changes made in his term were chiefly of restoration of what had been established by Professor A. Dallas Bache in the beginning." Truly Bache "gave character to the High School."

It is to be regretted that circumstances did not permit him to leave his influence upon Girard College. If the civic authorities and the members of its early boards of control had had the cosmopolitan spirit and the broad vision of Bache, a spirit and a vision that Girard himself would have applauded, Girard College would not have waited a half-century to take its rightful place among America's great schools, and it would long have enjoyed a wide reputation commensurate with its size and resources and the importance of its work.

The loss of Bache sustained by Girard College, a unique school, became the gain of another unique institution, the Central High School of Philadelphia. Here again it was unfortunate that the High School could not have had Bache's influence and leadership for a longer period.

With this discussion of curricula in mind it may not be inapropos to refer to a section of the autobiographical material dictated in the last year of his long life by Jefferson Davis, which Mrs. Davis included in her memoir of her husband:

> Among the cadets then and subsequently distinguished was Alexander D. Bache, the head of the first or graduating class, when I entered the Academy. . . . He had a power of demonstration beyond that of any man I ever heard; so much so that, by way of illustration, I have often stated that I believe he could explain the highest astronomical problems to any one of good understanding, if he would acknowledge at the beginning his entire ignorance and admit when he did not understand any point in the progress of the demonstration. He graduated at the head of his class in 1828. He resigned after a few years' service in the Engineer Corps of the army, became President of Girard College, and went abroad to study the European system of instruction.
>
> After his return from Europe we met, and he told me that the thing which surprised him most was the system of the West Point Academy, where any boy, regardless of his endowments

or previous preparation, was required to learn the same things in the allotted time; and implied that, what astonished him most was that he should have gone through the Academy without even realizing that. In defence of the institution I reminded him that it was not intended for popular education, but to prepare as many as were required from year to year for appointments in the army; that, therefore, it might well be that one might have a genius for something not specially required of a soldier, and be unable to learn a thing that was needful. The consequence would be that he would have to carry his talents into some calling for which he was especially endowed.

To take this extraordinary genius for illustration, though he readily mastered every branch of the curriculum of the Military Academy, and would doubtless have been useful as an engineer in the army, his career as a civilian proved that another field was more peculiarly his, and that he could there render greater service to his country. In the year 1842, on the decease of Mr. Hassler, Professor Bache was appointed Superintendent of the Coast Survey, and introduced methods and established rules in regard to triangulation and deep-sea soundings which have given to the American coast and sea border the best charts, I think, in existence, and which will remain for Bache an enduring monument. A great-grandson of Benjamin Franklin and grandson of Alexander Dallas, Secretary of State under Mr. Jefferson's administration, he seemed to have inherited the common-sense and the power to apply science to the utilities of life of the one, and the grace and knowledge of men possessed by the other.

IX

EARLY RESEARCH

BACHE thoroughly enjoyed his visit to Berlin. One thing disturbed him when he studied its public elementary schools:

Hempel's "Common School Friend," which I found in use in the schools [he said], appears to me, in general, to be a good compilation, though the ideas of history which it gives are very limited. The statements in regard to North America are, besides, of a kind to lead the child to suppose that the country is still peopled by red men, who are without the institutions of the old world, which are enumerated, to show the superior advantages of civilized over savage life.

Certainly Bache did not look like an Indian or act like one. He had enjoyed the superior advantages of civilized life. In fact, at the age of thirty when he left for Europe he had already earned a considerable reputation as a scholar, and his bibliography of published results of research was one in which he might well take pride.

The first published pieces of Bache's research recorded in the bibliography compiled by Benjamin A. Gould, which is almost complete, were in chemistry. All his chemical studies were made in this early period, prior to his European trip, and his abandonment of the field may have been caused by the empirical and qualitative nature of the science at the time. His was a mathematical mind that desired something more precise. His first paper in chemistry, *On the Specific Heat of the Atoms of Bodies*, tries to show that "the results of the correction of atomic weights . . . would seem to take all plausibility from the hypothesis that the atoms of simple bodies have the same specific heat."

The second item, *On the inflammation of Phosphorus in a partial Vacuum*, appeared in the *American Journal of Science* and is carelessly ascribed to A. D. Bache, M.D. It would indicate that in 1830 the editor did not know Bache and bestowed

upon him an unearned professional degree, because of a confusion with a distinguished older relative. With this study began Bache's interest in heat and its conductance by various substances. It was desirable to determine thermal conductivities, and to construct improved instruments for making the measurements. This work was interrupted by an accident that needs to be retold but calls for no comment. On at least this occasion Bache was only a little lower than the angels. Gould has recorded the incident in his account of Bache.

One room on the sunny side of his house was appropriated to these experiments; the various thermoscopes and all the subsidiary apparatus were arranged there, and the apartment was held sacred to scientific investigation. One evening, while he was attending a session of the Philosophical Society, an alarm of fire broke out in the neighborhood. His mother, then a member of his family, heard the alarm, and hastily entered the room without a lamp, to look from the front window. A crash reminded her, too late, of the inconsiderateness of her movements. The apparatus was entirely destroyed, and the first words which greeted her son on his return told him what he had lost. He made no reply, but went to the room and silently surveyed it. The destruction was complete, and the hard labors of nearly a year were rendered fruitless. An eye-witness has described it to me. He stood white with emotion for a few moments; then, turning away, only trusted himself to say that he would return soon, and hurried out of the house. Half an hour in the open air restored him to himself; returning, he consoled his mother, and made light of the occurrence; nor did he ever afterwards explain the reason why his observations on heat were discontinued.

Before the conclusion of his study of heat, most of which did not lend itself to published results, he had written an article on "the alleged influence of color on the radiation of non-luminous heat," which Edgar Fahs Smith, in his *Chemistry in America,* says "has become a classic. It is almost needless to say that he proved by it the fallacy of the notion, till then commonly received, that color did influence the radiation of non-luminous heat." He prepared an historical note showing that Faraday's

discovery of the non-conducting power of ice had really been made by Benjamin Franklin and his associates, and also published *Experimental illustrations of the Radiating and absorbing Powers of Surfaces for Heat, of the effects of Transparent Screens, of the conducting Powers of Solids, etc.* The last describes some instruments devised by Bache for the improvement of classroom demonstrations and shows his zeal for better teaching methods and equipment. Bache was no one-sided research devotee.

In 1832 Bache published his English translation of an essay on chemical nomenclature prefixed to a book on the elements of chemistry written by the great Swedish scientist, J. J. Berzelius, "the most experienced chemist of our day." What Bache calls "the most industrious portions of the chemical community, the chemists of Germany," had profited by the German translation of this work, "rich in the philosophy as in the details of chemical science." The French translation, he felt, had brought the work to the attention of French and English chemists. Bache thought that the nomenclature of the science was important enough for separate attention. His is a translation from the French and rich in his own explanatory notes.

A memoir on the elastic force of the vapor of mercury at different temperatures as discussed by Avogadro was followed by an analysis of Pennsylvania coals. With H. D. Rogers of London he analyzed the bituminous coal of Lycoming County and also Tamaqua anthracite, the latter being selected because it was "intermediate between the hard Lehigh . . . and the softer Pottsville coal." In June 1834, when he read this paper, Bache could not know that two years later he would be elected president of the educational institution that a century later was to have the nation's third largest educational endowment, an endowment largely built up by royalties from Pennsylvania anthracite coal lands.

One of his papers in chemistry discusses the comparative corrosion of metals by salt water, a practical problem presented to him by Joseph S. Walter, Jr., which he solved by finding

that zinc lost least and iron most weight in a salt solution; a second paper treats of Dr. Thomas Thomson's method for determining the proportions of potassa and soda in a mixture of the two alkalies; and a third has to do with the hardening of lime under water by the action of different alkalies.

His association with the members of the Franklin Institute gave his research a practical turn, and he began to experiment with safety apparatus for steamboats in an attempt to avoid the situation in which a safety valve "ceases to deserve the name of *safety* valve" when "the opening of it, by hand, may be the very means of producing an explosion." In 1831 he reported in the *Journal of the Franklin Institute* the combination of a fusible metal disk with the common safety valve, and the following year an alarm to be applied to the interior flues of steam boilers consisting of "fusible metal . . . to act as a warning thermometer. . . ." Naturally there was great public interest in avoiding steam-boiler explosions because of the heavy toll of human life and property they had taken. Railroad engines all too frequently blew up. In 1835 Bache reported to the Institute experiments

made soon after the description of the new steam boiler or circulator of Perkins, reached this country; they were undertaken at the request, and for the satisfaction of my friend, Mr. M. W. Baldwin, and I did not at the time make them public, because it was understood that this boiler would receive a full trial, on a proper scale, upon locomotives in England.

As Chairman, Bache wrote for the *Journal* the following year the *Report of Experiments made by the Committee of the Franklin Institute of Pennsylvania, on the Explosions of Steam-Boilers, at the request of the Treasury Department of the United States.* Among those on this special committee of seventeen were M. W. Baldwin, Dr. Robert Hare, James P. Espy, George and S. V. Merrick, W. H. Keating, Isaiah Lukens, James J. Rush, and Benjamin Reeves. Bache was active at this time in the Institute, for he was presiding over this committee and was a member of the Board of Managers and of the committees on Publica-

tions, on Monthly Meetings, and on Science and the Arts.

In the same journal he began reporting in 1831 for the committee of fourteen that was investigating a problem in mechanics. The work of this committee, appointed two years previously "to ascertain by experiment the value of water as a moving power," was supported by subscriptions. Two years later the *Journal* contained his report of *Experiments made on the Navigation of the Chesapeake and Delaware Canal by Steam.*

The year 1834 marks the official beginning of Bache's interest in "the necessity of fixing the standard of weights and measures throughout the world," an ambitious project to which he was to give a great deal of thought later in his life. The Pennsylvania House of Representatives had requested a report on this subject from the Managers of the Franklin Institute. This report was written by Bache, adopted by the Managers, and printed in the *Journal* as submitted to the legislative body.

Yet natural phenomena continued to interest Bache greatly. He published his meteorological observations made during the solar eclipse of February 12, 1831. His place of observation was "at the south window of the observatory attached to the Friends' school in Fourth-street," a neighborhood that he knew well, for it was near the old building where he had begun his teaching at the University. These observations were published in the *Transactions of the American Philosophical Society*, as was also Bache's note of meteorological observations made during the solar eclipse of November 30, 1834, which was one of a series of such observations of the eclipse made by various observers, such as J. Gummere of the Haverford School, Dr. John Locke at Cincinnati, Ferdinand R. Hassler at West Hills, Long Island, and Professor James Hamilton of Nashville University, and collected by Bache. He made some magnetic observations during the eclipse but held them for future communication.

The *American Journal of Science* contains three papers written by Bache having to do with an unusual meteoric display on November 13, 1834. The first of these refers to some observa-

tions Bache had made at Holmesburg, ten miles northeast of Philadelphia, on the preceding Sunday, suggesting that Bache got around as though he lived in the automobile age. This meteoric display involved him in a controversy of rather small consequence, for a Professor Olmsted contended that it was connected with a meteoric display of exactly a year before. Through the Secretary of War, Bache asked the commandants of military posts whether any unusual meteoric display had been witnessed on November 13, 1834. The replies convinced him that the phenomena were not widespread and that this fact and others showed that what had been observed had no connection with the meteoric display of November 13, 1833.

During "a very brief recess from duty at the University," Bache made the observations that resulted in *Notes and Diagrams illustrative of the Directions of the Forces . . . in different parts of the Brunswick Tornado of June 19, 1835*, in which he found himself in agreement with the unpopular theory of his friend Espy that the "effects all indicate a moving column of rarefied air, without any whirling motion at or near the surface of the ground." In other words, objects were drawn inward instead of being thrown outward by centrifugal projection. A paper on *Profused Forms of Diagrams for exhibiting to the eye the results of a register of the Direction of the Wind* followed a principle original with Bache and differing from that of W. R. Birt of London, who had sent him the first number of his new meteorological publication.

This exchange establishes the fact that he was in touch with European scholars and the work of their associations. As a matter of fact, during his trip abroad he reported to the meeting of the British Association for the Advancement of Science held at Newcastle in August 1838, on the effect of deflected currents of air upon the quantity of rain collected by rain-gauges. The gauges had been placed in Philadelphia at three different heights—the top of a tower "formerly used for making shot," a place "near the ground within the enclosure about the tower," and, as an "intermediate one . . . the roof of the university."

The quantities collected depended on wind direction; "in general, the gauges to leeward received more rain than those to windward." Bache's observations, which had been made in 1833, were never published in detail. Some years later he said: "The experiments have never been published *in extenso,* because I thought the cream of them had been taken off, and there was no use for the skim-milk!"

A "believe-it-or-not" sort of phenomenon is discussed in Bache's paper entitled *Historical notice of a Hypothesis to explain the greater quantity of rain which falls at the surface of the ground than above it.* A report on this topic had been made by Professor Phillips of King's College, London, embodying a hypothesis that had been suggested by Benjamin Franklin about 1771. Bache concludes:

In investigating a complex subject of this kind, the experimenter not infrequently proceeds as if it were entirely new, and to this cause I attribute the fact that Prof. Phillips was not aware that he had been anticipated in his hypothesis. The demonstration of the hypothesis, if it is considered conclusive, is sufficient distinction, and belongs to a more advanced state of science than that of which the eighteenth century could boast. The credit of *originating it* we should abandon.

Almost a century before Bache worked upon it, his great-grandfather had made the astonishing observation that the storms, combining thick clouds and rain for two or three days, that persons on the eastern seaboard know so well as "northeasters" do not begin in the northeast at all. In point of time, they begin in the southwest: "that is to say," as Franklin states in a letter to Alexander Small, dated London, May 12, 1760, when he lived in London as agent for the colony of Pennsylvania,

the air in Georgia, the fartherest of our colonies to the southwest, begins to move south-westerly before the air of Carolina, which is the next colony north-eastward; the air of Carolina has the same motion before the air of Virginia, which lies still more north-eastward; and so on north-easterly through Pennsyl-

vania, New York, New England, &c. quite to Newfoundland. . . .

What first gave me this idea, was the following circumstance. About twenty years ago, a few more or less, I cannot from my memory be certain, we were to have an eclipse of the moon at Philadelphia, on a Friday evening, at about nine o'clock. I intended to observe it, but was prevented by a north-east storm, which came on about seven, with thick clouds as usual, that quite obscured the whole hemisphere. Yet when the post brought us the Boston newspaper, giving an account of the effect of the same storm in those parts, I found the beginning of the eclipse had been well observed there, though Boston lies north-east of Philadelphia about 400 miles. This puzzled me, because the storm began with us so soon as to prevent any observation, and being a north-east storm, I imagined it must have begun rather sooner in places farther to the north-east than it did at Philadelphia. I therefore mentioned it in a letter to my brother who lived at Boston, and he informed me the storm did not begin with them till near eleven o'clock, so that they had a good observation of the eclipse; and when comparing all other accounts I received from the several colonies, of the time of beginning of the same storm, and since that of other storms of the same kind, I found the beginning to be always later the farther north-eastward. I have not my notes with me here in England, and cannot, from memory, say the proportion of time to distance, but I think it is about an hour to every hundred miles.

Bache reviewed the circumstances and proved that Franklin's observation was suggested by the lunar eclipse of October 21, 1743. This interesting bit of scientific detective work he embodied in a paper in the *Journal of the Franklin Institute*. It served as a sincere tribute to his great-grandfather, one of many that Bache paid him. The memory of Franklin influenced Bache in his early research and in his associations with the American Philosophical Society, in which Franklin had been so active, and with the Institute which had been named for him. He necessarily carried that memory with him on his two-year European trip. To at least some European savants Bache's ancestry set him apart from his fellow mortals.

X

MAGNETISM

IT MAY well be that, because of the admiration felt for his great ancestor, Bache, both as a scientist and as an educator, was received in Europe with more attention than even his scholarship and personality merited. The character of his university associations before he left home "naturally led to similar associations while abroad," though he concluded that he should not discuss European universities in his report. At a German university, for example, he visited an elderly scholar who was physically worn out and had to stimulate himself by dipping too often into his snuffbox. The savant greeted him with an embrace, kissed him on either cheek, and exclaimed, "Mein Gott, now let me die, since I have lived to see with mine own eyes an emanation of the great Franklin!"

Almost a century before, Franklin had flown his famous kite in a thundercloud and had started American investigations in terrestrial electricity with an experiment that has given us one of the thrilling pictures in science. Franklin was an amateur scientist in time stolen from a busy life. Perhaps his thrills in investigating such matters as fireplaces, the direction of storms, and terrestrial electricity were greater than a professional scientist would have experienced. If his interest in terrestrial electricity had led him into terrestrial magnetism he might have uttered the words of John Quincy Adams, who said on the floor of the House of Representatives during the discussion of the establishment of the Smithsonian Institution:

What an unknown world of mind is yet teeming in the womb of time, to be revealed in tracing the causes of the sympathy between the magnet and the pole—that unseen, immaterial spirit, which walks with us through the most entangled forests, over the most interminable wilderness, and across every region of the pathless deep, by day, by night, in the calm serene of a cloudless sky, and in the howling of the hurricane or the typhoon. Who can witness the movements of that tremulous

needle, poised upon its center, still tending to the polar star, without feeling a thrill of amazement approaching to superstition?

The property of the loadstone of attracting iron has been known to civilized man for centuries. But the directive property of the magnet was not known and utilized in the western world before the tenth century, however early the compass needle may have been used by the oriental nations. For some reason, the loadstone was thought in the Middle Ages to be capable of routing toothaches, dropsy, gout, hemorrhage, and spasms. Medieval physicians might even prescribe powdered loadstone to attract estranged husbands and wives to one another.

Persons undergoing such treatment were probably cautioned not to eat garlic, for a magnet rubbed with garlic was said to lose its directive property. Mariners were warned, as debutantes today might be, not to eat onions or garlic since these would take them off their proper course. A prince of India insisted that his food be prepared in loadstone dishes to arrest his advancing age; a quaint notion suggestive of modern health fads. In Bache's century so-called magnetic belts were worn to prevent disease, and in our own time people believe that they should place their beds from north to south in order to secure the benefits of terrestrial magnetism.

Philadelphia had been laid out with magnetic instruments, and the eastern and southeastern states had been surveyed with a magnetic compass. George Washington used this instrument in his land surveys. Since that time the strange phenomenon of terrestrial magnetism has become important in navigation, in aviation, in land travel, in surveying, in geology, and in radio and telegraphy. It is natural that at a time when less was known about the phenomenon, and when aviation and radio were still in the future, men would try to find out more about it; "how it is distributed over the earth's surface," to quote Daniel L. Hazard, "how it changes from hour to hour and from year to year, how it originated and what causes it to change, how it is related to earth currents, atmospheric

electricity, solar activity, and other allied phenomena."

It was probably Columbus who first added complexity to the study of magnetism by discovering that the compass needle did not at all times, or in all places, point to the true north; a variation now referred to as the declination of the needle. Later it was found that this declination is continually changing. Hazard says: "The importance of this change to the land surveyor may be realized when it is considered that a line 1,000 feet long run due north by compass in Boston in 1925 would have its north end 125 feet farther west than a line from the same starting point run due north by compass in 1785." Still later it was discovered that the compass needle was not even "on the level." It had dip or inclination from the plane of the horizon, and this too varied with time and place.

Of importance to navigators were Halley's charts, published in 1701, showing the lines of equal magnetic declination over the Atlantic Ocean. Edmund Halley, of comet fame, had made his observations from 1698 to 1701 at the expense of the British government on a ship with the challenging name *Paramour Pink*. The eighteenth century was not without additional contributions to the study of terrestrial magnetism, but the establishment of the relationship of electricity and magnetism stimulated research in both. Dr. Paul R. Heyl, of the National Bureau of Standards, has summed up this development:

In 1819 Hans Christian Oersted, a professor in the University at Copenhagen, discovered that an electric current could produce a magnetic effect, and twelve years later Faraday made the converse discovery that a magnet could produce an electric current. This union of these two subjects was remarkably fruitful. In addition to giving a great impetus to the development of theory, it made possible the whole of modern electrical engineering, with its manifold applications.

Far back in 1600 Gilbert's famous work on the magnet showed that the earth itself is a great magnet. Here was something fundamental like gravity, yet the classical period of research in terrestrial magnetism did not come until two centuries

later in Bache's time. A whole company of eminent scholars studied the phenomenon: Humboldt, Lamont, and especially Gauss, who designed some of Bache's instruments at Göttingen, were important workers in Germany; Duperrey and notably Poisson in France; Quetelet in Belgium; Sabine, Lloyd, and Airy in Great Britain; Hansteen in Norway; Kupffer in Russia; and Locke, Long, Loomis, and Nicollet, as well as Bache, in America. The Magnetic Union of Göttingen was founded to promote magnetic observations all over the world, and undoubtedly Gauss and Weber and their work at Göttingen strongly influenced Bache.

But Bache's real inspiration came from a different source. Both as an educator and as a scientist Bache had his eyes on the whole globe. In a day when parts of his own country were farther away than the antipodes now are, he reached out to profit by what was going on or might go on elsewhere. Just as the British Association for the Advancement of Science recently provided leadership in the ambitious attempt to bring together specialists in the natural and the social sciences, so the British Association in Bache's youth suggested simultaneous observations in the realms of magnetism and meteorology throughout the world. As early as 1830, when he was twenty-four years of age and teaching at the University, Bache had set up a small magnetic observatory in the garden of his house in Philadelphia, where he was assisted by his wife and John F. Frazer. There for the first time on our continent Bache had determined accurately the periods of the daily variations of the magnetic needle.

During his period (1832–44) as one of the secretaries of the American Philosophical Society, Bache made to the Society on September 20, 1839,

a verbal communication of the measures taken by the British Government, on the recommendation of the British Association, and under the advice of the Royal Society, for obtaining a series of magnetic observations in different quarters of the globe, in conjunction with a naval expedition in the southern

hemisphere, under the command of Captain James Clark Ross, and read extracts from letters of Professor Lloyd and Major Sabine, relating to the preparation for the undertaking.

Professor Bache further stated [Bache's own account continues] that on submitting the circular addressed to him by the Foreign Secretary of the Royal Society, with extracts from the letters before referred to, and other information as to the nature and importance of the results to be obtained by this combined system of magnetic observations, to the Building Committee of the Girard College, through their architect, they had, with creditable liberality, given orders for the erection of an observatory suited to the observations contemplated, and to the instruments already in the possession of the Trustees of the College.

The minutes of the Philosophical Society for November 15, 1839, contain the following:

Resolved, That in the opinion of the American Philosophical Society, it is highly desirable that the combined series of magnetic observations now in progress under the direction of the British government, should be extended to the United States, by the establishment of Magnetic Observatories at suitable places.

Resolved, That a Committee be appointed, with authority, on behalf of the Society, to invite the attention of one of the departments of the Government of the United States to the plan for combined magnetic observations, a sketch of which was presented in the documents from a Committee of the Royal Society of London, and to urge cooperation in the plan as a national undertaking, in every way worthy of the United States.

