NATIONAL ACADEMY OF SCIENCES

CHARLES THOM

1872—1956

A Biographical Memoir by

KENNETH B. RAPER

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November 11, 1872–May 24, 1956

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WITH THE DEATH of Charles Thom on May 24, 1956, at his home in Port Jefferson, New York, the nation lost one of its most colorful and most productive microbiologists. For more than half a century he was a consistent contributor to microbiological literature, and during the course of his career he contributed much to the basic science in this field and to the practical application of microorganisms in agriculture and industry. While he was best known for his monumental studies on two genera of molds, *Aspergillus* and *Penicillium,* he was at home in the dairy, the canning factory, and the cotton field as well. His interests in biology stemmed from his boyhood on the farm and from his early contacts with outstanding biologists who instilled in him an unquenchable zeal for the study of living systems, large and small. The pattern of his scientific work was determined in substantial part by the various official positions which he held in the United States Department of Agriculture from 1904 to 1942, but sustained by an

The writer was closely associated with Dr. Thom from 1929 until his death in 1956, first as his assistant, subsequently as associate and collaborator, and always as an admirer and friend. A few of the quotations contained herein are related from memory; most of them are taken from autobiographical papers kindly provided by his son, Judge Charles Richard Thom of Port Jefferson, New York. Portions of the textual material have been taken from an extensive memoir prepared by the writer for the Mycological Society of America (Mycologia, 49:134-50, 1957).

exceptional intellect and an insatiable curiosity he applied to each successive phase the same scholarly approach. Independent in thought and action, as befitted the son of pioneers, he fashioned a professional career with many facets, yet singularly dedicated to scholarship and public service.

Charles Thom was the fifth of six sons (two died in infancy) born to Angus Sutherland Thom and Louisa (Herrick) Thom, both of pioneer stock, who settled in Woodford County in central Illinois around the middle of the last century. As a boy of sixteen, Angus Thom moved there in 1848 with his family by wagon train from Ohio. He was married to Louisa Electa Herrick in March 1862. Charles Thom's mother had come to Illinois eight years after the Thoms with her family from Indiana, having moved there in 1838 from northern Virginia. The Thoms were, as Dr. Thom often related, of "Scotch-Irish ancestry, and persistently Presbyterian"; his mother was of English and Quaker descent.

Angus Thom was a farmer with little formal education, but with a keen interest in public affairs, engendered in no small measure by the fiery political speeches of Lincoln, Douglas, and other great leaders of the time who presented their views at the county seat. He was deeply religious and was for many years an elder in the Presbyterian church, into which his sons followed him. He was fully conscious of the advantages of education, and with such support as he could provide encouraged his sons to acquire what he and their mother had been denied. According to Dr. Thom, a characteristic remark of his father was the following:

"I've known every preacher [Presbyterian] in central Illinois for 40 years. I would not vote to settle one in my church unless he had a full college and full seminary education. Without it, a man is soon pumping a dry well."

The Herricks were persons of scholarly instinct, and both

of Louisa's parents had at times taught school. They passed to their daughter the desire for education, which she in turn early cultivated in her sons. Of his education, Dr. Thom wrote:

"As a small boy, my mother taught me to read and added a rigid drill in elementary arithmetic, spelling, geography, and the beginnings of grammar before sending me to the public school at eight. I graduated in 1888 from a high school which fell short of college preparation. The next year was spent on the farm, followed by four terms at Lake Forest Academy where I made contact with Roland A. Harper, then a young instructor. I entered Lake Forest College in 1891. The contacts of a small college sometimes furnish exceptional inspiration. Dr. William C. Roberts was president and taught a class in ethics which included every new student. W. A. Locy was professor of zoology, Harper of botany. John M. Coulter became president in my junior year and took direct charge of botany in my senior year."

Dr. Thom graduated from Lake Forest College with an A.B. degree in 1895. After an interval of one year teaching high school in Danville, Illinois, he returned to Lake Forest to rejoin Harper, who had just returned from Strasburger's Laboratory at Bonn, Germany. He received the A.M. degree in 1897, and upon the recommendation of Professor Locy he was appointed instructor at the University of Missouri, which position he assumed after spending the summer at Woods Hole. At Missouri he worked closely with Professor Howard Ayers, both as instructor and as graduate student, and in 1899 was awarded the first Ph.D. degree granted by that institution. Of Ayers, he said: "Ayers had a penetrating mind, a keen perception of the difficulties of the student, and an exceptional power to fire him with enthusiasm for continued work."

He remained on the staff at Missouri for three years, spending his summers off-campus. Two of these were spent botanizing in the Ozark Mountains of Missouri and in the swamps of southeastern Missouri, the third in the laboratory of Dr. Erwin F. Smith in Washington. These experiences rekindled his interest in the fungi, first engendered by Harper, and in 1902 he went to Cornell University to study with Professor G. F. Atkinson. Benjamin M. Duggar and H. H. Whetzel were there at the same time, and in company with these emergent mycologists his dedication to this field of study became firmly established. Of his Cornell period, he said:

"Atkinson's laboratory was always open. Atkinson himself was usually there from 7:30 in the morning until 10 at night and was accessible to any worker with a question."

