HARRY GODWIN

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Elected F.R.S. 1945

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Harry Godwin died on 12 August 1985 at the age of 84. His lifetime saw both the transformation of plant ecology to a leading experimental subject in the plant sciences and the related development of Quaternary research as an interdisciplinary science subject to, and contributing to, botany, zoology, geology, archaeology and geography. In both these developments Godwin was a pioneer and took a very major part, providing active and enthusiastic leadership, with valuable discipline, throughout his long career at Cambridge. His work led him to close friendships, both with his professional colleagues and students and with a wider range of researchers he worked with in the field. Few of his associates did not benefit from his readily given advice and help over the years. Godwin greatly relished the life and relationships he found at Cambridge, an enjoyment he mulled over in his last book *Cambridge and Clare* (55)*, an autobiography that celebrates his personal and scientific life, and that greatly enlarges this memoir.

Early life and schooling

Harry Godwin was born on 9 May 1901 at Holmes, Rotherham, Yorkshire. His parents were Charles William Thomas Godwin and Mary Jane Godwin (*née* Grainger). Soon after his birth the family moved to Long Eaton, Derbyshire, his father, a grocer and licensed victualler, taking advantage of the industrial development of that area. Two years later his sister Winifred was born. The family remained in Long Eaton, where Godwin attended Long Eaton High Street Council School from the age of four to twelve. He records that he was an active Boy Scout between the ages of ten and twelve, getting much pleasure and profit from camping at weekends and on holidays.

* Numbers in this form refer to entries in the bibliography at the end of the text.

At twelve Godwin left the school, with a Free Place, value £1 a year, which was later converted to a Minor Scholarship, for Long Eaton County Secondary School. Godwin's experience at this school determined his future. He records that experience as follows:

> This school was then and throughout my school life under the exceptionally cultivated and able educationalist Mr Samuel Clegg, to whom I owe an immense debt of gratitude, especially for his inspired teaching of English, the visual arts and handicrafts, and for encouragement 'in all things' to 'follow thy soul, for that is the law of the prophets—whether spelt "fits" or "phets"'. At this school the years of the 1914–1918 war had great effects on the staffing and teaching. Mathematics were regrettably interrupted in the upper forms (a circumstance which gravely handicapped me later), but in Botany (taught throughout the school) and Geology it forced senior students to perform much reading and practical work for themselves, to their great advantage, whilst on the head boys fell much of the responsibility that in peace-time the masters took. The school was a co-educational day school with no corporal punishment and no prefect system.

Samuel Clegg was grandfather of Sir David Attenborough, F.R.S., his interest in the visual arts clearly inherited both by Sir David and his brother Sir Richard Attenborough. He was also editor of the *Bibliophile* and author of *Drawing and design: a school course in composition*, published by Pitman in 1918. Among his pupils was W. E. Gye, later F.R.S.

The origin of Godwin's enjoyment of writing and appreciation of visual art is apparent from this account. Both became evident later in his scientific writing and illustration. At the school he also became proficient in German. In the absence of other texts the work was done through translation of a German bible. One result was that Godwin, who had a prodigious memory, could repeat lengthy chunks of the German New Testament. A more important result was that he later had a most valuable insight into fundamental German papers on European vegetation and vegetational history. The wide interests that Godwin was able to develop at school formed the basis for the outlook of the polymath that is needed for successful Quaternary research.

Towards the end of his school career Godwin obtained a distinction in botany in the Oxford Senior Local Examination, also reading this subject for the County Scholarship examinations. At this time he also extended his geological studies by visiting University College, Nottingham, for practical laboratory work 'under the inspiring direction of Professor H. H. Swinnerton'. In 1918 he obtained a Derbyshire County Major Scholarship and later in the year an Open Scholarship of £60 at Clare College, Cambridge, offering botany, geology with elementary chemistry and physics. In his last year at school he wrote a paper for the school magazine on the vegetation of a Liassic limestone outlier near Gotham. He notes 'I was already aware of a primary interest in ecology'.

Clare College

Life and personalities in Clare College in the decades following 1920 are vividly portrayed in Godwin's *Cambridge and Clare* (55). He entered Clare in 1919 and read botany, geology and chemistry for Part I of the Natural Science Tripos. He was already keenly interested in ecology and read avidly the works of A. G. Tansley and F. E. Clements. In botany he was supervised by F. T. Brooks, encouraging his interest in mycology and plant pathology, but not at the expense of ecology. He obtained a first class in Part I and went on to read botany in Part II of the Natural Sciences Tripos, obtaining a first in June 1922. Immediately after the Tripos in 1922 he took the London (external) B.Sc. degree with first-class honours in botany and subsidiary geology. In 1922 he was elected to a College research studentship, residing in lodgings near Parker's Piece, and in 1923 was awarded the College's Greene Cup for general learning. His Ph.D. degree was awarded in 1926.

The change to life in Clare after Long Eaton was described by Godwin as 'akin to falling over a cliff'. He made the most of the enlargement of experience in social and scientific directions. At this time he began lasting friendships with A. G. Tansley, then a lecturer in the Botany School, and with his tutor, H. Thirkill, later Senior Tutor and Master of the College. He extended his interest to include psychology, perhaps a response to Tansley's great interest in the same subject.

Godwin was elected to a Research Fellowship in Clare in November 1925, and became one of a small band of 13 Fellows. Their stories and antics are given life in *Cambridge and Clare*. Godwin's main responsibilities in Clare involved teaching rather than college administration, so enabling him to develop his research interests strongly. He became an Official Fellow of the College in 1934, on appointment to a University Lectureship.

In the course of his long service to the College Godwin became an authority on the aesthetic aspects of college life, always ready with a strong opinion on the merits or otherwise of some particular scheme of decoration or development. He was particularly concerned with and knowledgeable about the College Plate, writing with R. J. L. Kingsford a supplementary catalogue of the Plate in 1972. His college career came to a natural high point in his period as Acting Master of the College in 1958–59, in the inter-regnum between H. Thirkill and E. Ashby. The period was one of great change in the College, including procedures at College meetings, and that the transition was started so successfully is attributable to Godwin's combined qualities of humanity and leadership. Godwin was Senior Fellow of the College for many years, and continued in this period to contribute to college life and meetings. His affection and loyalty to Clare is nowhere better seen than in *Cambridge and Clare*.

THE BOTANY SCHOOL, CAMBRIDGE

After graduating in 1922 Godwin became a research student in plant physiology, supervised by F. F. Blackman. This decision followed uncertainty about the choice between ecology and plant physiology; the latter was the prevalent discipline in the Department, whereas Tansley had very much excited his interest in ecology. In 1923 he was appointed Junior University Demonstrator, involving practical teaching of the Part I classes in support of Professor A. C. Seward's lectures. He assumed the main responsibility for practical teaching in the Department in 1927 when he was appointed Senior University Demonstrator following S. M. Wadham's move to Melbourne.

Godwin's work in the Department then developed rapidly. He took on his first research student, F. R. Barucha, in 1928, and, with his wife, Margaret, started palynology in 1929. He and Margaret had met at school, and after she had graduated in botany at Nottingham, they married in 1927. In 1930 he published the first edition of his elementary text on *Plant biology* (4) (which ran to four editions), the fruit of his experience of plant physiology with Blackman and of his practical and field teaching, and in the same year organized the ecology section of the International Botanical Congress held in Cambridge. In 1934 he was appointed University Lecturer in Botany, and thereafter for many years gave an invigorating elementary course for first-year botanists, replacing Seward's teaching, which he greatly admired.

Following the institution by the University in 1948 of the Sub-department of Quaternary Research, Godwin became the first Director and was appointed Reader in Quaternary Research. He remained Director until 1966, leading the great expansion of Quaternary research that took place in the U.K. at this time.

In 1960 Godwin was elected Professor of Botany, following the retirement of G. E. Briggs. It must have been a moment for which he had been preparing himself, for he was well-qualified to take on the position much earlier. If that had happened, possibly his research and the development of Quaternary research in the University, which had blossomed in the period 1936–60, would have been very different. Godwin showed prodigious energy in the re-organization and updating of the Department's facilities in the eight years he held the Chair. Teaching laboratories were improved, new facilities such as electron microscopy were introduced, and he was a major force in the introduction of the new interdepartmental first year courses in the biology of cells and of organisms. By the time he retired in 1968 the Department had been set on course by new appointments and new facilities for the revolution in biology teaching that has taken place in the last two decades.

Godwin's contribution to the Department over more than four decades was major and continuous. His teaching, both elementary and advanced, was enthsiastic and skilful. His administration left no doubts in the minds of those administered, and he appreciated the qualities and contributions of his colleagues. But perhaps an outstanding part of his work was in connection with his research students. In the period 1928–67 he supervised 40 research students in ecology and vegetational history, instilling into them the nature of scientific research, the need for clarity of expression and a regard for the subject. Many of his supervisees have become distinguished botanists and leaders in their own fields in many parts of the world, a reflection of Godwin's supervision.

Retirement

Immediately on retirement Godwin launched with characteristic energy into a reconsideration of the evidence for the history of the British Flora. This required the building of a new databank of plant records, a substantial task in which he was aided by J. Deacon. Since the publication of the first edition (1956) of his *History of the British Flora* (44) much new evidence, both lithostratigraphic and biostratigraphic, had been forthcoming and he was able to make a new synthesis for the second edition of 1975. He also returned to the Fenland to write up an account of the Flandrian stratigraphy and vegetational history of the Holme Fen and Whittlesey Mere area, developing ideas he had formed in his former Fenland studies.