The Committee under the above resolution, consists of Professor Bache, Doctor Patterson, Professor Henry, Mr. Kane, and Colonel Totten.

In the following month this committee addressed a long letter to the Secretary of War, Joel R. Poinsett, who had "long been enrolled as a member of the American Philosophical Society." The Society through this committee proposed

in furtherance of this plan, that five magnetic observatories should be established in the N.E., N.W., S.E., S.W., and at some central point of the United States, furnished with the instru-

ments and observers necessary, fully to carry out the proper plan of combined magnetic and meteorological observations. Should the proposition to make this cooperation truly national, be acceded to, the details in relation to it can easily be arranged, and the Society will, the undersigned confidently believe, feel proud to lend any aid in their power, in planning or executing them. It may perhaps be more satisfactory however, to state briefly, beforehand, the nature of the observations to be made, and the means required for their execution.

The magnetic observations to be undertaken at the fixed observatories are, first, of the variation (declination), absolute horizontal intensity and dip; second, of the changes of the variation of the horizontal intensity, and of the vertical intensity. The regular observations for changes in these elements, are to be made every two hours every day, (with the exception of Sundays,) for the next three years, beginning as soon as the several observatories can be arranged. To these are to be added more frequent observations on one day of each month, including the four terms during the year, fixed by the German Magnetic Association. At each station, a building of stone or wood will be required, in the construction of which no iron must be employed. . . .

There followed a description of the instruments that would be necessary at each observatory, and an estimate of their cost. The hands of Bache and Totten, as old army men, can be seen in the opening sentences of the concluding paragraph of the letter:

No estimate is made of the cost of the principal and assistants for the proposed observatories. In the organization of the new British stationary observatories, these persons are taken, in part, if not altogether, from the officers, non-commissioned officers, and privates of the artillery. The acquirements of the graduates of our Military Academy, admirably fit them for directing the observatories, which might be appropriately placed at military posts; so as to provide the officers and men necessary for making the observations, without additional expense.

On July 3, 1840, Bache proudly told the Philosophical Society that his observatory at Girard College, the first magnetic observatory in North America, had initiated a "regular system

of bi-hourly magnetic and meteorological observations," and that they "had been in progress since the close of the month of May." Those who contributed to the support of the Observatory were, according to Bache's own statements, Nicholas Biddle, Richard Price, Thomas Biddle, Dr. Chapman, Dr. R. K. Patterson, John K. Kane, Dr. George B. Wood, B. W. Richards, Dr. C. D. Meigs, J. R. Frazer, T. Dunlap, N. Dunn, J. D. Brown, J. P. Wetherill, H. Kuhn, G. M. Justice, and Bache himself. Later he saw the Observatory in danger. In October 1842 he "drew the attention of the Society to the necessity of providing means for continuing the observations . . . or of closing the Observatory," and in January 1843 he "communicated to the Society, that in consequence of the want of funds for the support of the Magnetic Observatory, the bi-hourly observations, and those for maxima and minima, had ceased with the first of the present year." But a man like Bache salvages whatever he can. The Minutes, perhaps arranged by Bache himself, continue:

He [Bache] further stated that it was his intention to keep up the term-day observations, and also to have an observation of the magnetic instruments made each day, to connect the indications of the magnetometers from one term-day to another. Certain of the meteorological observations were also to be continued.

It is now that the long letter of 1839 addressed to the Secretary of War and referred by him to the Congress becomes significant. It had contained a suggestion that the Girard College Observatory might be made one of the five national observatories without cost to the government. The letter had evidently precipitated departmental and congressional committee discussions that for a time bore no fruit except in so far as they may have aided the subsidization of Bache's observatory. On April 7, 1843, Bache

informed the Society that he had received a letter from the Hon. James M. Porter, Secretary of War, through the bureau of Topographical Engineers, making an allowance for the con-

tinuance of the observations at the magnetic observatory. In consequence of this liberal and well-timed supply of means . . . the series of observations was resumed on the first of the present month.

The Observatory must have been for its time an unusual wooden building with its copper nails, its brass hinges, its foot-thick partitions and walls, and its double doors and windows, together with the complete absence of iron, all affording protection for the work carried on in it. It was built by the master carpenter of Girard College, James O. Sawyer, whose skill in the placing of instruments was praised by Bache. The building may have had a plebeian appearance, but its origin was patrician, for it was designed by none other than Thomas U. Walter. This young man, like his friend Bache, distinguished himself early in his career by designing at the age of twenty-nine the great Corinthian structure that has long symbolized Girard College. A little later, as architect of the United States Capitol in Washington, he planned its Senate and House wings and was responsible for the rebuilding of its western front and dome. When its glory departed, the Girard Observatory returned to the care of the carpenter who had built it. He moved it to another site, used it as a shop, and later razed it.

According to the carpenter's report, this "small frame building" had originally been erected "on the western part of the grounds." Its exact location has offered quite a problem. In 1898, when a portrait of Bache was presented to the Philadelphia public school at Twenty-second and Brown Streets which bears his name, one of the speakers was Professor George F. Barker, who filled the chair once held by Bache at the University of Pennsylvania. Referring to Bache's Magnetic Observatory at Girard College Professor Barker said:

Not only is there no trace of the building itself or any of its parts to be found within the walls of that institution, but there is even a considerable difference of opinion as to its exact location. No single spot in Philadelphia surpasses this in scientific interest. May we not hope that the Trustees of Girard College

will see to it that the exact site of this observatory is accurately determined and that at least a tablet be placed thereon to mark a spot so important as a magnetic center?

Spurred by the investigation that had evidently preceded this statement, the Board of Directors of City Trusts met on the same day that the portrait was presented, considered "the importance of placing a suitable tablet to locate" the Magnetic Observatory, and referred the matter with power to act to its Committee on Instruction. The tablet could not be placed. Dr. Adam H. Fetterolf, the President of the College, reported to this Committee that no definite means of locating the site had been discovered, saying: "Even if we had the exact latitude and longitude of the spot it would be difficult to come within one hundred feet of it. At least, such is the statement of our professors of mathematics." It would appear that the professors of mathematics had been preoccupied with other matters, since the preface to the three published volumes of observations plainly defines the position of the Observatory as "in 39°58′17″ north latitude, and 75°10′44″ longitude west of Greenwich."

A month later Dr. Fetterolf's report to the committee furnishes a pleasant commentary on the value of human testimony:

> We have not yet found the exact location of Professor Bache's Magnetic Observatory. We have had the opinion of men who were employed in it, of men who as College boys played around it, and of others equally familiar with the building, and they differ widely in their recollections of the locality.

The Committee of the Board reported "progress," a word that is frequently a forecast that nothing will happen, and action was postponed for a time. Finally the matter was allowed to become a memory.

Dr. David A. McIlhatten, the Head of the Mathematics Department of Girard College, recently interested the Bureau of Surveys of the City of Philadelphia in the problem of locating the site of the Observatory. This Bureau and the United States Navy Hydrographic Bureau were in agreement that its latitude and longitude, as given in Bache's preface to the three published

volumes of Observations, would locate the Observatory at or near Stillman and Poplar Streets, just southwest of the present campus and outside it, but not outside the southwest corner of the original Peel Hall tract on which the Girard Estate has built houses. In other words, Bache doubtless tried to locate his Observatory as far to the west and as far from the proposed school site as possible, though on the property of the College.

Bache lived in what A. G. McNish has called "the heroic age of geomagnetism." Gauss, who had designed some of the instruments that Bache used, was one of the heroes. His name survives not only in the history of science but also in the word "degaussing," which refers to the safeguard against magnetic mines used in war, namely an insulated wire cable fitted around the hull of a ship. Lloyd was another of the heroes who contributed to Bache's collection of instruments. One instrument, a declinometer manufactured by Gambey of Paris, was used in Bache's magnetic survey of Pennsylvania and became known as the Bache Magnetometer.

When Bache was abroad for two years on his tour of educational institutions, he used portable instruments that yielded a series of observations, at continental and British cities, on the dip and intensity of terrestrial magnetism. Such migratory science naturally had its vexations. In one place his journal reads: "A mortifying failure in my chronometer took place today, the chain I believe has given way and there I am deprived of the use of this instrument just when I want it most and thrown upon Ency's little Genoa which gallops at a fearful, as well as an irregular rate." This use of magnetism as a traveling hobby capped off his previous work with it and quite naturally led to the establishment of the Observatory in Philadelphia. He often talked of his plans while he was abroad. Of one such discussion he records: "We adjourned to a supper of tripe etc. ending with the usual glass of toddy . . . and over this settled how the Girard [College] was to have a most splendid observatory & how it was also to train observers."

In July 1832 he had written on Faraday's discovery of

magneto-electricity and of his own repetition of the experiments of Saxton and Nobili, but his first paper in terrestrial magnetism was published later the same year in the *Transactions* of the Philosophical Society. Dr. Edwin G. Conklin, at the meeting in February 1941 commemorating Bache, referred to the fine quality of this monograph produced by a scholar of twenty-six years and said: "It shows a breadth of view, a maturity of judgment and a becoming modesty such as are not always manifested by brilliant youth." The first sentence of this paper, *On the Diurnal Variation of the Horizontal Needle*, shows that he used the long academic vacation for scientific research. He wrote:

During the month of August, and part of September, of this year, the usual summer vacation of the University permitted my absence from the city, and finding myself favourably situated for meteorological observations, I undertook to observe the diurnal fluctuation of the barometer and thermometer, and, ultimately, the hourly variation of the horizontal needle. It was a source of great regret to me, that, in these latter observations, I was not also furnished with a dipping needle, or with the means of directly measuring the variation of magnetic intensity.

This vacation had been spent near West Chester, about twenty-one miles from Philadelphia. However little the published observations and the accompanying tables and charts mean to the unscientific reader, Dr. Cheyney says that he likes "to think of this young college professor hurrying away at the close of the term to the Delaware County hills, to his 'garden on the side of a hill,' to make rigorous observations on earth magnetism."

Other papers follow. One is *On the variation of the Magnetic Needle*, containing further observations made during this same West Chester vacation in which he concludes "that ordinary meteorological phenomena, such as the formation and dispersion of clouds, the occurrence of showers and gusts, of fogs, etc., have a powerful modifying effect on the diurnal variation." Another paper records observations on the disturbance

of the direction of the horizontal needle during the aurora borealis visible at Philadelphia on two dates in 1833. One gets a picture of a city free from skyscrapers in Bache's statement in this article:

By going a short distance from my dwelling to the east, I have a tolerably good view of the northeastern portion of the horizon; by going a greater distance to the west, a complete view of the northwestern portion, and from the top of my dwelling a tolerable field of view to the north.

Two papers were written in collaboration with Professor Edward H. Courtenay, who was for a short time a colleague of Bache at the University after serving as Professor of Natural and Experimental Philosophy at West Point, where he had probably taught Bache. They treated of magnetic observations and of the possible connection between weather and needle variation. The observations were made in various places, such as Philadelphia ("observations were made upon a marble column in the yard to the south of Professor Bache's dwelling, in Chestnut street near Schuylkill Sixth street"), West Point ("on a brick column, raised for these and similar observations, to the north of the residence of Professor Courtenay," presumably after he had returned to his teaching at the Military Academy), New York ("dip was observed on the green in front of Columbia College"), Providence ("on the green in front of Brown University, and just in rear of the President's house"), and Springfield ("in the yard attached to the Hamden Coffee-house Hotel"). One paper appeared in 1837, while Bache was visiting Europe, in the *Proceedings* of the Royal Irish Academy, and is entitled *Corresponding Magnetic Observations, in connection with Professor Lloyd of Dublin, to determine the relative magnetic intensity in Philadelphia, Dublin and Edinburgh.*

After his return from Europe, Bache was active in the affairs of the American Philosophical Society. For the next few years his papers on terrestrial magnetism were presented to it. One compared Loomis' observations on magnetic dip with those obtained by Professor Courtenay and himself. A second treated

of corresponding observations made by Professor Lloyd of Dublin and by Bache himself in Philadelphia in one of the "buildings for the dwellings of the professors of the Girard College"—this was before the building of the Observatory at the College. A third compares the magnetic dip as determined at Philadelphia and at Baltimore, a fourth discusses an instrument devised "for measuring the changes in the vertical components of the force of terrestrial magnetism," and a fifth notes "changes of magnetic declination recorded at Cambridge and at Girard College."

What did Bache accomplish with the instruments that he took with him to Europe in 1836? The answer is given in a paper in the *Transactions* of the Philosophical Society in 1840.

The following observations of intensity and dip were made during a visit to Europe in 1836–7 and 1837–8, directed by the Trustees of the Girard College for Orphans. The special objects of my journey admitted of only an occasional attention to the observations in question, which I did not attempt unless when time and circumstances were generally favourable to their execution. The stations are twenty-one in number; three in Great Britain, and the others on the continent.

Did the instruments offer difficulties on his journey? "The needles were always kept separate from each other; while travelling, they were carried about my person, and, when stopping for any considerable length of time, were deposited as far from iron as was necessary to their safety." A list of the places in which the observations were made might arouse a feeling akin to nostalgia in European travelers:

Dublin—"the Provost's garden;"

Edinburgh—"Canaan Park near Edinburgh;"

London—"near Captain Ross' former residence, at Westbourne Green;"

Paris—"in the garden of the observatory in the Magnetic Cabinet of M. Arago;"

Brussels—"in the garden of the Observatory;"

Berlin—the Magnetic Observatory of Professor Encke;

Vienna—"the Botanic Garden, upon the upper platform;"
Trieste—"in the Botanical Garden;"
Venice—"in the garden of the Armenian Convent, on the island of St. Lazarus;"
Rome—observations "were made at two different stations; one out of the region of volcanic tufa upon which the city is built, upon the calcareous formation of Monte Mario, in the garden of the Villa Mellini, the other in the temple of Venus and Rome, opposite to the Colosseum;"
Naples—at Aversa, about 8 miles north of Naples, "in the large garden attached to the asylum for the Insane;"
Florence—"in the Boboli Gardens" (one can imagine Bache setting up his instruments near the statue of the naked fat man on whose head Italians used to place their hats while being photographed with him by amused friends);
Milan—"in the garden of M. Kramer, near the Porta Nuova;"
Turin—the Botanic Garden;
Chamberi—"in the Park of the Count de Boignes, a short distance only from the town;"
Chamouni—"in a field in rear of, and at some distance from, the Union Hotel;"
The Flégière—"the observations were made not far from, and about thirty feet above, the point where the cross is placed;"
Geneva—"in the garden of M. Prevost-Martin, not far from the city;"
Lyons—"in a meadow to the south-east of Lyons, and across the Rhone from the city;"
Brientz—"in a field in rear of . . . the White Cross Hotel;"
The Faulhorn—"nearly on the very summit, and as far from the chalet as the ground would permit."

In 1841 appeared papers on an improvement of part of Ostler's self-registering anemometer as devised by one of his assistants in the Girard College Observatory and on Nicollet and Graham's magnetic dip observations at Baltimore. The next year a paper suggested a modification of Lloyd's induction inclinom-

eter by which it might be used to measure changes of both declination and inclination. In May 1843, Bache gave the American Philosophical Society an "account of the observations made at Philadelphia and Toronto, during the magnetic disturbance of May 6, 1843, and pointed out their bearing upon the question of the kind of instruments and observations appropriate to determine the phenomena during rapid changes of the magnetic elements." He also presented the results "of two years' observations of the magnetic elements, and of the temperature, pressure, and moisture of the atmosphere, at the Magnetic Observatory at the Girard College." This was the last item on terrestrial magnetism that appeared from his pen for eight years, with the exception of the long report on the observations made at the Girard College Observatory.

This Observatory, at which observations had been made since May 1840, was finally closed in June 1845, and the building had the history that has been related. The friendly relationship that Bache tried to establish with everyone with whom he dealt enabled him to continue to use the facilities of the College for several years after he had actually severed his official connection with it. After Bache left Philadelphia in December 1843, the observations were under the direction of Professor John F. Frazer, who had been a student of Bache's at the University, a fellow worker in many of his scientific studies, a colleague of his on the faculty of the Central High School, and finally his successor on the faculty of the University when Bache left Philadelphia and entered the Coast Survey.

Among the Central High School boys who assisted Bache and Frazer in the Girard College Observatory were Charles H. Cramp, who became a shipbuilder, and George Davidson and James S. Lawson, both of whom Bache later took into the Survey. In November 1843 he had to write a note of reproof to one of his other assistants. What the young man had done could not be tolerated from the point of view either of training or of the validity of the results. Addressing "my young friend" he said: "I am much mortified by the failure which

you have reported to me and would urge you to increased diligence. When you find yourself getting drowsy you should go into the air though it may be sharp. Sleeping on post is a high misdemeanour. Try to avoid such an accident again."

The accumulated records of the five years of the life of the Observatory remained unpublished until 1847, when they were printed by order of the United States Senate and issued under the direction of the Topographical Bureau in three large volumes of over three thousand pages with an accompanying atlas of 159 plates. One of these plates gives an exterior view of the Observatory and a floor plan of it. In his exhaustive introduction to the first volume Bache wrote:

As during the progress of the observations, I was engaged in laborious duties, requiring the absolute devotion of a very great portion of my time, I trust that many omissions and irregular performances of duty in directing the observations thus accounted for, will be excused. I must further plead the pressure of absorbing engagements and necessary absence from the place of publication, in excuse for errors which may occur in the course of the following publication of the records of observation. Upon the task of comparison of and deduction from the observations, I have not presumed, under present circumstances, even to enter; but have been obliged to be satisfied with superintending the reduction of the results, and directing such general comparisons as can be made under general instruction.

An examination of these volumes of observations would demonstrate the truth of Admiral Byrd's statement in *Alone* that when instruments in continuous operation are being observed, the instruments are the masters, not the observer. Nevertheless these observations, made day and night for five years, formed "a rich mine of statistics" from which Bache drew, beginning in 1851, without exhausting the material. This phase of his work in terrestrial magnetism may well be left to another chapter. In passing, however, we may note the fact that Bache was responsible for the establishment of a magnetic observatory at Key West, Florida, in 1860, and that the Division of Geomagnetism and Seismology in the United States Coast and

Geodetic Survey and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington represented natural developments of Bache's interest and work.

For the unscientific reader the foregoing recital may indeed be dull. Any technical subject is dull for most of us who are not initiated into at least some of its mysteries. Yet it must be recalled that we are dealing with a scholar of diversified interests, an energetic administrator, a person who loved human society, a man who was far from being dull, who was, in fact, so full of enthusiasm for whatever he studied that he was fascinated by the magnetism of the earth as John Quincy Adams thought he himself was and as Franklin would have been if he had had the chance. Bache was, above all, even in his busiest moments a man of vivacity and charm of manner who drew people to him. Indeed, with a perhaps unconscious word-play of a sort that would have delighted ancient Romans and some moderns, Gould said of Bache: "His was what might be called a magnetic nature."

If they saw it, both Dallas and Ency Bache must have enjoyed a poem entitled "Induced Current" that appeared in *Blackwood's Magazine* in March 1847 under the name of Herbert Mayo:

> Around the magnet, Faraday
> Is sure that Volta's lightnings play;
> But *how* to draw them from the wire?
> He took a lesson from the heart:
> 'Tis when we meet, 'tis when we part,
> Breaks forth the electric fire.

XI

A FIRST CAREER ENDS

BACHE was undoubtedly a "lover of his kind," as one of his unidentified high school students asserted, but such love in a schoolmaster suffers great strain when a culprit generously charges the hot-air heating system with red pepper. This happened at the High School in Bache's reign. Classmates noticed that the boy who was the most reserved and the least likely to be guilty was nowhere to be found, but never suspected that he was responsible for the tears and disorder that ensued.

Years later Bache and George Davidson were sitting over a campfire when the latter suddenly asked what had become of the offender in the red-pepper episode. Bache revealed that he had come upon him an hour after the occurrence and in conversation with him had received his confession as well as the statement that he had no accessory. It was apparently a first offense. He took the boy aside, talked to him in a fatherly manner, urged him to straighten himself out and not "blast his life," and then let him go. Bache had never previously mentioned the incident to anyone, but he said that he often wondered what had become of the boy. The thoughts of youth may be long, long thoughts, but the thoughts of a real teacher are longer.

Like many another good teacher down the centuries Bache knew that there are times when things should be observed and perhaps noted but not officially seen. He was at once firm and kindly. Zephaniah Hopper, a member of Bache's classes at the Central High School, praised his former teacher:

Professor Bache's administration was signally successful in placing the Central High School on a firm basis. He endeared himself to the students by his kindly advice and by the parental regard he manifested in their personal welfare. . . . From his experience at West Point, he knew how to maintain good discipline; but it was evident that he took no delight in seeing everything that was going on among the students. He appealed to their sense of honor and to their good faith, and made them

all feel that they had an important part in sustaining both the character and reputation of the School.

To be sure, there must have been those who thought Bache was "soft," even though he had been a West Pointer. They shook their heads when they heard that in his reports he had used the term "mild" in a commendatory way in relation to discipline. To those to whom any boy or girl or young person is guilty until proved innocent, Bache's ideas of discipline were probably shocking. We seem to have heard present-day echoes of the blast of a newspaper commentator that Bache's statements on discipline in the Report of 1839 "seem to us to savor quite too much of the *anti-government* notions of the day. There is a prevailing disposition to consider the teacher, and the parent, as a *mere adviser*, and to regard the exercise of true authority as an evil if not a violation of human rights. Parents often do what they can to ruin a school by objecting to a system of discipline which is essential to its success." Editorials had to be written then as now, and current events and documents had to be commended or attacked or looked at quizzically. We should certainly agree with the remark of George V. Fagan, who discovered this editorial in the *North American*, that "the modern philosophy of education and discipline has proved this editorial attack absurd and has vindicated Dr. Bache of trying to inculcate 'anti-government' sentiments."

When George Davidson sat over the campfire as one of Bache's associates in the Coast Survey, and discussed the red-pepper episode, he saw nothing subversive in the way Bache had handled the culprit. He was one of the most distinguished of the early alumni of the Central High School, as Franklin Spencer Edmonds, who wrote the authoritative history of the school, has pointed out. Davidson served in the Coast Survey from 1845 to 1895, much of the half-century being spent in supervising the Pacific Coast Survey. For more than a half-century he was regarded as the most famous scientist west of the Rockies. It was Davidson who persuaded James Lick to

establish the great observatory that bears his name. Davidson became a professor in the University of California late in his life. At Mr. Edmonds' request he wrote some impressions of Bache and of Bache's headship of the school where his own scientific interests had been nurtured. He says in part that Bache's

tastes and his recent experiences peculiarly fitted him for the position, and he entered upon the duties with enthusiasm. He had the faculty of gaining the friendship and support of men, and of winning the confidence of young people. I never forgot my being called up by him in the last day of our entrance examinations and told that I had passed. And he won me by adding that as I was above the average age (sixteen), he would look to me to assist him by example in urging the younger students to gentlemanly conduct and studious habits. The kind words and the kindly smile remain clearly in my memory.