That the hours mentioned should have impressed Dr. Thom is not surprising, for at an early age he accepted long hours of work as a satisfying way of life. Regarding his childhood he wrote:

"When I was six, my father put me on a dependable horse and sent me to the fields with forty cattle. Some social reformers of today might have arrested him for requiring child labor but I would not have missed the experience at any price. By the time I was eight, I rode any horse on the farm. At 12, I claimed a team of horses and went to the field whenever close of school permitted. These experiences, which covered every phase of farm work, gave a first-hand knowledge of agricultural operations and the ways of coping with farm problems which have saved me many mistakes and embarrassments in my scientific dealings with agriculture."

When he went away from home the pattern did not change materially, for of his college years at Lake Forest he had this to say:

"In college, some probably called me a 'grind.' In fact,

however, a better term would be a 'lesson getter.' I represented that considerable proportion of students who disregarded the long-time significance of the lesson assigned but prepared it for the immediate reason that it was the task of the day. Whatever our lack of vision, we obtained the day by day drill which improved the sharpness of our mental tools, stored our minds with reserve material which proved working assets for years to me, and perhaps most important, acquired the working habit which disdains the limitation of a five-day work week and a petty fraction of the day.

"Work was interrupted for the literary society and especially for debate. Student politics always got a share of attention. The college football team claimed all my spare time for three playing seasons. By my junior year, the laboratory swallowed me up for most of the daylight hours and often till bedtime. As field botanist, I explored the shores of Lake Michigan and the ravines and wooded areas for several miles about the college. The same habit was carried into the first few years of teaching and graduate experiences.

"Tennis furnished exercise but little sporting satisfaction. I carried a bag of golf clubs once! The bicycle was for a number of years a useful vehicle. Similarly the automobile, in which I have always been a conservative driver because the cost in nervous tension was too great for extensive touring. I went with three men on a fishing trip in the Ozarks once; I handled the boat while my partners fished."

Even in later years, diversions outside the laboratory seemed to be, by comparison, of secondary interest. This facet of his character was perhaps best expressed by Dr. Thom himself:

"The laboratory was not a treadmill of drudgery but a place of opportunity. This spirit went with me into the research fields since occupied for many years. To me, life has

not been divided into two compartments—work, synonymous with punishment, contrasted with pleasure or amusement—but work always pleasant, always interesting, supplemented by occasional diversion of interest to other things not more pleasant than the hours in the laboratory.

"I rarely have attended the theatre and those experiences did not fire me with enthusiasm. I have seen an occasional motion picture but for the most part have avoided them. The social card game claimed an evening now and then, but has not been a habit. But I have always enjoyed my contact with individual people."

Concerning the last statement, one may add that this seemed to apply particularly to reunions with old friends and acquaintances when visits were held in one or the other's laboratory with full and free discussion of problems and researches of mutual interest.

Such was the character and background of the man who on May 5, 1904, entered the employ of the United States Department of Agriculture where he remained throughout his professional career, holding important research and administrative positions prior to his retirement in 1942 and thereafter acting as collaborator to one of its most important centers, the Northern Regional Research Laboratory in Peoria, Illinois. How he came to accept his first position, that of mycologist in the Dairy Division, Bureau of Animal Industry, is best told in his own words:

"In February, 1904, Professor Atkinson was asked to name a dairy mycologist for a project in cheese ripening. He looked around his laboratory and fixed on me to be sent, rather peremptorily offered me the nomination, then wrote a letter. I saw that letter long afterward. He wrote approximately this: 'I know no man in America that is qualified in Dairy Mycology. I know nothing about it myself but if I had time, I

could learn it, but I am too busy. Thom has training enough and brains enough to learn it and he needs the job.' I resigned my petty but perfectly orthodox academic job at Cornell and went."

The position was with Professor H. W. Conn, always alert for new ideas, who had initiated a study of the ripening processes in Camembert and Roquefort cheeses. In beginning his work at Storrs, Thom first isolated the molds from imported Camembert and Roquefort cheeses, which he was expected to duplicate for manufacture in the United States. While the propagation of a specific mold was required for the production of a particular type of cheese, he soon found that his task involved far more than straight mycology, with success or failure hinging upon a full understanding and appreciation of the microecology (temperature, water content, salinity, etc.) of the fermenting milk curd. Thus he became an applied microbiologist. Cheese ripening was recognized as primarily microbiological, but practices were empirical and vague, and many reports suggested that successful production could be achieved only in the region of origin of a particular cheese. To understand better such possible geographic advantages, Thom in 1905 visited the cheese centers in Normandy (Camembert) and in Roquefort, France, where he soon realized that although a complex microflora was involved, success in each case depended upon a unique combination of environmental conditions that favored especially the molds essential for the ripening process. For example, the Camembert mold would dominate when the cheese entered the ripening process with about 55-56 percent water and 2.5 percent salt at a temperature of 54-58° F. and a relative humidity of 86-88 percent. For the Roquefort mold optimal conditions were different and, with regard to humidity and temperature, as he anticipated, represented those present in the limestone caves of

Roquefort and environs where the cheese originated. Upon returning to Storrs, Dr. Thom was signally successful in his work, for within a five-year period he and his associates succeeded in introducing practical processes for the manufacture of both Camembert and Roquefort cheeses in the United States.

