BIOGRAPHICAL MEMOIRS

Sir Alan Sterling Parkes. 10 September 1900 — 17 July 1990: Elected FRS 1933

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Alan Parkes was one of the most influential figures in the field of reproductive biology in the twentieth century. He had a huge impact on its growth and development during that time, and the legacy of his work still remains.

His research was highly innovative and original because of his imaginative and inquiring mind, which, coupled with an entrepreneurial bent, led him into several very different fields and into uncharted waters. He played a leading role in the spectacular rise of reproductive endocrinology in Britain in the 1920s and 1930s when the nature and activity of many of the reproductive hormones were first discovered. This laid the foundations of our understanding of reproductive processes in animals and humans and was an essential factor in the development of methods for their control. Even more pioneering was his research in low-temperature biology in the years after World War II. This was sparked off by the discovery that glycerol had a remarkable property of protecting spermatozoa against damage during freezing and storage at very low temperatures. Far-reaching applications arose from this discovery, especially in the preservation of bull semen, which led to a worldwide revolution in artificial insemination in cattle. Later, many other cells and tissues were also successfully frozen, including red blood cells, ovarian tissue and bone marrow, and a new branch of biological science, which became known as 'cryobiology', was born. Effects of deep hypothermia, including freezing, on whole animals were also investigated at that time.

Having successfully launched a new area of science, it was characteristic of Alan Parkes to switch to new fields. First he became interested in the influence of pheromones on mammalian reproduction. Then, resuming a long-standing interest in comparative aspects of reproductive physiology in British wild mammals, he became involved in the work of the Nuffield Unit of Tropical Animal Ecology in Uganda, where similar studies were carried out on African animals. Even after retirement from the academic field, he was for some years a consultant to an enterprise in the conservation and captive breeding of green sea turtles in the Cayman Islands.

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In addition to his research, Alan Parkes was just as influential through the huge amount of work that he did for committees and other activities. Over the years he was on 35 different committees, study groups or advisory groups, and these were concerned with a wide variety of interests. He often served as chairman or secretary and had a great ability to take on a large amount of work and responsibility. He threw himself wholeheartedly into promoting the interests of reproductive biology and was a founding member of both the Society of Endocrinology and the Society for the Study of Fertility. He also played a leading role in the establishment and running of the *Journal of Endocrinology* and the *Journal of Reproduction and Fertility*. Getting these journals established often required a considerable amount of financial acumen. One of his special concerns was a long-standing interest in demographic and population issues, which led to his working closely with the International Planned Parenthood Federation and the Family Planning Association. He saw the 'population explosion' as a growing threat to the environment and to human welfare, and he was an outstanding proponent of measures to effect population control. Sometimes this led him into controversial areas. He spoke strongly in support of women's right to abortion and questioned the morality of expensive measures to overcome infertility.

Throughout his life he was a prolific and lucid writer and his many publications remain as a lasting monument to his contribution to science. He entitled the first volume of his autobiography *Off-beat biologist*, which is perhaps a very apt description of this remarkable man.

Background and early life

Alan Parkes was born at Castleton, near Rochdale in Lancashire, on 10 September 1900. He had an elder brother and sister and one younger sister. His father, Ebenezer Thomas Parkes, son of Josiah Parkes, was a banker who rose during his career to an eminent position in what was later to become the Midland Bank. However, his father had broken with tradition because most of the family were in the locksmithing business. In fact, Josiah Parkes and Sons were the originators of the well-known 'Union' locks, named after Union Street, which was the site of the old family home and factory. His father married Helena Louisa Banks in 1890. She was the daughter of a brass founder. There were no scientists or academics in the family background.

When he was nine years old the family moved to Oldham into a large old house with winding back stairs and dusty old attics. There were also numerous outbuildings, which proved a happy hunting ground and a fascinating place for a young person to explore when growing up.

He first attended Hume Grammar School, which he enjoyed and where there was good teaching in science, but at the age of 13 years he was sent away to Willaston School, a very small boarding school in Nantwich, Cheshire. This had a disastrous effect on his education. The teaching there was poor, uninspiring and based almost entirely on classics and music; there was virtually no science and the school also became extremely militaristic after the outbreak of World War I. These factors pretty well killed any urge that he might have had for formal learning, with the result that he failed both the Lower and Higher Certificate examinations.

Later in his life Alan Parkes sometimes recounted that his despondent father pointed out that the only opportunities that might be open to someone with such an academic record as his were the army, the church, or farming. Alan Parkes chose the farming option and was accepted

at Harper Adams Agricultural College. He enjoyed the teaching and activities there, but was only able to attend for one year because he was called up to join the army at the age of 18 years. Even then academic achievement had eluded him because he was not able to take the end-of-year examinations at Harper Adams because of illness.