I suspect that he had a kind word for all, and certainly I never heard him use a harsh word, nor was he ever charged with so doing. . . .

I enter into some personalities merely to show that I was in a position to know much of Professor Bache's character and his devotion to the High School, and to indicate that coming at once into public service I was able to judge of the standing of Bache and the earlier standing of the institution. I entered the High School in June, 1841, and from the third month to graduation stood at the head of 'Old E,' as we lovingly called that class. Professor Alexander Dallas Bache was principal. Sometime in 1842 or perhaps early in 1843 he resigned to accept a professorship in the University of Pennsylvania. (I have often thought with the prospect of becoming Provost.) In November, 1842, he employed two or three students of the Central High School as observers at Girard College Magnetic Observatory to watch for meteors. . . . I was one of the observers and made reports. . . .

In my school career I was ambitious to go to West Point and appealed to Professor Bache for advice and direction. The advice came quickly and pointedly but friendly, to repress such aspirations, because I would do better at the High School.

In after-years, in our confidences as man to man, he told me his ambition had been to make the Central High School equal to West Point in all points pertaining to a thoroughly prac-

tical education, to fit a man for the duties of his professional or civil career. . . .

Professor Bache's name, experiments, observations, labor, and activities in the American Philosophical Society served to give a certain glow and warmth to the character of the High School.

In every possible way he inspired his immediate friends and teachers and the teaching public with the importance of fostering and uplifting the "People's College," as he sometimes called it. And upon graduation the student looked upon his connection therewith as a sure passport to honorable occupation. He did not forget his former students. When in addition to other duties he was conducting the Magnetic Observatory of Girard College, even as late as June, 1845, all of the observers, except the day observer, were students of the High School. . . .

Professor Bache had a remarkable suavity of manner; a pressure in a hand-shake that made you believe you were the chosen confidant; a smile of his liquid brown eyes that was irresistibly winning with both man and woman. His voice was low and gentle, and only upon dire occasions in later years have I heard it raised momentarily in severity. The offence seemed at once forgotten. His forcible manner of presenting his case abided with him through life. He made himself sure that he was right and then held his reasoning clear and forcible.

In spite of much criticism Bache persevered at the High School, for he was "sure that he was right" in championing popular education in the face of attempts to abolish the school. Letters to newspaper editors inveighed against the school as an institution "not for the benefit of all." In general, the editors supported the school.

One feature of the character that Bache gave the Central High School was its strong science offering and its development of the talents of men like Davidson whom it sent into various scientific services, including such governmental organizations as the Coast Survey and the Topographical Bureau.

Bache knew how to develop men as well as boys. He was genuinely fond of his associates, if they permitted him to be, and he was able to develop the best that was in them. If one wishes to differentiate between executive ability and administra-

tive, he would say that Bache displayed both in directing the work of other men. Gould suggests the doctrine of Thomas Carlyle when he writes of Bache:

Had his tastes been military or political, instead of scientific, none the less would he have been a Chief. It may safely be said that by no act of his life did he ever curtail any man's means of usefulness, or fail, whenever it was in his power, to render available whatever abilities might be disclosed. . . . Justice and even-handed firmness controlled his action. No man was ever readier to acknowledge and atone for a wrong done by him, in thought or deed. Cautious in plan, bold in action, generous without impetuosity, as courteous and considerate of his subordinates as though they had been his superiors, ever as open to conviction as to argument, such was his noble character. With these traits was united a feminine tenderness of heart, and an intensely sympathetic nature. To him all came for comfort in personal sorrow, for sympathy in bereavement, for help in calamity. And his purse, like his heart, stood open to his friends, and to the needy.

Sixteen years after Bache had left the Central High School he spoke to its alumni in the most affectionately reminiscent way of his former associates on its faculty:

How rise before me the forms of those who then filled the professors' chairs! The charming classical mind of John Sanderson, so enthusiastic in the beauties of his author, so eloquent in expatiating, so varied in information, so gentle, so affable, a wit so keen, and yet a heart so relenting! He had been my own beloved preceptor in earlier years, and it was a source of intense gratification thus to have offered him the niche to which he was exactly fitted, and which had been his life-long search. The "American in Paris" would, I thought, have made an admirable instructor in French, but his modesty forbade his entering upon instruction in a foreign language. The laborious, philosophical, analytical instruction in French of Professor Deloutte, how it rises with all its peculiarities before me now! and well do his old pupils around me remember him and it and those magical tables of white and red, covering the walls of his class-room and from which he taught and lectured. These men are gone to their rest, and we may speak freely of them. Shall I not also do the same of that venerable doctor (McMurtrie) who, learned in

his sciences, thought it no derogation to bring them down to uses of common life; whose kindness of heart carried away his pupils, removing the barrier which a sternness of manner sought to erect for discipline's sake? The quiet, classical, elegant turn given to his instruction by Professor Frost. The systematic and yet original and developing character of the teaching of Professor Wines; the ardent, enthusiastic, artist-like, philosophical aims of Rembrandt Peale, who, the inventor of a new system, found here his first "large-scale" experimental field for its demonstration. The quiet, philosophical, thorough method of Professor Kendall; the patient, practical grounding of Professor Vogdes; the brilliant scientific expositions of Professor Frazer; the systematic and practical chemical teaching of Professor Booth. I see these men as in the magic mirror of the past, and hear their teachings in the never-dying waves of the air, moved by their voices.

It was the early dawn of the school, but was already quite light.

But the faculty in Bache's time was by no means an harmonious unit. The Professor Frost, Dr. John Frost, in charge of English and History, of whom Bache spoke so kindly, was probably the most active of a not inconsiderable group strongly opposed to his idea, expressed in his report to the Philadelphia School Controllers in 1839, that there should be no place for Latin and Greek in the regular course of instruction in the new High School. In his mind it was probably a compromise that permitted their introduction in the classical as distinguished from the principal course. Perhaps Bache had something to do with the fact that the parents of ninety-four students had chosen the so-called principal course while only twenty-six had elected the classical course, according to his own semi-annual report of July 20, 1840, though the very term "principal" might in itself have a powerful effect. Bache felt that "a thorough classical training" could not be acquired in four years.

Perhaps his opponents felt just as sincerely and as vigorously that the benefits accruing from the study of Latin and Greek were as great as those gained from their newer rivals in the curriculum. The physical and biological sciences were new-

comers and encountered the same kind of opposition as the social sciences met some decades later. Certainly tradition was entirely on the side of the cultivated gentlemen who espoused the cause of the classics. Bache was waging a good fight from his point of view, one that his great-grandfather would have fought, but it was a fight that was not to be won for a long time.

John A. Deloutte, the teacher of French referred to in Bache's address to the alumni, was probably on his side. He taught at the High School from 1840 to 1843, afterwards at Girard College, and finally at the University of Pennsylvania. It is quite likely that Bache, who was his intimate friend, had much to do with Deloutte's connection with Girard or the University or both. When he resigned his High School connection, Bache wrote a letter to Deloutte on August 13, 1842, that leaves the main issue concealed but clearly shows that there had been considerable friction in the High School faculty:

Let me begin by again returning your thanks for the kindness with which you have kept me acquainted with events from day to day. Finding that time was desired, I was in no haste to send in my resignation until it appeared entirely essential to do [so] from the reciprocity of accepting the appointment at the University. . . . I was very careful in writing to Mr. Frost not to commit you in any way and not to make any remark which he could construe into a hint—that I had heard of his conversation. I spoke of the *wiles* of our enemies and endeavored to put him on his guard in relation to them. The effect which your letter had was just what you intended; it prevented me from committing *myself* to Mr. Frost as I should probably otherwise have done, supposing the "ground to be hard, when it was really *soft*" and not doubting his *staunchness* as well as his general friendly feeling. As you say it is natural, and I have not thought it otherwise; only I should be sorry to be used for the sake of injuring myself and the system. . . . I have always supposed that there were two sides to this, and that the school might lose as much from the warm support of my friends as it would gain on the other side. Looking at the matter in the light of a disinterested spectator (*can I do so?*) it really appears to me amazing that the friends of the High School generally should have taken example by the University and not have allowed one

who was courted by the latter institution to be drawn away. My mission is perhaps accomplished: we shall see. Looking back over the last seven years I am entirely satisfied with the train of events (not merely *resigned* but thankful) and I feel more than ever a trust for the future. If republican institutions are right in the sight of the Supreme Ruler, they must prevail; if so the schools must and will flourish; and though through temporary depression and through opposition the cause will advance. No man is necessary to any cause, and perhaps I have done my part. If so, you may benefit by a separation; if not, I shall yet be found side by side working in the good cause, and under more favorable circumstances than in days past. I agree with Mr. Walker that you do in this case look too much at men; in our country principles are everything and men very little. I admit that the process of principles is sometimes impeded by the inefficiency of those who advocate them and that stronger men are required at times at the helm than the general tendency to change makes prominent, but still principles advance and *perhaps fast enough,* at all events as fast as it is intended they should.

The vacancy in his old chair at the University, together with his faculty difficulties at the High School, made Bache welcome the change. When Bache had left the University in 1836 to assume the presidency of Girard College, his successor was a fellow alumnus of West Point, Lieutenant Roswell Park, who was Bache's junior by six years and like him the academic leader of his class. As an engineer he had been working on the Delaware Breakwater. At this point the similarity of his career to Bache's ends. Instead of engaging in research, publishing papers, and identifying himself with scientific societies, Park became attracted by theology and resigned his University connection in July 1842, to qualify for ordination. The Trustees were glad to reëlect Bache, who returned to the University with enhanced glory. Certainly Bache was pleased to get back to the academic situation in which he had happily launched his career. Whether or not he had ambitions to become Provost of the University, as Davidson thought, is hard to say.

On the occasion of the dedication of the third home of the Central High School in November 1902, the University of

Pennsylvania presented to the school a portrait of Bache in order to testify, in the words of Joseph G. Rosengarten, "alike its reverent and affectionate memory of Alexander Dallas Bache." It was a copy of Huntington's portrait painted for the American Philosophical Society, and served as a reminder that Bache had shared in the growth of both the Central High School and the University of Pennsylvania.

So Bache found himself, in August 1842, once again a member of the faculty of the University. The position of the institution was greatly improved, and Bache looked forward to at least another period of years in its service. He threw himself into the work with renewed vigor, relieved, as he was, of the cares of administration. Bache had a mind that was precise and mathematical, that lent itself well to details and to statistics, and that had in it the qualities of justice and sympathy and fair play which were ideal for administrative work. Yet he was greatly interested in people and their development. Nothing could replace teaching in affording him opportunities for training young people to develop to the extent of their capacities.

Even in his second period of service at the University, short though it was, he influenced students. There was Charles Mayer Wetherill, for example. Bache was the chief influence upon Wetherill and was responsible for his career in chemistry. They were devoted friends. Wetherill looked to his former teacher for assistance throughout his scientific career; Bache gladly gave it. When Wetherill was thirty, Bache wrote to him on July 8, 1856, concerning a vacancy in the Professorship of Chemistry at the College of Physicians and Surgeons in New York:

Can you not make them a visit at once? Communication is so ready now that a few days will carry you right into their midst. I sympathize fully with you in the disappointments which you express and only wish that I had been in Philadelphia to endeavor to give a different turn to it, more in accordance with your merits and aspirations. Life is strangely made up and no one, more than myself, knows the value of good friends, ready to act when opportunity offers. May you in your new connec-

tion find all the stability wanting in the first. I know something of the shock to which you refer and of the better results of a second choice. I want to see you in that position in New York if you find it a suitable one. It will give you prominence and I hope you may make it tell for science in our country as well as for your private advantage. Let me know your intentions.

When Bache learned in a day or two that Wetherill was not interested in the New York position because financially "the game . . . might not be worth the candle," he reflects in a letter dated July 12, 1856, on how the possession of a competence has spoiled many a good scientist and on the position of science in general:

I regret that you have been obliged to come to the conclusion which you communicate, but really can see few charms in the position offered, hampered as it is with such pecuniary outlay. The game might or might not be worth the candle. I shall not fail to keep my eyes open to see any position which may be suitable to you. If you were a poor man, you would have to work and science would be the gainer. In the last generation we lost Henry Seybert just in the same way and I suppose his laboratory remains like the palace of the King of the Marble Isles to this day. In a different way we lost William H. Keating, but none the less lost him to science. So it goes in our country and between the men of fifty and those of thirty very few are embarking on a scientific career. Let me hear from you from time to time.

Five years later Wetherill thought that he would like to have a college teaching position, and he wrote to Bache asking if he knew of any opening. On August 27, 1861, in the grim period following the revolt of the South, Bache replied in a letter that might have been written in 1917, 1918, or 1942:

Everything is in such confusion yet in this part of the country, not having adapted itself to the state of war suddenly forced upon it by the rebels, that no one can tell how soon the educational institutions will be able to start. Hence it is a very bad time to make a change of place. It may happen that some such vacancy as you seek may open but you could hardly be sure that it would be at all enduring and might find that after all

the expense and trouble you had incurred a loss. The institutions here are curtailing their expenses and the young men of college years are entering the army. Should I hear of anything such as you describe you shall know it.

Later Bache was instrumental in obtaining Wetherill the position of agricultural chemist in the Department of Agriculture, and, after the stormy termination of this connection, was probably helpful in securing his appointment as chemist of the Smithsonian Institution, of which Bache's intimate friend, Joseph Henry, was secretary. He had also tried to induce the Trustees of Jefferson Medical College to appoint Wetherill to the professorship of chemistry that Dr. Franklin Bache had held prior to his death. Bache followed Wetherill's career as an uncle might have done, again illustrating the truth that we have the warmest spots in our hearts for those for whom we have done much. When Wetherill was on leave from his position in the Department of Agriculture to investigate a new gunpowder invented by a German named Hochstätter and offered to the North, Bache wrote him from Washington on May 27, 1863: "Do tell me, when it suits you, more about that strange powder and when we come together in the same town do let us try to *see* each other, I beg you. I take the greatest interest in you and your affairs."

The boys of Girard College would have been fortunate if they could have come under the influence of Bache as had those of the Central High School and the University. But Bache continued his interest in the College. As its opening approached, Bache wrote on November 1, 1847, from Agamenticus in Maine to Joseph R. Chandler, enthusiastically recommending a Professor Reid or Reed for the presidency. When Judge Joel Jones, who was elected in December of that year, resigned from the presidency in June 1849, in order to become mayor of Philadelphia, the office remained vacant until the end of the calendar year. In the meantime, Bache was evidently mentioned as a possible candidate, especially if there were some political changes in the city. But he was a burnt child. The cares and

trials of the federal service in which he now found himself were in his eyes preferable to those of municipal service, for Girard College was to be closely connected with the city government for another score of years.

Bache's intimate friend, Deloutte, was then teaching at Girard. He received from Bache a letter written September 24, 1849, from "near Portland, Maine" and marked "Confidential," that shows the strong feelings that Bache still held after nine years had passed:

I cannot express to you on paper my views of your last letter, without fear of being misunderstood and that would not do at all. *There will be no change* in the councils as Mr. Duane supposes & no essential change in the Board. They will make me no offer which I could accept, nor do I believe now that any offer which could or would be made, any offer at all would be accepted by me. If a change occurs it would render any offer still more *un*acceptable to me, as it would be based on a *political revolution* & I will not have anything to do with the politics of the day. It might injure me to have such a connection *assumed*, in my present position, but could not induce me to accept thro' it the Presidency of the Gir. Coll. On the contrary [it] would be an additional reason to the many that now exist for not accepting it. My feelings are just these. I regret from the bottom of my heart that circumstances occurred to prevent the organization of the Girard College under my direction when I returned from Europe in 1838 & to keep up my connection for life with the Institution which then had all my thoughts & would have had my best exertions. That connection was dissolved in the most violent way & it was not the fault of those who effected the dissolution that I was not ruined by it. Providence over-ruled the designs of evil men to good, as is the general moral law! I have now entered a different career. Have spent five of the best years of my life in organizing a great work. One of science, of humanity, of public & private usefulness. I have assumed new responsibilities, formed new ties, become interested in new designs. The opposition which I have met with has so far rather seemed to strengthen than to injure. . . . I have received from home & abroad most unequivocal testimonies of satisfactory service. Has any thing been done to detach me from these ideas? You know! Could any thing

be done which would detach me. I doubt. Which is only a polite way of saying I am sure *Not!* If by another convulsion in the sphere in which I am now moving I should find my services no longer necessary my mind is fixed to devote the rest of my life only to such things as might be found to interest me most, having failed thro' Providential circumstances in doing those which I considered most useful, when ready to make personal sacrifices.

The work of "public and private usefulness" with which Bache expresses justified satisfaction was the work of the Coast Survey. He was appointed head of the Survey in December 1843, during the course of the academic year at the University. Bache offered to place his lecture notes in the hands of his successor or even to continue without compensation until the successor was appointed. The Trustees graciously decided to relieve him of further anxiety by giving him a leave of absence without compensation for the rest of the academic year. To be sure, he always retained his interest in University affairs, as his correspondence with Frazer and others shows. On two occasions when the Provostship became vacant he addressed letters to J. R. Ingersoll of Philadelphia and to other trustees recommending men for the position.

When Bache gave his last college lecture in December 1843, and put aside his last piece of demonstration apparatus, he was closing a crowded career at the age of thirty-seven. He had been an educator for fifteen years and the *finis* was being written to this part of his life. As Edmonds says: "His after-career belongs to the scientific history of America." University teaching, organization work and planning for Girard College, the educational mission to Europe and its fruits, active supervision of a new high school and a city school system—all these had been crowded into the fifteen years, and all these he left behind him at an age when most men are only coming into their full power.

XII

THE COAST SURVEY

His journal shows that while in Ireland Bache discussed the triangulations of the survey of the Irish coast. Its problems interested him. Some day Hollywood may build a moving picture around the old United States Coast Survey, for it offers the drama of patient accomplishment, outdoor life, and adventurous action. Because of this Survey thousands of lives have been saved from reefs, shoals, and rocks. The famous maps of the Survey beneficently show the exact depth of water at low tide. Mountain heights as well as ocean depths have been indicated. The channels of our three seaboards have been marked out on the maps. Ocean currents have been explored, the variation of the needle and its rate of change determined, tidal laws formulated and tide-tables published. All this was done at relatively small cost. As one contemporary said at the height of Bache's activities, the Survey cost annually but little more than a first-class steamship.

When we discuss the part that government plays in our business structure and in our public and private affairs generally, we are likely to forget its part in the history of our science. One authority reminds us that the contributions to the advancement of science and laboratory work

on the part of our Federal, State and Municipal governments, have not received the recognition they deserve. The first important step forward was in 1843, when the United States Coast Survey came under the direction of Alex. Dallas Bache. . . . An enthusiastic scientist, Bache originated many new methods and displayed great skill in devising new instruments, and he did much to broaden the growing interest in scientific affairs of the period.

That Bache was interested in the governmental subsidization of science and in governmental direction of at least some research is revealed in a statement in the *Proceedings* of the Amer-

ican Philosophical Society for September 15, 1843: "Professor Bache expressed the hope that the magnetic survey of the State of New York, would not be left to the desultory efforts of individuals, but would be undertaken and rendered systematic and complete by the authorities of the State." Bache must have felt justified in his belief that science could be aided by government when the Girard College Magnetic Observatory was reopened with the aid afforded by the Secretary of War, and when the Federal Government subsidized through the Franklin Institute his steam-boiler experiments.

Like so many things of importance in the intellectual life of the nation, the Coast Survey probably had its origin in Philadelphia. A noted engineer of Swiss birth, Ferdinand R. Hassler, was a member of the American Philosophical Society, and may have discussed with his fellow member, Thomas Jefferson, the desirability of establishing a Coast Survey. President Jefferson recommended its establishment to the Congress in 1807. The recommendation was approved, but actual field work was not begun until 1816 when Hassler was appointed Superintendent.

Hassler could not fail to leave an impression upon the Survey. He was that kind of man. With no gifts for administration, he earned respect because of his scientific ability and his thoroughness, accuracy, and energy. Even when the operations of the Survey were virtually stopped from 1818 to 1832, he brought his old enthusiasm to the work upon its resumption. Bache said of him: "For his successful struggle against great difficulties, his adopted country will, no doubt, honor his memory, as the pioneer in a useful national undertaking." He maintained his European scientific ties but, despite ample opportunity, failed to perceive the advances of American science. He engaged few native-born Americans in his department. One man stated that in his surveying party he was the only one who spoke English habitually. One of Hassler's friends affirms that "he died in the belief that the nation as a whole, was, in 1843, where he had found it in 1801, so far as its science was concerned."

His sincere and disarming frankness was balanced by a lack of tact. Once, when he felt that he deserved an increase in salary, he stormed the office of his superior, the Secretary of the Treasury, and named the figure to which he was sure he was entitled. The cabinet member protested: "Why, Mr. Hassler, that is as much as I receive myself." In his strong foreign accent that he never lost, Hassler exclaimed: "What if it is! Any President can create a Secretary of the Treasury; but only God Almighty can make a Hassler!"

When the Survey was active, Hassler served as the capable head of its primary triangulation party, while the Secretary of the Treasury, John C. Spencer, had to function as the real executive of the Survey and receive directly the reports of Hassler's assistants. The work of the Survey had, in truth, hardly begun. Spencer was doubtless anxious to place it in charge of a man who was a real administrator. When Bache's name was urged upon him for appointment to the vacant Superintendency of the Coast Survey, the Secretary thought that he was without administrative ability and referred to him as a "mere college professor." He is said to have preferred the appointment of a man already in the department with whom his contacts had been pleasant. In the few months following Bache's appointment, the Secretary completely changed his attitude. He became Bache's firm friend and supporter, for although Bache was young in years he was not without experience or depth and breadth of thinking. He was able to convince the cabinet member of his capabilities. Indeed, when Spencer resigned several months after Bache had come to Washington, he wrote to Bache on May 1, 1844:

I am unwilling to leave this Department without communicating to you the great pleasure I have derived from the intercourse which has subsisted between us since your appointment as Superintendent of the Coast Survey; and my conviction of the great service you have already rendered the country in the arrangements made for carrying on that work. The system, order and regularity to which you have brought the complicated and difficult operations of that great work, afford the

strongest assurance that it will now proceed with vigor and despatch, as well as with economy. My thorough knowledge of all your difficulties, plans and improvements, derived from the intimate communications that have been maintained between us, justify me in saying, that in my opinion the work could not be entrusted to more capable and judicious hands than yours. I shall look forward with great anxiety to the accomplishment of those great results which I am confidently anticipating in the successful prosecution of your very laborious and highly responsible undertaking.

With great respect and esteem,
Your friend and servant,
J. C. SPENCER.

Bache's appointment was first proposed by members of the American Philosophical Society. Henry says that this nomination was "fully concurred in by the principal scientific and literary institutions of the country," but probably says more than he intended to when he says of Bache's candidacy:

In this movement he himself took no part, and indeed regarded the position as one not to be coveted; for while it opened a wide field for the exercise of talent and the acquisition of an enviable reputation, it involved responsibilities and presented difficulties of the gravest character.

