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PHILIP HERRIES GREGORY 1907–1986: Pioneer Aerobiologist, Versatile Mycologist

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ABSTRACT

Philip Gregory pioneered aerobiology as a topic for research, drawing together inputs from many disciplines to contribute to better understanding of fungal spore dispersal, plant disease epidemiology, and allergy. In childhood, he was interested in natural history and meteorology and frequently suffered from asthma. Initially, he worked with dermatophytes in Winnipeg, where he was influenced by Buller. Returning to Britain, he investigated the epidemiology first of flower bulb diseases and then of potato virus diseases, noting the occurrence of disease gradients in crops. He developed theories of spore dispersal during wartime air-raid duties and published these in his classic paper of 1945. The remainder of his career was largely spent obtaining data in support of his theories of spore dispersal and disease gradients, on understanding splash dispersal, in identifying the cause of farmer's lung disease, and in his retirement, in elucidating the epidemiology of black pod disease of cocoa in Nigeria.

Philip Gregory will be remembered best as a pioneer of aerobiology, a subject that interested him for most of his life, not only for research but also because of his personal encounters with asthma. However, this was only one strand in a varied career. He likened the development of aerobiology to the history of a river that gathers together different streams into the whole (10, 12). Its origin may not be evident initially but can be traced back only in retrospect to a wet patch or an upland bog here, a spring or rivulet there. At times, branches leave the main stream only to rejoin it later. The development of his career

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was like such a river: the source arising from his childhood interest in natural history and the handicap of asthma, branching into plant pathology through his education, but then diverted into medical mycology. Subsequently he returned to plant pathology, first to fungal diseases of flower bulb crops, then, during wartime, to potato virus diseases where he encountered the phenomenon of disease gradients. Returning to mycology, he provided data to support theories on dispersal, conceived largely during wartime air-raid duties and, despite ill health, developed the synthesis that characterized his research. This led to the development of spore traps, further medical mycology, and in his retirement, to an outstanding program of research on black pod disease of cocoa. During his career, barriers occurred when grants failed to materialize or were cut short and when illness or war broke out, but these were followed by the entry of new streams and periods of uninterrupted flow. He was fully conscious of debts he owed those he had worked with who facilitated his progress past these barriers. The development of his career owed much to Alice Bacon (Brighton Technical College), William Brown (Imperial College), AHR Buller (University of Manitoba, Winnipeg), GR Bisby (Winnipeg), Andrew Davidson (Winnipeg Medical College), Albert Beaumont (Agricultural Advisory Service, Seale Hayne), Fred Bawden (later Sir Frederick Bawden; Rothamsted), Kate Maunsell (London), and Eric Beauchamp (Cocoa and Chocolate Alliance). In particular, Sir Frederick Bawden recognized his genius and twice stepped in to bring him back to Rothamsted where he did the work for which he is best remembered. To those who worked with him there, he provided a continuous stream of ideas for new lines of investigation to the extent that one of us found it necessary to continually counter this with “yes, but” to be able to finish one job before starting the next. In every sense of the word, Philip Gregory was a gentleman. He never liked to argue, a habit that originated in his early upbringing.

Childhood

Philip Gregory was born in Exmouth, Devon, on 24 July 1907, the son of an Anglican clergyman with Baptist tendencies. During childhood, he was confined to bed with asthma for long periods, preventing regular school attendance. Consequently, his education was erratic and came mainly from reading, looking down a microscope, visiting teachers, and his father. Large gaps remained, especially in the art of conversation. At 14 years of age, the asthma moderated and, liberated into the open air, he rapidly developed interests in meteorology and the natural history of the sea and country. This led to ideas at conflict with those of his parents but, because he recognized their inherent goodness, he avoided arguments that might interfere with their views. He became fascinated with the complex behavior of functioning organisms, their interactions with one another and with their environment. He saw the explanation of biological phenomena through interactions with physical factors as having the same validity as the chemical sequence of causation although they had different endpoints.

Brighton and London

Philip Gregory considered several possible careers. Farming was ruled out because it required capital. Medicine was attractive but too physically exacting. Engineering appeared to provide more flexible training and he enrolled at Brighton Technical College to study engineering drawing for matriculation, with English, mathematics, and physics, the last a vehicle for teaching scientific method. At the end of the first year, he was surprised to discover that a career in biology was possible and he switched immediately to pure science. After matriculating, he came under the influence of Mrs. Alice Bacon, a student of Professor FE Fritsch, an inspiring and dedicated teacher, and from her first heard of Rothamsted. He graduated in 1928 with an external London B.Sc. (General) degree in botany, chemistry, and zoology.

