BIOGRAPHICAL MEMOIRS

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Elected F.R.S. 1972

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INTRODUCTION

DENIS PARSONS BURKITT was born in Lawnakilla near Enniskillen, County Fermanagh, Northern Ireland, in 1911 and spent his early boyhood there. He graduated M.B. from Trinity College Dublin in 1935, passed the Edinburgh F.R.C.S. examination three years later, and served during the Second World War as a surgeon in the Royal Army Medical Corps (RAMC) in East Africa. On demobilization, Denis joined the Colonial Medical Service and went to Uganda to become what he described as ‘a simple bush surgeon’, but while working there he made observations on a hitherto unrecognized cancer of children which now bears his name, Burkitt’s lymphoma, with profound consequences for human oncology.

In 1964, Denis transferred to a new appointment funded by the U.K. Medical Research Council (MRC) to work on geographical pathology in Uganda, but in the aftermath of Ugandan independence he moved his activities to London in 1966 and became interested shortly after this in the effects of diet on disease. As a result, he remained throughout the rest of his life a leading proponent of the importance of dietary fibre in the prevention and treatment of a wide range of human pathologies.

Denis Burkitt came from a deeply religious family with a strong tradition of service in the Empire; these influences not only determined the way he lived, but were also responsible for the pattern of his career and, indeed, for the manner in which he made his scientific contributions. He was the elder of two brothers who both became surgeons.
Burkitt’s family was rooted in Ireland on both his paternal and his maternal sides. The Reverend Henry Burkitt, Denis’s grandfather, was Presbyterian Minister in the small fishing town of Killybegs in the South of Donegal, with a huge parish which extended all along the wild and rocky coast of the county. The Reverend and Mrs Burkitt had five boys and two girls; one of the daughters became headmistress of a girls’ boarding school while the other stayed at home all her life to look after her parents. Of the boys, the eldest, Robert, was sent at the early age of 14 to be educated by relatives in Canada for which he never forgave his parents; he never communicated with his family and nothing is known about him beyond the fact that he ended up as Professor of Archaeology in the University of Guatemala. The second son, James, was Denis’s father. Of the remaining three sons, Harold joined the Indian Civil Service and became Governor of Madras, Roland spent his life as a surgeon in East Africa, and Frank also worked in India where he ended his career as Chief Engineer to the Punjab. Denis’s younger brother Robin recalls that Uncle Roland removed tonsils and adenoids from both brothers on the kitchen table of their house in Lawnakilla, and that it was many years before they pardoned him for this. Denis’s father, James Burkitt, acquired an enduring love of natural history as a boy in the remote Donegal countryside and later became the first person to use the ringing of birds to map their territories and movements; he spent his working life as County Surveyor for Fermanagh. Denis’s mother, Gwendoline Hill, was the daughter of Mr and Mrs Hill who lived in a large house in Cork. The maternal grandfather, William Hill, was a well-known architect who designed many of the public buildings in Cork city; after winning an international competition he was said to have been offered a knighthood which he declined – according to Robin Burkitt ‘much to the annoyance of the family’. The Hills had five sons and seven daughters, but only Denis’s mother and one uncle had an influence on Denis as he grew up; Uncle Louis was a canon and a leading evangelical in the Church of Ireland who lived in Dublin and with whom Denis and Robin used to spend their Sundays while they were at Trinity College.

Denis Burkitt was sent to Portora Royal School in Enniskillen, of which both Oscar Wilde and Samuel Beckett were former pupils, until his life was interrupted at the age of 11 by a serious accident. During a fracas between two groups of boys, stones were thrown, Denis had his glasses broken, and his right eye was injured; he was in hospital for five weeks but despite every effort the eye had to be removed. When Denis recovered, he and his brother Robin were moved to another preparatory school at Tre-Arddur Bay in Anglesey, North Wales, whence he went later to Dean Close School in Cheltenham, a public school well-known as a stronghold of evangelicalism. Throughout Denis’s boyhood and adolescence family religious influences moulded his life. There was the strong non-conformist tradition from his paternal grandfather which was passed on by Denis’s deeply religious father, and equally strong evangelical and fundamental Christian beliefs based on biblical faith which were held by his parents and their brothers and sisters, particularly his uncles Roland Burkitt and Canon Louis Hill. An unshakable belief in divine guidance and the efficacy of prayer lasted from these early days throughout Denis Burkitt’s life and resulted in daily bible reading, the display of biblical texts in each of his successive offices, and abstinence from alcohol. The pattern of his own family life was not surprisingly rather austere and focused on Christian religious observance.
TRINITY COLLEGE DUBLIN AND MEDICAL TRAINING

In 1929 Denis Burkitt entered Trinity College Dublin to read engineering and during his first year became an active member of a bible study group. Engineering did not prove engrossing and in the course of the bible readings Denis became convinced that he had received a divine call to study medicine; at the end of his first undergraduate year he moved over to the Medical Faculty where he started on his pre-clinical courses. Denis Burkitt did not find the teaching at Trinity College at all inspiring but worked hard and greatly enjoyed his clinical studies at The Adelaide Hospital in Dublin. He was placed second in his final qualifying examinations and won the Hudson Prize and a silver medal. There were two house appointments at the teaching hospital and it was generally assumed that Denis had earned one of these, but one was given to the student who came first and the other to a rugger international.