Important as were his cheese investigations per se, they were soon overshadowed by another interest that emerged as a necessary adjunct to them, namely, the study of saprophytic molds with special attention to *Penicillium* and *Aspergillus*. With reference to the cheese molds, the then existing literature contained a plethora of Latin names but without agreement as to usage or descriptions adequate to characterize the molds to which they had been applied. Thus, in 1906, Thom was led to describe *Penicillium camemberti* and *P. roqueforti*. For purposes of comparison he had isolated a number of other Penicillia and, being unable to identify these from the older literature, he began his monographic studies on this ubiquitous genus. This took him to the cryptogamic herbarium at Harvard University where he came under the influence of Professors W. G. Farlow and Roland Thaxter, and it was the latter who urged him to "clean up the mess in *Penicillium* and *Aspergillus*," which was to become a major endeavor throughout his life.

An important step in this direction was taken in 1910 with the publication of his "Cultural Studies of Species of *Penicillium*." Instead of following the prevailing practice of describing species from their natural habitats, he turned to the use of defined, reproducible media and the comparative examination of cultures grown under similar conditions in the laboratory. The validity of this approach has been amply confirmed, and it is interesting to record that after more than half a century virtually all of the species then described are

still recognized as valid taxons. The next step came in 1915 with the publication of "The *Penicillium-luteum-purpurogenum* Group," for in this brief paper he advanced the notion that molds with common basic characteristics could be assigned to definite groups and series, a step that, for many practical purposes, was often more useful than attempted identification to species. The merit of this concept has been demonstrated many times, but never more dramatically than in the search for superior penicillin-producing strains during World War II.

Dr. Thom's cheese investigations were transferred to Washington, D.C., in 1913, and a year later he accepted the position of Mycologist in Charge of the Microbiological Laboratory, Bureau of Chemistry, which was charged with the enforcement of certain aspects of the Pure Food and Drugs Act. From the outset, Thom took the position that the criteria for judging the quality of foods and the adequacy of processing methods should extend beyond actual toxicity and danger to health. "Sight, taste, and smell," he said in effect, "were given to man to keep him from eating rotten foods: decomposed and heavily contaminated materials are intrinsically offensive and always bear evidence of mishandling." The courts upheld his position, and the confidence with which we today unthinkingly purchase processed foods is an unspoken tribute to the effectiveness of the campaign waged by Thom and his associates. From conversations many years later, it is evident that arguing a court case must have been for Thom a thoroughly enjoyable and stimulating experience, for he possessed many of the characteristics of a skilled prosecuting attorney. One of many anecdotes may be cited. The case involved contaminated tomato catsup, and as he took the witness stand Thom quietly placed on the railing of the jury box two partially rotten tomatoes. Naturally, these were regarded with considerable curiosity. Upon leaving the stand as he

finished testifying, he pointed to them and asked, "Should the American people have to eat them in their catsup?" The jury agreed with him. Thom held his position with the Bureau of Chemistry until 1927, and the principles evolved and established for the food industries were summarized in the book *Hygienic Fundamentals of Food Handling,* published with A. C. Hunter in 1924.

During the period 1913-1927, when Dr. Thom was Chief of the Microbiological Laboratory, Bureau of Chemistry, his primary responsibility was the enforcement of those phases of the Pure Food and Drugs Act with which his laboratory was charged. This involved as well the development of improved methods for detecting contaminants and adulterants, and the establishment of acceptable and reliable standards for the handling and processing of foods of various kinds. Molds were encountered at every step and, as in the cheese laboratory and factory, most prominent among these were species of *Aspergillus* and *Penicillium.* With Margaret B. Church, he investigated some of the Oriental food fermentations based upon the Aspergilli, and together they published a series of papers on different groups of these molds, further emphasizing the primary importance of the group characterictics in these fungi—studies that culminated in the publication of their monograph, *The Aspergilli,* in 1926. Meanwhile, Thom and James N. Currie, who had followed him from the work on cheese investigations, gave particular attention to the black-spored species comprising the *Aspergillus niger* group. They had early detected unusual metabolic activity in these fungi and in 1916-1917 demonstrated that certain of these molds if cultivated under appropriate conditions would produce very substantial amounts of citric acid. Within five years a large factory had been constructed in Brooklyn and the first major mold fermentation was firmly established. With Thom's collab-

oration, other investigators in a different branch of the Department of Agriculture (H. T. Herrick, O. E. May, P. W. Wells, A. J. Moyer, and L. B. Lockwood) subsequently took up this type of investigation to extend the still lengthening list of industrial mold fermentations. It is not too much to say that this early pioneering work led to the creation of the four Regional Research Laboratories of the Department of Agriculture by act of Congress in 1938, and that it contributed immeasurably to the successful development of methods for the large-scale production of penicillin a few years later when that drug was so urgently needed during World War II.