He was determined to follow a career in research and, having read a leaflet on late blight of potatoes by GH Pethybridge, had a preference for plant pathology. After preliminary inquiries at the University of Oxford, he was directed to the Imperial College of Science and Technology, London. With a Royal Scholarship, he took the final year of the B.Sc. (Special) degree course in botany there before starting research with Professor William Brown. His research project was in two parts, a field study of *Fusarium* disease of *Narcissus* and a laboratory study of pectinase preparation. The rigorous training in pure culture technique and plant pathological methods laid a good foundation for his career but his enthusiasm for the field problem caused him, perhaps tactlessly, to neglect the laboratory problem. Nevertheless, he received his Ph.D. and D.I.C. (Diploma of Imperial College) and had expected to get a grant from the Ministry of Agriculture to continue his work on ornamentals. Instead the financial crisis of the early 1930s broke, and on the same day as he was offered the grant, he received a second letter canceling it. The disappointment was a blessing in disguise as it opened up an opportunity to go to Canada. AHR Buller was looking for a medical mycologist to work with AM Davidson, a dermatologist, in Winnipeg and Gregory was recommended for this post by his Ph.D. examiner, GH Pethybridge.

Winnipeg

Winnipeg was an exciting place for a young mycologist. His research was directed by Buller, the best all-round mycologist Gregory ever met. Also in Winnipeg around this time, Craigie discovered sex in rusts, Hanna was working on tetrapolarity in *Coprinus*, and T Johnson and Margaret Newton were pioneering genetic studies on *Puccinia graminis* Pers., cause of black stem rust of wheat. At the same time, it was shown that this rust reached Manitoba each year as airborne urediniospores. Buller's childlike enthusiasm for the function and role of fungi in the environment represented a complete change of outlook for Gregory; his previous mycological contacts had been with taxonomists, who worked only with dead fungi, and with academic lecturers, to whom they were inferior organisms.

In the Medical College, Gregory was paid by the Banting Research Foundation to work on dermatophyte infections, and he held posts as Honorary Mycologist to the Winnipeg General Hospital and Children's Hospital. He enjoyed attending skin clinics and collecting samples from patients. He showed that when infected hairs and skin scales were kept in a moist atmosphere just below saturation, the restricted fungal morphology normally seen in them could give rise to the same range of spore forms as were found in artificial culture. These spores then functioned as a dispersal phase for infecting new individuals. In retrospect, he felt that he missed many opportunities there and worked on too small a scale. However, working with Buller strengthened his interest in fungi in general and in spore dispersal in particular. Later, Gregory picked up the problem where Buller left off, studying what happens after liberation.

Soon after arriving in Canada, he was joined by Margaret F Culverhouse, to whom he had become engaged three years earlier. They were married in Winnipeg Cathedral and for a honeymoon stayed in a hut in the Rockies. However, even in Canada, he could not escape financial crises. By the end of 1934, depression hit Manitoba. The situation was aggravated by embezzlement of University funds, for which the Bursar was jailed, causing Gregory's grant to be cut. With many misgivings, he and his wife decided to return to England. Professor Brown recommended Gregory for a grant from the Great Western Railway, the National Farmer's Union and, later, the Ministry of Agriculture, to work on flower crop diseases in southwest England.

Seale Hayne

At Seale Hayne, Gregory was fortunate to be guided by Albert Beaumont, then Ministry of Agriculture and Fisheries Regional Mycologist for the area, who had a wide knowledge of the principle flower bulb disease problems. He advised Gregory to study the foliar diseases of *Narcissus*. All fieldwork had to be done west of Truro, Cornwall, and most was completed in the Isles of Scilly over the years 1935–1939. These experiments showed that extensive but unrecognized losses of 25–40%, controllable with copper sprays (Bordeaux mixture), were caused by *Ramularia vallisumbrosae* Cavara (white mold) and *Botrytis polyblastis* Dowson (*Narcissus* fire). Spraying also improved flower quality but delayed flower opening in the principal trumpet cultivar by a few days.