Retirement is a time for reflection backed by long experience, and indeed for Godwin this was a period of great enjoyment of his interests and of productivity. He was able to combine his knowledge of vegetational and landscape history with his enthusiasm to write two books bringing together his long experience of peatlands and of the Fenland. Both express his love for the subject and his interest in the people he encountered in his work. Again in his last book, *Cambridge and Clare*, published very shortly before his death, these same characteristics are foremost.

Research

Godwin's research covered many fields, starting in plant physiology and ecology, then moving entirely to ecology and finally to vegetational history, and what he pointedly called factual phytogeography. He identified outstanding problems of the time and approached them critically. M. E. D. Poore writes that 'he had the ability to foresee the topics of importance', and D. Walker that 'Godwin was a problem-identifier and problem-solver *par excellence*. He certainly planned his work around broad theoretical issues, but I think he was uneasy in straying very far from well-documented observations and firmly established experimental results'. Godwin's pragmatic approach is well illustrated in a story recalled by M. E. D. Poore of an incident during the I.P.E. Excursion to Ireland in 1949: R. Tüxen, a leader in continental phytosociology, 'was standing on a chair and explaining with enthusiasm to a somewhat sceptical audience in respect of his idea of phytosociology that "the proof of the pudding is that you eat him", an opinion which was heartily endorsed by Godwin.'

The influence of Godwin's teaching and publications extended far beyond the U.K. Thus after the war he supervised a number of research students who later greatly developed Quaternary research, notably vegetational history, overseas, as in New Zealand and Australia.

Plant physiology

Having graduated in 1922 Godwin had considerable difficulty in deciding whether to undertake research in ecology under A. G. Tansley or in plant physiology with F. F. Blackman. He saw that training with Blackman would give him experimental experience with a quantitative approach. So when interviewed by Blackman, as described in his book *Cambridge and Clare*: 'I had candidly informed him that my purpose in pursuing research under his direction was ultimately to apply the methods of plant physiology to ecology and I still admire the typical crispness of his remark that, whilst he appreciated my desire, he for his own part had found plant processes hard enough to explain when he had the subjects in the laboratory under controlled conditions, without undertaking the examination in the wild, where every factor in the environment might vary independently. I did not answer back.'

He then started research with Blackman on the topic of the mechanism of starvation in leaves, receiving one of the first Ph.Ds in the University in 1926. A lively account of the life of a physiology research student in the Botany School at the time is given in *Cambridge and Clare*. An important item of equipment was the 'Piccadilly Circus' of Pettenkoffer tubes, measuring the time course of respiratory changes. Godwin's research involved the relation between respiratory drift and leaf starvation and yellowing in cherry laurel. The work was partly published in 1927, with L. R. Bishop. A simultaneous study was made of respiration, cyanogenetic glucoside content and yellowing of cut cherry laurel leaves starving in the dark; the processes involved varied with the age of the leaf, and the observations were used to put forward a hypothesis of protoplasmic behaviour related to colloidal condition. In 1935 Godwin found opportunity to publish further results from his thesis when L. J. Audus published a paper on the response of respiring plant material to mechanical stimulation, a response he had found in his work with Blackman on cherry laurel leaves.

Godwin's training with Blackman in the critical analysis of experimental data is evident in all his later work in other areas of botany.

Even though he did not go on to develop what is now called experimental ecology, apart from the work on Wicken Fen and Calthorpe Broad, the training was invaluable for the analysis and interpretation of palaeo-ecological data, itself largely quantitative. The experience also gave Godwin an ideal background for teaching botany in elementary and advanced classes, as seen in the content of his successful elementary textbook *Plant biology* (4).

Anatomy and fine structure

Godwin, while an undergraduate in 1921, made an anatomical investigation of the stele of *Cyathea medullaris*, but this was only published in 1932 (7), prompted by the publication of a paper by H. Bancroft on a fossil Cyatheoid stem, the structure of which was made difficult to interpret by the lack of knowledge of the anatomy of living tree fern species. In this work Godwin followed the notions of Bower and Tansley on the evolution of filicinean steles and related the organization of the vascular bundles around the leaf gap to the origin of polycycly.

The 1960s was a time of rapid development of transmission electron microscopy, and the exciting possibilities of study of the fine structure and physiology of pollen grains by this method was soon taken up in Britain by J. Heslop-Harrision and Godwin. Godwin concentrated on the fine structure of the exine and its development. Soon after taking the Chair of Botany in Cambridge in 1960 he started electron-microscopic studies of pollen grain walls. The first work, with T. C. Chambers (47), on the fine structure of the wall of *Tilia platyphyllos*, related the structure as defined by transmission electron microscopy with that seen under the light microscope.

In 1964 the Department obtained its own EM6 and detailed studies were made by Godwin, P. Echlin and R. E. Angold of the pollen development of *Endymion*, *Ipomoea* and *Helleborus*. In particular Godwin and Echlin published three detailed papers on the development of the pollen grain of *Helleborus*, discussing the development of the tapetum and Ubisch bodies, the origin of the exine pattern within the callose special wall, and the development of the exine bulk from tapetal sources at a later stage. Godwin summarized the research on exine development in 1968, making a critical survey of the most useful lines of approach to the study of the exine. His own work was based on fine structural studies and did not extend to the physiological and biochemical studies exemplified by the rapid advances made by J. Heslop-Harrison and his colleagues in the same period. However, with the advent of scanning electron microscopy (s.e.m.), Godwin, again with T. C. Chambers, was able in 1971 to develop their interpretation of the exine structure of *Tilia*, and showed the valuable potential of s.e.m. to exine studies.

Plant ecology

Godwin's own contribution to ecology lies in two closely interwoven strands, that of his own research and that of his administrative and editorial contributions, particularly those to the British Ecological Society. In addition he had a significant interest in phytosociology. M. E. D. Poore writes

> Because neither nature conservation nor phytosociology were in the main stream of his work I saw, perhaps, a rather different side of Harry to many others. Phytosociology was, of course, very relevant to the interpretation of palynology and peat stratigraphy but his interest in it was much broader than that—as an integration of the findings of plant geography and experimental ecology. He was very much concerned, too, with the philosophical problems of classification and put me in contact with John Gilmour on this subject. From his reminiscences I am sure that this interest in phytosociology had its origins in the close contact with Tansley and the early International Phytogeography Excursions. It has taken a long time for the phytosociological message to come through, but the British Vegetation Survey is now proving the accuracy of his diagnosis.

Ecology research

Godwin's interest in plant ecology was aroused at school, aided by the purchase of Kerner & Oliver's *Natural history of plants*, and realized by a contribution to the school magazine on the contrasting floras of local limestone and marl soils. In 1923, shortly after graduating, he published an account of plant distribution in ponds of the River Trent valley, testing the Age and Area theory of J. C. Willis, who had given lectures on this subject to him at the Botany School. The results showed a relation between age and species content, with the comment that 'the paper will have attained its end ... if it renders any ecologist one whit less facile in his too frequent assumption that when a plant is not growing in a certain area it is mainly because it cannot', an early example of Godwin's critical approach to such matters.

At university Godwin's interest and knowledge of ecology was increased under the tutelage of S. M. Wadham and A. G. Tansley, in particular by excursions to Wicken Fen. Intermittent studies of the Fen vegetation had been going on for some years, but Godwin in 1923 started the first systematic and experimental studies, which led to a series of papers on anthropogenic effects on the development of plant communities (1,2), water level and its control of plant communities (5,6), the development of fen carr (17, 53), crop-taking experiments (25), as well as more general contributions on the fen vegetation. The basic interest was in the mechanism of vegetation succession and the factors controlling the development of the hydrosere. In this work the observation of plant distribution from time to time in recorded plots and the experimental approach (water-level recording, annual crop dry weight measurements) were combined. Godwin was critical of a certain F. E. Clement's definitions of successional stages (sub-climax) and his work at Wicken Fen led him to realize the importance of successions deflected by different frequencies of cutting. From these studies it became clear that Wicken Fen's interest was not so much as a relic of undisturbed fen vegetation, but as a relic of ancient methods of management of Fenland vegetation. His views are summarized in his and Tansley's account of the vegetation of Wicken Fen (3), in which there is an instructive introduction containing an account of 'modern conceptions and terms which have helped very materially to an understanding of the nature and history of all kinds of natural and semi-natural vegetation'.

Godwin's interest in succession extended in the 1930s to the study of hydroseres elsewhere. At Calthorpe Broad, Norfolk, he and J. S. Turner showed that soil acidification was a normal result of succession as ground level rose with the accumulation of organic sediment. They compared their evidence for this with Lake District and continental sequences leading to the development of raised bogs, described by Pearsall and Steffen respectively. In 1936 and 1937 Godwin led excursions to the raised bogs at Tregaron, Cardiganshire, excursions that did the first detailed work on the ecology of raised bogs in Britain. With V. M. Conway he published the results in 1939. The morphology of the raised bogs and their vegetation were described in detail. Quantitative studies were made of the distribution and content of the major vegetation units and water-level relations of these units described. H. Osvald's influence is seen in the discussion of the distribution of the regeneration complex and its component communities; Godwin and Conway observed that the regeneration cycle 'cannot be demonstrated clearly in more than a few spots, the degradation stages being particularly hard to find', a forecast of the problems of the regeneration cycle later investigated and clarified through stratigraphical studies by Godwin's pupil, D. Walker, and P. M. Walker. The occurrence of drier communities (*Scirpus*, *Molinia*) on parts of the bog surfaces led Godwin and Conway to postulate a previous period of climatic dryness, also indicated by discontinuities between the surface vegetation and the type of peat immediately below, often with *Sphagnum imbricatum*, now absent from the living flora. They thereby related the present vegetation to recent climatic history. The ecological work at Tregaron was directly associated with stratigraphical investigations of the mires. Following the Tregaron investigations, Godwin's interests turned further to peat stratigraphy and environmental history, but his ecological work and knowledge formed the foundation for these developments and indeed for his later consideration of the history of the British Flora.