The Bureau of Chemistry was abolished as such in 1927, and Dr. Thom was appointed Principal Mycologist in Charge of the Division of Soil Microbiology in the newly created Bureau of Chemistry and Soils. He was not happy about the change, for he considered that twenty-three years of accumulated experience with foods and the food industries would have to be thrust aside, for the most part. He took courage, however, from an old saying that he often quoted: "There is a time to shut a door," turned his face to the future, and made common cause with his new associates and the microorganisms with which they worked. Actually, he found more species of *Aspergillus* and *Penicillium* in soil than on foods; and the growth and physiology of many of these often proved to be quite comparable despite their immediate source. He soon felt at home again. With characteristic vigor, he immersed himself in the literature and problems of soil genesis, soil composition, and more especially the soil microflora with its manifold influences upon soil fertility and soil texture. His adjustment to the new task was rapid. Within a few years Thom was recognized as an authority in soil microbiology, presenting invited papers at national and international meetings and teaching courses at the University of Maryland

and in the Graduate School of the Department of Agriculture, which he had helped to establish in 1921. In 1934 the Division of Soil Microbiology was shifted to the Bureau of Plant Industry but without change in basic objectives, albeit the research was integrated more closely with crop physiology and agronomic practice as these might be influenced by soil microorganisms. More specifically, his attention was directed to certain destructive root rots of cotton, wheat, and other crops.

Investigations on the taxonomy and interrelationships of *Aspergillus* and *Penicillium* were continued in his new position as in earlier ones. Because of the greater dimensions of the latter genus, its more voluminous literature, and the considerable difficulties encountered in differentiating groups, series, and the species which comprised these, publication of his monograph *The Penicillia* was delayed until 1930. This new book, like the one on *Aspergillus* before it, immediately achieved universal recognition as the standard reference work on *Penicillium*.

As Dr. Thom moved from one official position to the next he took his growing culture collection with him, for he was never satisfied to base decisions upon published descriptions alone if there was any possibility of obtaining living cultures of the actual molds studied by his predecessors. In this he was highly successful, and when I joined him in 1929 these accessions numbered well over one thousand, including scores of types. It is most fortunate for mycology and for applied microbiology as well that for nearly four decades he had the vision and the energy to carry forward his studies on these two genera of fungi. The significant part of this story is that never in the thirty-eight years of his employment by the Department of Agriculture was he authorized officially to collect and maintain mold cultures, and the monographs on *Aspergillus* and *Penicillium* were produced over and above

his assigned duties in each of the responsible positions he held. The reader will readily understand why these cultures, long maintained as a labor of love, later became the nucleus of the Culture Collection which the U.S. Department of Agriculture subsequently instituted at its Northern Regional Research Laboratory in Peoria, Illinois, two years before Dr. Thom's official retirement.

During the years preceding his retirement from active service in 1942, a considerable number of new Aspergilli and Penicillia had been isolated in our laboratory and elsewhere. The need for new books on these cosmopolitan genera was urgent, and because he was still vigorous in mind and body Dr. Thom was immediately invited to become a Collaborator to the Northern Laboratory's Fermentation Division, a post that he held on a part-time basis until shortly before his death. Work was initiated promptly and the new volume, *A Manual of the Aspergilli,* was published by us in 1945. Four years later, with financial support from the National Science Fund and with the invaluable aid of Dorothy I. Fennell, we were able to publish a completely rewritten volume on *Penicillium* under the comparable title *A Manual of the Penicillia.* Thom's interest in these fungi never diminished, and his bibliography reveals that one of his last contributions to science, published in 1954, concerned itself with the evolution of species concepts in these two singularly important genera of molds. Thus, a study modestly begun by a young man groping for an understanding of two molds that he had isolated from cheese gradually developed into a lifetime of productive research. Whereas these investigations were important in themselves and stand as models of what should be done for scores of other fungus genera, their greater importance perhaps lies in the new and enlarged dimensions they created for all of microbiology. It is no exaggeration to

say that the current stature of the fermentation industry can be traced directly to the early researches of Thom and his associates.