Both fungi produced sclerotia on the dead foliage. Those of *R. vallisumbrosae* overwintered on the soil surface and germinated only to produce a tuft of *Cercosporella*-like spores, whereas sclerotia of *B. polyblastis* produced apothecia of a new species of *Sclerotinia*, described as *S. polyblastis* Gregory. The ascospores infected the perianth of *Narcissus* flowers to produce enormous conidia. Gregory was able to control both diseases by removing all dead leaves and flowers from the plants, while the method used to produce apothecia of *B. polyblastis* worked also for other *Botrytis* spp. He confirmed de Bary's association of *Botrytis cinerea* Fries with *Sclerotinia fuckeliana* (de Bary) Fuckel and refound de Bary's original account. War then intervened, forcing him to conclude flower disease work.

Rothamsted 1

Wartime caused a complete change of activity for Philip Gregory. The Ministry of Agriculture, fearing that bombing might prevent transport of sufficient seed potatoes from production areas in Scotland to growing areas in England, instituted a certification scheme for once-grown English seed. Gregory was therefore brought to Rothamsted to study, with entomologist JP Doncaster, the amount and distance of spread of potato leaf roll and virus Y, in relation to roguing, burning off, and lifting dates. They showed that there was little hope of producing good seed potato stocks in England. Both diseases were spread by winged migrant aphids soon after shoot emergence, and spread occurred before symptoms were sufficiently clear in infected plants to enable them to be rogued. Infected "ground-keepers" (tubers accidentally left in the ground after harvest) were an additional serious source of infection. He also observed that infections in a healthy potato crop decreased with distance from a once-grown crop planted alongside. The infection gradient and its causes struck Gregory as an important general problem in plant pathology. This unexplored topic drew together his diverse lines of interest in plant pathology, mycology, meteorology, insect-borne viruses, and medical mycology. Together with the avenues it opened up in aerobiology, this subject became his dominating interest for the following 40 years.

In his spare time he read relevant literature and soon discovered a 56-page paper on infection gradients published in Russian by Stepanov in 1935. To read it, he learned Russian during long nights sitting up as an Air Raid Warden using a language course on phonograph records purchased with the proceeds from selling his grandfather's gold watch. The translation showed the general occurrence of infection gradients but did not explain what caused the characteristic hollow curve when disease incidence was plotted against distance (Figure 1*a*). Empirical curve fitting and geometrical and statistical arguments did not help, but studies of atmospheric turbulence by W Schmidt and OG Sutton showed

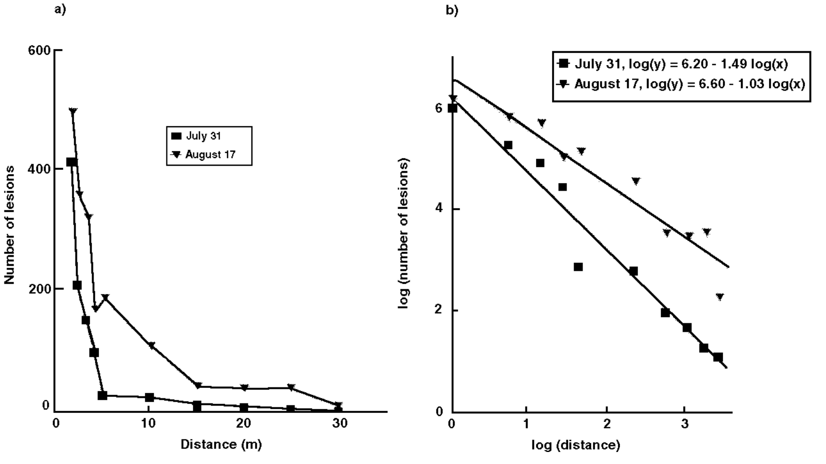

Figure 1 Potato late blight (*Phytophthora infestans* de Bary) infection gradients (PH Gregory, DR Henden & DH Lapwood, unpublished): (*a*) numbers of lesions plotted against distance from infected plant sources on a linear scale; (*b*) the same data plotted on log-log scales, with linear regression lines (31 July, $r^2 = 0.96$; 17 August, $r^2 = 0.92$).

him that clouds of particles were diluted by eddies as they traveled downwind. Observed gradients (Figure 2) still deviated from Sutton's predictions because clouds of spores, unlike smoke or gas, suffer appreciable losses through deposition. Gregory persuaded his wife, a trained mathematician, to insert an exponential term into Sutton's equations for a cloud emitted at ground level to correct for this deposition (4). This formula, with extension by AC Chamberlain to allow for emissions at other heights, has stood the test of time and has been used widely. He also realized that disease gradients were distorted, when plotted as percentages of plants or leaves infected, by the occurrence of multiple infections. To correct this and obtain an estimate of the numbers of actual infections, he developed the now widely used multiple infection transformation (5).