As a matter of fact, Bache wrote to Henry on November 21, 1843, that he had been suggested for the Coast Survey appointment. Could he do justice to the position? There seems to be little doubt that he wanted it, for he says he is finding it hard to make ends meet. Five days later he wrote Henry that the matter was going favorably and he gave him a list of men to get into line.

Bache wrote to one of his other scientific associates on November 23, 1843:

Will you oblige me by considering whether the pretensions set up for me by my scientific friends here, to the post of Superintendent of the Coast Survey vacated by the decease of Mr. Hassler, are valid? They ground themselves upon scientific attainments & administrative qualifications. Should you think favorably of this a letter signed by you or any of your colleagues

who might feel at liberty to join in it & dated from the College might serve me materially, if forwarded to me. The appointment rests with the President, & the Sec. of the Treasury, the Navy & War departments will be his official advisors in the matter.

Bache's friends worked on his behalf. Henry was among them, of course, and wrote a recommendation in which he asserted: "No other living man is so well qualified as himself to fill this office." John Torrey wrote from New York to Professor Benjamin Silliman, the creator of the scientific tradition at Yale:

You may have heard that Prof. A. D. Bache is applying for the situation left vacant by the death of Mr. Hassler (Supt. of the Coast Survey). He wishes your recommendation in his behalf & would have written to you himself on the subject had he not thought it would have been asking too much of you. His reputation is so well established in the world of science, that among his peers no testimonials would be required, but not so with the great men at Washington. . . . You are familiar with most that he has done—& know that few men in this Country stand higher than he as a nat. philosopher. He is a practical man also, & is perfectly well acquainted with the use of all kinds of scientific instruments. He is a gentleman & a scholar. Now if you can say this much in behalf of Prof. B. it may be of the greatest consequence to him & materially aid in procuring his appointment. Your name would have much weight with the President, & others at Washington. The Secty. of the Treasury will have much to say in the matter & the Secty. of the Navy will also have a voice.

Gould testifies to the vigor of the campaign that was made on Bache's behalf:

The volume of testimonials and recommendations, upon the strength of which this appointment was made, has been shown me; and their number and character has made a deep impression. I cannot believe that such a weight of recommendation was ever brought at any time in support of a candidate for office, on purely intellectual grounds. I can think of no man in the country, eminent in physical science or holding a prominent scientific position, whose name was not signed to some

one of that voluminous mass of memorials, asking the appointment of Professor Bache. . . . How such a unanimous declaration on the part of experts could have failed of success, it were difficult to conceive. . . . But to all these was added a yet more effective influence, growing out of the personal and political relations which by good fortune were brought to bear, and which it was impossible to resist. The President, Mr. Tyler, issued the commission, in spite of the avowed and vigorous opposition of the Secretary of the Treasury, Mr. John C. Spencer. . . .

Before the close of 1843 Bache was appointed to the Coast Survey Superintendency by President Tyler and was preparing to relinquish his duties at the University and move to Washington. The present Director of the Coast and Geodetic Survey, Rear Admiral Leo Otis Colbert, says that if Bache

could return today he would doubtless be amazed by some of the latest methods of the Coast and Geodetic Survey, such as echo sounding and radio acoustic ranging, but he could rightly feel that these and many other similar developments were only the logical outcome of the work started by him almost a century ago. His readiness to investigate and adopt new methods was perhaps his outstanding characteristic, and one of the principal reasons for his success in the early stages of applied science in this country.

As Bache himself said, in reviewing the progress of the Coast Survey before the American Association for the Advancement of Science in August 1849:

It was no small work. It was not limited to the survey of harbors, nor to the small extent of country capable of being grasped by the ordinary modes of surveying; but it was a geodetic work in which astronomical observations should fix the principal headlands of the coast; in which suitable bases should be measured for triangulations, and the distance between points should be accurately determined by reference to those bases; in which the topographical features of the coast, as far as required by the navigator, should be ascertained; and in which the hydrography of the coast, connected with this great geodetic operation, should be made perfect and complete in all its parts.

His first year, 1844, was what Bache calls "a year of observation," for he did nothing in a hurry. Up to that time the survey had been run only from Point Judith in Rhode Island down to Cape Henlopen at the entrance of Delaware Bay. That year operations were carried on in nine states, but the next year the number was increased to sixteen. Two factors made the task seem large. One was money. "In pecuniary matters," said Bache, "when one has a certain sum assigned him, to do a certain work, and when he has done all that sum will enable him to do, how can you say to him, 'You do not go on fast enough.' " Another reason why the task became bigger was the increase in the size of the nation itself. The ten-year period following Bache's appointment saw more land added than in any other decade of American history. Congressmen would ask, "When will this survey be completed?" and Bache would reply by asking a question of his own, "When will you cease annexing new territory?"

Yet Bache felt that the work could be accelerated "in accordance with legitimate scientific principles." Unlike Hassler, Bache knew that American science along with science in general had made great strides since the beginning of the survey and that men had received training that would equip them for the work. Bache wanted to get on; he would not hurry himself into some step that he would later regret, but he confessed to "feeling that same nervous impatience which belongs, I suppose, to all Americans."

Early in his study of the matter Bache saw that by working north and south from New York as a center, as Hassler had done, "there was a limit put at once to progress." He therefore established several separate centers well distributed. This arrangement had both scientific and political advantages. It gained support from more states and weakened the opposition, Colonel Benton and others, in the constant battle for necessary appropriations. Bache admits that he had "Boston Harbor surveyed two years before it would have been done in the regular course," because Massachusetts had held out the bait of a state appropria-

tion to hasten the survey, "an act of liberality," he says with obvious regret, "which has never been imitated by any other State in the Union." The South also rallied behind Bache, and Senator Jefferson Davis of Mississippi, whose name was later to be used to frighten little children in northern states, was one of his staunchest supporters in Washington. Before the close of the forties, scientific work was being carried on in every state on the Atlantic seaboard and on the Gulf of Mexico, and parties with their instruments had begun to conquer geodetically the coast of the Pacific which had already been won by hardy pioneers.

Hassler encountered trouble in securing engravers to work for the Government, and here again he had availed himself of the services of foreigners. This is probably one reason why Hassler did not immediately publish his results. Bache says:

In taking charge of the survey, I found a large amount of back-work to be brought up. The idea I have had, from the first, has been to bring up the back-work, and then to keep the publication abreast of the work itself; and I have nearly been able to effect this, though the work has been increased rather faster than the means for engraving have enabled us to publish.

Bache and his friends realized that the American Association for the Advancement of Science was a formidable body whose support would help considerably in convincing both Congress and the public of the need of proper appropriations. After Bache had shown the Association what the Survey had done up to 1849 in a review that was both scientific and humanly convincing, President Edward Everett proposed that the communication be referred to a committee "to express an opinion on the importance of the work, and to report what course it may be proper to pursue in order to further the prosecution of the work." This motion was adopted and the committee, composed of Everett, A. Caswell, and Benjamin Peirce, America's most distinguished mathematician, submitted a strong report of endorsement. As a result, the committee was asked by the Association to prepare a memorial to the Government concerning the

Survey. The report referred to the survey of the coast "as a work of the highest national importance and utility," as an undertaking "in all respects of truly national magnitude and character." It expressed

the strong conviction that the manner in which the survey has been conducted by the present superintendent and his associates, is in a very high degree creditable to those gentlemen and to American science. This opinion is formed not only on the highly satisfactory exposition of Dr. Bache referred to the committee, but upon the official reports of the survey published by order of Congress, on the surveys and charts which have been already engraved, containing a portion of the results hitherto attained, and on other documents, well known to the members of the Association, relative to the operations of the survey in various departments of science.

Then came the vigorous bid for continued appropriations:

The committee earnestly hope that Congress will not be discouraged from the further prosecution of the survey, by the necessarily heavy expenditure required to carry it on; which, however, is believed to be materially less than the expenditure for similar purposes by several governments in Europe. The enterprise is now in the best hands, and in the most favorable train for successful prosecution. It has been the good fortune of the government to secure for the direction of this great work the services of a gentleman, whose eminent talent—whose early training in the National Military Academy—and whose acknowledged position among the men of science of the country, signally point him out for the trust. A corps of assistants has been gradually formed in the various branches of the survey, whose skilled experience, if withdrawn by any suspension of the work, could not be replaced for years, nor wholly lost without great detriment to the public service. The committee are decidedly of opinion that an enlightened public sentiment will require the completion of the survey as projected and thus far successfully prosecuted by Prof. Bache, and they are consequently persuaded that a wise calculation of economy would dictate the continuance of those appropriations, which are needed for the prosecution of the work on the present scale of operations.

A number of Bache's extant letters deal with the administrator's chronic worry, the budget. He found that he had to cultivate the good will of Congress. Late in the December of his first year in the Survey he wrote to his friend George Ord that he did not expect to be in Philadelphia on January third:

The period of vacation is just the one which the Committees of Congress take . . . and for the sake of the Coast Survey I must not be lacking in effort just now. It may turn out that I can leave my post without danger, but there is no prospect of it now. I waited to answer you until the congressional breeze began . . . that I might discern whether the quarter from which it was coming would enable me to run a course to Philad.

The national financial troubles of 1857 brought demands for governmental economy. In July of the next year Bache wrote to T. Apoleon Cheney:

The present Atlantic & Gulf Coast will be completed in some twelve years from this date, if appropriations like those of 1856–57 are made. If less then in longer time. This year we have $90,000 less to work with than we had last year, which of course will tell in our results, very materially.

The additions to our Coast have been great since the survey was begun, Florida, Texas on this side, & the great Western Empire on the Pacific! If we continue to be extensionists the time of finishing the work will extend with the country.

Bache used both his shoe leather and his pen to reach members of Congress whose support was uncertain. To St. George T. Campbell he wrote in February 1859: "Stir up Phillips. He is full of tariff and may forget us." This was Henry M. Phillips, who in the preceding December had written to Campbell:

Bache is more frightened than hurt. The Coast Survey is safe and in no danger, beyond a slight reduction of the appropriation asked altho' there is a feeling against it, owing to its increased expense. Yet no sane man would dream of stopping or interrupting the work at this stage of its progress.

But Bache was vigilant. In some cases his labor might have been spared. Phillips, for example, wrote to Bache's school

friend Fraley: "A careless remark . . . about the great increase of its expenditures reached the ears of Professor Bache and has, I fear, induced him to think me unfriendly to the enterprise." The strain of maintaining support for the Survey in addition to the demanding nature of the work itself depressed Bache at times, and he could not keep his feelings from close friends like John F. Frazer. The latter wrote to Bache in December of the critical year 1857: "I fear that notwithstanding your self-control & your experience in politics, politicians, you are a little given to melancholy fits, like men with torpid livers. Your letter has a despairing tone. . . ."

In her biography of Jefferson Davis, his wife tells how Davis, after a long illness in 1859, left a sick bed to go to the assistance of Bache:

> Mr. Davis grew slowly better, the unimpaired eye cleared, his throat had been for some time pretty well; but Mr. Seward came daily until the day Mr. Davis was taken in a close carriage up to address the Senate on an appropriation for the coast survey. Mr. Seward and I both objected earnestly, but Mr. Davis said, "It is for the good of the country and for my boyhood's friend, Dallas Bache, and I must go if it kills me." He left me at the door of the waiting-room with beef-tea and wine in a little basket and went in—carried his point, then came almost fainting home.

Comparisons helped Bache in his claims for the support of the Survey. In fifteen years the appropriations, because of Bache's pleas, had doubled, but the output of work had trebled. The scientists working under his direction evidently performed their tasks more efficiently and with better organization than those in the English Survey, and the President of the Royal Geographical Society of London said of the two groups: "I have studied the question closely, and do not hesitate to pronounce the conviction, that though the Americans were last in the field, they have leaped into the very first rank." Similarly, a committee of twenty of the American Association for the Advancement of Science appointed in 1857 to study once again

the progress of the Survey, and perhaps again endorse it in order to help it win the confidence of Congress and the executive officers of the Government, asserted:

A careful study of the progress made from year to year, especially since the enlargement of the scale of operations under the present Superintendent, affords ample evidence that the work has been expeditiously prosecuted, and that the amount accomplished up to the present date is materially greater than has ever been accomplished in any other country in the same length of time and with the same means.

Yes, winning support and getting appropriations demanded of Bache something besides scientific talents. In other respects, too, it was no sinecure. Bache was a field man as well as a desk man. Admiral Colbert points out the fact that from 1844 to 1860 only two of Bache's annual reports were dated from Washington and that the rest came from places ranging from Maine to North Carolina. He spent a considerable part of each year in the field and found the arrangement good for his health. Yet fieldwork had its discomforts. In June 1848 he pointed out some of its trials in a letter: "We have been half *roasted* in our tents within the last week, after actually suffering with cold a week before. Such is canvas life!" Field parties often worked far from physicians. Before going on a trip to the south he asked his cousin, Dr. Franklin Bache, whom he addressed formally in his letter as "Dear Doct.," for directions as to what he should do in a bilious attack.

The preparation of the annual report of the Superintendent was a large extra task that seemed formidable to him because of an otherwise busy life and the fact that he took great pains in preparing any document. One September he wrote to a friend:

This is a bad time for me to have extra work for on the 1st Oct. I begin the preparation of my report to Congress & I am exceedingly pressed, but what I can do shall be done & my remark applies rather to the quality of what may come out than to the fact—for I require to excite my ideas by dwelling much

upon a subject before I can elaborate any thing that is at all what it should be.

Even the nonscientific reader cannot fail to be impressed by these annual reports of several hundred printed quarto pages with their many plates and maps.

Bache's administration really put the Coast Survey upon its feet. It was characterized by extensive studies in oceanography and magnetism, by refinements of method in the determination of latitude and longitude, by the development of better instruments, by a popularization of the work of the Survey through the publication of manuals and other official documents, and by a completely efficient management. Shortly after he succeeded Bache as Superintendent, his friend Benjamin Peirce of Harvard University wrote:

This important service originated with Hassler; but it received its efficient organization from Bache. . . . It is only necessary conscientiously and faithfully to follow in his footsteps, imitate his example, and develop his plans in the administration of the Survey. To describe what the Superintendent should do is simply to describe what Bache actually performed. . . . I have before me the inspiration and example of my friend Bache. It is his organization. I have only to administer as he showed the way.

In the twenty-odd years in which it had Bache's active direction, the Survey gave special attention to the Gulf Stream. It studied wind direction, tides, and currents. It made investigations of harbors. Naturally Bache would not allow the Survey to neglect geo-magnetism. It also developed a new way of carrying on deep-sea soundings, of bringing up samples of the ocean bottom, and of studying the animal life found there—all having some bearing on the art of the navigator and his safety. The great Agassiz was sent to Florida on two occasions to work on the problem of coral reefs. Bache made use of new methods and instruments. Among the latter were the electric telegraph for the determination of longitude, photography for chart reproduction, and electrotyping for multiplying copper-

plate engravings. The apparatus for measuring base lines developed under Bache's direction an accuracy almost unbelievable. In ten days Bache measured on the coast of North Carolina a base line of almost seven miles with a total probable error of less than one-tenth of an inch. The immense triangulation running from the farthest corner of Maine to the lowest tip of Florida and involving thousands of triangular measurements was found, when completed, to be only eighteen inches wrong. Bache's associates reviewed their records and found their eighteen inches in an error made near Cape Hatteras.

The commercial and the maritime, not to mention the scientific, importance of the Survey justified this whole effort and its cost. Yet Bache had to convince the public and the members of Congress of the need of the Survey, and to keep up this work of public relations and salesmanship year after year. He had to combat an opposition ready to rally behind the prejudice of any individual of power who chose to attack the Survey. His friend Gould had seen what strength the opposition could develop:

His [Bache's] administration of the Coast-Survey was by no means an easy one in its political relations. For many years there was scarcely a session of Congress, without some vehement attack upon the Survey in each House, made for the purpose of defeating the appropriations. . . . Hostilities growing out of his original appointment and incapable of being allayed, jealousies on the part of other institutions professedly established for kindred purposes, resentments on the part of persons subjected to discipline, furnished fuel for the flame, in the form of ready assistance to whatever threatened the welfare of the Survey, come from what quarter it might. At one period, the representatives from inland districts, impelled by narrow local jealousy, opposed the expenditure of public money for purposes which they supposed not so useful to their own States as to others. At another time certain naval officers disseminated, to a considerable extent, the impression that, because it was a Coast which was the subject of Survey, the work should be placed in charge of nautical men. At still another date, similar claims were urged in behalf of the army. But the minds of the people, and of their legislators became enlightened, so that

for some time before the recent war, the facts were recognized, that the services rendered were to no particular State so much as to the nation, and that the helpful aid of army and of navy were alike requisite, as well as that of a corps of civilians trained exclusively to the work.

As though this continuous opposition were not enough, during his first few years as Superintendent, Bache had the task of unifying the personnel of the department. There were "internal disorganization, insubordination and dissension" within his group. Professor Fairman Rogers, who played polo, rode to hounds, founded the Philadelphia Coaching Club, was active in the American Philosophical Society, followed Bache's interest in both magnetism and the National Academy of Sciences of which he was treasurer, and held the bewildering professorship "of Civil Engineering, Geology, Mining, Surveying, Art of Mining and Mining Machinery" at the University of Pennsylvania, had not yet entered that institution as a student when Bache left it and went to Washington to head the Survey. But he wrote a short sketch of Bache presented to the Franklin Institute two years after the latter's death that sums up well the departmental difficulties that Bache encountered and the methods that he used to overcome them:

When Professor Bache took hold of the Survey, he found himself in a position which required all his tact to make comfortably tenable. Some of the older assistants felt aggrieved that a person hitherto unconnected with the work should have been selected as its head, and for many months there was a disposition to make things go roughly, which might have disheartened a man who had smaller views, or less disposition to seize upon the opportunity afforded him to make his new work one of the grandest contributions to the science of the age.

Extreme firmness, imperturbable good humor, and a manner which made all who approached him friends and totally disarmed his enemies, finally enabled him to overcome all obstacles in the interior of the survey, and he applied himself with all his energy to the elaboration of the organization, and the introduction of all the best scientific methods, most of which he extended in their practical application, to a point not before reached.

Bache possessed the rare executive ability to develop other men and get from them the best that was in them. He had not only his distinguished ancestor's interest in scientific investigation but also his tact and diplomatic skill in dealing with diverse kinds of people. Although he reached definite conclusions about scientific data slowly and then held to them tenaciously, he was quick and rather certain in his judgment of men. He showed no hesitation in his choice of well-qualified associates in the Survey, and he did his utmost to develop those whom he found already on its rolls.

He tapped the scientific resources of the country by obtaining at different times the assistance of men such as Agassiz, Barnard, Kendall, Peirce, Bailey, Walker, Mitchell, Alexander, and Bond, and for twenty years made the Survey, as Gould asserts, the only really national institution in the realm of science. A considerable number of able military and naval officers, a list that would mean much to those who know the history of the armed services, attained their first distinction in the Survey. During the Civil War many of the naval officers found their previous Survey service under Bache very helpful to them. Many of his subordinates from the armed services thanked him for his helpful, friendly treatment after they had been returned to the army or the navy.

Rogers says that Bache

> enlisted the best scientific power of the country, either as officers of the Survey, as temporary assistants for some special work, or as friends, who, for pure love of the man and interest in a work to which he devoted his energies, were always ready to contribute their advice or co-operation in those matters which belonged specially to their line of study. It was in this way that he won the title of "Chief," applied to him by a large and ever increasing circle of scientific men, who appreciated him as the leader of organized science in America.

There was an intimate relationship between Bache and many of his subordinates in the Survey as well as fellow scientists. Since he was the "Chief" to his subordinates, his equally well-

liked spouse became the "Chiefess" in the letters that they wrote to him. Benjamin Peirce habitually addressed him in correspondence as "Most Darling Chief." Peirce's children were fond of the two Baches, so his notes sometimes end "God bless the Chief and Chiefess." Louis Agassiz conveyed the "kindest love" of a mutual friend "to the Chief and Chiefess." In some correspondence Bache is referred to as "Chief of the Scientific Lazzaroni."

Lazzaroni are Neopolitan beggars, but the name was taken by a group of American scientists to which Bache belonged. It consisted of outstanding scholars scattered over the country, who gathered together occasionally for very informal scientific discussion and for even less formal good fellowship of a convivial nature in which the flowing bowl had more than scientific importance. In the last month of the trying year 1857 Frazer wrote to Bache: "Your list of the Lazz: is acknowledged and will be attended to. Please observe that Feby. 6th is Saturday, which is Wistar Party day—which ought to be much more important to the Lazz. than the Am. Phil. Soc. . . ."

As a man with a taste for travel Bache made frequent inspections of his triangulation parties. When he visited the larger cities on or near the seaboard he kept in touch with his friends, and for a score or more of years undoubtedly had frequent contact with his fellow scientists. This relationship enabled him also to keep informed of the young men of ability as they came along. When he took a tyro into the Survey, he looked after his growth. He kept in touch with him either personally or through his lieutenants, checking his accuracy, advancing his initiative, encouraging his enthusiasm and hope, cautioning him when he needed caution, and giving him opportunity for gaining breadth of knowledge in the Survey. He encouraged him to write up his investigations for publication. In the Survey, as in the classroom or in the headmaster's office, Bache was a teacher. The same qualities that had made him a successful university teacher, a profound student of current education, an organizer and administrator of recognized ability in the public

schools, a leader in scientific societies, and a distinguished researcher in the physical sciences, led him to develop his associates as an understanding educator would.

A letter dated April 4, 1853, to an assistant named J. M. Wampler, who had evidently tendered his resignation in a huff, indicates Bache's kindly consideration for a young man and something of his training methods:

I have received with no little surprise your letter of April 1st marked private. You take a very different view of your case from what I have always supposed. You came in the C.S. as draughtsman & went into the field to suit yourself. Had you remained in the office you would have been promoted as your experience & knowledge rendered advisable. But you preferred to go to the field & get experience in a new line. I wished to put you at the head of a triangulation party a few days since but you had not the requisite experience & I assigned you as an assistant to prepare you for a charge. I think you will be throwing away your prospects to leave the C.S. but of course you are the best judge. Until you have been the rounds of the parties & acquired knowledge to take charge in each it must of course depend upon circumstances of vacancies whether you can be put ahead or not. You can hardly expect to be put in charge until qualified nor to fill a triangulation or astronomical vacancy until you have served in that line. Such is my view of the matter. I will not act upon your letter until I hear that you desire it. Perhaps as you now understand my motive (which I supposed you did before) you may be satisfied with the results. I am willing that any of those who enter the survey should obtain a large experience, at its expense, or by confining themselves to one line as drawing should make progress & be advanced, but they cannot do both.