Two inadequately publicized incidents may be cited in support of this notion. Alexander Fleming had discovered penicillin in 1928 and had published his classic paper in 1929, identifying the responsible mold as "*Penicillium rubrum.*" Professor Harold Raistrick, who had long collaborated with Thom, subsequently took up the study of this mold and its antibacterial substance. He submitted the culture to Thom, who correctly identified it as representative of the cosmopolitan species, *Penicillium notatum* Westling. Later, when strains capable of producing more penicillin were urgently needed, this correct diagnosis gave invaluable direction to the quest for such cultures. Equally important, it was Thom who recommended that our government's research program on penicillin be centered in the Fermentation Division of the newly established Northern Regional Research Laboratory in Peoria. If Dr. Thom ever felt that he should have received greater recognition for his contribution to the success of this program he never expressed this feeling publicly.

Dr. Thom was always keenly interested in the fungi implicated in human and animal diseases. Over the years he identified hundreds of mold cultures submitted to him by physicians and hospital personnel. More directly, and in collaboration with Harry S. Bernton, M.D., of Washington, he was one of the first to demonstrate the role of common saprophytic fungi as incitants of allergic reactions in man. Owing in part to this and because of his earlier role as a government official charged with the responsibility of establishing sanitary practices in the nation's food industries, he was invited to become a member of the Washington Academy of Medicine, a unique tribute to a nonmedical man.

One of his greatest contributions to applied microbiology was that of leading the microbiological group which made the control of root rot in the cotton fields of the Southwest possible. Of this he wrote:

"There were many workers involved at one time or another. No apology is offered for combing this literature for ideas—which had been tested and found wanting, but which might give clues to the fundamental line of attack. Finally we adjusted soil handling practices so that we could produce a bacterial population effective in destroying the agent of root rot, *Phymatotrichum*. This amounted to an integration of mycological, bacteriological, chemical, and agronomic information into a practice or procedure in reach of the common farmer."

What was done may be summarized in this way. They discovered that the fungus could be "contained" if readily decomposable plant materials were added to the soil as amendments during the growing season, and subsequently that the pathogen could be controlled if the cotton plants were plowed under immediately after harvest, thus in effect allowing the indigenous microflora to destroy the pathogen before it overwintered. This is now standard agronomic practice throughout the Southwest and *Phymatotrichum* is no longer a limiting factor in the areas where it was formerly widespread.

With Drs. H. P. Holman and Harry Humfeld, Bureau of Chemistry and Soils, Thom was instrumental in developing in 1934 the *Chaetomium* Test for the evaluation of fungicides and other protectants used to extend the usefulness of awnings, tents, tarpaulins, etc. This was designed to provide at least a partially quantitative test, and although it has now been supplemented and in substantial part superseded by other methods it merits the distinction of having first demonstrated that something more reproducible than guesswork could be applied

to these problems. The researches thus instigated paid rich dividends during World War II when the armed forces were faced with serious losses from the rapid deterioration of all types of matériel, cellulosic and otherwise, particularly in the hot and humid jungles of the Southwest Pacific.

Working with Dr. Robert A. Steinberg of the Bureau of Plant Industry, Dr. Thom did pioneering research in the use of chemicals of various kinds (notably NO_2 salts) to effect mutations in *Aspergillus niger*. While these investigators were not attempting to alter the identity of metabolic products, or to enhance the productivity of some specific and desired metabolite, it is significant to note that they succeeded in producing a whole series of mutants differing in pigmentation and in growth characteristics several years before the use of x-ray and ultraviolet irradiation became an accepted and widely used method for obtaining higher penicillin-producing substrains of *Penicillium chrysogenum*. Today, of course, the mutational approach is almost universal as a procedure to be exploited in the reduction to practice of any new antibiotic or other metabolic product of microbial origin.

Important as were his many direct contributions to the expanding field of microbiology, Thom's more indirect contributions were perhaps equally important. He gained much from his contacts with outstanding biologists during his formative years, and as he became an established scientist he was always willing to give of his time and counsel to everyone who sought his opinions and advice, and they were legion. Working in Washington at the crossroads of a nation's scientific effort, he encountered a steady stream of investigators with diverse interests and problems as they passed through his laboratory. Many of these were the great biologists of that period, and many were young scientists just starting their careers. To each he gave unstintingly of his time, and in the ensuing spirited

conversations the course of untold research investigations was influenced and oftentimes redirected. Always direct and outspoken in his writings and sometimes almost brusque in his speech, Dr. Thom loved people and by his own admission preferred talking with a fellow scientist more than the theater, the movies, the concert hall, or the day's best-seller. During his active career in the Department of Agriculture he identified thousands of cultures for other investigators all over the world, taking little cognizance of the credit that he might or might not receive. He was withal a selfless and devoted scientist and public servant.