Despite this disappointment, it was necessary to gain postgraduate experience and training; so for the three years after qualifying in 1935 Denis took house jobs in Chester, Dublin and Preston before becoming Senior Resident Surgical Officer at Poole. In 1938, with some surgical experience behind him, Denis went to Edinburgh for a six month course in preparation for the examinations for Fellowship of the Royal College of Surgeons of that city, and passed these examinations that same year at the end of the course. In order to have time to think about the next steps in his career while seeking experiences of a wider kind, Denis signed on with the Blue Funnel Line and sailed as ship’s surgeon on the freighter Glen Shiel to northeast China with a Chinese crew. During the voyage he began to form the view that he should ultimately work somewhere in the developing world and that meantime he needed more experience in surgery. He was appointed as Resident Surgical Officer at the Prince of Wales Hospital in Plymouth where he remained during the early part of the Second World War and where he met a nurse, Olive Rogers, who had a similar religious background to his own and whom he later married.

At the time of Dunkirk in 1940, Denis volunteered for the RAMC but was rejected and instead worked briefly in Barnsley before applying early in 1941 to the Colonial Office to serve in West Africa ‘with a Christian motive’; this application was also unsuccessful. Nevertheless, Denis was by this time convinced that he had received a call to serve somewhere, and therefore immediately applied again to join the RAMC and was accepted and duly commissioned that same year.

WAR SERVICE

For the first two years after he was commissioned, Denis was stationed in England first for preliminary training in Hampshire and then as a surgeon with 219 Field Ambulance near Norwich. In July 1943 he married Olive Rogers and a few months later embarked with his unit on a troopship for Mombasa. Burkitt served first with African troops in Kenya and Somaliland, and saw something of Uganda during local leave.

Uganda did not have settlers with attendant racial problems as in Kenya, but did have much Christian activity, and it was at this stage that Denis Burkitt decided that after the War his vocation would lie in helping the people of Uganda both medically and spiritually. At the end of his service with the RAMC he was posted to Ceylon and then briefly to Singapore before returning to the U.K. for demobilization in 1946, with the firm belief that he had been ‘called’ to work in Uganda.
The Years in Uganda

Olive Burkitt had been a ward sister in England throughout the last years of the War and with the return of her husband, when it was over, naturally looked forward to settling down; the idea of Uganda was not appealing but Denis’s convictions on the matter were in a sense religious rather than reasoned and after much heart searching it was agreed that they should try to go. Denis applied to the Colonial Office once again, this time for service in Uganda, and was successful, but the appointment was for him to go out alone in the first place without his wife and the child they were expecting. Olive was only able to join him with their infant daughter six months later on his first station at Lira in Lango District where Denis was in sole medical charge of about 300,000 people with a primitive 100 bed bush hospital to cover the needs of all fields of medicine and surgery.

After a year and a half at Lira, Denis Burkitt was moved in 1948 by the Colonial Office to Mulago Hospital in the Ugandan capital, Kampala, to take charge of the surgical division during an illness of the surgical specialist, I.W.J. McAdam (later Professor Sir Ian), and he remained there working with McAdam until he left the Colonial Service in 1964. At the time of his arrival, Mulago Hospital consisted of thatched, single-storey huts housing the wards together with rudimentary ancillary facilities, but over the next two decades it grew into a modern university medical teaching centre with a distinguished reputation extending far beyond Africa.

In the conditions prevailing in Uganda before the medical and other services were expanded and developed after the War, it was frequently necessary for limb amputations to be carried out, an unsatisfactory outcome under any circumstances, but made worse by the absence in the country of any provision for the supply of artificial limbs. On his first home leave, Denis Burkitt went to the Royal National Orthopaedic Hospital in London for a five month course covering orthopaedic surgery and recent advances in artificial limb technology, and when he returned to Kampala he was able to initiate the local production and fitting of simple orthopaedic devices.

The first dozen years Denis spent in Uganda were filled with enormously valuable service of this kind to the inhabitants and the few papers he produced in this period consisted mainly of routine case reports, but also included some simple observational findings which relatives and friends have in retrospect linked to his father’s bird-watching and bird-ringing activities. However, in 1957 Denis Burkitt made a unique and seminal discovery which led to a spate of internationally important publications, to a series of outstanding field studies, and to the opening up of a whole new theme in relation to the causation of certain cancers in man.