From 1928 to 1956 Godwin supervised many research students in ecology ranging from his own immediate interests in Fenland ecology and flora (V. M. Conway, M. E. D. Poore) to tropical forest (P. W. Richards), salt marsh ecology (V. J. Chapman), autecology and taxonomy (C. E. M. Tidmarsh, R. H. Scott, S. M. Walters, C. D. Pigott, D. N. McVean, M. C. F. Proctor). The autecological work (*Carex*, *Cladium*, *Eleocharis*, *Thymus*, *Helianthemum*) greatly encouraged the field of experimental ecology and the beginnings of the Biological Flora of the British Isles.

The ecological interest

Godwin started his ecological research in the 1920s, mainly involved with the vegetation of Wicken Fen. In 1929 he gave a lecture to the Botany Club of the Department on 'Plant Succession'. He concluded:

> I hope by what I have said, and I hope by the examples I have shown you that I have made the principle of succession clear to you—if so I am sure that you will understand my enthusiasm for this aspect of ecology. The study of the *reaction* in succession is a guide which takes one always nearer and nearer to the biology and physiology of the constituent individual plants, in the end to interlock with physiological work done in the laboratory. Work undertaken with such an aim cannot be wrongly directed and must always be full of interest. I hope I have encouraged some of my hearers to try for themselves to understand some of these problems of ecological succession.

In 1974 Godwin added a gloss to the cover sheet of the lecture that illuminates a feeling about ecology at the time the lecture was given: 'This was given at a time when ecology was despised and I gave this to the Botany Club rather against general advice. To my surprise it was very well received and Charles Haynes, then doing physiology in the department, clearly thought there was a good deal to be said for these ideas'. Godwin later wrote that as a young research worker 'I was warned by my senior colleagues of the sloppiness and transience of ecology'.

In 1930 the International Botanical Congress was held in Cambridge and Godwin was joint secretary of the ecological section. He organized excursions to Wicken Fen and the Breckland and thereby met many of the leading ecologists of the day. In 1931 he furthered his international contacts by attending the VIth International Phytogeographical Excursion in Romania led by E. Pop. Also on the excursion were H. Brockmann-Jerosch, K. Domin, B. Pawlowski, I. Podpera, E. Rübel, C. Skottsberg, W. Szafer and P. W. Thomson. Several of these notables had firm research interests in vegetational history as well as phytogeography and the European experience, and the stimulation gained by Godwin on this occasion, must have been immense. Steffen's *Vegetationskunde von Ostpreussen*, with its valuable accounts of mire plant communities, was published in 1931 and obtained by Godwin in the same year; he immediately saw its value in placing the East Anglian mires in a European context and its influence is seen in Godwin's subsequent publications on mire ecology.

In 1931 Godwin became Honorary Secretary of the British Ecological Society, a task 'into which I was pitchforked by A. G. Tansley'. He held the post until 1947. The membership at the time was about 300, and the job included membership, subscriptions, meetings and field activities; he notes that he could not have done the work without his wife Margaret's constant assistance. In 1942–43 Godwin was elected President of the Society, and then later became editor of the *Journal of Ecology* from 1948–56, following W. H. Pearsall. As an Officer of the Society from 1931 to 1956, Godwin's outstanding service covered the expansion and increasing influence of the Society in the 1930s, 1940s and 1950s, the establishment of the *Journal of Animal Ecology* and the difficult period of World War II. As a final contribution to the Society much of the development of the Society was recorded with a keen historical sense in the first Tansley Lecture, given to the Society in 1976.

Quaternary research

Godwin was largely responsible for stimulating the development of Quaternary research in Britain, and it is necessary to consider first his general contribution against the general background of the subject and, secondly, his specific contributions to particular fields of Quaternary research.

Pollen analysis (or pollen statistics) and peat stratigraphy developed in Sweden in the early decades of the century under the direction of N. G. Lagerheim and L. von Post. They soon came to be seen as an essential accompaniment to the analysis of plant macrofossils in the study of vegetational and climatic history, and classic studies of these topics were soon published in Sweden, Denmark, Germany and Poland. In the 1920s G. Erdtman, a student of von Post, made field excursions to Britain and Ireland to examine and sample post-glacial deposits, and his pollen analytical results from 49 sites or areas were published in 1928. At this time others were stimulated to take up pollen analysis of British organic sediments (K. Blackburn, G. K. Fraser, T. W. Woodhead, C. B. Travis) and these included Godwin and his wife Margaret. Their start in the field was supported by Tansley and Seward; it is succinctly described in *Cambridge and Clare*. Godwin's interest in geology had started at school and he took the subject for the Cambridge entrance examination, an uncommon choice at the time. The combination of botany and geology that Quaternary research offered provided him with an intellectual challenge that met his enthusiasms and interests in an ideal way.

In 1932 the Fenland Research Committee was formed, chaired by A. C. Seward with J. G. D. Clark as secretary. Godwin played a very important part in this multidisciplinary development, providing evidence for vegetational history, sea-level changes and chronology. The results were the first multidisciplinary studies of their kind in Britain and paralleled developments in Ireland where the Committee for Quaternary Research in Ireland (1934) had started, with K. Jessen, their classic studies of Irish Late Quaternary deposits.

In the 1930s Godwin's research advances substantiated and fully justified the move to multidisciplinary research in the Quaternary. His enthusiasm for such research is reflected in his 1938 lecture on Fenland to the British Association in Cambridge. The lecture was well received by Seward, who afterwards presented Godwin with a copy of *Lord Orford's voyage round the Fens in 1774*, inscribed 'In grateful remembrance of an admirable "Discourse on the Fens" at the Cambridge Meeting of the British Association Aug. 1938, from his friend Albert C. Seward'. Of this lecture W. A. Tutin writes 'His 1938 lecture to the British Association in Cambridge was a landmark in British Quaternary research—that was the first time I saw him, and it was a tremendous experience. I still remember most of the lecture after 50 years, and it changed the direction of my working life (already committed to a Ph.D. on algae, including fossil ones in the Windermere sediments). By the end of that lecture I was determined to go on to pollen analysis post-doctorally.'

Godwin started the promotion of a University organization to support Quaternary research on these lines in 1938, with a detailed paper to the General Board of the Faculties on the advantages to several faculties of such an organization. The war delayed its consideration and when in 1943 postwar developments had started to be considered by the University, Godwin again took up the matter, with the result that in 1948 a Subdepartment of Quaternary Research was founded, based in the Botany Department, with Godwin as Director, but responsible to the Heads of the Departments of Geology and of Archaeology and Anthropology as well as to the Head of the Department of Botany. The success of the new Subdepartment is illustrated by the developments Godwin fostered within it and which are reflected in the accounts to follow (see also the reports of the Subdepartment, published in 1950 and later annually in the *University Reporter*). He supported a great extension of Quaternary research in his period as Director of the Subdepartment (1948–66), the work extending from post- and late-glacial vegetational history to that of earlier periods (full-glacial, interglacial), and to radiocarbon dating (E. H. Willis, V. R. Switsur), palaeotemperatures and marine geology (N. J. Shackleton), insect and mollusc studies (R. G. Pearson, P. E. P. Norton) and stratigraphy, both marine and continental. Godwin's role in the founding of the Subdepartment was recognized by the University by the naming of a new laboratory for Quaternary research, The Godwin Laboratory.

Godwin's major part in the development of Quaternary research and his wide knowledge of the subject can be summarized by reference to the series of influential and critical reviews he published from 1934 onwards. The reviews were critical assessments of the results, problems and future of parts of the subject and provided timely surveys for those developing their own interests in the rapidly expanding subject of Quaternary research. The reviews included the following: pollen analysis (13,14), pollen analysis and forest history in Britain (23), pollen analysis and Quaternary geology (24), prehistoric charcoal (with Tansley, 26), coastal peat beds and sea-level change (28, 29), bog stratigraphy, climatic change and archaeology (30), pollen analysis of glacier ice (33), the late-glacial (31, 34, 41), recurrence surfaces (42), history of the British flora (44, 54), pollen analysis in mineral soils (45), radiocarbon dating and Quaternary history (46), and radiocarbon dating and archaeology (51).

Vegetational history

Godwin's earliest contributions, 1933–35, were made jointly with his wife Margaret, and concerned lowland, mainly coastal, sequences of post-glacial (Flandrian) age. Pollen analysis was applied to Fenland sediments (including St German's Plantation Farm), 'moorlog' from the North Sea, and Lea Valley peat. Many of the sites were associated with archaeological finds. Many also had complex stratigraphies resulting from land/sea level changes. The results of the pollen analyses had, therefore, to be interpreted carefully and the Godwins discussed fully the effects of edaphic changes and vegetational succession, both related to sea-level change. As was the custom at the time a form of pollen frequency was given, in terms of pollen grains counted per traverse. The analyses covered the major tree pollen types, with Gramineae, Compositae, Ericales, fern spores and *Sphagnum*. Thus from the start the complex relations between pollen spectra and vegetation were analysed and related to stratigraphy.

These early pollen analytical results were related to the known sequences of continental northern Europe, the 'climatic' periods of Blytt and Sernander, the stages of the Baltic and the archaeological sequence, and it was shown that forest history closely paralleled that of neighbouring parts of the continent, with Boreal and Atlantic periods, the boundary marked by the rise in *Alnus* pollen, and possible Subboreal or Subatlantic peats with *Fagus* pollen.