Dr. Thom was a mycologist and microbiologist by profession but at heart a naturalist of much broader interests. His early work at Lake Forest and in Missouri was relatively unspecialized, and he gained a wide knowledge and appreciation of plants (and animals, too) that remained with him throughout his later years. His first publications were on algae, the goblet cells of the small intestine, and the process of fertilization in ferns. Two summers spent botanizing in the mountains and swamps of Missouri, respectively, left a lasting impression. His copy of Gray's *Manual of Botany* was well worn and never far from hand, and even in his later years a small hand lens attached to a thin black cord about his neck was a normal part of his attire. His abiding love of nature is reflected in a reminiscence of the prairie, undated but probably written about 1942:

"As I remember Illinois in the later 1870s the last sections of the original prairies were fast being plowed. Timber was confined to the broken areas along the larger streams. Occasional sloughs too wet for the plow were still filled with native marsh plants; an occasional pond bordered with willow, and crowded with cattail (*Typha*) and bur-reed (*Sparganium*), was teeming with the original inhabitants. The redwinged blackbird

swinging from the trees and the larger reeds, plover, kildeer, and snipe were frequent. Great V-shaped flocks of geese passed over in spring and fall making casual stops.

"The wet borders of the ponds showed turtles and snakes of several species. The mud catfish and minnows could occasionally be seen, while frogs and toads were present by the thousand.

"In the fields, the prairie chicken and quail (Bobwhite) were still abundant and the drumming of the nest season was most characteristic. The cottontail and the striped ground squirrel ran a precarious existence against the skunk, the mink, the weasel, and the hawk.

"These were some of the fellow inhabitants whom we met, incidental to a keen fight for life, during a period of depression that covered the later '70s and '80s of the nineteenth century."

Dr. Thom was most considerate of those who worked for and with him. At the same time, he abhorred laxity or procrastination, for having learned early to discipline himself he naturally expected the same conduct of his colleagues. In dealing with his professional staff he was scrupulously careful not to take advantage of his position as chief. He practiced as he believed that every man should carry his own share of the load and, having done this, that he should receive due recognition for his professional knowledge and for his contributions to the solution of the problems at hand. Commenting upon a tendency which he sensed to be growing in some research organizations, he had this to say:

"I wrote my own manuscript. The ghost writer is deemed essential to the literary reputation of some types of public men. His existence in American political fields has become so well known that his exploiters are beginning to get the contempt they deserve. In the scientific service, he is also present but superfluous. Those who live on the job with a man

are not deceived. I long ago established the rule that I would sign nothing which I could not write. It is easy to write a letter of transmittal to carry forward what your assistants produce. To me, it is essential to self-respect."

He encouraged the younger men in his employ to seize every possible opportunity to improve their position by additional education, often at considerable inconvenience to himself and his researches. They were urged to take leaves of absence, if necessary, and in any case to attend advanced courses in the night classes offered in the universities of Washington, D.C., and in the Graduate School of the Department of Agriculture which he had helped to organize and in which he offered courses from time to time. He firmly believed his father's dictum: "Without it [an adequate education], a man is soon pumping a dry well."

Dr. Thom was a prodigious worker. He rose early, a result perhaps of his boyhood on the farm augmented by his years as dairy and food microbiologist, and was usually at his desk one or two hours before the official beginning of the work day. It was during these early hours that he did much of his voluminous writing. He rarely used a written outline in preparing a technical paper or report but thought and wrote in paragraphs, placing each on a separate sheet and dropping it on the floor beside his chair. His secretary would come in later in the day, pick up the papers that sometimes simulated a minor snowstorm, and type them for future revision and editing. They were then assembled in what appeared to be a logical sequence, tied together with transitional phrases, sentences, or additional paragraphs, if needed, and reedited for final copy. The writer never ceased to marvel at the unity and smoothness of text that characterized the published products.

Dr. Thom was active in the affairs of many scientific societies. He strongly believed that a man owed it to his profes-

sion to support such organizations and their journals, and to do everything possible to promote the active interchange of ideas among their membership. He was for nearly fifty years a member of the Society of American Bacteriologists and its president in 1940. He was a charter member of the Mycological Society of America and its president in 1953. He was the temporary chairman of the organizing committee and the first president of the Society for Industrial Microbiology. He was at one time president of the Bacteriological Society of Washington, the Botanical Society of Washington, and also of the Washington Academy of Sciences. He was a charter member of the American Dairy Science Association and died shorty before its Golden Anniversary Meeting in June 1956, at which he had been invited to speak. He was a member of the American Association for the Advancement of Science, the Botanical Society of America, and the American Society of Naturalists for most of his professional life; and he was associated with other organizations such as the American Public Health Association, American Phytopathological Society, American Society of Agronomy, and the American and International Soil Science Societies for more limited periods, reflecting in the main his scientific pursuits at different periods of his career. He was a member of the Cosmos Club for many years. As a graduate student and postdoctorate fellow he was elected to Phi Beta Kappa and Sigma Xi. He was a member of the National Academy of Sciences for nearly two decades, having been elected in 1937.