It is not generally known that the artist Whistler was at one time a draughtsman in the Coast Survey. A fellow worker named Key, the son of the author of our national anthem, said that Whistler made more sketches than drawings and that he wished he had saved the many sketches Whistler threw on the floor. The son of Benjamin Peirce, Charles Sanders Peirce, the brilliant and unconventional philosopher who was the founder of pragmatism, may have acquired his habit of close reasoning

and attention to details through his Coast Survey experience in the techniques of precise measurement. So diverse was the talent in the Survey that Bache must many times have regretted some of his choices. Of a young Philadelphian, for example, who had doubtless come to him well recommended, Bache exclaimed: "I can't imagine how Joe has made such a failure of life; I believe thoroughly in blood, and that there is always some good and redeeming point in a man; but there is nothing in Joe whatever."

Although there is not the slightest indication that Bache felt genealogical pride other than in the illustrious Franklin, he entertained a great affection for the members of his family, and he had a number of his relatives identified with the Survey. There was even an indecorous jest perpetrated over the family name because of this fact. The names of these relatives appear in some of his annual reports. One of them, a second cousin, Richard Meade Bache, who doubtless had ample opportunity in the Survey to observe *mal de mer* and its causes, wrote an article, *The Physiology of Sea-Sickness*, for the *American Journal of Science*, in which he maintained "that sea-sickness is a disease of the brain, and not of the stomach, except incidentally, or as affected by the brain, although, it is true, that the stomach reacts upon the brain," "that the appearance of motion 'per se' does not nauseate, and . . . the nervous system is impressed by the imagination so as to bring about nausea." "It is not motion which affects us, but inequality of motion," and nature "has so constituted us, that undefined motion is repugnant to our organizations. . . . The nauseation of sea-sickness, of course, eminently proceeds from undefined motion." The article contained an admirable analysis of *mal de mer* from the lay point of view, but unfortunately offered no cure. Another relative was Charles Meigs Bache, a son of Dr. Franklin Bache, who saw a service of almost forty years in the Survey.

There must have been times when Bache regretted his own connection with the Survey, for it led to the death of a brother who was his immediate junior, Lieutenant George Meade

Bache, a naval officer on temporary assignment in the Survey. He was in command of the Survey brig *Washington* and had completed a successful cruise in the Gulf Stream when he headed for Norfolk, Virginia, to avoid the destructive hurricanes that make the coast dangerous in September. Oceanographers now enjoy the comparative luxury of steamers and better machines for sounding. Those were rough days. At midnight on September 7, 1846, the weather was thick and squally. At daylight of the next day heavy gales were pounding the brig. By ten o'clock it was blowing a hurricane. The jibboom and both starboard boats were gone, the mainmast was cut away, and the lee guns were heaved overboard. The ship's log reads: "Got her before the wind and hove overboard the larboard guns; sounded in eight fathoms of water, not able to see a cable length ahead; the tops of the seas blowing completely over and aboard us, the men clinging to keep from being washed overboard." A little after eleven o'clock George Bache and three of his men were washed overboard somewhere off Nags Head, North Carolina, while attempting measures that would save the brig. Upon the heart of a childless man so thoroughly human as Bache, the death of a younger brother in an activity that was his own chief intellectual interest must have weighed heavily.

In 1846, when this disaster occurred, Henry Wood was a child of only six years. He was to play a part in the lives of the Dallas Baches. The childless couple adopted him, and as Henry Wood Bache he joined the Survey in the capacity of a young aid in 1858. The boy was adopted partly to fill a void, but partly because of the tragedy that had befallen George Bache. The young man did not long survive his adoptive father. He died a natural death at the age of thirty-nine. Little has ever been heard of him.

A small monument in the form of a stump of a mast, reminiscent of the dismasting of the *Washington*, stands in the Congressional Cemetery in Washington in memory of George Meade Bache and his men. Near it is the grave of Captain Dal-

las Bache Wainwright, another relative of a later generation, who died in 1934 after serving more than fifty-five years in the Coast and Geodetic Survey. He was the last of the lineal descendants of Benjamin Franklin to be connected with the Survey.

A man had to have rich inner resources to carry even the ordinary burdens of such work as that of the Coast Survey in Bache's day. Gould speaks of some of the saving graces of his nature: "his keen appreciation of humor, his love of pleasantry and jest, and his social geniality. These alleviated the cares of severe administrative duty, and the anxieties inseparable from his official position." Were these the factors in his ability to lead men, especially young men?

> To a faculty of persuading the most obstinate, of soothing the most irritable, of encouraging the most disheartened; to a power of stimulating the indolent, controlling the impulsive, winning over opponents by the charm of his manner, and confirming friends by the truthfulness and sincerity of his nature,—he added that rare endowment, which imbued others unconsciously with his own zeal. . . . His companionship evoked latent aspirations, and pointed to noble aims. It was to his personal, more even than to his scientific, qualities, that the Coast-Survey owed the recognition of its importance by Congress and the people, and the annual provision made for its maintenance. He knew the secret of obtaining work from his subordinates, by doing more than they did.

But Bache loved people as people. As he said himself, he had studied men as he would study physical phenomena, and yet not exactly as he would study physical phenomena. One examines scientific data coldly, dispassionately, objectively. But Bache met a man more than halfway. If in his judgment he had good stuff, Bache wanted to do something to help him fit into some valuable work that was being carried on. To no small degree Bache made the men who made the Survey. His accomplishment as its Superintendent was due to a happy combination of the scientific and the human.

XIII

SERVICES TO THE NATION

His superintendency of the Coast Survey has been called "the great and crowning work" of Bache's life. His great-grandfather Franklin had "outvied Prometheus," as Gould reminds us; yet Bache, as though with oriental magic, stretched his arms from Maine to Florida and from California to Oregon. In the work of the Survey his scientific range included everything from the animal life on the ocean floor to the stars in the heavens. He measured both mountain heights and ocean depths.

Bache's governmental services were not, however, limited to the Survey. As far back as 1839 he had been appointed by the President a special commissioner to attend the Assay at the Philadelphia Mint. But even earlier than this he had made a contribution toward the standardization of weights and measures.

In 1833, while Bache was teaching in the University, a bill was introduced into the Pennsylvania legislature regulating standards of weights and measures in the State. Since Federal legislation had not fixed such standards, the lower house of the legislature referred the question to the Franklin Institute for an opinion. The report of the Institute's committee of nineteen, of which Bache was chairman, was a critique of previous reports on the matter, recommended that no action be taken by the state for a season, and strongly urged that Congress fix uniform standards for the entire nation, a power that had been delegated to Congress by the constitution. The report of the committee was adopted by the Board of Managers of the Institute, and Congress soon took the suggested action.

Hassler, the Superintendent of the Coast Survey, began constructing standards in 1835. In 1843, a month after Bache had succeeded Hassler in the Survey, he was also made Superintendent of Weights and Measures of the United States. The completion of the standards and their delivery to the Custom Houses and the States were carried on under Bache's direc-

tion, at the same time that he was also supervising a series of investigations in connection with excise duties on liquor. It ought to be noted here that the Office of Weights and Measures was the progenitor of the present National Bureau of Standards.

The world from time to time enjoys waves of internationalism, and with these waves scientists are usually sympathetic. It was the dream of Bache and many of his fellow scientists that the entire civilized world would adopt a universal system of weights and measures in the same way that all States had adopted uniform standards by Federal enactment. One might imagine that the metric system, as introduced in the Survey by Hassler, would be Bache's choice. Yet we learn from Rogers that at one time Bache

leaned evidently towards making an attempt to establish, by a Congress of nations, an *entirely new* standard, which should be adopted as an universal one. His two general objections to the metrical system were: first, the fact that later observations have shown that the metre is not the 10,000,000th part of the earth's quadrant; and secondly, that the actual length of the metre is not, in practice, nearly so convenient as that of the foot or the ell. The latter is no doubt the strongest objection that can be made to the metre as an universal standard, and perhaps the only one; and later, Mr. Bache seems to have determined that the metric system had too strong a hold to be rooted out by any other where it already has been adopted, and was prepared to give his unqualified support to any measures looking to its adoption as an universal system.

Bache's routine work as Superintendent of Weights and Measures may be traced in several annual reports from 1844 to 1848 and especially in a fuller report for 1856 tracing "the progress of the work of constructing weights and measures for the custom-houses, and balances for the States, and in supplying standard hydrometers to the custom-houses since the 1st of January, 1848."

During his first years in the Survey Bache was also appointed a member of a commission to survey the lighthouse system of

the country. This assignment fitted in well with his Coast Survey work. The commission suggested many improvements, and in its work Bache's scientific knowledge counted for much. The Light House Board succeeded the commission and Bache served upon the Board until his death. This, like his other connections, brought Bache many requests to extend assistance to friends of friends or to friends of friends of friends. Bache's decision not to "have anything to do with the politics of the day" protected him. Bache wrote from a Coast Survey station near Lane's Brook, Maine, in September 1859, to a friend making a request of this sort:

. . . In regard to the Light House matter, my supervision is confined to the L. H. system, as one of the Light House Board, all appointments being made by the Secretary of the Treasury. It is proposed to supply Light Houses with anemometers by the Smithsonian Institution & to require the keepers to observe.

Reference to the Smithsonian recalls another service that Bache rendered to the nation, for in 1846 he was appointed one of the Regents of the Smithsonian Institution, "an institution," in the words of its founder, "for the increase, and the diffusion of knowledge among men." His name appeared in the act of incorporation, and Congress continued the appointment until his death. That same year Bache was successful in inducing his close friend Joseph Henry to leave Princeton University to assume the secretaryship of the Smithsonian. Speaking for his fellow Regents, Bache wrote to Henry from Washington on December 4, 1846:

All is as you wish. We offer you $3500 & a house. I can make the arrangements you desire in regard to a temporary connection to fall back upon your Professorship if you do not like us. That should be done quietly. . . . Come you *must* for your country's sake. . . . You have a name which must go down to History the great founder of a great Institute. The first secretary of *the* American Institute.

This was one of the few occasions on which Bache appeared to write extravagantly.

Science triumphs in you, my dear friend, & come you *must*. Redeem Washington. Save this great National Institution from the hands of charlatans. Glorious result. In the midst of personal troubles I forget all but that this great beginning stamps our Institution.

A half-year later Bache was pleading with Henry not to leave the Smithsonian:

Dr. Paterson's call to you to rescue the University from James Rogers is strange enough. . . . Turn not from the rising to the setting sun. . . . At present the independent voices of two of your Committee say NAY. *Mrs. Bache* says Nay.

Pleasant evenings at the Baches' home in Washington may have helped Henry to make a decision. At any rate, he did make a negative answer, and on July 7, 1847, Bache wrote him: "Your letter was a great relief and rely upon it you have done what is best for your fame."

Bache had mighty plans for the Smithsonian, and Henry was at the center of these. No one could speak with more authority of Bache's influence upon the new foundation than Henry. To say that Bache "assisted in shaping the policy of the establishment," Henry wrote after Bache's death,

would not be enough. It was almost exclusively through his predominating influence that the policy which has given the institution its present celebrity was, after much opposition, finally adopted. The object of the donation, it will be remembered, had been expressed in terms so concise that its import could scarcely be at once appreciated by the general public, though to the cultivators of science, to which class Smithson himself belonged, the language employed failed not to convey clear and precise ideas. Out of this state of things it is not surprising that difference of opinion should arise respecting the proper means to be adopted to realize the intentions of the founder of the institution. Professor Bache, with persistent firmness tempered by his usual moderation, advocated the appropriation of the proceeds of the funds principally to the plan set forth in the first report of the Secretary, namely, of encouraging and supporting original research in the different branches of science. Unfortunately this policy could only be partially adopted, on account of the

restrictions of the enactment of Congress by which provision was to be made for certain specified objects. He strenuously opposed the contemplated expenditure of a most disproportionate sum in the erection and maintenance of a costly edifice; but failing to prevent this, he introduced the resolution adopted by the board as a compromise, whereby the mischief which he could not wholly avert might at least be lessened. This resolution provided that the time of the erection of the building should be extended over several years, while the fund appropriated for the purpose, being in the meantime invested in a safe and productive manner, would serve in some degree to counterbalance the effect of the great and unnecessary outlay which had been resolved on. It would be difficult for the secretary, however unwilling to intrude anything personal on this occasion, to forbear mentioning that it was entirely due to the persuasive influence of the professor that he was induced, almost against his own better judgment, to leave the quiet pursuit of science and the congenial employment of college instruction to assume the laborious and responsible duties of the office to which, through the partiality of friendship, he had been called. Nor would it be possible for him to abstain from acknowledging with heartfelt emotion that he was from first to last supported and sustained in his difficult position by the fraternal sympathy, the prudent counsel, and the unwavering friendship of the lamented deceased.

His demeanor in the board was quiet and unobtrusive, and his opinions sought no support in elaborated or premeditated argument; but when a topic likely to lead to difficulty in discussion was introduced, he seldom failed, with that admirable tact for which he was always noted, to dispose of it by some suggestion so judicious and appropriate as to secure ready acquiescence and harmonious action. The loss of such a man in the councils of the Institution, when we consider the characteristics which it has been our aim to portray, must, indeed, be regarded as little less than irreparable.

As an administrator and executive Bache was a believer in the efficacy of scientific organizations. His activities in the American Philosophical Society, in the Franklin Institute, and in the American Association for the Advancement of Science indicate this belief. He was president of the last organization in 1850 and 1851, and his address in Albany, on retiring from

the duties of president, proposed a strong organization to which the Government might be able to turn for advice on scientific questions. His ideas on the subject had doubtless been formed by his discussions with European scientists whom he met on his Girard College mission, by the services rendered by the Royal Society in England and the Academy in France, by the occasional assistance extended from the American organizations in which he was active, and by conversation with such friends as Agassiz, Henry, and Silliman.

The Albany address of 1851 is a landmark in the history of American scientific organization and of the establishment of the National Academy of Sciences. In it he sketched the development of national scientific organizations and envisaged a more general or world union of such organizations when "modern facilities of communication . . . shall have brought Berlin and New-York as near as were Berlin and Paris at the close of the last century." To be sure, the scientific associations bring out "common men," of whom there are many, but they return from the sessions "wiser, better, more zealous . . . from a meeting with Arago, with Humboldt, with Gauss, with Brewster, with Faraday, and their compeers; or, to come nearer home, with Henry, Peirce, or Agassiz." Such influence would fail to benefit only a man beyond improvement. Bache felt that "the general level of science is raised by slow deposit, which may on occasion make mountains by upheaval."

Bache resented the phrase "*dry* man of science." He denies that dryness is "one of the tendencies of our Association." One feels almost certain that his added statement, "I have sometimes thought there was danger of the opposite," is a droll reference to the conviviality of the social aspects of its meetings. National characteristics, rather than science itself, probably cause whatever aridity exists.

Nothing certainly struck me [Bache says] with more force than the contrast between the happy fluency with which the Irish men of science brought out their ideas, and the difficulty which marked the expression of thought by their brethren on

the other side of the channel. Some of the most brilliant discussions which I heard were in the French Academy, where the absence of dryness certifies that dryness is not, as in bitter reflection I may have supposed, a test of soundness.

He had reasons which led him to feel that "*an institution of science, supplementary to existing ones, is much needed in our country, to guide public action in reference to scientific matters.*" He paid tribute to the work of such organizations as the American Philosophical Society of Philadelphia, the American Academy of Boston, the Smithsonian Institution, the Franklin Institute of Pennsylvania, the departmental societies of France, and the town philosophical societies of Great Britain, but he proposed for the United States something quite different from any of the American groups, including the American Association for the Advancement of Science:

Suppose an institute of which the members belong in turn to each of our widely scattered States, working at their places of residence, and reporting their results; meeting only at particular times, and for special purposes; engaged in researches self-directed, or desired by the body, called for by Congress or by the Executive, who furnished the means for the inquiries. The detail of such an organization could be marked out so as to secure efficiency without centralization, and constant labor with its appropriate results. The public treasury would be saved many times the support of such a council, by the sound advice which it would give in regard to the various projects which are constantly forced upon their notice, and in regard to which they are now compelled to decide without the knowledge which alone can ensure a wise conclusion. The men of science who are at the seat of government either constantly or temporarily, are too much occupied in the special work which belongs to their official occupations, to answer such a purpose; besides, the additional responsibility which, if they were called together, they must necessarily bear, would prove too great a burthen, considering the fervid zeal, and I might almost say fierceness, with which questions of interest are pursued, and the very extraordinary means resorted to to bring about a successful conclusion.

Bache had been in Washington long enough to know that politics rather than science decided too many matters, espe-

cially in the absence of any body to which officials might turn. Of this he said:

The legislative and executive branches of our General Government are called upon often to decide questions which belong rather to scientific than to political tribunals. A timely recommendation by a scientific congress would frequently be a relief from serious embarrassment, and ensure the most beneficial results to the progress of science.

The questions that Bache had in mind were those bearing "on the interests of commerce and navigation, naval or military concerns, the customs, the lighthouses, the public lands, postoffices and postroads, either directly or remotely."

Quite apart from his own predilection for organization, he knew that America had a genius for it and that accomplishment in our country meant organization. "Organization here," he said, "for good or for evil, is the means to the end. While science is without organization, it is without power; powerless against its enemies, open or secret; powerless in the hands of false or injudicious friends."

Bache continued to plan for an Academy. In September 1853 he wrote to a friend from "Mt. Blue near Phillips, Maine": "I expected to have had something to tell you about a dawning project for an Academy of Sciences or a near approach to it, but the savants who were to have come here to consult about it were kept away by their wives & a north easter." It was indirectly the Civil War that made Bache's dream of 1851 a reality. Rear Admiral Charles H. Davis came to Washington in November 1862, as Chief of the Bureau of Navigation, became intimate with Bache in the latter's capacity as Superintendent of the Coast Survey, and, with Joseph Henry, Secretary of the Smithsonian Institution, was probably responsible for the appointment by the Secretary of the Navy in February 1863 of a scientific commission called the "Permanent Commission," the three members of which were Bache, Henry, and Davis himself, to report on "matters of science and art" of various kinds. This Commission was quickly succeeded by the National

Academy of Sciences. Bache's Washington home at 723 Twentieth Street, S.W., near the office of the Coast Survey, was the meeting place of a planning group that included Benjamin Peirce, Benjamin A. Gould, Joseph Henry, Senator Henry Wilson of Massachusetts, and Bache. Among those who joined the group a little later was Louis Agassiz, after he had been nominated a Regent of the Smithsonian Institution by Senator Wilson. Agassiz's biographer, Jules Marcon, implies that he took part in the incorporation of the Academy as an accommodation to his friend Bache. Admiral Davis records that on February 27, 1863, "the dinner at Bache's was particularly pleasant, even for the chief's entertainments, which never fail to be agreeable. Judge Loring, Mr. Hosford, and Mr. Hilgard were there. . . ."

There may be conflicting claims as to who the prime movers were in the establishment of the Academy. Certainly Bache was at the beginning and at the center of it. Arnold Guyot, who refers to Bache as "the enlightened and far-seeing head of the Coast Survey," calls him "the founder of this Academy." Bache knew his way around Washington and Senator Wilson provided the necessary political connections. Congress received, late in February, the bill to incorporate the Academy and passed it March 3, 1863. President Lincoln approved it the same day.

Soon after its incorporation Bache probably spoke for American science when he said that the need of such a body as the Academy had "long been felt by the patriotic scientific men of the United States. No government of Europe has been willing to dispense with a body, under some name, capable of rendering such aid to the government, and in turn of illustrating the country by scientific discovery and by literary culture." In his Albany address of 1851 he had proposed a definite plan for the Academy, a purpose very different from those embodied in the earlier plans of Franklin, Adams, Barlow, and others for the extension of the boundaries of knowledge. The plans of these men were concerned with the founding of a national

university, the initiation of research in newer fields of learning, the development of the nation's territory, and the formal study of literature, art, government, and morals.

Bache's vision was expressed in the third section of the act of incorporation: "The Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art." Henry, who became the president of the Academy after Bache's death, reveals the purposely exclusive nature of the membership:

> It was implied in the organization of such a body that it should be exclusively composed of men distinguished for original research, and that to be chosen one of its members would be considered a high honor, and consequently a stimulus to scientific labor, and that no one would be elected into it who had not earned the distinction by actual discoveries enlarging the field of human knowledge.

The members of the new Academy met in New York on April 22, 1863, completed their organization, made plans for the future, elected Bache President, James Dwight Dana Vice-President, Louis Agassiz Foreign Secretary, Wolcott Gibbs Home Secretary, and Bache's fellow townsman, Fairman Rogers, Treasurer, and debated whether or not they should take an oath of allegiance to the Government, such as the one prescribed by the United States Senate for its members. The debate must have had in it much of the frantic argument aroused by similar loyalty oaths that are proposed for groups at various times. Situations usually decide such matters. There was a division of loyalty among Americans at the time and a disastrous civil war was being fought. Quite naturally the members of the Academy decided to take the oath.

Bache served as president of the Academy until his death in 1867. With his death his help to the Academy did not cease. Its funds had never been adequate, and Bache had been one of those who made private contributions for its support. He left his Washington house to his sister and the rest of his estate to

his widow, with the provision that upon the death of both ladies the residue should be paid over to the Academy to provide grants-in-aid. Mrs. Bache died three years after her husband, and in 1871 the Treasurer, Fairman Rogers, received more than $40,000, which was subsequently increased to almost $50,000, constituting the first grants-in-aid fund of the Academy. It seems fitting and proper that the first grant from the Bache Fund was made in connection with one of Bache's favorite realms of investigation, the magnetic survey of the United States, to J. E. Hilgard, who supervised the work of the Survey during Bache's fatal illness, and later became its Superintendent in 1881. In 1941, the President of the Academy, Frank B. Jewett, reported that the principal sum of the Bache Fund then totaled $60,000, and that during the sixty-nine years of its existence 385 grants, averaging about $450 each, had been dispensed, or a total of $171,762.67. What satisfaction this investment would yield to Bache and to his forbear Franklin!

The Academy doubtless completed its organization too late to give effective help in the prosecution of the war against the Confederacy. Yet the organization had been provided. Bache died too soon to see his purpose accomplished.

One subject that had been close to Bache's heart and hand for many years was the matter of uniform weights and measures in relation to international commerce. The Academy set up its own Committee on Weights and Measures to consider international uniformity of weights, measures, and coins. A letter to Bache from the Secretary of State ten months after the incorporation of the Academy indicates that efforts were being made in this direction even during the war:

Department of State,
Washington, January 8, 1864.

SIR: I have the honor to acknowledge the receipt of your note of the 7th instant, tendering to this department the aid of the Academy of Sciences in any investigations that it may be thought proper to institute with a view to the great reform of producing an uniformity of weights and measures among com-

mercial nations. Be pleased to express to the academy my sincere thanks for this enlightened and patriotic proceeding, and assure them that, with the authority of the President, I shall be happy to avail myself of the assistance thus tendered to me, and to that end I shall at all times be happy to receive the suggestions of the academy, or of any committee that may be named by it, in conformity with the spirit of the note you have addressed to me.

I am, Sir, your obedient servant,
WILLIAM H. SEWARD

PROFESSOR A. D. BACHE,
President of the National Academy of Sciences.