Gregory had concluded, on leaving Canada, that his best chance of furthering medical mycology lay in working outside the control of medical practitioners. However, as a result of the reputation he obtained there, he was invited to attend a Medical Research Council (MRC) meeting in 1943 that recommended forming a Committee on Medical Mycology with Gregory as Secretary. The Agricultural Research Council (ARC), which funded his work at Rothamsted, initially vetoed his participation but, with greater cooperation between the two Councils, he was able to attend meetings regularly from 1953 to 1964. Later, the MRC Committee was transformed into the present British Society for Medical Mycology.

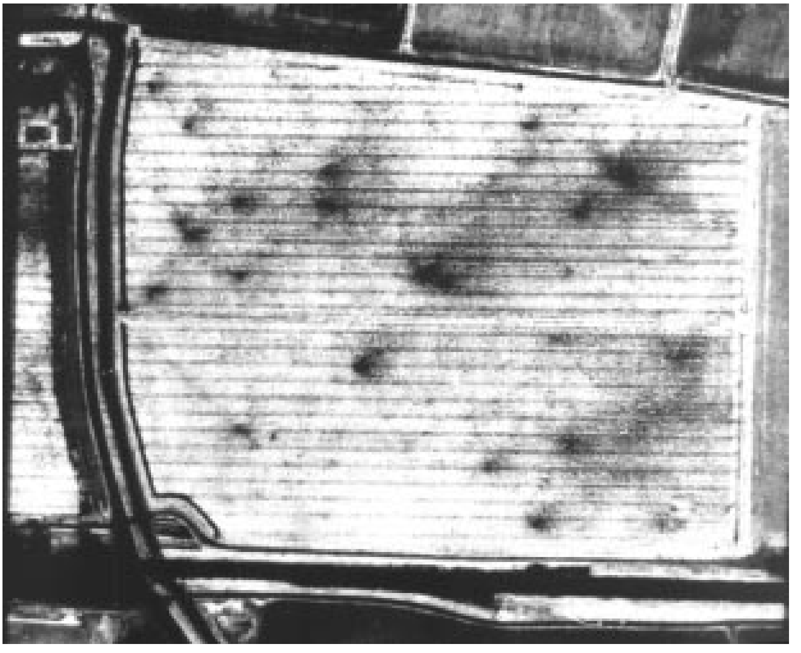

Figure 2 Aerial infra-red photograph of potato late blight (*Phytophthora infestans*) disease gradients from primary foci in a potato crop (2).

Manchester Interlude

After six years of potato work, curiosity about the production of penicillin by *Penicillium chrysogenum* Thom (then known as *P. notatum* Westling) and inclination to avoid staleness caused Gregory to take a one-year secondment to work with the ICI team in Manchester. He arrived just as Barbara Whinfield, a research student under CW Wardlaw, showed that penicillin was produced by the germinating spores. He confirmed her findings and concluded that much penicillin production in surface culture is produced by spores germinating in situ on the felt. In nature, the germinating spores presumably use penicillin to set up a microzone of inhibition, but Gregory felt that Whinfield's work was not fully appreciated in soil microbiology.

Rothamsted 2

On his return to Rothamsted, Gregory continued to work on potato viruses. Now almost 40 years old and still working on temporary grants, he was determined to obtain a permanent appointment. He was attracted by the developing East African Groundnuts Scheme and was promised appointment as a plant pathologist. He resigned his ARC post at Rothamsted, but less than three weeks before his expected departure, he was turned down for health reasons. The Plant Pathology Department at Rothamsted and the ARC then acted with a speed that would be impossible today. Within a matter of hours, he was reappointed.