Godwin's detailed knowledge of the continental literature on vegetational history was made available to others in his classic review of the problems and potentialities of pollen analysis (13, 14), which covered techniques, interpretation and applications, both general and more specifically to the British Isles. Geological, climatic and archaeological applications were discussed, and it was noted that while the early post-glacial forest periods (Boreal, Atlantic) presented little difficulty in comparison with Europe, the later post-glacial, with strong effects of man and the absence of *Picea* and *Abies*, was more problematical.

Work on the Fenland quickly developed, with studies of the peat stratigraphy accompanied by pollen analysis. An important development from 1933 was the study of macroscopic remains in peat done by M. H. Clifford while a research student of Godwin. At Wood Fen, near Ely, the Godwins and Clifford showed that the peat stratigraphy could be related to the forest sequence previously described by Skertchley, that fen development could be traced through a study of the macroscopic plant remains and non-tree pollen and spores, and that the fen development was controlled by vegetation succession, edaphic and topographic factors and climatic factors. Horizons rich in *Sphagnum* suggested the presence of 'Zwischenmoorwälder', with woodland associated with acidic peats, as described by Steffen on the north German coast. An important conclusion was that pollen spectra must be interpreted in terms of both the local fen vegetation and of the more regional pollen rain. Godwin's interest in the development of fen towards ombrogenous acidic plant communities started at Calthorpe Broad, continued at Wood Fen and again much later when he compared a buried forest at Terneuzen in The Netherlands with those of the Fenland, and again in 1975 when he discussed the origin of ombrogenous peats at Holme Fen.

The Fenland research was published in four classic papers in 1938 (21) and 1940 (22), on the Woodwalton area, the southern Fenland, Fenland pollen diagrams and relative land and sea-level changes. These papers established the broad stratigraphy, with a lower peat, the fen clay, an upper peat and later mere sediments. This stratigraphy was related to pollen diagrams based on tree pollen. The history of the forest trees was considered and pollen zones were set up for the Fenland, based on tree pollen: a birch–pine zone (IV); a pine zone (V); a pine–hazel zone (VI) subdivided into (*a*) hazel peak, (*b*) oak > elm, and (*c*) lime; an alder, oak, elm, lime forest zone (VII), subdivided into a sequence reflecting local changes, (*a*) open sedge fens, (*b*) fen woods, alder, birch, pine, (*c*) fen clay transgression, local effects low, and (*d*) fen woods, alder; a transition zone (VII–VIII) and an alder, oak, elm, birch (beech) forest zone (VIII).

These zones were correlated with Jessen's Danish zones and with the Blytt and Sernander sequence, Pre-Boreal to Subatlantic. There was still a problem with zonation of post-Boreal pollen assemblages, which derived from the complex local effects of the Fenland sequence, and a lack of knowledge of details of non-tree pollen stratigraphy, now known to be so important in post-Mesolithic time. This matter was put right in 1975 following the detailed study by Godwin and Vishnu Mittre of the Holme Fen region, when the rich archaeological sequence of the area was related to the vegetational history and consequences drawn from the non-tree pollen about deforestation and land use.

The synthesis by Godwin of the Fenland post-glacial was a landmark in Quaternary research in the British Isles. Forest history was brought into relation with climatic change, sea levels and archaeology within the area and to the continental successions of Jessen, Blytt and Sernander, and Granlund's recurrence horizons in Sweden.

Following the Wood Fen investigations Godwin's interest in peat stratigraphy extended to the raised bogs at Tregaron in west Wales where, with H. A. Hyde and G. F. Mitchell, he took parties of students and colleagues in 1936 and 1937. The state of knowledge of raised bogs at the time is reflected at the beginning of the publication of the work by Godwin & Mitchell in 1938 (20), where they found it necessary to give in parenthesis a layman's guide to raised bogs. The stratigraphy of the west and southeast bogs at Tregaron was fully investigated and demonstrated local successions through open water muds, *Phragmites* peats to ombrogenous *Sphagnum* peats forming the domes of the bogs. The identification of a regular change from highly humified to fresher *Sphagnum* peat enabled the Grenz horizon of continental northwest Europe and so the beginning of the Subatlantic to be identified. Four tree pollen diagrams were constructed, demonstrating vegetational history in the region from the Pre-Boreal. The Boreal–Atlantic transition was identified at an abrupt rise in *Alnus* and fall in *Pinus*. The zonation applied, however, was local, the lower zones relating to the tree pollen curves, the post-Boreal zones relating in addition to the peat stratigraphy. In Hyde's pollen diagram from the southeast bog a decline of *Ulmus* is seen (zone F1/F2), and Hyde (1940) later suggested this decline as a basis for the division of VII into *a* and *b*. This subdivision was confirmed in Godwin's review of pollen analysis and forest history in England and Wales, also published in 1940 (23).

In this review and synthesis Godwin assembled pollen diagrams from many sites in England and Wales, and successfully applied the Fenland zonation to these diagrams, except that he adopted the subdivision of VII into *a* and *b*, as mentioned above, rather than the original local Fenland zonation of *a* to *d*. Clock diagrams were presented to show the percentage pollen frequency of the trees in each zone. The earliest zone (IV) left room for the tripartite division of the Devensian late-glacial, already documented on the continent and found in Cornwall. The diagrams showed the parallel development of forests across the country, a contrast, as at present day, between a southeastern province with a greater development of thermophilous trees and a northwestern province with more birch and hazel. As well as this regional parallelism, in von Post's term, Godwin also considered that the rise of *Betula* in the late post-glacial was an example of von Post's principle of revertence. He also considered that presence of low frequencies of pollen of trees in zones before their rapid expansion indicated that expansion was under climatic control rather than a result of migration, a question still under much discussion today. Godwin also clearly demonstrated the native status of our forest trees, including *Fagus* and *Carpinus*. The synthesis related the forest history to archaeology, bog stratigraphy, sea level and changes in fauna and flora, and pointed out how the pollen zonation could most usefully be used in future in these areas, a prospect now widely realized. The same theme was reviewed in an address to the Geologists' Association in 1941 (24).

In 1936 and 1937, in parallel with the Fenland and Tregaron research, Godwin turned his attention to the Somerset Levels, having been invited to investigate the vegetational history of archaeological horizons discovered by St George Gray, A. Bulleid and H. S. L. Dewar. In 1941 he published (27) the first results of these investigations at Meare, Shapwick and Combwich, describing the peat stratigraphy, marine incursions and vegetational history of the area, with their archaeological relationships, including the association of the Neolithic with zone VII*b*. The pollen diagrams showed that brackish marine clay was overlain by freshwater *Phragmites* peat of zone VII*a*, itself succeeded by ombrogenous *Sphagnum* peat, divided, as at Tregaron, by a Grenz horizon, into a lower humified part (zone VII*b*) and an upper fresher part (zone VIII).

Work on the Somerset Levels continued, partly in collaboration with A. R. Clapham, and was stimulated by the archaeological richness of the area. In 1948 accounts of swamping surfaces, the prehistoric trackways, and of the correlation between climate, forest composition, prehistoric agriculture and peat stratigraphy were published. Close study of peat composition lead to detailed reconstruction of the plant communities associated with swamping levels, with aquatic *Sphagnum* peat, *Scheuchzeria* peat and 'regeneration-complex' peat being identified. Trackways were associated with these swamping surfaces. The interpretations of the vegetation succession and the archaeological relations were greatly aided by an improved level of identification of non-tree pollen, stimulated by Iversen's demonstration of the effects of 'landnam' on pollen diagrams in Denmark (Iversen 1941). In 1955 a further study of the Meare region was published (43), integrating Glastonbury and Meare Lake Villages into a scheme of environmental history for the Somerset Levels, again enhanced by a high level of non-tree pollen identification.

The publication of Iversen's work on 'landnam' in 1941 marked a turning point in the interpretation of pollen diagrams, now aided by much improved knowledge of pollen morphology. The 'landnam' effect—a decline in *Ulmus* and other high forest tree pollen frequency and a rise in non-tree pollen, especially *Plantago*—was associated with Neolithic agricultural practice. Godwin reviewed this major contribution by Iversen in 1944, and he noted in his *History of the British flora* (44) that 'No sooner had Iversen's work been published than its applicability to other parts of Europe was evident, and it clinched the interpretation already formulated for the pollen curves at Hockham Mere near Thetford in East Anglia', a Breckland pollen diagram obtained in 1940. Godwin showed that the elm decline at Hockham was followed by an increase in non-tree pollen, including *Calluna* and *Plantago*, suggesting that the Breckland heaths were derived from forest through the intervention of clearances associated with the Neolithic. In 1951 a full account by Godwin & Tallantire of the important Hockham site was published (37), with detailed stratigraphy, pollen diagrams and analyses of macroscopic plant remains. The pollen diagram, with its clear sequence from the Devensian late-glacial to recent times has remained a standard diagram to the present day.

The increase in knowledge of pollen morphology, which was aided by an expansion of contemporary hay fever research (Hyde), allowed much more detailed studies of the late-glacial period immediately preceding the post-glacial expansion of forest trees. Godwin in 1947 reviewed the considerable continental and Irish evidence of this period in Europe, with its threefold division into upper and lower periods of cold climate and a middle more temperate period, the Allerød period, noting the geological importance of the sequence in relation to ice advances, the character of the herbaceous vegetation represented by the pollen assemblages and the associated fauna, and Upper Palaeolithic archaeology. W. A. Pennington had recorded such a climatic fluctuation in the sediments of Windermere by 1941, and published her results in the *Philosophical Transactions* for 1947. A sequence showing a similar climatic fluctuation at Hawks' Tor, Bodmin Moor, was published in 1950 by A. P. Conolly, Godwin & E. M. Megaw (35), and in 1952 an account of late-glacial deposits in the Lea Valley at Nazeing was published by J. Allison, Godwin & S. H. Warren (38).