Yet it is not to be imagined for a moment that Bache maintained a scientific detachment from the war. That was impossible. He was in Washington, ever the center of rumors and of forebodings. The routine work of the Coast Survey had been diminished, but Bache had a variety of tasks. One of the lightest was his service as Vice-President of the United States Sanitary Commission, the forerunner of an American Red Cross. As he labored in the administration of this association of volunteer workers throughout the country and watched Mrs. Bache's energetic activities in it, he must have thought often of that sturdy grandmother of his, Sally Franklin Bache, who superintended in Philadelphia the similar work of volunteer women workers during the Revolution. There is fortunately in America a deep tradition that we shall labor and give of our own to help those who need help.

In Washington there could be no scientific detachment from the Civil War. It is difficult for us to imagine its disrupting influences in the governmental offices in Washington. Nerves had been jumpy for some time. As early as June 1858, George W. Blunt had written to Bache from New York:

I have good reason to beleive [sic] that some person in your office gives out in advance documents *not published* without your knowledge. My reason for beleiving [sic] is yesterday a proof of a plate of a chart of the S. Coast of the U.S. was taken in our printing office containing the capes South of Hatteras.

Washington itself was far from reassuring. The capital, as Margaret Leech reminds us in *Reveille in Washington*, was in 1860

> the sprawling and unfulfilled embodiment of a vision of national grandeur. . . . It was a mere ambitious beginner, a baby among capitals. Its defects were those of youth and energy and inexperience. Yet people were ready to fancy it mouldering and abandoned, a relic of an optimistic moment of history when men had essayed an experiment called democracy. Dissolution was heavy in the air; and even the rising monuments of the republic wore the image of ruin and decay.

Henry Adams, who worked in Washington, tells us that at this time governmental departments worked in unfinished Greek temples. The city had sloughs for roads. The Government itself seemed to lack stability and had about it an air of incompleteness that seemed to support the theory of secession. The careless observer might well feel that after all there was little from which to secede. There was so much talk about secession that one person who sought to say the smart thing remarked that Washington vied with Charleston in treason. Like many others, Bache must have been made very uncomfortable by the rumors of an intragovernmental secessionist organization.

International trouble also threatened. Writing to Bache in November 1861, the scientist Peirce speculated on the possibility of war with England but felt that England would not risk it. Somewhat flippantly he added: "It will be well for the country that this war should last at least for three or four years. We need its lessons." In the following month Professor Reed wrote Bache from Philadelphia: "As regards politics everything is quiet here, persons seem to bear the prospect of a war with England with the greatest equanimity. The Peace Party (that diluted form of Secessionism), here are betraying a secret exultation at the prospect. . . ."

Men left great holes in the Government organizations by

leaving their posts and joining the Confederate cause. There was Matthew Fontaine Maury, for example, Director of the Naval Observatory, who was of the same age as Bache. He had constructed the famous *Wind and Current Charts*, which have been called "road maps of the sea," and was the father of modern weather forecasting. He launched his electric torpedoes against the Union and destroyed an alarming number of Union vessels. Benjamin Silliman, who referred to Maury's defection as "infamy," made the comment to Bache: "We now make History so fast that we have no time to stop for philosophising on it!"

Southern leaders made overtures to other officials, including Bache, and won some of them over. But Bache succeeded in preventing their taking from the Coast Survey Office unpublished maps and charts of Southern harbors and coasts. He was able to bring up from the South his Coast Survey vessels and men almost without loss. Since engineering officers of the army had to be used as line officers, Bache and his men undertook new military surveys. They supplied topographical maps needed by the army. His office furnished a large proportion of the campaign maps used by the Union forces. Especially valuable were the coast and inlet charts that the Union blockading squadrons obtained from him. Bache's ability to interpret the charts gave them additional value. In the work of a secret commission to devise plans for blockading ports and capturing seaboard points of importance, he was helpful to naval and military officers of high rank. Bache also personally supervised experiments with signal systems.

A war was to be won. For that reason, in a sense, Bache saw the realization of his dream of a National Academy even before the incorporation of that body. The Government suddenly needed the help of Bache and other scientists in the war, and quickly called upon them. With others he studied various projects that were referred to them. These were projects designed to win the war for the Union and involved scientific principles. It is Henry's opinion that

in this capacity it is not too much to say that his judicious counsel contributed to save the Government millions of dollars by preventing the adoption of plausible though impracticable propositions from which nothing but failure and loss could have resulted.

Real inventive genius should be encouraged, but every crackpot amateur scientist, like every amateur military strategist, has a way of winning the war. Such men are at work in season and out, and Bache's words concerning the work of a Franklin Institute Committee are apropos:

It will, perhaps, hardly be believed, but it is, nevertheless, true, that not ten years since there lived in our city an ingenious man, who wasted his time and substance, and the resources of his family, in a pursuit after the perpetual motion. How many such disastrous results are prevented from year to year, by the application of principles taught in the lecture room, may be inferred from the number which require the additional nipping action of the Committee on Science and the Arts.

It would be unwise to pass over the type of thinking in which Bache was indulging. What has been discussed in this chapter had very practical connections with the life of the period. But what was Bache's reach that exceeded his grasp?

Three years after he had returned from Europe Bache delivered an address at the close of the twelfth exhibition of American manufactures held by the Franklin Institute. In it he extolled the sort of procedure that arises from our American way of doing things. One wonders whether Franklin would ever have said it. Thinking no doubt of the learned societies in America that he knew, Bache says:

The principle of voluntary association by which, in the United States, we obtain some of our best results, is derived from the country to which we owe our origin. It is imperfectly understood on the Continent of Europe, and is but feebly applied even in those countries where a semblance of political freedom exists. The government too often assumes the power to direct the mind and to control the will.

Prussia has undertaken to show what an "enlightened despot-

ism" may effect, and the results of her combined educational, military, political, and religious system, yet remain to be fully developed.

But Bache develops his discourse by expressing great faith in the future of the public institution, and especially public education. There are special applications to Philadelphia.

Where shall we draw the line between that which is to be supported by general assessment, and that by particular contribution? *Shall the principle be that, what is for the good of the whole, shall be supported by the whole?*

It has been long established that the poor must be instructed at the public expense. It is found *cheaper* to educate the masses than to pay for the fruits of ignorance. Besides which, christian charity cares for the souls as well as the bodies of men. But the scheme of public education, free to all, is, even now, and in our own country, very imperfectly understood. Indeed it may be doubted if the public are yet prepared fully to follow it to its consequences. We began, in this country, after the example of the old world, to endow institutions for higher education, universities and colleges. Then we found that this was beginning to build the house at the top. We turned and established schools, common schools, and occasionally a high school. And now the foundation and superstructure have no connexion. Is not this all wrong?

If we want precedent for a different state of things from the old world, we can find it, and so be borne out by experience, as far as institutions trammelled by feudalism can be guides to us. The so-called University of France includes all public instruction within its organization; the highest and lowest are free; why not the middle? why not all? . . .

But it may be said we agree that that which shall benefit all shall be supported by all. We agree that education shall be put upon a *truly republican* basis, that all the schools, from the lowest to the highest, shall be supported from the public purse, that a wider range shall be taken than now in education, and yet the whole shall be supported by the public. But you go further, you ask that institutions for the benefit of certain classes, by name merchants, manufacturers and mechanics, shall be supported or subsidized from the public purse. These classes certainly, in my view, make up no small or unimportant portion of our community. They are surely not so few in num-

bers, nor so insignificant in influence, that their interests may be overlooked.

But I would go beyond this, and include in one wide system all the institutions of every name for the promotion of knowledge. It is not necessary to weigh their relative usefulness. It would be easy to bring up an array which would include all classes of our community. The Mercantile Library has its objects, the Apprentices' Library others; the Philadelphia Library, the Athenaeum, the Philosophical Society, the Academy of Natural Sciences, the Philadelphia Museum, the Athenian Institute, and many similar associations, each and all have their spheres of usefulness. Take them together, do not their objects include in their range the interests of every citizen of Philadelphia? Are they not intended for the benefit of classes which include all? Would not good done to all of them be done to the whole community? If not, let others occupy the vacant ground. Nor would the difficulty of adjusting claims be an insuperable one. For such it never has been in any country where such a plan has been in fact executed, and executed it has been in many, though not perhaps systematised. What, for example, is the support of the Polytechnic School of Vienna, and of its Conservatory, from the public purse, but part of such a scheme? and just such a part as the subsidizing of the Franklin Institute, under its present organization and management, would be. What the establishment of a Museum of Natural History and of Coins and Antiquities, but the support of the Academy of Natural Sciences and the Museum? What the support of a Royal Library but that of the Philadelphia Library? All of these, or nearly all, every where, are under different boards of administration. The scheme is not so Utopian as, at first sight, it might appear. Our schools, colleges, universities, institutes, museums, academies, associations, under whatever name, for the diffusion and advancement of knowledge, constitute an assemblage of objects, embracing within its scope all classes and all interests. Let me commend to your thoughts the idea of forming *a system* from these various parts, not centralized, but like our own political union, each independent, while all are united, *a great system of public instruction, worthy the patronage and support of a free and enlightened people. . . .*

Perhaps liberal individuals among us may one day turn their attention to the beginning of some scheme of general secular instruction, required imperiously in aid of moral and religious culture, by the nature of our political institutions. Without in-

telligence, virtue is comparatively powerless; without virtue and intelligence, liberty degenerates into licentiousness, independence into brutality.

His thinking carried him in fourteen years to an expression of belief, perhaps not for the first time, in the need for a national university. In 1856, giving the anniversary address before the American Institute of the City of New York, he considered "the great want of the day, yet unsatisfied—a University of the Arts and Sciences." He thought he saw its beginning in such institutions as the Cooper Union, the Astor Library, and the Dudley Observatory. On such slender foundations do men base the faith by which they live. Older Americans of prominence had nourished the ideal of a national university, long since forsaken. George Washington had bequeathed money to start the endowment of such a national university. Such is the faith in which men die.

XIV

MAN OF SCIENCE

In 1858 Bache sent G. W. Childs, in compliance with his request, a list of his scientific papers. By this time the list was rather long. The almost complete bibliography of Bache was assembled after his death by Gould and is appended to the address in commemoration of Bache that he gave before the American Association for the Advancement of Science in Chicago in August 1868.

Before Bache was forty years old he had two large collections of material on which he could have drawn for publication for many years. In his *Report on Education in Europe* he refers, for example, to the desirability of making a comparison of the Prussian *gymnasia* with those of other German states, but adds: "In the documents and notes which my tour has furnished, I have ample means for such a purpose, which I may at a future day accomplish, as it would throw the light of further experience on our operations." His great collection of educational material was never dipped into, however, after he entered the Coast Survey, unless he used it in preparing suggestions for the University of the South about 1860. The other collection fared better. It consisted of the studies in magnetism which he had started early in life.

In an earlier chapter mention was made of Bache's first papers on geomagnetism and of the three formidable volumes of observations accumulated at the Girard College Magnetic Observatory, and published by the Government in 1847. More papers on magnetism followed from 1851 to 1863, many of them based on the Girard College observations. The Coast Survey developed an active interest in geomagnetism, and Bache's annual reports refer to magnetic studies. Most of them appear in the *Proceedings* of the American Association for the Advancement of Science, or in the *American Journal of Science.* The most extensive treatment of the subject appears in twelve

parts in several volumes of *Smithsonian Contributions to Knowledge* under the title "Discussion of the Magnetic and Meteorological Observations made at the Girard College Observatory, Philadelphia." The twelve parts would fill a volume of more than 250 quarto pages and constitute what, according to J. A. Fleming, Director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, is "even today an epitome of avenues of research." In the last part he refers reminiscently to a dip circle that he had bought in London in 1836 at the beginning of his Girard College mission. It "was made by Robinson, of London, in 1836, and is six inches in diameter." He adds in a footnote: "It is the same instrument with which I made the observations in Europe . . . and those in the magnetic survey of Pennsylvania, in 1840 and 1841, and at other stations farther northward and eastward, in 1843."

This magnetic survey of his home state was a study of considerable significance. It was the first detailed regional magnetic study on the continent. The observations made by Bache himself were completed during summer vacations and at his own expense. Bache believed that there should be such intensive state magnetic surveys in addition to the country-wide survey. An eighty-five-page article in the *Smithsonian Contributions to Knowledge* embodies "Records and Results of a Magnetic Survey of Pennsylvania and parts of Adjacent States in 1840 and 1841, with some additional records and results of 1834–35, 1843 and 1862, and a map." There were some odd places for making observations: for example, in Reading, Pennsylvania, "in middle of graveyard of Universalist Church"; in Steubenville, Ohio, "across river from city, in a glen near city ferry"; in Johnson's Tavern, near Brownsville, Pennsylvania, "in cornfield in rear of inn"; and in Geneva, New York, "new cemetery west of public square."

In collaboration with an assistant, J. E. Hilgard, he wrote a paper in 1856 "On the General Distribution of Terrestrial Magnetism in the United States, from observations made in the United States Coast Survey and Others." In passing it should

be noted that Bache always gave proper credit in his scientific discussions to the labor of his assistants, and also encouraged them to prepare papers describing their own investigations.

Today Bache would be interested in the extensive work in geomagnetism in the Western Hemisphere being carried on by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. Perhaps he would feel some satisfaction in the fact that he and other pioneers had started this important work on its way and that the magnetic survey of the United States would always be associated with his name. He would recall that in this early magnetic work a magnetometer had become so identified with him that it came to be known as the Bache Magnetometer. Yet in his own day Bache realized that geomagnetism offered no opportunities for spectacular discoveries. On one occasion he remarked almost sadly, "The ordinary labors in magnetism are like those in astronomy; they yield no point of discovery, but go to the general accumulation of facts." He doubtless knew that geomagnetism alone would not give him one of the great names in the history of science. There is also little doubt that his position in pure science would have been greater if his career had not become administrative.

Most of his papers originating in the major work of the Coast Survey are found in his annual reports as Superintendent and in the *Proceedings* of the American Association for the Advancement of Science, exceptions being a short description in the *Proceedings* of the American Philosophical Society of a new base apparatus and an equally short paper in the *Monthly Notices of the Royal Astronomical Society* on a new method of observing transits. In 1849 he presented to the American Association a paper entitled "Comparison of the Results obtained in Geodesy by the Application of the Theory of Least Squares," which was discussed by his friends Gould, Henry, and Peirce. In it he again gave evidence of his admiration of German methods, for the paper begins:

The most elegant method of reducing the results of a geodetic work is by the application of the theory of least squares, and the finish of the results has been held to justify the great labor of the computations involved. Bessel's volume on the survey of East Prussia is a model of this kind of work.

Other communications to the Association having to do with the work of the Survey treat of the progress of its telegraph operations, its new charts of New York Bay and Boston Harbor employing the method by which the direction and velocity of currents are indicated, the use of the zenith telescope in determining latitudes, the cause of the growth of Sandy Hook in which the New York Commissioners on Harbor Encroachments were interested, the measurement of the base for the primary triangulation of the eastern section of the coast of the United States on Epping Plains in Maine, and chronometer exchanges in connection with the determination of longitude.

Three papers deal with the Gulf Stream and its temperatures. One, a "Lecture on the Gulf Stream," was delivered before the American Association meeting in Newport in 1860 and is a rather charming exposition of "the cold wall" as "one of the most interesting features of the approach to the Gulf Stream." Bache pictured what the bottom of the ocean is like below the Gulf Stream and explained the law of change of temperature with depth. He drew attention to the existing "instruments for determining depths and temperatures and for obtaining specimens of the bottom," and sketched for his listeners the plans for further research. A couple of sentences from this lecture recall the tragedy which befell Bache and his family in connection with the work of the Survey:

Our little vessels could not, without considerable danger, be exposed to the roughness of the wind and water in the Gulf Stream in winter, and when we attempted comparative winter observations, disappointment was often the result. The loss of one valuable officer and ten of his crew, and the extreme peril of another in autumnal explorations of the stream, has but too fully justified these precautions.

Natural phenomena still had their hold on Bache, and the work of the Survey gave point to this interest. He had papers on meteors observed at the High School in November 1840, and at the Girard College Observatory in November 1842; on rainfall and the direction and force of wind as observed at the Girard College Magnetic Observatory and at Coast Survey Stations; on the formation of a cumulus cloud from the action of a fire observed at Ellicottville, New York, during a summer vacation; "On the application of the Self-registering Rain-gauge to registering the Fall of Snow"; on occultations of the Pleiades on March 1, 1857; and on the solar eclipse of July 18, 1860. Four years after his return from Europe he described to the Philosophical Society an instrument that he had invented for determining the dew-point. Observations with this instrument were made over a period of two years at Girard College. Several forms of the new hygrometer were exhibited. Bache later found that his principle had been anticipated by Belli of Milan. "The form of my instrument is quite different from his," said Bache, "and I think it has advantages enough to entitle me to keep the name, but alas, principle was the soul, and I do not care much to dispute for the dead body."

The Coast Survey was greatly concerned with tides. We have, therefore, more than a dozen papers on tidal observations at Cat Island, Louisiana, in the Gulf of Mexico, where the tides, "with special exceptions, ebb and flow but once in twenty-four hours," at Sand Key near Key West, Florida, and at Key West itself, at San Francisco, San Diego, and elsewhere on the Pacific Coast and at New York, Sandy Hook, and elsewhere on the Atlantic Coast. Approximate co-tidal lines of diurnal and semi-diurnal tides of the Atlantic Coast were drawn. Most notable of the group was a paper entitled "Notice of Earthquake Waves on the Western Coast of the United States, on the 23rd and 25th of December, 1854." Self-registering tide gauges on the Pacific Coast detected the waves. Bache traced these waves from Simoda, Japan, where with a maximum height of thirty feet

they had damaged a Russian frigate, to Oregon and California where there had been eight waves with a maximum height of six inches, and he deduced a speed of six miles per minute as the rate of motion of the first great wave.

Bache held appointments in connection with harbor studies that had no official connection with the Survey. In these he was sometimes associated with General Totten, under whom he had worked at Newport when he was a young lieutenant, and Admiral Davis, who was interested in the project for a National Academy. He wrote numerous reports between 1852 and 1864 on the harbors of Charleston, Cape Fear River, Portland, New York, and Boston, either singly or in collaboration with Totten and Davis. These reports consider obstructions in rivers and harbors and the methods by which channels may be improved and their deterioration checked.

While still in Philadelphia in the early forties, he had presented communications to the Philosophical Society on the old question of the application of fusible metal to steam boilers, and on an instrument for determining the heat-conducting power of bodies. In 1851 the American Association printed his short paper "On the Determination of the Velocity of Sound, by the Method of Coincidences." This paper originated in experiments started almost twenty years before when he returned to West Point for a vacation. Bache says that the suggested

> method occurred to me about the year 1832, when observing the marching of the corps of cadets across the plain at West Point, to martial music, and at quick step. . . . I tried many imperfect experiments in this method in 1834. . . . I ought not to omit the statement that, in describing my experiments to the late Prof. Adrain, of the University of Pennsylvania, he informed me that the same idea had occurred to him several years previous to my communication to him, but had not been carried into execution.

When Bache went on his educational mission to Europe he visited many classes, but it was natural that his special interest was in classes in natural philosophy and chemistry. By these

visits and by scientifically proceeding from the known to the unknown, he thought he could best judge a school or college. He doubtless had in mind acquiring information about methods and apparatus to improve instruction in these subjects in America. He met some great educators, Dr. Bryce of Belfast Academy, for example. He was delighted by the opportunity to talk at length with Prechtel, the head of the Polytechnic Institute of Vienna, who had formerly taught chemistry, and with Meissner, the professor of general chemistry in the same institution, who had a laboratory that was "one of the best arranged which I saw abroad."

Such men were full of talk of what was new in the world of science and in the intellectual life of Europe generally. Bache's early life, in fact, fell in a period of scientific awakening. Learned societies were springing up. As an illustration, Bache jots in his notes, after he had visited the classes of a chemistry teacher, Dr. D. B. Reid, in Edinburgh:

He has been getting up some sort of a Philosophical Society which is to work like our Committee of Science in the Frank. Inst. and to have Lectures connected with the Society. Moreover there is a sort of soirée in his Laboratory every Saturday Evening for the producing of novelties in science and the arts and for conversation.

With his gift for working in organizations, it is quite understandable how Bache became active in the old and new learned societies that flourished in his time. There was, of course, the American Philosophical Society, founded by Franklin, to which Bache was elected at twenty-two during the first year of his professorship at the University of Pennsylvania. In 1832 he was elected a secretary. For a period of years two of the four secretaries were Baches, the other being a cousin, his senior by fourteen years, Dr. Franklin Bache. The latter, who was the son of Benjamin Franklin Bache, was always referred to within the Philosophical Society, which he later served as vice-president and president, as "Dr. Bache," while the subject of our biography was always "Prof. Bache." Dr. Franklin Bache was the

Professor of Chemistry in Jefferson Medical College and the co-author of *The Dispensatory of the United States.*

There are persons who are most at home in officiating as secretary. Bache was not one of these, but whatever work of this sort he did was performed conscientiously and thoroughly. The College Faculty at the University had decided that he should act as secretary soon after he joined it. The Philosophical Society waited three years before making him a secretary, but had him retain the office for twelve. One can imagine him performing his duties as secretary, writing letters about topics in which he was much interested to people of whom he was fond. He found himself, for example, a member of a committee to celebrate the centenary of the founding of the Society and he wrote letters asking some members to participate in the program. His friend Professor Edward H. Courtenay, then at the University of Virginia, and others were forced to decline, and the interesting note of William Darlington of West Chester reads:

I am particularly disqualified for such a task, at this time, in consequence of having recently had my Barn burned,—and being now in the midst of the hurry and bustle of *rebuilding*, in order to be ready for the approaching harvest. This accident has interfered materially with my accustomed pursuits; and is attended with so much inconvenience and vexation that, I assure you, all the *Philosophy* which I can muster will be required for *home consumption!* I trust, however, that among the many accomplished members of the Society, there will be no lack of communications worthy of the event. . . .

When Bache took over the direction of the Coast Survey he resigned from the secretaryship in the Philosophical Society. Shortly afterward he was elected Vice-President. Genuine pleasure, rather than mere courtesy, is reflected in his acknowledgment of January 7, 1845, to Dr. Robley Dunglison, a secretary, who had informed him of the election:

I know not how to express my sense of the great honor done me by the Society and will therefore beg of you to return suit-

able thanks in my stead, and to express the deep attachment which I feel to the members individually and collectively, an attachment which neither time nor absence can weaken.

Bache was vice-president until 1854 and president from January 5, 1855, to January 2, 1857.

He held membership as an associate fellow in the American Academy of Arts and Sciences, but does not appear to have been active in it. Only residents of Massachusetts could be fellows in this organization and vote at its meetings. Since Bache was only occasionally in the neighborhood of Boston he probably attended meetings rarely, if at all. The *Memoirs* of the Academy contain only one communication in which he had any part. This was a paper in geomagnetism presented in 1855 by W. C. Bond, the director of the Observatory of Harvard College, embodying data obtained from Bache and from W. H. Emory, who served as astronomer in the group that surveyed the boundary line between the United States and Mexico.