FC Bawden, then Head of the Plant Pathology Department, encouraged Gregory's interest in disease gradients, and Gregory decided it would be easier to work with fungal spores than with "behavior-plagued" aphids. The theoretical work had been done during the war but it remained to test his theory. For this, he had to construct a small wind tunnel (6) to determine how many spores would be deposited over a given area from wind carrying a known concentration of spores. He was ably assisted in this work by OJ Stedman and was aided by the development of a cascade impactor by KR May at the Chemical Defence Establishment, Porton, United Kingdom (21). The appointment of JM Hirst to the Plant Pathology Department resulted in development of the Hirst Automatic Volumetric Spore Trap (19), which revealed the richness and diversity of the air spora, many components of which Gregory, with his broad mycological experience, could identify. It also added new precision to the study of plant diseases, showing how spore dispersal was affected by time of day and weather, allowing better forecasting and timing of control measures. It also attracted the attention of allergologists and suggested possible new causes for allergies. Traps of this type are now employed widely throughout the world to sample airborne allergens.

Gregory drew attention to the abundance of ballistospores of *Sporobolomyces* and of basidiospores in the air spora and suggested that they might be allergenic. He also demonstrated the presence of basidiospores of *Serpula lacrymans* in bomb-damaged houses in London and found mites in house dust before *Dermatophagoides pteronyssinus* had been shown to cause house dust allergy. Later he emphasized the importance of mite feces and showed that they could be controlled by vacuum cleaning. He convinced many allergists that fungi should be considered as allergens, and worked closely with Drs. K Maunsell, AW Frankland, DA Williams, and others in identifying some of these. Perhaps his most difficult jobs were to convince American allergists to change from horizontal Durham sedimentation slides to more efficient samplers and to get palynologists to change their harsh methods of slide preparation that often removed features useful in identification. That this was achieved was reward for much patient discussion.

During this period at Rothamsted, Gregory's attention was drawn to unexplained deaths among sycamore trees (*Acer pseudoplatanus* L.) in northeast London. He identified the causal agent as *Coniosporium corticale* Ellis & Everhart, a fungus already known to attack maple trees in North America, and surmised that infection originated in the nearby East End docks. Although the feared epidemic did not materialize and gaseous pollution may well have contributed to the rapid deaths of the trees, he gained much satisfaction in unraveling the taxonomy of the fungus, for which he had to create a new genus, *Cryptostroma* (18). In view of his later interest in farmer's lung, it is coincidental that this fungus caused maple bark stripper's disease in North America, the first form of extrinsic allergic alveolitis to be identified with a fungal cause.

Imperial College

Gregory's interest in spore dispersal was further developed when he left Rothamsted in 1954 to become Professor of Botany at the Imperial College of Science and Technology, London. These four years were not the happiest period in Gregory's career, not least because he underwent major surgery and spent ten months in hospital as a consequence of tuberculosis. He was unhappy with the distant professor-student relationship and felt he helped the development of a colleague's student, with whom he shared a laboratory, more than he did most of his own. Despite the setbacks, while at Imperial College he studied the dispersal of spores from point sources near ground level, and showed that a large proportion were deposited within the first 100 m. Subsequently, with his student EJ Guthrie, he investigated the splash dispersal of spores from thin films of water. The experiments caused much amusement in the College, because of the asbestos pipe suspended from the balcony in a corner of the main hall at the Imperial College Field Station at Silwood Park. The work was meticulous and sought to define the basic principles underlying splash dispersal. These studies provided the basis for subsequent work by Hirst out of doors where wind and evaporation had measurable effects and, later, for interpretation of the epidemiology of black pod disease of cocoa. Even the prolonged spell in Midhurst Sanatorium had its benefits: He planned and started to write *The Microbiology of the Atmosphere* (7), and was introduced to oil painting.