When he joined the army in 1918 the war was drawing to a close. Later, he joked that soon after he joined the army the Kaiser surrendered, which caused his friends to comment that he should have joined up earlier! He had a very brief time as a private in the Young Soldiers' Battalion of the Manchester Regiment and was demobilized after only three months.

At this point his father, who had a major influence on his early life, made a very important decision that affected his whole future. He discovered that the University of Cambridge was making special concessions to ex-servicemen with at least three months' service and had waived the entrance examination. It is unlikely that Alan Parkes would have passed the examination in the normal course of events. However, he was accepted as a member of Christ's College and registered for the Diploma in Agriculture, which he was later able to transfer to the recently founded degree course. His career at Cambridge was not particularly distinguished, but he did end up with a second-class pass degree. While he was there, his tutor at the School of Agriculture was F. H. A. Marshall (FRS 1944), and John (later Sir John) Hammond (FRS 1933) was a demonstrator. Nevertheless, neither of these men, who were leaders in the field of reproductive biology, had much influence on him at that time. The one significant step he took towards anything related to reproductive biology was as a result of seeing an article in a magazine by Julian Huxley (FRS 1938) on the sex ratio. He became interested in the subject and did some background research in libraries on genealogical aspects. He produced a paper that he entitled 'Sex-heredity', and this was published in a semi-popular science journal. Another influence on his life at Cambridge was that for some time he shared lodgings with James Hilton. This budding author even then was writing prolifically and, from his example, Alan Parkes lost any inhibitions about writing that he might have had, and grew to enjoy it. This attribute remained with him for the rest of his life.

After he left Cambridge in 1921 he was accepted to study for a PhD degree under Sidney J. Hickson FRS, Professor of Zoology at Manchester University. This opportunity arose partly from his father's help but mainly as a result of his 'Sex-heredity' paper. Not surprisingly he chose the sex ratio as his subject for postgraduate research. A lot of his work was in libraries, but he was also able to extend his training by attending lectures in botany and zoology. He performed some practical work in mice, which he purchased himself from a local pet shop, and these formed the basis of a small breeding colony. He was later able to take this colony with him to University College London and to the National Institute for Medical Research, where the strain became known as the 'Parkes mouse'. It was at Manchester that his keen interest was aroused in animal and human reproduction. This was due to an opportunity for extensive reading, but also because in 1922 F. H. A. Marshall asked him to index the second edition of *The physiology of reproduction*, which he had just finished writing. So started a long and productive friendship with Marshall, who was responsible for producing the first comprehensive treatise dealing with the reproductive processes. It opened Alan Parkes's mind to many aspects of the physiology of animal reproduction. It was also at Manchester that he developed the habit of working for long hours into the night, and the capacity for hard and prolonged work remained as an asset for him in the years to come. Having completed his thesis, his external examiner was F. H. A. Marshall, and his internal examiners were S. J. Hickson and A. V. Hill FRS, who was then Professor of Physiology at Manchester. This was a lucky break because

Hill had recently been invited to become Head of the Department of Physiology at University College London (UCL), and he asked Alan Parkes to go there with him as Sharpy Scholar.

Reproductive endocrinology

There were several examples in Alan Parkes's research in which chance played a significant role in leading him to important new discoveries. The first of these was an unplanned event that occurred soon after he had moved to UCL, and resulted in a complete change in his career. At UCL he had at first been continuing his work on the sex ratio that he had started in Manchester. One experiment in mice was on the effect of X-irradiation of the male on the subsequent sex ratio at birth. It so happened that within some groups of immature male mice that were being irradiated a few females were inadvertently included. This mistake was not discovered until later when the animals were killed and dissected. A curious thing was that, although the ovarian follicles were completely destroyed by the irradiation, in a few of the females the reproductive tract was enlarged in a way similar to that of the receptive stage of oestrus. Instead of discarding this observation as an irrelevant mistake, Parkes's enquiring mind was alerted to its importance because the sexual cycle in mammals was thought at that time to depend solely on cyclic structures in the ovary, the follicles and corpora lutea. So started what Parkes described as a 'happy hunting ground' and a quest for extra-gonadal control of the sexual cycle.