The Franklin Institute claimed much of Bache's time while he was in Philadelphia. In this organization, as in the Philosophical Society, he served on many active committees. He was on the Board of Managers from 1831 to 1839, and was corresponding secretary from 1839 to 1843. He also held what was called a professorship in the Institute. William H. Keating, Robert M. Patterson, and Robert Hare had held Institute professorships before Bache, as did subsequent University professors such as Roswell Park and John F. Frazer. Bache, who was referred to by the Institute as "its most distinguished member" on the occasion of his death, was the first chairman of its Committee on Science and the Arts, which replaced its Committee on Inventions in 1834. Almost a sixth of Bache's published items included in Gould's bibliography appeared in the *Journal* of the Franklin Institute. About the same number appeared in the *Transactions* and *Proceedings* of the American Philosophical Society.

Approximately a fourth of his publications are found in the *Proceedings* of the American Association for the Advancement

of Science. Both Dallas Bache and Franklin Bache were members of this organization from its first meeting held in Philadelphia in September 1848, and Dallas Bache attended its subsequent meetings whether they took him to Cambridge, Charleston, New Haven, Cincinnati, Albany, Cleveland, or elsewhere. He thought that the Association gave science the opportunity to develop a strong national organization and to be more popular without being less scholarly.

Bache felt that the Association would be an active agent for the actual advancement of science, not merely in encouraging research and publication, but in humanizing and popularizing science and divesting it of some misunderstandings in which it had been draped. In his remarks at Charleston in March 1850, when he was serving the first of his two years as president of the Association, he said:

Is it desirable or not to increase the interest of the public in our meetings, by devoting a portion of our time to popular accounts of new subjects? The meetings of the British Association include meetings of the sections which are strictly scientific, and general meetings, at which accounts of the proceedings of the sections are given by the chairman of each, where general business is transacted, and particular subjects presented by members chosen by the General Committee for that purpose. This, though strictly belonging to the diffusion of science, may not be found to be prejudicial to its advancement. It has mixed good and evil in it. May not the good predominate?

Bache was a sincerely religious man. His religion and his church were not used as an escape from the sense of meaninglessness that is sometimes felt by those who are surfeited with science. His science had never carried him into agnosticism. His journals do not even reveal the gentle uncertainties embodied in the verses on Huxley's tomb written by Mrs. Huxley:

> And if there be no meeting past the grave,
> If all is darkness, silence, yet 'tis rest;
> Be not afraid ye waiting hearts that weep,
> For God still giveth his beloved sleep
> And if an endless sleep He wills, so best.

Bache doubtless held a firm belief in immortality and in what orthodox Christianity taught him. He had been brought up in the tenets of the Episcopal Church, and was faithful to them, though never bigoted.

His letters show that as an interested churchman he wrote about church matters, even while at Coast Survey stations. He believed that science and religion were not contradictory, and that any attempt to pit one against the other was injurious to science. This is well illustrated by what he said on the subject at the American Association meeting in Charleston:

There was one circumstance in this meeting which gave me pain—first a shock of surprise, then unalloyed pain. It was, to see that science, which I had always considered the fast friend and natural ally of religion, was, in some of its paths, or in some turns and windings, and seeming ends of those paths, regarded with suspicion by the religious. The able address of Dr. R. W. Gibbes, of Columbia, vindicating geology from suspicion of leading to infidelity, was not written without abundant and, indeed, urgent reasons, derived from circumstances in the midst of which he is. In observing European science, one of the facts which struck me most forcibly and agreeably, was the connection in England, through her University education, between science and religion, so that some of the most eminent men were ministers of both. I thought it gave higher aims, a higher tone to science and scientific men, to be thus devoted to religion, the moral and religious man being developed at the same time with the intellectual. I believed the time had long gone by, when the study of God's works could be supposed to lead away from the revelations of his word; that the language which I heard last Sunday, from a pulpit in this city, was of common consent and acceptance—"science is no ally to skepticism." It is, nevertheless, true that a lesser wave of the same class with that which rose to overwhelm geology some twenty years since, sweeps with considerable force over the Southern portion of our Union, and requires to be stayed with judgment to subsidence, unless, by making ill-shaped and untimely obstacles, we raise it to the height and force of breaking—a dangerous experiment for those who must meet the shock.

The progress of science is towards truth. But how distant the goal! We think we discern clearly; but the medium changes,

the objects assume new colors, forms, and proportions. One age teaches cycle and epicyle for truth, and makes the earth a fixed centre; another approaches nearer the truth, and shows the law which ministers the will of Him who made all things and us, to give way in its turn to some higher truth. Science is emphatically progressive. Who would be so indiscreet as to hinge his religious faith upon changeable, progressive science?

When Bache died, Gould told the American Association:

Can any of us forget his relation to this Association, of which he was one of the founders? No man surpassed him in efforts for its success. Never absent, never without some tangible proof of interest and good wishes,—his counsel, more than that of any one man, was sought on all questions of policy, and his opinion received with unsurpassed respect. Over three of the fifteen sessions of the Association held during his life, he presided, and hither he brought the annual contributions of his abundant discovery.

This same Dr. Benjamin Apthorp Gould is at the center of the story which follows.

Science had to be protected from its misinterpreters. It also had to be protected from those who in no way had its interest at heart, Bache was convinced. Such, for example, were the members of the Board of Trustees of Dudley Observatory in Albany, New York, which had been inaugurated in August 1856, with high hopes for the advancement of astronomy. The volume containing the inauguration proceedings contains brief remarks by Bache in which he announced support of Dr. Benjamin A. Gould's astronomical journal published at Cambridge for a period of six years by twelve gentlemen of Albany. Keeping in mind the fact that these were the days of long programs, we find in the volume a seventy-five-page oration or "discourse" by Edward Everett and a seven-page poem by Alfred B. Street dedicated to the American Association for the Advancement of Science. Of chief interest, however, is a short *Letter and Schedule of the Scientific Council* addressed to Thomas W. Olcott, the president of the Trustees, by Bache, Joseph Henry, Benjamin Peirce, and Gould himself, in which it is estimated

that the cost of maintaining the observatory would be $10,000 per annum. To this proposal Mrs. Blandina Dudley had agreed, becoming the main supporter of the enterprise.

Two years later Bache, Henry, and Peirce, as the three members of the Scientific Council other than Gould, addressed a printed document of eighty-nine pages in defense of Dr. Gould "to the donors and friends of the Dudley Observatory." The lid had blown off. Olcott, the Board president, and the man most active in the efforts to remove Gould from the directorship of the Observatory, appears to have been a business man who was given to strong feelings and to flights of rhetoric. Writing to a member of the Scientific Council only six months before the defense appeared, Olcott had said: "We are willing to sink or swim, with a Henry, a Peirce, a Bache and a Gould, as the only chance of immortalizing ourselves in this world."

Soon he had chosen neither to sink nor to swim with any of them, especially Gould, whom the Board wished to replace. Mrs. Dudley, who had donated nearly $80,000, appealed to Bache, Henry, and Peirce to do something about the matter, and these men felt that she and the other donors were entitled to hear their side of the argument. Moreover, they felt impelled to make a statement, since the money was collected with the use of their names and some of it on their personal solicitation. None of them, including Gould, had received any compensation. Indeed, Gould had advanced more than $3,000 to operate the Observatory. The three men had grave questions to raise as to what Olcott and the Board had done with the principal and how they had spent the income.

The annual income of $10,000 for the Observatory that the Council had thought was necessary had not been forthcoming. The defenders explained their willingness to go ahead with only one-third of this amount because of their hopes that new donations could be gained as the fruits of "Dr. Gould's extraordinary talents and precision." The Board's general conduct of affairs and attempt to thwart and then to remove Gould had dashed these hopes. Bache had detailed men from the Coast

Survey to the Observatory, their non-governmental work being on a voluntary basis. But the Board had impeded the progress of the work by placing in the Observatory a kind of caretaker who was in the way. Dr. Peters, a Dane of no great scientific ability, to whom Bache had given a position as a computer in the Coast Survey and had later placed in the Dudley Observatory, was another disturbing factor. Bache became increasingly dissatisfied with Peters' work. But after Peters had missed four comets with a telescope of the "comet seeker" type to which he had been assigned, he had ingratiated himself with Olcott by naming a comet (1857, IV) that he finally found the "Olcott Comet," contrary to scientific practice. When Bache, in an effort to help matters, transferred Peters to assist Peirce at Cambridge, an assignment which certainly could not be regarded as exile, Peters resigned from the Coast Survey.

The section of the *Defence* that deals with the four young Coast Survey assistants working at the Observatory might have come from Bache's own angry pen. Bache was ever ready to defend youth. He was impatient with older people who were pompous or patronizing or habitually censorious toward youth. Three of the trustees of the Observatory had failed to visit it on the occasions when Gould would have shown them around, but they chose to come when he was absent. In the strongest language the *Defence* flings back at the three men their unproved charge that they were treated by the four Coast Survey assistants, Bache's boys, with "insolence, prevarication and falsehood." It is hard to say exactly what had happened, but Olcott says: "The committee felt called upon to rebuke recent gross and deliberate insults offered by Dr. Gould through his youthful subordinates!"

The account of the incident that one of the three trustees gave "was such as to condemn him in the eyes of the friend to whom he related it." The young men were volunteer workers, not paid employees; they were "barely provided with a place to shelter themselves and essential by its proximity to the Ob-

servatory to the execution of work by night or by day," but they were not showmen or subject to the demands that the sudden visitors made on them. The *Defence* concludes that "the rudeness was on the part of the visiting Trustees."

It is a sordid story that has its roots in a lack of funds and a lack of understanding. The defenders may have overstated their case, for they felt that true science was being attacked. They reached the center of the difficulty in the statement:

It is evident that the Trustees and the Scientific Council have views of the Observatory, incompatible with each other. The aims of the two are as different as the motives of those who seek mere notoriety are from the motives of those who seek true reputation. The great object of the former seems to be to make an impression upon the popular mind, by means of a display of imposing instruments and apparatus. The object of the Scientific Council is to render the institution a means of producing original additions to knowledge, which may command the approval of the scientific world and confer lasting honor upon the Observatory.

The Dr. Peters who had given trouble at Albany was not to be lost sight of. Perhaps still mindful of how he had been complimented by the discoverer of the "Olcott Comet," Olcott wrote in November 1859 to Bache inquiring if Peters had indicated a wish to recall his resignation from the Coast Survey. Bache replied in part:

When at Cambridge Prof. Peirce & I had a very long conversation with Dr. Peters endeavouring to impress upon him the kindly dispositions which we felt & the necessity for reciprocation on his part. Prof. Peirce went so far as to explain his intended course to Dr. P., in the Pleiades matter, & to show him that it must work well if he came to Cambridge, & was impracticable if he did not. I also took the unusual course of explaining my motives for official action, & of giving assurances intended to remove misconstruction on Dr. Peters' part. When called upon for reasons why he should *not* comply with my wishes, Dr. Peters declined giving any, threw himself upon his "reserved rights," & asked time, which I readily gave, to decide upon his course. Throughout the whole matter I was very

unfavorably impressed as well with his discussion of the scientific details, as of the business ones, & especially with the temper & tone assumed by Dr. Peters towards Prof. Peirce, immediately in charge of the work in which Dr. P. was assisting, & towards me as Supt. Loyalty in an assistant, my dear sir, is an essential quality; no knowledge or talent can compensate for the want of it.

There is much sound administrative philosophy in the last sentence.

Ten years before the Dudley controversy Bache had written to his friend Henry from Agamenticus: "Life is too short & there is too much of the positive to do to waste it in broils: what amount of civilization did the Highlanders reach while they were always in feud?" But he asserted his firm belief that if assaulted one should fight. In the Dudley affair a reputable Scientific Council had been assaulted. "Fight years if assaulted," he wrote; " 'Friend, thou hast no business here,' said the quaker as he lifted the pirate over the taffrail & let him fall into the sea."

This entire tragedy of errors at Albany quite naturally developed more heat than light. The newspaper editors were not too stable, and at least one shifted from the support of the scientists to the opposition. The controversy was given much unfortunate attention in the newspapers of Albany. The statement of the trustees appeared on the desk of every member of Congress, accompanied by an anonymous pamphlet attacking Bache. It is little wonder that Bache felt that he had to strike back.

Gould himself realized how little was to be gained by prolonging the controversy. He wrote to one paper: "I feel confident that a moment's thought will show you that no attempts to influence public opinion in a difficulty purely personal are likely to promote the diffusion of truth or the attainment of justice." Jefferson Davis, whose letters to Bache are very human documents, expressed twice the fear that it would all look like a sordid quarrel, that "the public would probably never

read so long a statement" as was necessary to answer the trustees, and that a debate might serve to elevate the trustees and "to that extent depress you." Davis wrote: "I do not think either Professor Peirce or Henry consider it incumbent upon them to proceed further for the defence of Dr. Gould."

Another close friend of Bache, J. H. Alexander of Baltimore, ascribes the authorship of the *Defence* to Gould and thinks it "hideously long" though he admits he "makes out a very awkward case against the parties, nevertheless." He says if he had been councilor he would have followed one of two court procedures. "A war of pen and ink . . . never amounts to much. . . . At least such is my experience." Gould himself wrote to Bache that he was very sorry the *Defence* was so long.

Of Mrs. Dudley, Alexander says: "Poor lady! she is an intolerable victim. What an encouragement for Benefactors! I am resolved never to do any good to my Race that I can help, if the dispensation of it is to be committed to others." The shade of Mrs. Dudley may feel relieved that after all the trouble occasioned by her gift the Observatory is still continuing and now occupies a new building erected in 1893.

From this Dudley controversy the conclusion must not be reached that Bache was a man preoccupied with small matters. A principle was involved at Albany, and men like Bache, Henry, and Peirce felt that it was worth defending. Actually, Bache had developed the habit early in life of casting his eyes over the entire scientific horizon. His interests were worldwide and his scientific range was great.

His desire to coöperate with British efforts to obtain magnetic observations in different quarters of the globe has already been discussed. In 1842 he was a member of a committee of five of the American Philosophical Society to coöperate with the Brussels Academy of Sciences in "simultaneous observations of natural phenomena." This is only one of a number of examples which might be cited of Bache's early and lasting desire to coöperate internationally with scientists working in fields that commanded his interest. The late 1850's found him a mem-

ber of a committee of the American Association "on Dr. I. I. Hayes's Proposed Expedition to the North Pole." The expeditions of Gilliss to Chile and of Kane to the polar regions received his advice, official help, and financial assistance. After Kane's death his various magnetic, meteorological, and astronomical observations as reduced by C. A. Schott of the Coast Survey were presented to the American Association by Bache himself. He also wrote the obituary notice of Dr. Kane for the American Philosophical Society.

Bache's memberships in the Royal Society of London, the Royal Society in Edinburgh, the Imperial Academy of Sciences at St. Petersburg, the Institute of France, the Royal Academy of Turin, the Academy of Sciences in the Institute of Bologna, the Mathematical Society of Hamburg, the Royal and Imperial Geographical Society of Vienna, the Royal Astronomical Society of London, and the Royal Irish Academy of Dublin bear witness to his breadth of interest and his recognition by foreign scholars. Moreover, between 1855 and 1859 he received four foreign medals: a Danish cross for general scientific contributions, and gold medals for his work on the Coast Survey from the King of Sweden, the King of Sardinia, and the Royal Geographical Society of Great Britain. When his friend Henry learned that Bache was to receive the Royal Geographical Society medal he gleefully expressed the hope that Bache would have to petition Congress to be allowed to accept the honor and "thus be obliged to take the shine off the man on the hill."

Nor was he without honor in his own country. He received the honorary degree of Doctor of Laws from New York University in 1836 following his election to the presidency of Girard College. The University of Pennsylvania in 1837 conferred upon him the same degree "on account of his distinguished learning," as the mandamus reads. Both degrees were conferred *in absentia.* In 1851 Harvard University also honored him with this degree, referring in the Latin citation to his Coast Survey work and scientific learning: *Oris Maritimis Reipublicae Foederatae dimitiendis praepositum, Scientiarum cognitione*

praeclarum. . . . His name was given to a mountain overlooking the Pacific that his triangulation parties had conquered for science. And in the Northwest a lake received his name, perhaps to remind us that the larger waters had been charted under his direction and brought within the knowledge of all.

XV

THE CHIEF

THE generic type, as he is represented in literature and art, is likely to be annoying to a member of his class, whether the type be the absent-minded college professor, the Bohemian artist, the swindling lawyer, or the impractical clergyman. Bache was greatly annoyed by the "dry scientist." He had visioned a large place for science and scientists in the world of the future. In such a world the type of scientist that non-scientific people were imagining would have his difficulties. Perhaps Bache was afraid that the creature of fiction would become a creature of reality. He must have known that men with his own talent for mathematical and precise thinking at times do develop the characteristics of the "dry scientist." Whatever desiccating tendencies he saw within himself, he successfully fought off. Certainly his own career in which he rubbed shoulders with politicians, business men, and army and navy officers kept him from being immured within his science. His administrative work was no ivory tower offering the seclusion of the laboratory.

When he looked at a map it must have suggested friends as well as survey measurements, for he had friends everywhere. As the Civil War approached, for example, his friend A. O. Andrews wrote as "President" from Charleston: "Our 'Chamber of Commerce' have their anniversary on 16th Feby. next. It would give *all* our members great pleasure, and myself I need not say, *especial* gratification, if you would come and 'take a cup o' kindness' with us at dinner on that day." Bache's associates in scientific circles did not conform to the "dry" type, he claimed. The Lazzaroni, including Bache himself, were not arid scholars. His mind may have been stronger than his physique, but life was always in his grasp. He loved the outdoors. For indoor recreation he read light novels. He appreciated humor and pleasantry. He had a capacity for fun-making. The

impersonal demands of science never caused him to lose his sense of human values. Bache's words about his friend James A. Pearce might well have been applied to himself: "Refined in his tastes, brilliant in society, instructive from the affluence of his ideas and extent of information, without ostentation as without pretension, social, genial, even playful among his intimates." He had a genius for friendship and for making friends.

He loved hours of leisure with friends. Conversation was meat and drink to him, although it was usually supplemented with more substantial meat and drink. He preferred German wines as he preferred some aspects of German education. He imported Rhine wines and others directly from German dealers. One wine bill from Frankfurt am Main among his papers includes seven varieties: Liebfraumilch, Geisenheimer, Hochheimer, Rüdesheimer, Marcobrunn, Steinberger, and Forster Auslese.

A Coast Survey associate wrote him:

I have come across some remarkably fine Pale Sherry at Beaufort, purchased at a forced sale, and now offered for sale at $4. per gallon. It is not so much in your line as Hoch or Sauterne but as I believe you keep it for your guests, perhaps you might like some of this reserved for you. If you come to see us you shall try it, without prejudice to the matter of Sauterne.

In Prague he was called "de Bache" and "von Bache" and in Vienna discovered that he was honored with a "von" since it was "a title of civility to equalize." In Ireland he may have been "Bâshè or Bàshe for I make no head way in getting any other pronunciation." But at home there was such an intimacy among his close associates that he was always Dallas or the Chief. His associates used familiar terms of address. Frazer, who was one of his Philadelphia cronies, even shortened the name of another, Fairman Rogers, to Frodgers.

Bache preserved a youthful spirit for his friends. Except when desk fatigue overtook him or the physical infirmity that presaged his death wore him down, his outlook was youthful. He loved youth and defended it, whether at school or at the Dud-

ley Observatory. He loved youth so much that he even hated to see it assume the gravity of greater years. When he visited the Irish Inns of Court his friend asked if he did not think the wig and gown made young men look well. To this he made reply:

I could not conceive them to be young men. I felt myself indeed in the company of a collection of fogies and had something of the same feeling that came over me in entering the room where the figures of "the signers" were ranged in dread array.

He did not lose friends as he passed from one sphere of activity to another. Several years after he had gone to Washington he was still on terms of easy familiarity with his French friend Deloutte, whom he advised, in connection with a position, to cultivate

that lady whose ringlets if I remember right make her far from disagreeable to look upon; & who is really a woman of mind, & if won a true friend. There is nothing it seems to me in the lady herself or in the position which should make you avoid guiding her in the right way, or which should make it disagreeable to you to acquire a proper influence. What is [it] that makes the woman so repugnant to you? Do not undervalue the *sex*, & take the opinions of a Benedick of their high value & importance.

Another French friend, François Amédée Brégy, obtained through Bache's influence his appointments at the Central High School, Girard College, and perhaps the University of Pennsylvania. Bache was responsible for Joseph Henry's connection with the Smithsonian and for his declination of a later invitation to return to teaching in the form of what Bache refers to as "Dr. Paterson's call to you to rescue the University from James Rogers." His letters to Henry, in whose company he made official New Year's calls when they were both in Washington, were concerned chiefly with scientific and political-scientific matters. He exchanged correspondence with men from northern New England to the deep South. The many letters of recommendation that he wrote testify both to his

importance in public life and science and to the number of those whom he knew, and to his willingness to help them.

The Washington home of the Baches must have been a comfortable place where Senator Jefferson Davis and other friends enjoyed their visits. Mrs. Davis draws a pleasant picture:

The Coast Survey at that day was a large, old-fashioned barrack of a house, on the edge of Capitol Hill, overlooking Pennsylvania Avenue. It was very plainly furnished, and had no curtains to the drawing-room windows, but certain riotously healthy rose geraniums that grew in boxes were interlaced across the window panes and made a flickering green and gray light, and exhaled a delicate odor. This perfume now brings back a ray of the old joy that used to pervade us all when "the family" were bidden to supper there.

On these occasions Mr. Davis and Professor Bache, General Emory and Mr. Walker, jested like boys, told stories of their West-Point life, or of canvasses for office in Mississippi. . . . Mrs. Dallas Bache was a petite and eccentric childless woman, with a great deal of character and much common-sense, and she had not a little epigrammatic wit. Like Mrs. Gladstone, she had given up her life to her husband and was part of all his labors. Once he wrote to her from the Capitol to tell the clerks to send him, in great haste, some papers, needful for the defence of the Coast Survey. She inquired of them and found they knew nothing of what was wanted. She searched until she found them, and wrote only this commentary, "Pins have heads."

About nine o'clock we were ushered pellmell into a long, unfurnished room, the walls of which were hung everywhere with scientific instruments; disused theodolites were shunted into dark corners; old telescopes, with all the paraphernalia of adjuncts to scientific investigation; and, in the middle of the room, was a great table laden with everything good and appetizing that Washington could furnish. Then the terrapins and canvas-back ducks were not, as now, going to join the buffaloes, the dodo, the roc, and the phoenix as extinct animals; so they were there in profusion. The perfume of the long-necked bottle of Rhine wine filled the room, which the Professor opened himself, there being no servants present, and the gentlemen pledged us and each other in a glass, and the quip and jest flew from one to another, and made of our suppers at the Coast Survey

real *noctes ambrosianae*. When Professor Bache was domesticated with Humboldt, whither he went to investigate the school system of Germany, he learned to like these wines, and always imported them himself.