Early routine medical publications

In the 20 or so years after qualification, Denis Burkitt published 12 papers mostly reporting on disparate conditions of interest which had passed randomly through his hands, but he also described the results of a considerable clinical study of 200 cases of primary hydrocele encountered at Lira. In the course of this work Denis made his first observations on the geography of disease when he realized that almost all the patients came from Eastern Lango District where he found a 30% incidence among adult males, whereas in the Western section only 1% were affected (8)*; the explanation was subsequently shown by others to lie in the distribution of filariasis in this region. Other publications from activities during this period were concerned with artificial limbs and similar aids for the crippled (11, 14, 18).

* Numbers in brackets refer to entries in the list of publications on the accompanying microfiche.
The recognition of Burkitt’s lymphoma

In 1957 a physician at Mulago Hospital, Hugh Trowell, asked Denis Burkitt to examine with him a five-year-old boy who presented with swellings in all four quadrants of the jaws. Single tumours in the jaws of children were a well-recognized peculiarity in Uganda and were assumed to be some kind of round cell sarcoma, but swellings in all four quadrants made no sense either as tumours or as the result of infection. Denis was puzzled, but kept careful clinical and photographic records, and he remained so when histological examination of a biopsy sample proved inconclusive.

Some weeks later when visiting the District Hospital at Jinja on Lake Victoria Denis noticed quite by chance another child with a swollen face sitting outside a ward. This boy also had swellings in all four jaw quadrants and Denis Burkitt was immediately conscious of something special; as he recalled later (302) ‘A curiosity can occur once, but two cases indicated more than a curiosity’. This second boy was taken to Mulago Hospital in Kampala for further examination and care, and was found to have an abdominal mass in addition to the jaw lesions. Once again, clinical and photographic records were assembled and with these for comparison, Denis studied the hospital’s accumulated case and autopsy reports on all children with cancers and it then became very clear that jaw tumours were frequent, that they were associated with multiple tumours in other unusual sites, that tumours occurred in such sites in the absence of jaw involvement, and that the tumour masses were sometimes accompanied by paraplegia. At this point Denis Burkitt realized that these various and seemingly different childhood cancers were all facets of a single, previously unrecognized tumour complex which was exceedingly common in Uganda.

Denis Burkitt established the clinical features of the condition with its peculiar multifocal distribution in jaws, eyes, orbit, kidneys, adrenals, ovaries, testes, thyroid, long bones and in retroperitoneal masses compressing the blood supply to the spinal cord. He also noted that peripheral lymph nodes were not involved and that the disease was largely restricted to young children. Each of the components of the disease had been seen regularly by clinicians in Uganda as well as in other parts of tropical Africa, and indeed the clinical notes made by Sir Albert Cook, a medical missionary and the first doctor in Uganda, include descriptions and line drawings of children with multiple jaw tumours examined in the first years of the present century. But no one before Burkitt had understood the relatedness of the diverse manifestations.

The first clinical description of the tumour was published in 1958 in the British Journal of Surgery (13) and the very brief comments on histology quoted from a pathologist colleague of Denis’s, J.N.P. Davies, suggested that the condition was a sarcoma, perhaps a lymphosarcoma. This paper, which became a citation classic 25 years later (297), failed to attract any attention whatsoever when it appeared. It was only when Denis managed to involve the pathologists at Mulago Hospital and the pathological studies fully confirmed his clinical findings, established the lymphomatous nature of the tumour, and made clear that the lymphoma was unlike any other known before in its bizarre multifocal anatomical distribution, that international interest started to be aroused. These points were presented for the first time, together with some very preliminary epidemiology, by Burkitt and O’Conor in 1961 (19) and by O’Conor (1961) in an accompanying paper in the same journal. It was now evident that Burkitt’s lymphoma was a new syndrome more common in parts of Africa than all other cancers of children added together, and with a peak incidence around the age of seven though older children, and even adolescents under certain conditions such as lactation, might be affected.
Early in the investigations on Burkitt’s lymphoma the impression emerged that more cases came from northern and eastern Uganda than from the more populous south and west with which Kampala had much better communications. There had also been a visit from G. Oettle, a cancer epidemiologist from Johannesburg, who had stated when shown patients with the lymphoma that it did not occur in South Africa. In the context of his geographical study in Lira on the distribution of hydrocele in Lango District, Denis began to wonder how widespread the newly recognized lymphoma might be in Africa and where, between Uganda and South Africa, the ‘edge’ of the tumour belt was located. He therefore applied for a research grant of £25 and with this he printed leaflets and posted them to a large number of government and mission hospitals throughout Africa; the leaflets described and illustrated the lymphoma and asked the recipients whether they were seeing it among their patients. Very large numbers of replies were received and Denis was able by 1960 to plot the crude outlines of a tumour belt across Africa, south of the Sahara and north of South Africa, but with a tail running down the east coast through Mozambique. At the same time geographical epidemiology in East Africa revealed that the tumour was abundant in low-lying areas and absent in the highlands with an altitude barrier at about 5,000 feet. Comparison of the tumour belt with maps of yellow fever distribution kept at the East African Virus Research Institute in Entebbe, not far from Kampala, allowed the Director, A.J. Haddow (later F.R.S.), to interpret the details of the altitude barrier as reflecting a temperature barrier; the tumour did not occur where the temperature fell below 62 °F and a role in causation for some biological agent began to be considered.