One of the most appreciated honors that came to him was an invitation for his wife and him to visit Spain in 1947, where he was elected an honorary member of the Consejo Superios de Investigaciones Cientificas and presented with a gold medal in recognition of his outstanding services to microbiology and medicine.

Following his formal retirement in 1942, Dr. Thom re-

mained quite active until a few months before his death. In addition to his collaboration with those of us at the Northern Regional Research Laboratory he acted as consultant to the War Foods Administration (1943-1944) and to a number of industrial laboratories. He was a frequent guest speaker on university campuses and at local and national meetings of many societies and trade associations. The breadth of his knowledge and experience, the picturesqueness of his speech, and his wide acquaintance with fellow scientists—none of whom were either idolized or feared—made him a popular lecturer. Such lectures were always entertaining—but to amuse the audience was never their primary purpose, for woven into their very fiber were basic and obvious truths always presented with pointed relevance to the topic being discussed. The spirit of these can be surmised in the presidential addresses and special lectures which are listed among his published papers. He was a biologist first and foremost, and he deferred to no other profession in its contributions to man's progress.

Dr. Thom was an ardent prohibitionist, a conservative in politics, and a deeply religious man. Like his forebears, he was a stanch Presbyterian and wherever he lived took a very active part in the program of the local church. For many years he taught a men's Bible class at the Church of the Covenant in Washington, D.C. Of this facet of his life he wrote:

"From boyhood, I have been a churchman and student of the Bible. To me, the spiritual has been part of life—a whole field which gave visions into distant countries where strictly scientific operations were left far away. But that land of the spirit was none the less real.— I find no incongruity as a scientist in holding a rigid standard in the fight against alcoholic drink, against vice, against sin as negative, and as positive, working for the highest ideals of life as taught and exemplified by Jesus.— I have many times told men that negative righteous-

ness keeps a man out of jail but does not make him either a good citizen or a Christian; that a man becomes a force worth while only as positive goodness displaces evil as the motive for living."

Dr. Thom was devoted to his family. He cherished the heritage he received from his parents, and he determined to leave no less to those that followed him. He was married to Ethel Winifred Slater on December 20, 1906, at Port Jefferson, New York. Of old Rhode Island families, she was born in Pawtucket, attended public schools in Rhode Island and in Massachusetts, and studied at the New England Conservatory of Music. She subsequently taught music in Mississippi, New York, and Connecticut. They had three children, one of whom died in infancy. A daughter, Beatrice, graduated from the George Washington University, but died shortly thereafter. A son, Charles Richard, graduated in law at the same university, was a Captain in the U.S. Army in the South Pacific during World War II, and is now Judge of the Family Court in Suffolk County, New York. Ethel Thom died in Port Jefferson in October 1942, only three weeks before Dr. Thom's retirement from the Department of Agriculture. Two years later he married Ethel's long-time friend, Charlotte J. Bayles, who preceded him in death by two years. He is survived by his son, Charles Richard, and two granddaughters.

The approaching end of a long and active life cannot be ignored; but, as in the case of Dr. Thom, it can be viewed with equanimity. This is eloquently revealed in his own words:

"The passing of one who has served long, successfully, and with the good will and recognition of his fellows is not a time for tears. I started with the example and carried with me the undimmed vision of a father and mother with firm ideals of Christian faith worked out in daily living. Among my gifts—received not earned—were a measure of strength and health

that has made it possible to face each task with courage. The days of physical suffering have been few. It is easy to list one's troubles and weaknesses, but when I look upon what others have endured, my blessings have been manifold. Opportunities for education were given me, not earned. Openings for service were due to the confidence of those who had already worked with me. It has been my privilege to face each problem as it arose with well-ordered forces, physical, intellectual, and spiritual. There have been mistakes, conflict, disappointment, and sorrow, but there has been a daily resurgence of strength and courage. Opportunities to serve have not been wanting. Year by year, I have been thankful for the increasing appreciation of fellow workers. The close of such a life is not defeat. I pass the torch to those who follow with the injunction to keep it burning."

Dr. Thom died at his home in Port Jefferson, New York, on May 24, 1956, following a few months of failing health. At his request, he was buried in Storrs, Connecticut, a community which he never ceased to regard as "home." It was there that he began his professional career; it was there that he was married; it was there that he built his first house; and it was there that his children were born.