Both these substantial papers reflect the great advances made at this time in identification of non-tree pollen, supported by a great extension of the pollen reference collection in Cambridge by R. Andrew and colleagues, and of macroscopic plant remains likewise. Both papers contain detailed systematic sections describing pollen and macroscopic remains, with contributions by J. Allison, R. Andrew, A. P. Conolly and E. M. Megaw. The result was that Godwin was able to make detailed reconstructions of the late-glacial flora in Britain, indicating 'tundra' or 'park-tundra' conditions, and proving the presence in Britain of species belonging to a number of Matthews's phytogeographical groups, including the arctic–alpine, continental northern and oceanic west European groups. He showed that there was a rich aquatic and marsh flora, that there were many shade-intolerant species, and that many species had a present-day status as weeds or ruderals.

These results had very important consequences for the study of the origin of the British flora and largely reconciled arguments concerning perglacial survival and the extent of re-immigration after cold (glacial) stages, already discussed by Godwin and others in the 1935 Royal Society discussion on the origin and relationship of the British flora (15). In 1949 and 1953 Godwin discussed these consequences, extending the evidence to take in floras of full-glacial age from earlier parts of the last cold stage (34, 39). He demonstrated the variety of phytogeographical elements and the variety of ecological groups represented in the floras of the full- and late-glacial periods, and showed the character of perglacial survivors in the southern half of Britain and how their present ranges were a consequence of competition as afforestation and later deforestation took place in the post-glacial. His discussions concluded that the evidence provided a factual basis for phytogeographic theory, an expression of a phrase he later used as the subtitle for his classic book (44) on the history of the British flora.

As the work on full- and late-glacial floras extended, Godwin also started research on interglacial sites at Cambridge (36) and Clacton (40), in cooperation with J. Allison, S. E. Hollingworth, K. Pike and D. Walker. The results showed that pollen zones with *Carpinus* and *Abies* could be compared with zones of the last and penultimate interglacials on the continent, pointing to the potential for investigating vegetational history in Britain before the last cold stage, and for correlations within Britain and with the continent. This opened the door on a field of immense richness, namely the use of pollen analysis in determining the basic sequence of geological and climatic changes in the Quaternary and the implications of these for biology, a field exploited by Godwin's pupil and colleague, R. G. West.

Godwin's book on the history of the British flora (44) brought together all his experience and results in an extremely readable form. During the preparation of the book he remarked to D. Walker 'You know, old man, I *never* thought I could become interested in plant geography'! He discussed the collection and identification of Quaternary plant remains, the background scale of Quaternary changes, provided a record of sites and a record of plant identifications taxon by taxon, with the history, distribution and ecological significance detailed. This evidence was synthesized into a history of the flora and vegetation, starting in the Tertiary, continuing with interglacials, but mainly concerned with full-glacial, late-glacial and post-glacial (Flandrian) vegetational history. For the first time the many aspects of the subject were brought before a wider public, and its significance made available for taxonomists, plant geographers, phytosociologists, geologists, geographers and archaeologists, indeed for all those for whom the history of biota and environment was important. A second edition of the book was published in 1975 (54), so enabling Godwin to incorporate the very many advances in Quaternary research made in the intervening decades.

Following Godwin's appointment to the Chair of Botany in Cambridge in 1960 he naturally found less time for vegetational history, but was able to complete work on further late-glacial and full glacial sites and on sites that gave information on land-use history in post-Mesolithic times, in particular at Wingham and Frogholt, Kent (48), and at Old Buckenham Mere, Norfolk (50), interpreting non-tree pollen spectra in terms of pastoral and arable agriculture, and noting periods of introduction of crop plants. At Wingham he suggested that a late increase of beech pollen reflected post-Iron Age withdrawal for the tops of the Downs and re-invasion by beech. The presence of *Cannabis*-type pollen at Old Buckenham Mere stimulated an account of the ancient cultivation of hemp.

After retirement Godwin again brought before the public the interest of two areas that had formed much of his earlier research and experience, in the form of books on the Fenland and on the archives of the peat bogs. The relevance of Quaternary research to the understanding of present and past environments was made clear and the books had very considerable success.

In summary, it can be seen in retrospect that Godwin's research in the period 1930–60 laid the foundations for the many branches of Quaternary research associated with palaeoecology, including vegetational history, peat stratigraphy, sea-level changes and archaeology. His critical approach to the field evidence ensured that these foundations were of the firmest and were able to support the later rapid development of the subject.

Radiocarbon dating

W. F. Libby's research on radiocarbon in the atmosphere and biosphere in the 1940s led him to develop methods of radiocarbon dating and the application of these methods to problems of chronology. Godwin quickly realized the importance of the method, and its superiority to methods of dating previously in use: varve chronology, pollen analysis, archaeology. By 1950 he had submitted 9 British samples to Libby's Chicago laboratory, covering a sequence of ages: last temperate stage, last cold stage, Devensian late-glacial, and early, middle and late Flandrian. The resulting dates were published with a commentary by Godwin, which discussed their relation to the varve and archaeological chronologies and the source of possible errors. In 1952, with the advice of A. G. Maddock, a grant was obtained from the Nuffield Foundation for setting up a radiocarbon laboratory. Late in that year E. H. Willis was appointed to build the laboratory, and by 1955 successful application of the method was made to samples accumulated for this purpose in the previous years. The samples dated were intended to solve chronological problems in Godwin's main areas of interest: the synchroneity or otherwise of post-glacial pollen zone boundaries in the British Isles and the relation of these boundaries to those of northwest Europe, dating of sea-level changes around British coasts, and bog stratigraphy and its related archaeology in the Fenland and Somerset.

In the period 1955–60 Godwin and Willis, with other colleagues, published a series of papers that demonstrated the rewards of these developments. The samples were very carefully selected for the particular research projects. Thus the general synchroneity of major pollen zone boundaries on either side of the North Sea was established, a curve for eustatic rise of ocean sea level was put forward, the use of the method for dating archaeological features such as trackways in the Somerset Levels and elsewhere was demonstrated. The seven date lists published by Godwin with Willis and the one list published with V. R. Switsur in the period 1959–66 summarize the results.

The application of the method in this systematic way wrought huge developments in Quaternary research. Godwin summarized these developments in his 1960 Croonian Lecture on 'Radiocarbon dating and Quaternary history in Britain'. He discussed the method and its applications to the 'New Drift' glaciation and its interstadials, post-glacial vegetational history, raised bogs and recurrence surfaces, and sea-level change. The result was a framework for chronology that revolutionized our conception of environmental history in the last 30000 years or so.

Godwin took a strong interest in the international development of radiocarbon dating, reporting periodically on new developments and international meetings, and organizing with E. H. Willis and R. Burleigh the fifth such international meeting in Cambridge in 1962. He also saw the use of radiocarbon dating in other botanical areas, publishing critical accounts on determination of the age of viable ancient seeds, and on the deposition of annual wood rings in *Populus*.

As with other subjects within Quaternary research, Godwin published valuable commentaries on the use and applications of radiocarbon dating. These included a survey with E. H. Willis on the late-glacial, his Croonian Lecture, a discussion of the value of plant materials for radiocarbon dating and, lastly, in 1970, an assessment of the contribution of radiocarbon dating to archaeology in Britain. These illuminated in a critical way the application of radiocarbon dating to Quaternary research in the same way that his early paper on pollen analysis defined the problems and potentialities of that method.

Sea levels

Studies of changes of relative land/sea levels in the Flandrian were started by Godwin at the beginning of his and Margaret's pollen analytical research in the Fenland in 1932. The site at St Germans, south of King's Lynn, showed an alternation of peat and inorganic transgression sediments, so giving immediate evidence of sea level changes. The evidence for such changes was greatly increased by Godwin's subsequent research on Fenland stratigraphy and pollen zonation, and were aided by W. A. Macfadyen's cooperation in the analyses of Foraminifera. The

Fenland results were presented in 1940 in the form of a curve showing changes of relative land/sea level over the period of his pollen zones IV–VIII. The curve was based on a series of index points where pollen analysis allowed the dating of stratigraphy that indicated sea-level change. The curve shows the rapid early Flandrian rise of sea level, with two periods of marine incursion into the Fenland, the Fen clay (Fenland zones VII*c/d*) and upper or Romano-British silt (Fenland zone VII–VIII/VIII transition).

The manufacture of the curve was only possible as a result of Godwin's very careful consideration of the evidence for sea-level change from sediments and from palaeobotanical evidence. The sedimentary evidence took the form of variation of inorganic content, and the palaeobotany was based on identification of the plant communities associated with succession from freshwater to fen to brackish or tidal conditions, or vice versa.

Godwin amassed considerable evidence for Flandrian sea-level changes in the 1930s and 1940s. Coastal sediment sequences were obtained from Swansea (1931), Cardigan Bay (1932/3), Southampton (1932), the Essex coast (1933), Portsmouth (1943) and the Somerset Levels (1936 onwards), as well as from the Fenland. He presented an interpretation of the data in 1943 in his Presidential Address to the British Ecological Society (28), which critically discusses the evidence (from 29 sites) for sea-level changes, the problems involved and the interpretation of the results. The conclusions concern the nature of vegetation succession in coastal regions, the demonstration that there is no one single period of submerged forest formation, that the greatest period of sea-level rise took place at about the time of the earliest expansion of warmth-demanding trees in the post-glacial forests, the dating of the '25-ft raised beach' in northern Ireland, the north–south and east–west tilting of the British Isles and the possibility of a Romano-British eustatic rise. It was an extraordinary achievement to be able to treat these diverse subjects and bring them together in a successful synthesis.