In the spring of 1961, Denis Burkitt went on leave to the U.K. and gave the first talks outside Africa on the lymphoma which made his name an eponym. The first was a lecture for students and staff on the Surgical Unit at the Middlesex Hospital Medical School in London which was attended quite by chance by one of the present writers (Epstein), who was working at the time on the unfashionable topic of chicken tumour viruses, but who, therefore, had the possibility of human oncogenic viruses very much in mind. The description of a bizarre, highly malignant cancer of children dependent on ambient temperature suggesting an arthropod-borne agent might be involved caused the search to be undertaken for a possible human cancer virus of this kind which led eventually to the discovery of Epstein–Barr virus as has been recounted elsewhere (Epstein 1984, 1985). The second presentation was in a large lecture theatre at the Royal College of Surgeons, also in London, and was attended by about 12 people.

On returning to Uganda Denis Burkitt decided that it was now necessary to obtain detailed information on the tumour belt and as a first step he planned to make a land journey of some 10,000 miles down the east side of Africa to visit as many central and bush hospitals as possible, and any other medical posts where first hand knowledge might be available. The need for a grant towards this had been discussed with Sir Harold Himsworth, F.R.S., Secretary of the MRC, when he happened to be in Kampala, and in the event the MRC provided £250 to cover the cost of a second-hand station wagon and the other expenses of the trip.

What is now sometimes referred to as ‘the long Safari’ was completed by Denis Burkitt and two medical missionaries, E.H. Williams and C. Nelson, in the last three months of 1961 and produced extensive data on the altitude barrier which fully confirmed that the tumour was temperature dependent (25, 26, 27). Subsequent travel to examine the tumour distribu-
tion in Nigeria and Ghana, and correspondence with neighbouring Francophone countries, revealed that in West Africa rainfall was also a vital factor in determining the incidence of Burkitt's lymphoma; it did not occur where there was less than 20 inches annual rainfall. This temperature and rainfall dependence was later found to hold good in the only region of the world where the tumour was endemic outside Africa, namely in Papua New Guinea (70). In the years after 1962 six review papers were published on the nature and epidemiology of Burkitt's lymphoma in major international journals and meeting reports, as well as an extensive and comprehensive survey (37) and a multi-author book edited by Burkitt and Wright (1970).

The treatment of Burkitt's lymphoma

Because of the very rapid growth rate and multifocal nature of Burkitt's lymphoma all attempts in the early days at surgical extirpation were doomed to failure. At the time radiotherapy was not available in tropical Africa and chemotherapy thus appeared to be the only treatment with any hope of success; it was fortunate that American help introduced some chemotherapeutic agents into East Africa just when the lymphoma had begun to attract international interest in the early 1960s. Denis Burkitt was therefore able to get some limited supplies of the cytotoxic drugs methotrexate, cyclophosphamide and vincristine, and proceeded to use them unconventionally in limited doses both because of the small amounts available and because he lacked the sophisticated facilities to care for patients on the accepted aggressive chemotherapy regimens. With minimal doses, and in some cases even single doses, Denis achieved astonishing regressions, remissions and apparent cures, which caught the attention of cancer chemotherapists world-wide and of the popular press which naturally made much of the 'simple bush surgeon' who discovered a horrific cancer of children in Africa and then went on to produce dramatic cures. Scientific accounts of this work were published between 1963 and 1967 (38, 51, 57, 59, 65, 67).

The scientific significance of Burkitt's lymphoma

Denis Burkitt's seminal early studies identified and characterized a new and unique form of cancer. Most researchers would have been content with a discovery of this magnitude, but because of an enquiring mind and a streak of dogged determination, he was not and went on to make a second outstanding contribution with his demonstration of the climate dependence of the tumour. This effect of temperature and rainfall on the geographical distribution of Burkitt's lymphoma suggested by analogy with known arthropod-borne infectious diseases that the tumour might also have an infectious cause and thus made it, as Sir Harold Himsworth, F.R.S., phrased it, 'something of a Rosetta stone' for the field of human carcinogenesis (Himsworth 1970). Once Burkitt's lymphoma became known, the entire biomedical world agreed with this view.