CHRONOLOGY

1872	Born, November 11, at Minonk, Illinois
1888	Graduate, Minonk High School
1889-1891	Lake Forest Academy, Lake Forest, Illinois
1891-1895	Lake Forest College. A.B. '95
1895-1896	Science teacher, Danville High School, Danville, Illinois
1896-1897	Graduate student, Lake Forest College. A.M. '97
1897	Woods Hole Biological Laboratory, Summer Session
1897-1899	Instructor and graduate student, University of Missouri. Ph.D. '99
1898	Summer: Botanical collections in the Ozark Mountains of Missouri
1899-1902	Instructor and Acting Assistant Professor in Botany, University of Missouri
1899-1903	Member, St. Louis Academy of Sciences
1900	Summer: Botanical collections in the swamps of Southeast Missouri
1901	Summer: Laboratory of Dr. Erwin F. Smith, Washington, D.C.
1901	Phi Beta Kappa, Missouri Alpha
1902-1904	Graduate Assistant in Mycology, Cornell University
1902	Fellow, American Association for the Advancement of Science
1903	Sigma Xi, Cornell Chapter
1904	Entered the service of the U.S. Department of Agriculture, March 5
1904-1913	Cheese Investigations, Mycology, Storrs Agricultural Experiment Station, Connecticut
1905	U.S. delegate to International Dairy Congress at Paris; travel in England, France, Italy, and Germany on cheese investigations
1906	Married Ethel Winifred Slater, December 20, at Port Jefferson, N.Y.
1907	Charter member, Dairy Science Association of America
1913-1914	Cheese Investigations, Washington, D.C.
1914-1927	Mycologist in charge of Microbiological Laboratory, Bureau of Chemistry

1918	President, Bacteriological Society of Washington
1921	Member of organizing committee of Graduate School, U.S. Department of Agriculture
1927-1934	Mycologist in charge of Division of Soil Microbiology, Bureau of Chemistry and Soils
1929-1936	Recording Secretary, Washington Academy of Sciences
1934-1942	Mycologist in charge of Division of Soil Microbiology, Bureau of Plant Industry
1935	International Soil Congress, Oxford, England International Botanical Congress, Amsterdam, Holland
1936	D.Sc. (Honorary), Lake Forest College
1939	Vice President, International Microbiological Congress, New York
1939	President, Washington Academy of Sciences
1939	President, Botanical Society of Washington
1940	President, Society of American Bacteriologists
1942	Retired from active service, U.S. Department of Agriculture, November 11
1942	Ethel (Slater) Thom died, October 17, Port Jefferson, N.Y.
1942-1946	Consultant to Merck and Company, Northwestern Yeast Company, General Mills, General Foods, University of Pennsylvania, Miles Laboratories
1943-1944	War Food Administration; inspection of canning factories in Maine, New Jersey, Pennsylvania, New York, Florida, Texas, California, Illinois, Minnesota, and Michigan
1943-1954	Collaborator, Fermentation Division, Northern Regional Research Laboratory, U.S. Department of Agriculture, Peoria, Illinois
1944	Married Charlotte J. Bayles, September 11, at Port Jefferson, New York
1946	Member of team receiving Lasker Group Award for work on penicillin at Northern Regional Research Laboratory, Peoria, Illinois
1947	Member of team receiving U.S. Department of Agriculture Distinguished Service Award for work on penicillin (Peoria Laboratory)

1947	Guest of Consejo Superios de Investigaciones Cientificas in Spain. Elected honorary member of the Council, April 29; awarded medal of the Consejo, May 8
1949	Chairman and Temporary President at organization of the Society of Industrial Microbiology in New York, December 29
1950	Designated Honorary President of VII International Botanical Congress, Stockholm
1950	Vice President, International Congress of Microbiologists, August 17-24, Rio de Janeiro
1950	First President, Society of Industrial Microbiology
1951	Second Annual Lecture, Mycological Society of America
1951	Address: "Soil Microbiology in America," at Dedication of Lipman Hall, Rutgers University, June 12
1951-1954	Consultant, Lilly Research Laboratories, Indianapolis, Indiana
1953	President, Mycological Society of America
1954	Charlotte (Bayles) Thom died, April 22
1956	Died, May 24, at Port Jefferson, New York

BIBLIOGRAPHY

KEY TO ABBREVIATIONS

Am. Food J. = American Food Journal
Am. J. Bot. = American Journal of Botany
Am. J. Public Health = American Journal of Public Health
Anales Inst. Espan. Edafol. Ecol. Fisiol. Veg. = Anales del Instituto Espanol de Edafologia, Ecologia y Fisiologia Vegetal
Bot. Gaz. = Botanical Gazette
Conn. Dairymen's Assoc. Dept. Proc. = Connecticut Dairymen's Association, Report of the Proceedings
J. Agr. Res. = Journal of Agricultural Research
J. Allergy = Journal of Allergy
J. Am. Med. Assoc. = Journal of the American Medical Association
J. Bacteriol. = Journal of Bacteriology
J. Biol. Chem. = Journal of Biological Chemistry
J. Wash. Acad. Sci. = Journal of the Washington Academy of Sciences
Proc. Nat. Acad. Sci. = Proceedings of the National Academy of Sciences
Storrs Agr. Exp. Sta. Bull. = Storrs Agricultural Experiment Station Bulletin
U.S. Dept. Agr., Bur. Animal Ind. Bull. = United States Department of Agriculture, Bureau of Animal Industry Bulletin
U.S. Dept. Agr. Yearbook = United States Department of Agriculture Yearbook

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