Two years later, in 1945, Godwin extended the study to take in the continental shores of the North Sea, discussing stratigraphy and pollen diagrams from Holland, the German North Sea coast, Schleswig-Holstein, Denmark, south Sweden, France and Belgium. He showed that the conclusions he drew from the synthesis he made of the British Isles evidence were generally supported by the continental evidence. In addition he was able to demonstrate an isostatic depression since the Boreal–Atlantic transition around the shores of the southern North Sea, but a rise in Sweden. Again this was a remarkable achievement of synthesis.

With the advent of radiocarbon dating in the 1950s Godwin was able to develop a far more secure chronology of sea-level changes, previously based on forest history and archaeological relationships. It is a tribute to his research that such dating generally confirmed his earlier conclusions. Aided by radiocarbon dates from British coasts he was able in 1958 to put forward, with R. P. Suggate and E. H. Willis, one of the earliest curves for the eustatic rise of the ocean in the last 14000 years.

Godwin's contribution to sea-level studies in Europe and elsewhere set a very critical and thorough standard for his successors, and indeed laid a firm foundation for this difficult but important area of Quaternary research, an area that has expanded greatly since his pioneer work.

Archaeology

Harry Godwin, with Margaret, became involved in archaeology at the very beginning of their pollen analytical investigations. In 1932 they attended excavations and made boreholes at Plantation Farm, Shippea Hill, a Fenland site being excavated by the newly formed Fenland Research Committee under the direction of J. G. D. Clark. This was the beginning of a most fruitful cooperation between Godwin and Clark, one that continued for the next 30 years. Professor A. C. Seward, at the time Professor of Botany in the University of Cambridge, was Chairman of the Fenland Research Committee, composed of a band of devoted professionals and amateurs, archaeologists, biologists and geologists, which met regularly and supported a long series of investigations and excavations in the Fenland until disbanded at the outbreak of war in 1939.

Godwin clearly foresaw the great potentiality of pollen analysis applied to the chronology and environment of archaeological sites, a potentiality equally appreciated by J. G. D. Clark. The coincidence of interest forced the development of interdisciplinary investigations. In 1933 H. Godwin & M. E. Godwin published their first joint results on pollen analysis in relation to archaeology, on Plantation Farm (8) and a Bronze Age skeleton at Southery (8), and a paper on British Maglemose harpoon sites (9), which discussed the relation, in terms of vegetational history, of harpoon finds of Boreal age in Britain, the Lemon and Ower Banks, Denmark and Estonia. Godwin's knowledge of the extensive continental literature concerning these matters gave him a great advantage in developing the work. This was followed by investigations in 1933 of coastal peats of Essex (18), in 1934 of a Mesolithic site at Broxbourne, Herts (11), and a Bronze Age find at Methwold Fen, Norfolk (10), and in 1935 of the Fenland site at Peacock's Farm, Shippea Hill (16).

The excavations at Plantation Farm and Peacock's Farm, Shippea Hill, were a landmark in the development of interdisciplinary studies of archaeological sites. Mesolithic, Neolithic and Early Bronze Age levels were clearly related by Godwin to peat stratigraphy, vegetational history and sea-level change, all summarized in a tabular form that became a hallmark of his approach to Quaternary research.

Subsequently Godwin related further archaeological finds in the Fenland to peat stratigraphy and vegetational history, studies much enhanced by his contemporaneous investigations of the Flandrian history of the Fenland. As a result he was able to integrate the archaeological history of the Fenland with vegetational history and sea-level change in a convincing and detailed manner. This correlation was extended further in England and Wales to the pollen zonation set up by Godwin in 1940, covering Mesolithic to Romano-British times.

In 1936 and 1937 Godwin started his research on the Somerset Levels, an opportunity taken when the local archaeologists, St George Gray, A. Bulleid and H. S. L. Dewar, obtained pollen samples from archaeological sites at Meare and Combwich, Somerset. Godwin then embarked on a massive study of the peat stratigraphy and vegetational history of the lowland area between the Polden Hills and the Mendip Hills, starting at Shapwick Heath and Station, Meare Heath and lake village and Combwich. The stratigraphy of the raised bogs and underlying fen peats and muds, and their relation to archaeological finds, was worked out, and by 1941 a first attempt at correlation of vegetational history, sea-level change and Neolithic, Iron Age and Romano-British archaeology was published. The work continued in the 1940s, partly with A. R. Clapham, with descriptions of prehistoric trackways at Meare Heath, Shapwick Heath and Westhay; the relation of the trackways to flooding horizons was clearly demonstrated. Godwin also developed an interpretation of pollen diagrams (Decoy Pool Wood), which allowed him to define periods of agricultural activity of the Bronze Age and later. In the course of this research Godwin, in 1946, reviewed the relation between bog stratigraphy and archaeology, so setting the scene for the Somerset Levels and for wider studies in Britain.

Godwin's work on the Somerset Levels continued into the 1960s, with further description and analyses associated with the trackways and further pollen-analytical dating of artefacts, including Neolithic bows and boats. The resulting synthesis of his findings showed the strong and significant archaeological component of the research. Godwin's contribution on the Somerset Levels provided the stimulation and foundation for the later archaeologically based Somerset Levels Project organized by J. Coles.

Godwin's research on the relations between archaeology and vegetational history continued with the important Mesolithic site at Seamer, Yorkshire, in cooperation with J. G. D. Clark and J. Moore. With D. Walker Godwin did extensive work on peat stratigraphy, pollen analysis and seed analysis in the period 1948–51, demonstrating clearly the relation of the occupational levels to Lake Pickering levels and to the surrounding birch–pine woodland (zone IV–V transition).

For the rest of his career Godwin's interests in archaeological sites and finds in the Fenland, Somerset Levels and elsewhere continued, especially with the advent and application of radiocarbon dating. Thus in 1960 he returned, with J. G. D. Clark, to Peacock's Farm to apply this method of dating to the sequence he had already established. He also, with S. H. Warren, K. P. Oakley and K. Pike, investigated an interglacial pollen sequence at Clacton, Essex, associated with the type site of the Clactonian Palaeolithic industry, and demonstrated a possible age, one of the earliest demonstrations of the application of pollen analysis to Palaeolithic archaeology. In 1970 he published a detailed account of the application of radiocarbon dating to archaeology in Britain, summarizing developments over the previous decades.

Godwin's main achievement in the area of archaeology can now be seen to be the establishment in Britain of the importance of radiocarbon dating and also of what is now called environmental archaeology. He laid the foundations of this type of research in Britain and demonstrated its application to the Fenland and the Somerset Levels. The huge expansion of environmental archaeology since 1970 was the consequence of his success.

Conservation

Godwin was a leader in the movement to set up a national conservation organization in the 1940s. He was President of the British Ecological Society when it set up a Committee on Nature Conservation and Nature Reserves. Dr Derek Ratcliffe, Chief Scientist of the Nature Conservancy Council, records Godwin's part in subsequent developments:

> The war-time deliberations (of the Committee) helped to develop the rationale which was later expressed in the seminal report *Conservation of Nature in England and Wales* (Cmd 7122, 1947) by the Wild Life Conservation Special Committee. Although Godwin was not actually a member of this Committee, he gave evidence to it and, through his friendship with Arthur Tansley (who took over the Chairmanship when Julian Huxley went to UNESCO), must have had considerable influence on the thinking behind the report. When, as a result of the Huxley Report, the Nature Conservancy was set up by Royal Charter in 1949, Harry Godwin was a founder member and remained on the Conservancy until 1954. He served variously on the England and Wales Committee, and the Staff Selection and Research Studentships/Grants Committees; and was on the Scientific Policy Committee from 1949–1964. When the Conservancy became a Committee of NERC in 1965 Harry again became a member and remained until the dissolution in 1972. He continued on the Scientific Policy Committee between 1965 and 1972, and was also Chairman of the Post-graduate awards Sub-Committee of the Nature Conservancy during this period. Harry thus had a continuous connection with the old Nature Conservancy in various formal roles from 1949 to 1972, and during this long period we had the benefit of his wisdom and knowledge on many matters, but especially in the field on scientific policy for nature conservation. This influenced not only the development of research programmes but also the

> whole thrust of conservation strategy. His guiding hand was also behind many appointments to the growing staff, and the supporting of a wide spectrum of biological, ecological and earth science research in the Universities, through the grant aid and research studentships function. Those of us in the Conservancy who had the good fortune to know Harry are now few. Yet we shall always appreciate the magnitude of his contribution to the development of nature conservation in Britain, and the profundity of the knowledge on which it was based.

Dr Duncan Poore, himself a Nature Conservancy research student (as was Dr Ratcliffe), later Director of the Conservancy, writes that Godwin's 'commitment to the movement was very deep and came from a conviction that the findings of ecology, if interpreted with wisdom and humanity, had a fundamental contribution to make to good land use. He was, I believe, one of the leading lights behind the setting up from the beginning of the Nature Conservancy research studentships which did so much to ensure that there was a corpus of competent ecologists available to the organisation in the future'. The Nature Conservancy research studentships were awarded to students from a wide variety of disciplines, including Quaternary research, a realization that conservation depended on a knowledge of present and past life and environments. The dependence was underlined during Godwin's work associated with the conservation of the unique Teesdale flora in the 1960s.