Although for various reasons the idea of a vectored virus required revision, this original hypothesis served to get investigations going and focused them correctly on the search for a viral cause. It was Burkitt himself who in 1969 assembled convincing evidence that it was an essential co-factor, hyperendemic malaria, which was responsible for the climate dependence of the lymphoma (98), thus explaining how a ubiquitous agent such as Epstein–Barr virus, could also be involved and essential for causation. A great deal of work started at about this
time devoted to the investigation of the viral aetiology of Burkitt’s lymphoma and has continued ever since in a growing number of laboratories. A major step forward came when the results of the World Health Organization’s massive seven-year prospective study of 42,000 Ugandan children demonstrated a risk factor for Burkitt’s lymphoma 30 times higher than normal in those children who showed a particular and unusual pattern of responsiveness to Epstein–Barr virus infection (de Thé et al. 1978), a risk factor almost twice that linking heavy cigarette smoking and cancer of the lung. Current findings are beginning to hint at the molecular pathways through which a virus that is necessary but not sufficient on its own, interacts with co-factors and chromosomal changes to transform normal human lymphocytes into the malignant cells of Burkitt’s lymphoma.

Denis’s observations on the extreme sensitivity of the lymphoma to very small doses of chemotherapeutic agents which arose by chance because of the inadequacy of the facilities for aggressive chemotherapy in Kampala, were of much lesser importance than his two outstanding major discoveries. The chemotherapy work did contribute something to knowledge of the range of dosage which could be used, but others using more conventional levels of drug treatment had also shown that Burkitt’s lymphoma responded dramatically.

The discovery of the lymphoma and the inspired field studies on its geographical distribution had a profound influence on the development of fundamental thinking on human cancer causation. Burkitt’s lymphoma and the search for a viral cause which Denis’s findings engendered focused the attention of the world biomedical community on the hitherto largely disregarded possibility that much of human cancer might have viruses playing some role in causation. The resultant change in attitude to human tumour virology initiated an extensive new research effort in this field throughout the developed world and it is now taken for granted by most experts that viruses are involved in the aetiology of at least 20% of human cancer, taking account of what is known of the role of Epstein–Barr virus in Burkitt’s lymphoma and nasopharyngeal carcinoma, of human T-cell leukaemia virus type I in adult T-cell leukaemia, of hepatitis B virus in hepatocellular carcinoma, and of human papilloma virus in genital and other epithelial tumours. In all these cases, the virus seems to be an essential link in a complicated chain of events leading to malignant change, other indispensable links being genetic background, co-factors and activation of cellular oncogenes.

**Service with the Medical Research Council**

The early geographical observations on hydrocele in Lira shaped Denis Burkitt’s ideas on disease in general quite apart from the crucial problem of the distribution of the lymphoma. Indeed, all through ‘the long Safari’ information was collected by Denis and his companions on the geographical location of various different clinical conditions encountered or heard about at the many hospitals they visited (33).

Once the painstaking mapping of the lymphoma had been completed, and after discussions while on home leave in 1963 and during an extensive first visit to research centres in North America, Denis worked out a programme of investigations into the geography of disease which proved of interest to the MRC and resulted in his being offered an appointment on the External Scientific Staff. From April 1964 Denis Burkitt was based in Kampala as an MRC scientist and through travel and correspondence began to examine the distribution of cancer and other diseases in Africa and beyond. At the end of 1966, a few years after Ugandan independence, Denis transferred this work to the U.K. and was given space in some
offices rented by the MRC at 172 Tottenham Court Road in London from which he continued to travel and correspond in pursuit of data. Tottenham Court Road was close to University College Hospital Medical School where W.R.S. Doll, F.R.S. (later Professor Sir Richard), was engaged in cancer epidemiology studies as Director of the MRC’s Statistical Research Unit, and from time to time Doll and Burkitt would meet. In 1967 Richard Doll showed Denis a book by Surgeon-Captain T.L. Cleave, R.N. (retd), and then introduced him to the author, a meeting that Denis described as one of the most important in his professional life (Burkitt 1979). Cleave advanced the view that modern processed diets enriched in sucrose, fat, salt and energy sources but low in fibre were responsible for many of the common illnesses of developed countries. Denis Burkitt, with his intense interest in geographical epidemiology and pathology immediately seized upon and developed this concept and for the remainder of his life devoted the prestige he had acquired by his great discoveries to the promulgation of the dietary fibre hypothesis.