Rothamsted 3

Philip Gregory returned to the congenial atmosphere at Rothamsted in 1958 as Head of the Plant Pathology Department, surrounded by full-time, experienced research workers. Just before he left Imperial College, he was awarded a grant by the ARC, at the instigation of the MRC Medical Mycology Committee, to study the microflora of moldy hay in relation to farmer's lung disease, the classic form of an extrinsic allergic alveolitis. He was able to take this grant to Rothamsted. There followed a period of profitable collaboration with Professor Jack Pepys at the Institute of Diseases of the Chest (now the National Heart and Lung Institute) in which Gregory provided antigenic material for Pepys to evaluate against sera from patients with farmer's lung using new immunological methods. Gregory experimented with batches of hay of different water contents, which were allowed to heat spontaneously and then used novel methods for isolating the microorganisms that grew. Because farmer's lung resulted from the inhalation of dust from moldy hay, spores were blown from the hay in the small wind tunnel used earlier to study spore deposition and were then sampled downwind, at first onto alginate filters but later using an Andersen sampler (1). The choice of the Andersen sampler was fortuitous as it proved especially suited to the isolation of actinomycetes and allowed the principal sources of farmer's lung hay antigen to be isolated and identified as *Thermopolyspora polyspora* Henssen (now known as *Saccharopolyspora rectivirgula* Korn-Wendisch et al) and *Thermoactinomyces vulgaris* Tsiklinsky (16, 22). At the start of this work, an eminent clinician had written "the medical doctors poured scorn on the idea that botanists could solve the problem of farmer's lung. It was only when they had wrongly blamed *Aspergillus fumigatus* that they finally, I believe, had to turn to Philip" (20). By identifying the cause of farmer's lung, Gregory fulfilled his earlier prediction, achieving progress in medical mycology while collaborating closely with doctors but not controlled by them.

Gregory often approached his research like a detective systematically searching for clues as he developed it from one stage to the next. For instance, with hay, he first characterized the microflora of hays implicated in disease, then sought to reproduce them experimentally and, with Pepys' help, to test individual components immunologically against patients' sera so that those causing the disease could be identified. One particular short study reads more like a whodunnit. Identification of the source of *Pithomyces chartarum* (Berk & Curt) MB Ellis in England is, perhaps, one of the few instances where a fungus has been tracked up a dispersal gradient. The spores, not previously found in Britain, were first identified on spore trap slides exposed in 1958 but counted in 1960. The fungus had recently been implicated in facial eczema of sheep in New Zealand, a mycotoxicosis, and coincidentally spores had just been painted for his book *Microbiology of the Atmosphere* from a slide, provided by GC Ainsworth. Gregory & Lacey (17) considered three possible sources of these spores. Extraneous contamination of imported packing materials and long-distance transport in an air mass of tropical origin seemed unlikely as air was of polar origin on the day of trapping. A local source seemed likely when Gregory found spores of *P. chartarum* in all samples collected while carrying a portable spore trap, in which a rotorod sampler was mounted in a plastic lattice shopping bag, on a British Mycological Society fungus foray. Further trapping in the adjacent parkland allowed the concentration gradient to be determined and the source identified as debris of the grass, *Holcus lanatus* L.

During this period Gregory turned his attention to the sedimentation velocities of fungal spores, an important component in models of spore dispersion. He measured the sedimentation velocities of many fungal spores using a stirred settling chamber and a cascade impactor, ably assisted by DR Henden, but regrettably, apart from papers on the sedimentation of *Lycoperdon* basidiospores and *Didymella exitialis* ascospores (14, 15), much of this work was published only as part of a Table in the second edition of *The Microbiology of the Atmosphere.*

Retirement

Continued ill-health and the increasing burden of contemporary research management led Gregory to retire in 1967 at the age of 60. However, after another short spell in hospital and improved medical treatment, he was able to add a further productive period to his career, as an international consultant on cocoa diseases. Although it was demanding, he enjoyed the opportunities for travel and, especially, the chance to return from Brazil once by supersonic *Concorde.*

He was employed to evaluate past and present research in the principal cocoa-growing areas and suggest future needs. In less than 18 months, he made visits and inquiries in a dozen countries and produced a comprehensive report on *Phytophthora palmivora* (Butler) Butler (9). With characteristic modesty, he separated the factual content of the report from his own opinions on the epidemiology of black pod. He recommended international collaboration to strengthen research into the epidemiology and fungicidal control of the disease and in genetics and breeding. As a consequence, the International Cocoa Black Pod Research Project was set up in Nigeria, and Gregory recruited an able team of young scientists to identify sources of the pathogen, modes of dispersal, and weak links in the life cycle, utilizing three-dimensional analysis of the dispersal gradients. Gregory visited the team only once a year but was in constant contact from his home. The project concluded that a new species, *Phytophthora megakarya* Brasier & Griffin, was more common in Nigeria than *P. palmivora* was, that it did not form persistent infections in flower cushions, and that it was splash dispersed. Drawing on his earlier experience of splash dispersal and by removing visibly infected pods daily, he was able to interpret the dispersal gradients observed. He speculated that zoospores, originating from sporangia produced on infected shallow feeder roots of the cocoa tree, were splashed up to the fruit. Infections below 70 cm were predominantly caused by larger splash droplets that carried spores from the ground along ballistic trajectories while higher infections resulted from smaller droplets that behaved as aerosol particles.