A quotation from Mark Twain ended one of Godwin's early lectures on Nature Conservation and illuminates his feelings on these matters: 'The country is the real thing, the eternal thing, it is the thing to watch over, and care for and be loyal to; institutions are extraneous to it, they are its mere clothing, and clothing can wear out, become ragged, cease to be comfortable, cease to protect the body from winter, disease and death'.

Godwin's outstanding contribution to conservation was honoured in 1978 by the renaming of the Nature Conservancy Council's second Headquarters office in Huntingdon as Godwin House.

National and international contributions

From the 1930s onwards, in addition to his research and teaching, Godwin undertook a wide range of other commitments. Within the University, apart from the normal committee work associated with university life, he was active in movements for examination reform as a member of the Local Examination Syndicate. Besides being Secretary of the British Ecological Society, and late Editor of the *Journal of Ecology*, in 1931 he became Joint Editor of the journal founded by A. G. Tansley, *The New Phytologist*, with A. R. Clapham and W. O. James; he remained an Editor of this journal until 1961.

During World War II Godwin assisted in the founding of the Biology War Committee and acted on its executive throughout the period. At the same time F. H. C. Butler started his discussions on the founding and organization of field study centres, which led to the founding of the Field Studies Council in 1943. Godwin was very much involved in the early meetings, and became chairman of the managing committee of one of the earliest field centres, the centre at Flatford Mill. The activity was directly in line with Godwin's enthusiasm for field observation and for teaching, but also in this case satisfied his interest in visual art, for the first director of Flatford was E. A. R. Ennion, the artist–naturalist.

After the war Godwin took steps to regain scientific collaboration with continental colleagues. He organized meetings in Cambridge in 1946, and in 1949, on the occasion of the meeting of the International Phytogeographic excursion in Ireland, a further meeting on vegetational history was held in Dublin. In 1952 an excursion to demonstrate Dutch Quaternary work was made, with a reciprocal visit to East Anglia in 1954. Later he became active in the meetings of the International Union for Quaternary Research, being appointed Vice-President in 1965–69, and delivering the opening address to their Tenth Congress held in Birmingham in 1977. This address stressed the importance of ecological understanding for those interested in the history of the environment, a premise of all Godwin's own work.

In 1964 the Tenth International Botanical Congress was held in Edinburgh; Godwin was President of the Congress. His address was concerned with the responsibilities of botany and botanists to the community, a theme developed 'because there is far too little realization by people in everyday life, by governments, by the main mass of scientists and even by botanists themselves, of how extremely important to the life of mankind the study of botany is. It is not understood in general what is meant by botany, nor how botanical science shares, and in some directions *leads*, advances in scientific thought, nor that it now is the basis of plant technologies of the greatest economic importance to the World'—a statement still valid 20 years later.

Godwin's feeling for the international character of science and scientists is well demonstrated by his obituary tributes to four of his continental colleagues of long standing: J. Iversen (1904–71), H. Osvald (1892–1970), K. Jessen (1884–1971) and W. Szafer (1886–1970); 'All four men were scientifically very able, original, durable and productive: they all made highly important advances in the areas most easily described as "palaeoecology", ecology and factual phytogeography. The personal bonds of their friendship extended freely to botanists in many countries, supplementing the powerful influence of their published work. Quaternary studies in the British Isles most particularly owe them an overwhelming debt' (52).

Family and personality

Harry Godwin married Margaret Elizabeth Daniels in September 1927 at Long Eaton Parish Church. Margaret was a daughter of James and Edith Daniels of Long Eaton and they had known each other since their schooldays at Long Eaton. Margaret took a London B.Sc. degree in Botany with subsidiary Geology at Nottingham University College and later taught biology, and from the start she played a most important role in the development of Godwin's scientific work.

In 1929 A. C. Seward and A. G. Tansley had suggested that Margaret Godwin take up the promising field of pollen analysis, and from that time to the middle 1930s she was engaged actively in field work and pollen analysis, which resulted in the pioneer papers by H. and M. E. Godwin. Margaret also gave great help with British Ecological Society affairs in the 1930s. But apart from the scientific side of their life, Margaret's role in the Godwin's family is well described by D. Walker 'it is almost impossible, even in retrospect...to convey the deep and all-pervading influence of his wife Margaret whose clear-minded calm meant so much to him in all aspects of their lives'. The Godwins had one son, David, born in 1934, who went up to Clare College and became a general practitioner in East Grinstead; he married Joan Simpson and they adopted a daughter, Fiona, whose company was greatly enjoyed by her grandparents. David's early death in 1974 was a great sorrow.

Godwin had a most warm humanity coupled with great enthusiasm and strength of personality. John Turner writes: 'In looks he, we all felt, was a replica of Harry Godwine the Saxon Earl "the leading Englishmen of his day" (d. 1053). Yet for me he must have had some Celtic blood in him—his sensibility in the field of painting and craft was remarkable.' Godwin's conversation was vigorous, he never pulled his punches in his comments and he was always willing and able to give advice and help to his colleagues and students. In the words of John Turner 'he matured early and retained the enthusiasm of youth to the end'. To his research students he gave sure guidance, creating an atmosphere of exciting scientific activity, of exacting scientific standards, and of loyalty, to stand them in good stead for the rest of their careers. Anne Tutin writes

> I first met Harry in 1941... by then I had looked at macroscopics in the Windermere late-glacial in my spare time from diatoms, and as soon as I mentioned *Betula* catkin scales, Harry leapt to his feet in excitement, asking about the species, and I heard the word Allerød for the first time. His kindness and enthusiasm were quite wonderful—a lesser man might well have been put out to see an unknown girl presented with such a promising section, the first incontrovertible evidence for late-glacial climatic oscillation from Great Britain, but Harry was all generosity and helpfulness, led me into the Scandinavian literature, and allowed me to work in the Botany School from 1942–1944.

Godwin's field excursions were always popular, and well-known for the speed with which, from time to time, he moved enthusiastically through the densest or wettest of vegetation, resulting in a single file of students, with those at the forefront writing his comments down and passing back the information by word of mouth to the rearguard. What the last undergraduate wrote is not known. As an undergraduate supervisor Godwin was also outstanding. E. G. B. Gooding writes (and the comments also apply to his research student supervision as well)

> There was no exhibition of his own brilliance, but an extraordinary ability to understand the way in which the minds of junior undergraduates worked, and to avoid undermining what little self-confidence they may have had. The weekly essays he required soon became a pleasure rather than a dreary necessity. His criticism, though penetrating and severe, was also kind and helpful. I recall, early on, when I had been anxious to show off some little piece of information, I had it dressed up in what I imagined to be scientific language, he gently told me 'please remember you are writing for the biggest nit in Cambridge—me; keep it simple so that I can easily understand what you are trying to tell me.' This was one of the best pieces of advice I have ever received.

His teaching activity was complemented by the hospitality he and Margaret gave at home to students.

Godwin's remarks were long remembered by his students: 'Let the data speak for themselves'; 'I have only to show the dog the rabbit'; 'if you want anything done always ask a busy man'; so were his recitations, from memory and with appropriate gestures, of the Hans Breitman ballads, which enlivened many an occasion; so was his vigorous facility for recalling with evident enjoyment incidents of his long career in college, university and committee life.

Godwin's strong friendship with Tansley, which had such an effect on his career, reflects feelings and attitudes common to the two men, not only in ecology and conservation but also in psychology and philosophy of science, all portrayed in Godwin's lecture on Tansley to the British Ecological Society in 1976. John Turner writes

> His lecture on Tansley is both superb and self-revealing. Possibly it was from Tansley that Harry (trained as a physiologist) developed his supreme confidence in the scientific and social values of ecology, something that not all ecologists possess. This, plus his great gift for making friends with his scientific peers at home and in Europe, led him into his leading role in his own field, which spread from ecology into many disciplines. But to me his success never spoilt him—he was modest, never conceited, though occasionally he could be an acerbic critic.

Thus Godwin was ready to challenge strongly and immediately published interpretations he thought wrong, backing his cases with detailed evidence; so, for example, he offered re-interpretations of

Pennine peats (12), roddons (19), prehistoric charcoals (26), soil pollen analysis (45) and strip lynchets (49). The very nature of Quaternary research, with the concomitant dangers of its width of disciplines, demands a rigorous approach, and such a critical attitude by Godwin fitted more than ever the need at this time of great expansion of the subject.

Indeed Godwin's abilities to recognize the major problems of the time, to recognize the need for interdisciplinary studies, to have the breadth of vision and interest to see and understand the development of the whole field, and to have the great strength and personality to pursue field research and teaching successfully, led directly to the leading reputation of British Quaternary research today. His achievements were recognized in 1970 by his appointment as a Knight Bachelor.

Services and honours

Royal Society. Member of Council, 1957–59; Croonian Lecture, 1960.

Awards. Prestwich Medal, Geological Society of London, 1951; Gold Medal, Linnean Society of London, 1966; Medal of the University of Helsinki, 1966; Gunnar Erdtman Medal, Palynological Society of India, National Botanical Research Institute, Lucknow; Albrecht Penck Medal, Deutsches Quartär Vereinigung.

Honorary Membership of Academies, Societies and international bodies. Royal Irish Academy, 1955; Botanical Society of Edinburgh, 1961; Royal Scientific Society of Uppsala; Deutsche Akademie der Naturforscher Leopoldina, 1962; Royal Danish Academy of Science and Letters, 1962; Botanical Society of America, 1966; Societas pro Fauna et Flora Fennica, 1966; Royal Society of New Zealand, 1967; International Union for Quaternary Research, 1969; American Academy of Arts and Sciences, 1976.