While travelling in South Africa in 1969 Denis met A.R.P. Walker in Johannesburg who had accumulated information on the disease patterns and different diets of various South African ethnic groups, and on the bowel transit times and stool weights resulting from different foods. The possible role of fibre in this context fitted well with Denis’s new enthusiasm and he therefore decided to include studies on bowel behaviour in his future work.

The first years as a member of MRC staff, before the meeting with Cleave, produced some interesting publications on geographical pathology, but after that Denis wrote almost exclusively on fibre, diet and disease.

Studies on the geography of disease

Some of Denis’s early ideas for looking at the geographical background to disease in developing countries were worked out in collaboration with M.S.R. Hutt, a colleague who had recently joined the pathology department at Mulago Hospital in Kampala. These first steps were mainly concerned with ways of assessing the value of the relatively incomplete information available in African centres, and with the methodology for verification and use of such information; papers on these topics were written with Hutt in 1965 and 1966 (49, 55), with Hutt and G. Slavin in 1968 (79), and by Denis alone during these and succeeding years (60, 76, 82, 92, 99). Numerous peripheral findings on Burkitt’s lymphoma and reports of papers given at many meetings were published at this time. Denis Burkitt also made a point of generously contributing articles to medical and scientific journals produced in the Third World, as well as semi-popular reviews which were much in demand.

Work on dietary fibre and disease

Immediately after meeting Cleave, Denis drew up a list of diseases that were only diagnosed infrequently in the many hundreds of hospitals in Africa with which he was in contact. The list included hiatus hernia, diabetes mellitus, coronary artery disease, colonic diverticulosis, cancer of the colon, appendicitis, varicose veins and haemorrhoids, all of which were extremely common in the developed countries, and Denis interpreted this as strong support for Cleave’s theories on diet and especially the role of fibre. He joined a group of individuals who were fascinated by fibre and tireless in advocating its value in the diet; of these, Hugh Trowell had been a colleague and close friend in Uganda and he had met a second, Walker,
in South Africa. Others included D. Kritchevsky at the Wistar Institute in Philadelphia, D. Southgate in Cambridge and F. Avery-Jones (later Sir Francis) in London. All had worked on this subject without the popular interest subsequently achieved, but it was not until the first fibre meeting in Edinburgh in 1972 that Denis Burkitt met them. His arrival in the field provided novel epidemiological evidence and distinguished authority, and with Cleave and Trowell the hypotheses on dietary fibre and disease were developed and extended.

They argued that since the nineteenth century infections and deficiency diseases were due to factors in the environment that could be controlled, the chronic non-infective diseases in the twentieth century could similarly be eradicated. Denis proposed that a comparison of the highest and lowest figures for the prevalence of various diseases provided a potential low level to which the diseases might be reduced and he believed, furthermore, that such observations indicated that primary causal factors must be environmental rather than genetic. A special focus for these ideas was the view that there was some common causative element in colonic diseases, particularly colon cancer. Denis Burkitt freely acknowledged (302) that A.R.P. Walker had first drawn his attention to the role of fibre-deficient diets in the aetiology of large bowel diseases, the main clue being that in all communities with a high prevalence of such diseases a constant feature was the passage of small, firm stools associated with prolonged intestinal passage times whereas in contrast, in communities where stools are large and soft these diseases are rare. The common factor in the causation of each of the diseases in question was, according to the interpretation which Denis adopted, the fibre content of the diet.

Important support for the theories of Walker, Burkitt and Trowell seemed to be provided by the observations of N.S. Painter, a surgeon, who had found that the symptoms of colonic diverticulitis resulted from an increase in intra-luminal pressure which was inversely related to the dietary fibre intake. Painter showed that when wheat bran was eaten by patients with symptoms, colonic pressures became normal and symptoms subsided. At the beginning of his fibre campaign in the 1970s, Denis presented his ideas in numerous widely read journals (101, 124, 130, 142, 152, 177), and his paper describing the hypothesis relating carcinoma of the colon to lack of dietary fibre (127) became a citation classic 10 years after it appeared. In 1975 Burkitt and Trowell co-authored a book which gave a comprehensive survey of their fibre theories and their views on disease prevention through high levels of dietary fibre, and from that time until the very end of his life Denis Burkitt promoted these subjects in some 200 published papers and articles, for the most part as reviews or in minor journals and the semi-scientific press. A book that Denis wrote for the lay person (Burkitt 1979) was an international best-seller shortly after it appeared.

The scientific significance of the work on fibre

As work on the aetiology of Burkitt's lymphoma progressed, Denis readily realized that he was out of his depth with the scientific developments, yet in the fibre field he was quite prepared to offer interpretations of scientific studies that he did not fully comprehend. No true laboratory or biochemical link has been identified between dietary fibre and the diseases to which Denis and his colleagues connected it; moreover, in the contrasts that were cited between Africans and Western populations there were no age control studies or comparisons based on modern diagnostic techniques. Denis's fibre work relied on anecdote rather than the detailed epidemiology that characterized the mapping of the lymphoma, and there was
always a concern to many critics that like was not being compared with like.