In his retirement, Philip Gregory maintained enthusiasm for his wide range of scientific interests and also developed others, such as the fungal mycelium (13). He published classic papers on the interpretation and misinterpretation of plant disease gradients (8, 11), demonstrating how the same spore dispersal mechanism could account for steep gradients close to a source and shallow gradients farther away. Such gradients could be used to explain interplot interference in small plot trials, affecting comparisons between treatments (e.g. fungicides). He was still contributing comments to a paper on dispersal gradients just before he died (3).

Philip Gregory continued to enjoy his hobbies, especially art and gardening, in his retirement. He had more time for painting and used this for further study at the local Further Education Centre. He successfully passed the General Certificate of Education "ordinary level" examination in art in 1971. From the oil painting learnt in hospital, he successively developed skills with water colors, taking delight in the washes and effects he achieved, and with oil pastels, which he found an especially congenial medium. He particularly liked to paint landscapes of places he had visited on his different trips and, in 1975, produced a diary of colorful sketches of his travels. Gregory saw his gardening as an extension of his art. He had started to create an artist's garden while he was at Imperial College, and continued this endeavor on his return to Harpenden, although the soils were very different. He went to great trouble to obtain particular effects of color and texture using plants instead of pigments. He proudly and enthusiastically showed his garden to visitors and they often regarded this as the highlight of their visit to Harpenden.

Recognition

Philip Gregory was awarded the D.Sc. degree of London University in 1949 for his work on spore dispersal. He continued his childhood interest in natural history, often attending and sometimes leading forays of the British Mycological Society and the Hertfordshire Natural History Society, and he regularly contributed notes on the fungi of Hertfordshire. He was elected President of the British Mycological Society in 1951 and of the Hertfordshire Natural History Society in 1966, and was made a Fellow of the Institute of Biology. He supported several other scientific societies and although he did not often serve in any office, he was frequently prominent in proposals to form or remodel societies. He was involved with the formation of the Federation of British Plant Pathologists with members from the British Mycological Society and the Association of Applied Biologists and, subsequently, in its transition into the independent British Society for Plant Pathology. He also assisted with the formation of the British Society for Mycopathology and the International Aerobiology Association and was made an Honorary Member of both societies as well as of the British Society of Allergy and Clinical Immunology.

Appreciation

We remember Philip Gregory for his kindness, gentleness, encouragement, and infectious enthusiasm. He provided modest, unassuming leadership of his research groups and department and freely shared his many ideas for different projects, quickly analyzing problems and identifying potential lines of inquiry.

He did not like to argue but preferred to give both the benefit of his experience and, where necessary, criticism in quiet discussion that maintained and built up confidence. Even distinguished scientists were reported to have left him red-faced but unrevealed after he had identified mystery bodies in histological preparations as fungal spores that had come in through the window (20). In later lectures, partly to maintain the attention of an audience but also to stimulate new thinking in mycology, he liked to be unorthodox and to challenge preconceptions.

He always allowed his co-workers the maximum credit for their contribution, even though he had been the instigation and inspiration for the work. He employed people for talents that they could contribute to research projects and one of us for her artistic ability, which he subsequently utilized for illustrating the *Microbiology of the Atmosphere.* Even when employed for a particular project, scientists were still allowed to develop their research at a tangent to the original objectives if this seemed profitable, something that becomes increasingly difficult as research programs are more closely managed and limited by narrower and more short term objectives.

His work on spore dispersal and disease gradients is one of the cornerstones on which aerobiology and plant disease epidemiology have been built. His work, together with that of Van Der Plank (23), provided the theoretical basis for much modern work on plant disease epidemiology and forecasting. The theory and practice of sampling spores and other airborne particles has been revolutionized by his ideas. Sufferers from respiratory allergies should be grateful to him for the improvements in their diagnosis and treatment that have resulted from his work.