Civil honour. Knight Bachelor, 1970.

University degrees. Sc.D. (Cantab.) 1942; Hon. Sc.D. Trinity College, Dublin, 1960; Hon D.Sc. University of Lancaster, 1968; Hon. D.Sc. University of Durham, 1974.

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The photograph reproduced was taken by F. T. N. Elborn in about 1960.

References to other authors

Iversen J. 1941 Land occupation in Denmark's Stone Age. Danmarks Geologiske Undersøgelse **2**, (66).

Pennington, W. A. 1947 Studies of the post-glacial history of British Vegetation. VII. Lake sediments: pollen diagrams from the bottom deposits of the North basin of Windermere. *Phil. Trans. R. Soc. Lond.* B **233**, 137.

Papers by Godwin referred to in the text*

(1) 1929 The sub-climax and detected succession. *J. Ecol.* **17**, 144–147.
(2) The 'sedge' and 'litter' of Wicken Fen. *J. Ecol.* **17**, 148–160.
(3) (With A. G. Tansley) The vegetation of Wicken Fen. In *The natural history of Wicken Fen*, part V, pp. 385–446. Cambridge: Bowes and Bowes.
(4) 1930 *Plant biology* (2nd edn 1933, 3rd edn 1939, 4th end 1945). Cambridge University Press.
(5) 1931 Studies in the ecology of Wicken Fen. I. The ground water level of the fen. *J. Ecol.* **19**, 449–473.
(6) 1932 (With F. R. Bharucha) Studies in the ecology of Wicken Fen. II. The fen water table and its control of plant communities. *J. Ecol.* **20**, 157–191.
(7) Anatomy of the stele of *Cyathea medullaris* Sw. *New Phytol* **31**, 254–264.
(8) 1933 (With M. E. Godwin) Pollen analysis of peats from Plantation Farm. In 'Report on an early Bronze Age site in the south-eastern Fens' by Grahame Clark. *Antiquaries Jl.* **13**, 281–296.
(9) (With M. E. Godwin). British Maglemose harpoon sites. *Antiquity* **7**, 36–48.
(10) 1934 (With M. E. Godwin, J. G. D. Clark & M. H. Clifford) A Bronze Age spear-head found in Methwold Fen, Norfolk. *Proc. Prehist. Soc., E. Anglia* **7**, 395–398.
(11) (With S. H. Warren, J. G. D. Clark, M. E. Godwin & W. A. Macfadyen) An early Mesolithic site at Broxbourne sealed under Boreal peat. *Jl R. anthrop. Inst.* **64**, 101–128.
(12) The age of the Pennine peats. *Man* (1934), 1–2.
(13) Pollen analysis. An outline of the problems and potentialities of the method. I. Technique and interpretation. *New Phytol.* **33**, 278–305.
(14) Pollen analysis. An outline of the problems and potentialities of the method. II. General applications of pollen analysis. *New Phytol.* **33**, 325–358.
(15) 1935 Post-glacial floras—vegetation phases reconstructed from pollen-analysis of peat. Discussion on the origin and relationship of the British Flora. *Proc. R. Soc. Lond.* B. **118**, 210–215.
(16) (With J. G. D. Clark, M. E. Godwin & M. H. Clifford) Report on recent excavations at Peacock's Farm, Shippea Hill, Cambridgeshire. *Antiquaries Jl* **15**, 284–319.
(17) 1936 Studies in the ecology of Wicken Fen. III. The establishment and development of fen scrub (carr). *J. Ecol.* **24**, 82–116.
(18) (With S. H. Warren, S. Piggott, J. G. D. Clark, M. C. Burkitt & M. E. Godwin) Archaeology of the submerged land-surface of the Essex Coast. *Proc. Prehist. Soc.* **2**, 178–210.
(19) 1938 The origin of roddons. *Geogrl J.* **91**, 241–250.
(20) (With G. F. Mitchell) Stratigraphy and development of two raised bogs near Tregaron, Cardiganshire. *New Phytol.* **37**, 425–454.

* The complete bibliography appears on the accompanying microfiche no. 1.

(21) 1938 (With M. H. Clifford) Studies of the post-glacial history of British vegetation. I. Origin and stratigraphy of Fenland deposits near Woodwalton, Hunts. II. Origin and stratigraphy of deposits in southern Fenland. *Phil. Trans. R. Soc. Lond.* B. **229**, 323–406.
(22) 1940 Studies of the post-glacial history of British vegetation. III. Fenland pollen diagrams. IV. Post-glacial changes of relative land- and sea-level in the English Fenland. *Phil. Trans. R. Soc. Lond.* B **230**, 239–303.
(23) Pollen analysis and forest history of England and Wales. *New Phytol.* **39**, 370–400.
(24) 1941 Pollen analysis and Quaternary geology. *Proc. Geol. Ass.* **52**, 328–361.
(25) Studies in the ecology of Wicken Fen. IV. Crop-taking experiments. *J. Ecol.* **29**, 83–106.
(26) (With A. G. Tansley) Prehistoric charcoals as evidence of former vegetation, soil and climate. *J. Ecol.* **29**, 117–126.
(27) Studies of the post-glacial history of British vegetation. VI. Correlations in the Somerset levels. *New Phytol.* **40**, 108–132.
(28) 1943 Coastal peat beds of the British Isles and North Sea. *J. Ecol.* **31**, 199–247.
(29) 1945 Coastal peat beds of the North sea region, as indices of land- and sea-level changes. *New Phytol.* **44**, 29–69.
(30) 1946 The relationship of bog stratigraphy to climatic change and archaeology. *Proc. Prehist. Soc.* **12**, 1–11.
(31) 1947 The late-glacial period. *Sci. Prog., Lond.* **138**, 185–192.
(32) 1949 Pollen analysis and post-glacial climate change. In Discussion on post-glacial climatic change. *Q. Jl R. met. Soc.* **75**, 163–165.
(33) Pollen analysis of glaciers in special relation to the formation of various types of glacier bands. *J. Glaciol.* **1**, 325–332.
(34) The spreading of the British Flora, considered in relation to conditions of the late-glacial period. *J. Ecol.* **37**, 140–147.
(35) 1950 (With A. P. Conolly & E. M. Megaw) Studies in the post-glacial history of British vegetation. XI. Late-glacial deposits in Cornwall. *Phil. Trans. R. Soc. Lond.* B **234**, 397–469.
(36) (With S. E. Hollingworth & J. Allison) Interglacial deposits from the Histon Road, Cambridge. *Q. Jl geol. Soc. Lond.* **105**, 495–509.
(37) 1951 (With P. A. Tallantire). Studies in the post-glacial history of British vegetation. XII. Hockham Mere, Norfolk. *J. Ecol.* **39**, 285–307.
(38) 1952 (With J. Allison & S. H. Warren). Late-glacial deposits at Nazeing in the Lea Valley, north London. *Phil. Trans. R. Soc. Lond.* B **236**, 169–240.
(39) 1953 British vegetation in the full-glacial and the late-glacial periods. In *The changing flora of Britain* (ed. J. E. Lousley), pp. 59–74. Arbroath: T. Buncle.
(40) (With K. Pike). The interglacial at Clacton-on-Sea, Essex. *Q. Jl geol. Soc. Lond.* **108**, 261–272.
(41) Late-glacial vegetation of Britain. In *Proc. VIIth Int. Bot. Congr. Stockholm*, 1950, p. 633.
(42) 1954 Recurrence-surfaces. *Danm. geol. Unders.* (2) **80**, 22–30.
(43) 1955 Studies of the post-glacial history of British vegetation. XIII. The Meare Pool region of the Somerset Levels. *Phil. Trans. R. Soc. Lond.* B **239**, 161–190.
(44) 1956 *The history of the British flora: a factual basis for phytogeography.* Cambridge University Press.
(45) 1958 Pollen analysis in mineral soil. An interpretation of a podzol pollen-analysis by Dr G. W. Dimbleby. *Flora, Jena.* **146**, 321–327.
(46) 1960 The Croonian Lecture. Radiocarbon dating and Quaternary history in Britain. *Proc. R. Soc. Lond.* B **153**, 287–320.
(47) 1961 (With T. C. Chambers) The fine structure of the pollen wall of *Tilia platyphyllos*. *New Phytol.* **60**, 393–399.
(48) 1962 Vegetational history of the Kentish Chalk Downs as seen at Wingham and Frogholt. *Veroff. geobot. Inst., Zurich* **37**, 83–99.
(49) 1967 Strip lynchets and soil erosion. *Antiquity* **41**, 66–67.
(50) 1968 Studies of the Post-glacial history of British vegetation. XV. Organic deposits of Old Buckenham Mere, Norfolk. *New Phytol.* **67**, 95–107.

(51) 1970 The contribution of radiocarbon dating to archaeology in Britain. *Phil. Trans. R. Soc. Lond.* A **269**, 57–75.
(52) 1973 A tribute to four botanists (J. Iversen, Hugo Osvald, K. Jessen, W. Szafer). *New Phytol.* **72**, 1245–1250.
(53) 1974 (With D. R. Clowes & B. Huntley) Studies in the ecology of Wicken Fen. V. Development of fen carr. *J. Ecol.* **62**, 197–214.
(54) 1975 *The history of the British flora: a factual basis for phytogeography* (2nd edn). Cambridge University Press.
(55) 1985 *Cambridge and Clare*. Cambridge University Press.