An early problem related to the measurement of fibre in the diet. The initial fibre figures used by Burkitt and Trowell in epidemiological studies were of crude fibre measured by a method developed in nineteenth century Germany to identify adulteration of cattle feed with sawdust. Although Southgate in Cambridge had elaborated a good method for measuring dietary fibre, insufficient fibre results were available at the time to allow epidemiological comparisons.

An additional and still continuing problem with dietary fibre concerns the name and the definition. Dietary fibre implies roughage; other names which have been used include plantex, complex carbohydrates and non-starch polysaccharides. The definition used by Trowell was based on plant cell wall material refractory to digestion by human intestinal tract enzymes, a definition which still haunts and confuses the subject. Considerable commercial interests depend on these wordings and the methods of analysis.

It is curious that in these circumstances many nutritionists gave a welcome to Burkitt and Trowell's explanation of disease aetiology supported only by anecdotal evidence, but clinical gastroenterologists remained sceptical and the flour milling and baking industry certainly did not appreciate their comments which included the suggestion that white bread should carry a Government health warning akin to that printed on cigarette packets. Nevertheless, the enthusiasm of Burkitt and Trowell, and the therapeutic benefits of fibre shown by N.S. Painter of Oxford and the Manor House Hospital in London, held the dietary fibre hypothesis together until such time as others began to take an interest in the physiology, biochemistry and physical chemistry of the passage of fibre down the intestinal tract, and in the effects of fibre on intestinal structure and post-prandial metabolism.

Yet there has been an expanding interest in the fibre hypothesis and the consequence has been to change the management of diabetes mellitus and symptomatic colonic diverticulosis by increasing the fibre content of the diet. Some, including Government dietary proclamations, have also suggested that an increased dietary fibre intake is important in preventing colon cancer, but despite these pronouncements no absolute or clinically proven relationship has been demonstrated.

Denis’s great merit was in associating the absence of fibre in the diet with disease causation. He spoke and wrote tirelessly about man’s maladaptation to a new diet to which people in the West have only recently been exposed, and advocated a return to a more natural diet with enhanced fibre and starch content, and reduced fat, salt and perhaps also protein. Denis expounded this simple story with few doubts expressed as to the correctness of what he was saying, yet much of what he suggested had a strong element of truth.

RETIREMENT

In 1976 Denis Burkitt retired from his MRC appointment in the usual way at the age of 65 and was able to take up an honorary appointment at St Thomas’s Hospital Medical School where M.S.R. Hutt (now Professor), a former colleague and collaborator from Uganda, had become Head of the Department of Geographical Pathology. From his office at St Thomas’s in London Denis continued to travel and lecture, and to pursue above all his campaign on behalf of dietary fibre. He remained at St Thomas’s as Honorary Senior Research Fellow until 1984 when he withdrew formally from active professional work although in reality he continued to write, travel and lecture using his home in Gloucestershire as a base; indeed, he had visited the U.S.A. in the weeks immediately preceding his death.
DENIS BURKITT THE PERSON

Denis was a kind man possessed of wit and insight. He was proud that he had never spent a day in the laboratory and had always worked as an epidemiologist. He often spoke of the importance of simple observational studies and contrasted these with ‘the limitations of modern medicine’. But it was his unshakeable faith in the divine ordering of everything in life that inspired his observations, provided unwavering determination in all his undertakings, and underlay his uncanny ability to make correct associations when confronting disparate phenomena. Denis was enormously enthusiastic and brimming with energy in all his activities; he was an amusing and voluble talker, but as his brother Robin has put it, ‘not such a good listener’.

Denis Burkitt enjoyed a happy home life and was supported in everything he did by his wife Olive. He was a devoted father to their three daughters, and as he mellowed in later years he revelled in his nine grandchildren. He made many lasting friendships during the course of his career.

Because of his faith he was rarely disconcerted and took the bad with the good; his persistence with a career in surgery despite the loss of an eye exemplifies his attitude. Such difficulties did not worry him nor did unusual situations. When one of the present authors (Epstein) was returning with him in the dark by dugout canoe from the Lake Victoria Sese Islands in April 1964, the outboard motor failed and the two passengers and the boatman drifted for some hours in waters well-known for sudden and violent tropical storms; yet Denis remained cheerful and lively throughout, and the time was passed observing the passage of the newly launched Sputnik, in beating off the clouds of mosquitoes, and in surprisingly eclectic conversation.