This led particularly to studies on the anterior pituitary gland, and to Parkes's highly productive journey into the realms of reproductive endocrinology for many years to come. After two or three years at UCL Parkes was seized by a mania for work. He worked long into the night and often through the weekends. He even set up a camp bed for sleeping in the laboratory, and records that he was doing a vast amount of practical work and writing about 20 papers per year! He developed productive collaborations with reproductive biologists and chemists including Rogers Brambell (FRS 1949), Guy Marion (FRS 1944), Archie Fee, Solly (later Lord) Zuckerman (FRS 1943) and Ruth Deanesly, and between 1926 and 1928 published 13 substantial papers in *Proceedings of the Royal Society* series B.

Ruth Deanesly collaborated with him at UCL, especially on the histological aspects of his studies on comparative reproductive biology in British small mammals. She was the daughter of Edward Deanesly FRCS and Ida Deanesly (*née* Marston), a graduate in zoology from Somerville College, Oxford, and in 1931 she joined Parkes at the National Institute for Medical Research, where she continued to provide invaluable collaboration. They were married on 27 September 1933 at Hampstead, and had one son and two daughters.

Parkes was elected a Fellow of the Royal Society in 1933 at the young age of 32 years. This naturally brought him a sense of achievement but also caused him some embarrassments such as when he was soon put on the Sectional Committee for Zoology and found himself sitting in judgement on candidates far more distinguished than himself.

In his Dale Lecture to the Physiological Society in 1965 Parkes described the tremendous leap forward in reproductive endocrinology that had occurred between 1926 and 1940. As evidence he records that 'the naturally occurring oestrogens and androgens as well as progesterone were all isolated, characterized and their biological properties extensively investigated between 1929–1935. In addition the hypophyseal, placental and endometrial gonadotrophins were discovered between 1926–30'. Parkes said that he did not make any special contribution

to these events except, perhaps, as a catalyst. But this belittles his outstanding contribution to the whole of the biological side of the unfolding tapestry of reproductive endocrinology. He was a leader in this field in the UK in the years before the war. Later we shall note that he would look back with some nostalgia to 'those exciting times' when he and his colleagues were young, full of enthusiasm and extremely hard working, and all were playing their part in this fascinating drama.

During this burgeoning time of reproductive endocrinology, which was well supported by the Medical Research Council, Parkes investigated the question of whether the two effects caused by pituitary preparations, follicular growth and luteinization, were successive effects of one hormone or two hormones acting sequentially. He participated actively in the standardization and nomenclature for gonadotrophins extracted from multiple sources such as human pregnancy urine, human placentae and pregnant mare's serum (mostly from Welsh ponies), and he worked on the activities of oestrogens, progesterone and androgens. He used biological techniques initially but these were superseded by chemical testing once biologically active extracts had been purified and crystallized. His work on prolonging the activity of such compounds in the body led to the subcutaneous pellet method. which he saw as the forerunner of depot preparations in humans.

Much of this work developed during his time at the National Institute for Medical Research (NIMR), to which Sir Henry Dale FRS had invited him in 1932. Parkes and colleagues plus many collaborators worked on almost every aspect of reproductive endocrinology: the lactogenic hormone, prolactin; the thyroid-stimulating effects of anterior pituitary extracts and the preparation of a large-scale collection of acetone-dried human pituitaries (also with Dr Idwal Rowlands) later used in Medical Research Council (MRC) studies of human pituitary hormones; preparations of ox, pig and sheep pituitary material; and gonadotrophic activity in human urine and human placentae (human chorionic gonadotrophin). Parkes also developed methods for testing for oestrogenic and androgenic activity by changes in plumage pattern in capons. He described this as 'a beautiful test object' and compiled a wonderful collection of feathers representing different patterns of plumage, which were quite dramatic and aesthetically beautiful. In World War II he worked on hormonal induction and the stimulation of lactation in cattle and on increasing prolificacy in sheep.

As an epilogue to his time in reproductive endocrinology at UCL and NIMR, Parkes referred to it as 'those exciting days, but also different days when research was still a vocation rather than a highly organised profession'. As a consequence, because laboratory conditions were generally less strictly controlled than they are today, there was a greater opportunity for strange happenings sometimes leading to new discoveries.