Mr. Davis was the life of the party, and I never heard him advert but once with regret to a night there. He was one Christmas persuaded to sing an Indian song, and Dallas Bache put on a fur coat to personate Santa Claus, and gave the presents in the most truly dreadful doggerel. Six months afterward, one warm summer day, Mr. Davis exclaimed that he felt oppressed; "but," said he, "I think it is not the weather, it must be the memory of my Indian song last Christmas, and dear Dallas Bache's execrable doggerel. I am sorry I did not make him sing, and do the rhyme myself." As the Professor could not turn a tune, and Mr. Davis had no capacity for jocular rhyme, I thought they had reached their utmost limits as it was, but refrained from venturing an opinion.

Both in Philadelphia and in Washington friends gathered frequently at Bache's house. The Club, as he refers to a group of cronies in his letters, used his home as one of its meeting places in Washington. Rogers gives us an attractive picture of the warm hospitality of the Baches both at home and in camp:

Released from his official duties, about which he was usually very methodical, he was the pleasantest companion at the dinner table or in the saloon, that young or old could desire. Extremely fond of society, his hospitable house in Washington was always open to his friends, who carried away with them the most charming reminiscences of its bright wood fires and sparkling candles, and in his summer camps there were always some extra tents for those who were fortunate enough to receive invitations to visit him in his wild retreats. He spent several months of each year under canvas, at the primary triangulation stations, or on base measurement, and returned to his duties in the capital refreshed and invigorated by the mountain air, long strolls, and change of scene. Bright reminiscences are those of these mountain camps, with the morning's writing, the midday dinner, the genial face of the kind hostess, the pleasant chat over the bottle of Rhine wine, and, if there was no observing in the afternoon, the long rambles down the hill, with the climb back again, the camp being of necessity very near to the summit, finishing up with an evening of conversation or

reading, unless the stars were good enough to allow themselves to be observed.

Bache was a good representative for America to send abroad on an educational mission, for he carried with him a spirit of friendliness. His tact and judgment are revealed many times in the notes of his trip; for example, his reference to the headmaster of John Watson's Institution in Edinburgh: "Mr. Marshall is a strong establishment man and a thorough tory but we managed generally to keep off of such matters as related to kirk and party." Bache got along with strangers easily and they were soon giving him their confidences. At another Edinburgh school the headmaster and masters avowed to him "that the Institution was used merely as a stepping stone to something better & the headmaster expressed the opinion that the first thing which occurred to anyone after appointment was to try how to get out." Needless to say, these comments do not appear in the printed *Report.* He had a capacity for liking people. Bache must have looked forward to visiting a distinguished educator named Girard, if for no other reason than that his name was Girard and that he might possibly be a younger relative of Stephen Girard, for whose foundation he was making the trip. His notes read:

Friburg. Visit to Pere Girard.

Sept. 9th, 1837. I went to see Pere Girard who is a monk . . . and resides in his convent in the town. He received me with cordiality and for the first time I found myself talking to a man in a black gown and cowl and cord in a monk's cell. . . . Full of enthusiasm for instruction he had a flourishing school . . . when in 1823 he left in a voluntary exile his friends here and his school to prevent any action of an unfavorable kind upon the latter from party spirit. . . . He was a professor of Philosophy at Lucerne for 10 years. . . . His school was and is superintended by a master. . . . Reading, writing, mental and common arithmetic were taught and the mother tongue as the basis of acquisition in language. The principles of morality were inculcated principally by drawing on the children's consciences; their relations to parents, to each other, to God were drawn on in the same way. Nature's religion followed. There the basis

of revelation—God the saviour. The spirit. The mystery of the trinity. Endeavouring all the while to act upon the heart and not merely to convince the head. . . . To proceed from the known to the unknown, from the simple to the complex were his endeavours in forming children. . . . The pere is now engaged upon a book intended to carry out his ideas of the mother tongue as the basis of instruction in language. . . .

Sept. 10th, 1837. After a slight dinner I called on pere Girard. His welcome was as before. By way of a souvenir he has given me a report on Pestalozzi's school in 1809 by a commission of which he was a member. . . . He gave me most valuable hints of institutions and men in other towns and authorized me to use his name. He is full of recollections of usefulness, of present exertions and even of hope for the future. "I shall not see the results or a better state of things," said he, "but it must come." "I love all men with Christian hearts tho' they may not be Christians in formulary; such is my profession of faith," he repeated twice. "It needs not a long acquaintance . . . when one's objects are the same and the heart is right; five minutes will do!" I was sorry to leave this interesting old man. Gripping my hand between [the] two of his he said at parting: "Que le bon Dieu benit vos objets and [sic] votre zele" and pointing upwards "et vous accorde le succes."

Bache found his scientific associates in the learned societies interesting as people, as his letters attest. His notebooks show that he visited the classes of colleagues teaching the humanities at the University of Pennsylvania, though such an exchange of visits at our institutions of higher learning is now quite uncommon. As a matter of fact, such visits prepared him for visits to European classes, and he sometimes compares the foreign teaching of a subject with instruction in the same subject at the University, rarely to the disadvantage of the latter.

In whatever type of work he found himself, he treated his associates as friends. In the Coast Survey, he never ceased to acknowledge his debt to Charles A. Schott, George Davidson, Henry Mitchell, James Alden, R. S. Avery, L. F. Pourtales, L. W. Meech, John Rodgers, W. P. Trowbridge, P. R. Hawley, H. Heaton, C. Fendall, W. W. Gordon, M. H. Ober, Alexander S. Wadworth, Jr., Richard Wainwright, and others who were

concerned with its success. He encouraged his younger associates to publish their results and thus enhance their scientific reputations. The resolutions written for the American Philosophical Society at the time of Bache's death by his old school chum Fraley read in part:

It rarely happens that so much mental strength and such stores of knowledge are combined with such winning manners, such delicate and profound discrimination in the choice of men and places, and such great executive ability in accomplishing results and awarding to every colaborer his full measure of appreciation and honor.

Gould may have been correct in believing that Bache's secret of obtaining work from his subordinates lay in "doing more than they did."

To be sure, Bache's type of administration with its kindly consideration of individuals develops the strong men of ability in an organization; the men of inferior mind misunderstand it and see in it only weakness. Bache was not aggressive or assertive; he was no dictator. As a school head or a government department head, he could not play the role of Mr. Prinsen, the head of a school in Haarlem, who, when he was asked by Bache's friend, M. Cousin, what rules his school had, replied in the *l'état c'est moi* style of Louis XIV, "I am the rule." Bache's was a type of departmental direction that won high respect from competent persons.

When death summoned Bache, Hugh McCulloch, the Secretary of the Treasury, said of him:

He possessed by nature the qualities most conducive to success in the management of widely extended public interests. Invariably mild and forbearing towards those serving under his direction, his unremitting energies and his untiring patience were as invariably given to the accomplishment of the service in view. His sympathy with the efforts of others, and readiness to give credit for their exertions, secured a cordial spirit of cooperation. Sagacity, perfect freedom from bias, and constant activity within the sphere of his public duties, strongly marked his relations with this Department.

There was, indeed, nothing of the detached, entirely objective specialist about Bache. He could departmentalize his thinking effectively but never to the extent that he ceased to be a human being very much interested in other human beings. Yet he was no back-slapping, hand-shaking humanitarian who had fastened himself upon science as a means of support, for Gould was able to tell the American Association for the Advancement of Science eighteen months after Bache's death that "to him the scientific progress of the nation is indebted, more than to any other man who has trod her soil." In 1869, Bache's friend Fairman Rogers said that "the void which Mr. Bache leaves in the general scientific strength of the country has not yet been filled." His professional career enriched and encouraged research in every phase of physical and natural science studied in his time. His scientific range took him from the ocean floor to the stars; from the microscope to the telescope. Bache would have welcomed the study of the structure of the atom or anything else that might help the physicist, the chemist, the astronomer, the geologist, and other scientists in their combined efforts to explain magnetism. Speaking to his fellow scientists, Gould said that Bache "stood forth preeminent as our leader in science, our first counsellor where her welfare was at stake, unflinching in the maintenance of her interests, wise in the guidance of her affairs. . . ."

When Theodore Roosevelt on one occasion referred to Bache as "a man of great eminence alike in the work of pedagogy and in other fields," he may have been thinking of the *Report on Education in Europe* and of Bache's pioneering in public education and teacher training. With equal validity he might have placed the emphasis of his remark upon Bache's accomplishments as a scientific investigator, or his leadership in important scientific organizations, or his contributions to the building of a governmental department rich in both commercial usefulness and abstract research, or his sacrificial part in the winning of the Civil War. In the strong light of such achievement we may not see the humanity of the man. A writer in a

scientific journal in which Bache had published many of his papers glimpsed it and put it into words: "He was the embodiment of the highest type of scientific man which America has produced, set in the person of the kindliest and most courteous gentleman." Père Girard would have said that his heart was right. Bache had stars and mountains and harbors and a remade world in his eyes. Yet he had warmth in his heart.

In his biographical memoir Henry suggests the growth or development of Bache's character and abilities. Until he resigned from the army Bache's training had been largely practical and less given to original thought, investigation, and invention. These last and the faculty of generalization he rapidly developed under the stimulus that his Philadelphia associations provided. His would have been an even more distinguished place in the realm of original research if he had not been partially turned aside from the pursuit of experimental science. His leadership in the Girard College venture expanded his capabilities in another direction, and his foreign mission in its interest brought him into touch with European minds of the first order, enlarged his sympathies, and gave him a chance to study men under many different conditions. This greater breadth he was later able to maintain through his country-wide friendships, his many trips for the Coast Survey, his attendance at scientific meetings, and his long residence and social position in Washington. His work for the Survey brought intimate contact with statesmen and politicians and the life of the capital. He learned how to measure men and discern their motives. He learned how to handle his associates and bring out the best that was in them. By transferring habits of observation cultivated in the sciences, he learned to study men as he would study physical phenomena.

There is a current notion that in former generations, when death did not rain from the skies, war killed only the soldiers on the battlefield. But decades ago men and women hundreds of miles from the lines of battle died from the effects of war on civilian life. Bache represented one such casualty. In 1863, when the North dreaded Lee's advance and when Philadelphia, which

Bache always thought of as his home, was threatened with invasion, he answered the call of the Governor of Pennsylvania, planned lines of defenses for the city, and superintended much of their construction. Even in this work he was surrounded by friends. Professor John F. Frazer, who had been led into his own professional career by Bache, and whose patriotism was an inheritance from his grandfather, General Persifor Frazer of the American Revolution, was the first to join him in building the fortifications around the city. George Davidson, who had been on the Coast Survey staff for almost twenty years, was also with him.

It was all very different from what he had been doing. There was a critical tenseness about it. The days were unendurably long. He could no longer work with a triangulation party in the invigorating air of a New England mountain top. The "sick headaches," from which he had occasionally suffered, became more frequent. He was weakening under the strain, and in the spring of 1864 he had to give up active work. The fingers of the right hand with which he had penned many a jolly letter, many an extensive annual report, and scores of papers of scientific importance, became numb, and the memory that had been so keen and reliable slipped. Later he lost much of his facility in expressing his thoughts and even his power to walk. Physicians said he suffered from a softening of the brain. Interest in his many duties remained, but even this gradually diminished. A summer spent in camp seemed to benefit him but little.

It was thought that a complete change of scene and the stimulation of a trip abroad might help him. And so, like one of the astronomical cycles that Bache had studied, the trip to Europe that had yielded the *Report* and the magnetic observations was to be repeated. As his sixtieth birthday approached he was to go again to the Germany which he had found so stimulating at thirty, and to the France and England that he and his great ancestor had loved. Again there was sadness at parting from his relatives and friends, more sadness than be-

fore, and for good reason. Again he pathetically took with him a set of instruments for magnetic observations. Again he visited some of the scientists, among them Struve of Rome, whom he had seen on his previous trip. But these visits further impaired his health and had to be discontinued.

Bache had gone to Europe before as a pioneer breaking ground. Now he was a man who was himself broken. Only the old earnestness remained. This time he would remain only eighteen months instead of two years, and it would be necessary for a friend to go to accompany him home. He would bring back no educational gospel. This time there would be nothing in the nature of a triumph on his return. This time, instead of returning at the peak of his intellectual and physical power, he would be an old man coming home to die. In years, he was a decade short of his allotted three score and ten. But his mind had outstripped his body in age, and would carry him no farther.

Davidson, who worked with him at Philadelphia and went to Europe to bring him home, tells the story:

Professor Bache was made a member of a secret commission to furnish information, maps, etc., to the government, and here again our relations became very confidential. I made surveys of the Delaware River for its defence; in 1862 I was placed in charge of the armed Coast Survey steamer *Vixen* and sent to Florida; in 1863 I was appointed by Professor Bache Engineer of Fortifications for the defence of Philadelphia between the Schuylkill and Delaware (north), and made a survey, which the Superintendent visited regularly as the work progressed. He was conducting the regular work of the survey, and patriotically undertook the general charge of the surveys of the defence of Philadelphia. He was always an excessive worker, but here he almost doubled his duties, and, moreover, worked with great anxieties during the early days of that July. He must have worked eighteen hours daily. The result was that his health gave way and he was sent to Europe. The government continued his salary, but his friends in Philadelphia supplied further funds for his comfort, for professional advice and for travelling.

In 1865 his health had broken down so much that Mrs. Bache had to beg the authorities in Washington to bring him home,

and asked that I be sent to London for that purpose. There was no official authority for such duty, but I was given leave of absence, and went out at my own expense and brought him to the home of one of his sisters in New York. I saw him occasionally up to his death in 1867.

When Bache died in Newport, his wife's native city, on February 17, 1867, men who knew his work acknowledged that the war had destroyed him. Joseph Henry told the National Academy: "This eminent savant devoted his life industriously to the advance of science, and may be said to have fallen a martyr to the cause of his country in the hour of its peril." In its minute the faculty of the University of Pennsylvania, which he had served so well, said:

He is justly to be regarded as a martyr to the cause of good government and the principles of human liberty, his death being directly caused by the overtasking of his faculties, in his active and never ceasing endeavors to sustain the authorities of his country against the rebellion, and to promote the efficiency and comfort of those who were fighting in our behalf.

New York, Philadelphia, and Baltimore honored Bache on the occasion of his death. Two days after it occurred, the scientific and learned societies of Philadelphia met in the chapel of the University and arranged through a committee to show their respect to Bache's remains as they were taken through Philadelphia to Washington. That same evening the Philosophical Society offered its coöperation and, on February 21, its famous halls, draped in black, were opened to receive Bache's body which lay in state in the south room.

A man's worth can be measured by what those who are subordinate to him think of him. Bache's associates in the Coast Survey, who later erected an imposing tomb as a tribute to his memory, met on the afternoon after his death and adopted resolutions which read in part:

Whatever of excellence there may be in the extended system of operations now carried on by the Coast Survey on every portion of our coast is due to Professor Bache. He came to the

charge of the work at a time when its operations were conducted upon a small scale and restricted to a limited portion of the coast. In a wonderfully short space of time he succeeded in winning the confidence of his official superior, and in securing the consent of Congress to a gradual enlargement of the work to its present scale. He called to his assistance men of thought and men of action from civil life, and from the army and navy, and, with a rare felicity, discerning and applying the special aptitudes of each individual, he wrought out from discordant material a harmonious whole.

He combined high administrative ability with vigor and energy in execution. While allowing and inviting free criticism of his plans during their inception, he exacted a rigorous accountability from the officers entrusted with their execution. Discipline under his administration was none the less real that it was not apparent.

Professor Bache was eminently just. The Coast Survey reports—those monuments of his fame—are full of evidence of the scrupulous care with which every officer serving under him received proper credit for his labors. His quick and ready appreciation of merit in every department of scientific inquiry and action, whether theoretic or practical, has been felt through the entire country, and has been of lasting benefit. . . .

Of those great intellectual qualities, aided by the highest culture, which made Professor Bache the foremost scientific man of America, this is not the time or place to speak. Other and more eloquent tongues and pens will record his eulogy, but none with greater love and veneration.

At the breaking out of the great rebellion new duties and responsibilities were devolved upon him, and he met them all. In the midst of these onerous duties he found time to be an earnest worker in the organization of the Sanitary Commission. As the war grew in proportion, so did the demand upon his energies. In the construction of defences around his native city of Philadelphia, when menaced by invasion in 1863, his powers of endurance were strained beyond bearing, and in the succeeding year he was seized with the malady which has now terminated in his death. He has given his life to his country, in its great struggle for national existence, as truly as did any of those heroes who laid down their lives upon the field of battle.

While we honor and respect the memory of our chief for his great abilities and untiring industry, for his wisdom and forethought, his scientific skill and administrative power, we also

feel that he was more to us than is implied in all these high qualities. We feel that we have each lost a personal friend, whom we dearly loved, and to whom, aside from all official relations, each felt a personal tie of warm affection. We remember him as the genial, cordial companion in social intercourse, as the wise and friendly counsellor in difficulty, as the kind and sympathizing consoler in sorrow and distress, ever ready to do a kind act, to seek out and to bring forward modest merit and true worth, and never wearying in well doing.

During Bache's illness Joseph Henry was of great assistance to the Baches. Henry shows in his letters that Bache had administered Coast Survey affairs so well that they continued to run smoothly after he became seriously ill. Henry carried on some of his activities and even assumed the responsibility of signing Bache's name to some reports. He feared the efforts of the Navy to absorb the Coast Survey while Bache was incapacitated, efforts in which the Army or its Engineers and the Navy itself had failed earlier. He made many visits to Bache, for whose position applicants were already lining up. To Mrs. Bache, whose heroism and devotion he admired, he revealed his intention of calling upon prominent congressmen to see how they would be disposed to retiring Bache on a pension. A little later Mrs. Bache informed Henry that she thought she should hand in her husband's resignation, for while he was better physically he did not improve mentally. In the light of their financial condition, she thought that she might rent part of their house. She was interested in the possibility that Bache might be retired on half pay. But Henry and Bache's other friends could not prevent the inevitable conclusion of the illness.

The funeral was held in Bache's Washington home. Men prominent in the public life and the scientific life of the nation attended it, and many of them could recall cheerful evenings that they had spent there. Gone the twinkle from the eye of the host who refused to act the distinguished scientist at his own dinner parties; gone the light jest from the lip of the ad-

ministrator in his unofficial moments; gone the hand that could with equal grace pass a bottle or pen a scientific paper. On Sunday, February 24, 1867, they placed what was mortal of him in the Congressional Cemetery.

BIBLIOGRAPHICAL NOTE

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Permission to quote from manuscript collections mentioned below and from Margaret Leech's *Reveille in Washington,* Harper and Brothers, 1941, is gratefully acknowledged. The *Proceedings* of the American Philosophical Society, vol. 84, no. 2, May 1941, contained papers presented at the Society and at Girard College on February 14 and 15, 1941, in commemoration of the life and work of Bache and in the symposium on geomagnetism. Needless to say, this volume of *Proceedings* was rich in material for the biographer of Bache, and the author is indebted to all those who participated in the program.

SOURCES

There are four sketches of Bache's life and accomplishments in addition to even briefer biographies in standard works. Joseph Henry knew Bache more intimately than the other authors. His sketch appears as a "Eulogy" in an appendix to the *Report for 1870* of the Smithsonian Institution and also in the *Biographical Memoirs,* National Academy of Sciences, vol. 1 (1877). An anonymous sketch appears in *Appleton's Popular Science Monthly,* November 1895, and a biographical notice by Fairman Rogers in the *Journal* of the Franklin Institute, May 1869. The most complete treatment is an address by Benjamin Apthorp Gould which appears in the *Proceedings,* American Association for the Advancement of Science, vol. XVII (1868). As one studies Bache his respect for Gould's sketch increases,

for it shows intimate knowledge, research, and friendly sympathy. Appended to it is an almost complete list of Bache's published work. It contains 123 titles in addition to more than thirty annual reports and twenty-one reports on harbors written jointly with General Totten and Admiral Davis. With proper acknowledgment this bibliography also appears with Henry's sketch in the *Biographical Memoirs*, National Academy of Sciences, vol. I (1877). The Barnwell Foundation of the Central High School of Philadelphia published in April 1941 a Bulletin entitled *Alexander Dallas Bache, Educator*, by George V. Fagan, which is especially useful for its references to newspapers of Bache's time and for its treatment of his connections with the Central High School.

Primary material in a study of Bache includes the numerous articles, addresses, and reports mentioned in Gould's bibliography, especially the *Report on Education in Europe*, Philadelphia, 1839, and also the sixty-odd items under Bache's name in the *List and Catalogue of Publications Issued by the U.S. Coast and Geodetic Survey 1816 to 1902;* collections of letters, written or received by Bache, most of them from the years 1854 to 1861 inclusive, in the Library of Congress, the American Philosophical Society Library, the Smithsonian Institution, the Pennsylvania Historical Society Library, the Library of the Academy of the Natural Sciences, the Library Company of Philadelphia (Ridgway Branch), Harvard University, New York University, and the University of Pennsylvania, including those in the Edgar Fahs Smith Memorial Library; the personal journals written by Bache in Europe, of which six volumes are in the Library of Congress and one in the Girard College Library; and the manuscript notes and notebooks written by Bache and by amanuenses while he was on his European educational mission and now in the Girard College Library. It might well include also the extant books, pamphlets, and other documents mentioned in the Appendix of Bache's *Report on Education in Europe*. No autobiographical sketch is available; the one mentioned in Joseph Jackson's *Encyclopedia of Philadelphia* has been lost and was, in any case, nothing more than a brief completion of a printed questionnaire sent Bache about 1853.

For special sections of this biography a number of books have been useful. Among them are Bernard Faÿ's *The Two Franklins*, Boston, 1933; James Parton's *Life of Benjamin Franklin*, New York, 1867; R. Ernest Dupuy's *Where They Have Trod*, New York, 1940; Ernest Child's *The Tools of the Chemist*,

New York, 1914; Mrs. Jefferson Davis' *Jefferson Davis*, New York, 1890; Edward Potts Cheyney's *History of the University of Pennsylvania 1740–1940*, Philadelphia, 1940; Cheesman A. Herrick's *History of Girard College*, Philadelphia, 1935; Francis Lieber's *A Constitution and Plan of Education for Girard College*, Philadelphia, 1834; Robert Ellis Thompson's unpublished and incomplete *History of the Central High School of Philadelphia;* annual *Reports* of the Controllers of the Public Schools, Philadelphia; Franklin Spencer Edmonds' *History of the Central High School of Philadelphia*, Philadelphia, 1902; Franklin Spencer Edmonds' *Proceedings of the Dedication of the New Buildings of the Central High School, 1902*, Philadelphia, 1910; *Handbook of the Central High School*, Mary Gaston Barnwell Foundation, Philadelphia, 1942; Edgar Fahs Smith's *Chemistry in America*, New York, 1914; Edgar Fahs Smith's *Charles Mayer Wetherill*, reprinted from the *Journal of Chemical Education*, 1929; Daniel L. Hazard's *The Earth's Magnetism*, Washington, 1925; and the publications of the learned societies with which Bache was associated.

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