Despite his great achievements and the honours that were heaped on him, Denis stayed modest and self-deprecatory until the end of his life. He was generous in giving acknowledgements to others, sometimes even where these were not due, and believed firmly in the applicability to his discoveries of the words of St Paul: ‘What do you possess that was not given to you? If, then, you really received it as a gift, why take the credit yourself?’

Denis Burkitt never laid claim to being a scholar or scientist and would often sum up his approach by saying ‘Attitudes are more important than abilities, motives than methods, and character than cleverness; and the heart takes precedence over the head’. It is not surprising therefore, that in the conventional scientific settings of meetings and lectures Denis, with his unsophisticated experiences in a remote part of Africa and austere religious faith, appeared as something of a phenomenon. His lectures were sensational and always packed, not only because of what he had to say, but also because of the way it was presented. His manner was in the lay preaching tradition and his simple approach to his message was enlivened with unexpected jokes and arresting slides. The scientific illustrations were outstanding and almost every point was underlined by line-drawing cartoons which perhaps owed something to the pictures put out in the pamphlets of the Religious Tract Society in Victorian and Edwardian Britain: the tap emitting a flood labelled disease while modern medicine, in the shape of a mop, tries to deal with the outflow instead of preventing it by turning off the tap; the steaming stools on the scales, the large, soft, fibre-rich African sample weighing down the hard and shrunken Western specimen. Denis Burkitt was unusual in carrying an old-fashioned evangelical faith into the present time. He was active in the Christian Medical Fellowship over a great many years and served as its President; in this context Denis wrote
Denis Parsons Burkitt

frequently and extensively on religion in the service of medicine and the influence of religion on the events which shaped his life. He also prepared various pamphlets and tracts for series issued by the Christian Medical Fellowship and the Christian Medical Society for the Third World, and for medical students and practitioners.

By any standards, Denis Burkitt was a remarkable and admirable person and his great contributions to medical science altered current thought in two distinct and quite unrelated fields.

HONOURS AND AWARDS

Civil Honour

1970 Companion of the Order of St Michael and St George.

Major Prizes and Medals

1969 Arnott Gold Medal – Irish Hospitals and Medical Schools Association.
1969 Katherine Berkan Judd Award – Sloan Kettering Institute, New York.
1970 Robert de Villiers Award – American Leukemia Society.
1972 Paul Ehrlich & Ludwig Darmstaedter Prize and Gold Medal – West Germany.
1972 Albert Lasker Award – U.S.A.
1973 Gairdner Foundation International Award – Canada.
1982 Charles Mott General Motors Cancer Award – U.S.A.
1982 Bristol-Myers Award for Cancer Research – U.S.A.
1982 Gold Medal – Académie de Médecine, France.
1983 Beaumont Bonelli Award for Cancer Research – Italy.
1987 Le Prix Mondiale Cino del Duca – France.
1993 Bower Award and Prize for Science – Benjamin Franklin Institute, U.S.A.

Other Prizes

1966 Harrison Prize – ENT Section of the Royal Society of Medicine, London.
1966 Stuart Prize – British Medical Association.
1990 Lucy Wortham James Award – Society of Surgical Oncology, U.S.A.

Honorary Degrees and Fellowships

1970 Honorary D.Sc. – University of East Africa.
1972 Fellow of the Royal Society.
1973 Honorary Fellow – Royal College of Surgeons of Ireland.
1976 Honorary Fellow – Royal College of Physicians of Ireland.
1979 Honorary M.D. – University of Bristol.
1979 Honorary Fellow – Trinity College, Dublin.
1982 Honorary D.Sc. – University of Leeds.
1985 Honorary D.Sc. – University of Western Virginia.
1989 Honorary D.Sc. – University of Ulster.

Honorary Membership of Professional Societies

Honorary Fellow – East African Association of Surgeons.
Honorary Member – Brazilian Society of Surgeons.
Honorary Fellow – Sudan Association of Surgeons.
Honorary Member – International Medical Club of Washington.

ACKNOWLEDGEMENTS

The authors are extremely grateful to Mrs Olive Burkitt and to Mr Robin Burkitt, M.D., F.R.C.S., for invaluable help and advice, particularly on family matters and with publications. We are also indebted for information on various aspects of Denis Burkitt’s life and activities to Dr O. Alabaster, Ms Paula Cook, Dr J.H. Cummings, Sir Richard Doll, Dr A. Fergusson, Dr K.W. Heaton, Dr D. Kritchevsky and Dr J.A. Storey. The photograph was taken by the Godfrey Argent Studio in June 1973 and is reproduced with their permission.

REFERENCES


BIBLIOGRAPHY

The full bibliography of published papers appears on the accompanying microfiche. A photocopy is available from the Royal Society Library at cost.