Throughout his career, he was ably supported by his wife, Margaret, who kept a hospitable home and provided him with her mathematical expertise. They had two children, Andrew and Rachel, who both graduated in natural sciences, one to become a University Lecturer in Applied Psychology and the other a school teacher and religious education adviser. We, like countless scientists throughout the world with whom he formed strong friendships, will always be grateful to Philip and Margaret for their quiet hospitality, often provided at short notice, at their homes in Ascot and, especially, in Harpenden. Philip Gregory died on 9 February 1986 and is survived by his wife and their son and daughter.

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Literature Cited

1. Andersen AA. 1958. New sampler for the collection, sizing and enumeration of viable airborne bacteria. *J. Bacteriol.* 76:471–84
2. Bell TS. 1972. Remote sensing for the identification of crops and crop diseases. In *Environmental Remote Sensing: Applications and Achievements,* ed. EC Barrett, LF Curtis, pp. 155–66. London: Edward Arnold
3. Fitt BDL, Gregory PH, Todd AD, McCartney HA, Macdonald OC. 1987. Spore dispersal and plant disease gradients; a comparison between two empirical models. *J. Phytopathol.* 118:227–42
4. Gregory PH. 1945. The dispersion of airborne spores. *Trans. Br. Mycol. Soc.* 28:26–72
5. Gregory PH. 1948. The multiple infection transformation. *Ann. Appl. Biol.* 35:412–17
6. Gregory PH. 1951. Deposition of air-borne Lycopodium spores on cylinders. *Ann. Appl. Biol.* 38:357–61
7. Gregory PH. 1961. *The Microbiology of the Atmosphere.* London: Leonard Hill. 2nd ed., 1973.
8. Gregory PH. 1968. Interpreting disease dispersal gradients. *Annu. Rev. Phytopathol.* 6:189–212
9. Gregory PH. 1969. *Black pod disease project report*. London: Cocoa, Choc. Confect. Alliance
10. Gregory PH. 1977. Spores in air. *Annu. Rev. Phytopathol.* 15:1–11
11. Gregory PH. 1982. Disease gradients of windborne plant pathogens: interpretation and misinterpretation. In *Advancing Frontiers of Mycology and Plant Pathology,* ed. KS Bilgrami, RS Misra, PC Misra, pp. 107–17. Delhi: Today & Tomorrow
12. Gregory PH. 1983. Aerobiology: past, present and future. *Int. Aerobiol. Newsl.* 17:9–16
13. Gregory PH. 1984. The fungal mycelium: an historical perspective. *Trans. Br. Mycol. Soc.* 82:1–11
14. Gregory PH, Henden DR. 1976. Terminal velocity of basidiospores of the giant puffball (*Lycoperdon giganteum*). *Trans. Br. Mycol. Soc.* 67:399–407
15. Gregory PH, Lacey J, Vittal BPR. 1982. Terminal velocity of fall of *Didymella exitialis* ascospores in air. *Trans. Br. Mycol. Soc.* 79:360–62
16. Gregory PH, Lacey ME, Festenstein GN, Skinner FA. 1963. Microbial and biochemical changes during the moulding of hay. *J. Gen. Microbiol.* 33:147–74
17. Gregory PH, Lacey ME. 1964. The discovery of *Pithomyces chartarum* in Britain. *Trans. Br. Mycol. Soc.* 47:25–30
18. Gregory PH, Waller S. 1951. *Cryptostroma corticale* and sooty bark disease of sycamore (*Acer pseudoplatanus*). *Trans. Br. Mycol. Soc.* 34:579–97
19. Hirst JM. 1952. An automatic volumetric spore trap. *Ann. Appl. Biol.* 39:257–65
20. Hirst JM. 1990. Philip Herries Gregory, 24 July 1907–9 February 1986. *Biogr. Mem. Fellows R. Soc.* 35:153–77
21. May KR. 1945. The cascade impactor: an instrument for sampling coarse aerosols. *J. Sci. Instrum.* 22:187–95
22. Pepys J, Jenkins PA, Festenstein GN, Gregory PH, Lacey ME, Skinner FA. 1962. Farmer's lung: thermophilic actinomycetes as a source of "farmer's lung hay" antigen. *Lancet* ii:607–11
23. Van Der Plank JE. 1963. *Plant Diseases: Epidemics and Control.* New York: Academic