Reproduction in British wild mammals

Alan Parkes had a long-standing interest in the reproductive physiology of a wide variety of British wild mammals. This was sparked off in the mid-1920s when he and Rogers Brambell realized that there was obviously a lot more to the study of reproduction than could be gained from experiments on a restricted number of laboratory animals. So they decided to start work on material that could be gathered in the field from specimens of wild animals. They obtained the material from many sources such as landowners, gamekeepers and farmers, but much of it they collected themselves on trapping and shooting expeditions. He records that they had

many interesting and amusing escapades on these field trips, and over the years they collected a great deal of material from many species including voles, shrews, woodmice, hedgehogs, squirrels, moles, bats, stoats and weasels. They were able to build up patterns of reproduction in these species by recording such things as seasonal changes in the reproductive organs, length of pregnancy, distribution of foetuses between the two horns of the uterus, and lactation as well as other observations. The laboratory work involved a good deal of histology in addition to gross morphological observations. Many colleagues collaborated with this work, which continued throughout the time that Parkes was at UCL and even after he moved to the NIMR, but was mostly completed by the mid-1930s.

He did not return to comparative aspects of reproduction until 1961, when he moved to become the founder of the Marshall Laboratory, Physiological Laboratory, University of Cambridge, where he resumed studies on a variety of other species including musk rats, coypus and chinchillas. Bob Edwards (FRS 1984), who was working in the Marshall Laboratory at that time, records that there was a veritable mini-menagerie of animals in the small animal house at the top of the physiology building. Parkes then widened interests to studies on African animals when he became involved in the work of the Nuffield Unit of Tropical Animal Ecology in Uganda, and obtained material from many species including dikdik, rock rabbit, elephant, and members of the pig family.

Cryobiology

I can write in a more personal vein about Alan Parkes's adventures into the realms of low-temperature biology, or 'Cryobiology' as it was to become known, because it was during this period that I worked with him and grew to know him quite well.

During World War II scientists at the NIMR were dispersed to take part in many aspects of work of national importance so that established programmes, such as Alan Parkes's on reproductive endocrinology, were largely disbanded. Picking up the threads after the end of the war, he took the decision to make a complete change and start a new programme of research on mammalian germ cells. In later times he sometimes joked that his decision to leave endocrinology was provoked by its growing incongruity such as the discovery that prolactin, then considered to be principally concerned with lactation in mammals, was found to be an important hormone in fish! But in reality it was his questing mind seeking new interests and challenges that set him on this new course.

The story of how the cryobiology saga unfolded is probably the best example of how Alan Parkes's keen mind was able to generate new research opportunities. First he found something that intrigued his imagination. In this instance it was seeing a brief reference in the literature to the fact that a small proportion of human sperm could survive after exposure to the extremely low temperatures of liquid gases. He realized that this approach might be developed further to prolong the life of sperm greatly *in vitro* because at extremely low temperatures chemical changes, and therefore ageing, would be suspended. Working on human semen, he himself obtained the survival of a limited number of sperm after freezing in liquid air. There was another reference in the literature, however, that a substantial proportion of fowl sperm survived freezing at −79 °C if they had first been partly dehydrated in sugar solutions. It was with a view to developing work with fowl semen that Alan Parkes invited me, who had some experience with poultry but otherwise only an ordinary degree in agriculture, to join his staff at the NIMR in 1948.

My first impressions of him were of a man with quite striking features emphasized especially by his mass of silver-white hair. He was friendly and, although he had an authoritative air, I did not find him intimidating as others sometimes appeared to do. He drove me from Hampstead out to Mill Hill in his big coach-built Vauxhall, which he referred to as his 'barouche', and showed me the Institute's farm with facilities for keeping poultry. We talked about getting artificial insemination (AI) established, but not a great deal about work on freezing semen at that time. He made it clear that he would leave me pretty well to my own devices to get the AI work going and then it might be seen what further opportunities arose. He was particularly helpful to me when starting my career, perhaps because he saw that I came from a rather similar background to his own with only a degree in agriculture, but with an open mind. To get me familiarized with laboratory procedures he asked me to collaborate with Audrey Smith, who was then working on antigenic properties of sperm. We started experiments on the storage of fowl semen at ambient temperatures, but at Parkes's instigation we also began some work on freezing. No sperm survived after many attempts to freeze semen in sugar solutions, as had been recommended in the literature. This work was therefore shelved for some time and it was not until several months later when it was resumed that we made the all-important discovery that glycerol had a remarkable property of protecting living cells against damage during freezing and thawing. The way in which this discovery was made has been described in considerable detail on many occasions, but in essence it was due to an exceedingly lucky chance occurrence in which Meyer's egg albumin, a mixture of glycerol and egg white for use in histology, was used mistakenly instead of a sugar solution to dilute the semen before freezing. When what had happened was realized it did not take long to show that almost complete recovery of fowl sperm could be achieved after freezing at −79 °C in media containing 10–15% glycerol.

This discovery then joined the ranks of the relatively large number in which chance had played an important role. The best known of these is probably the discovery of penicillin. Many others are also described in a short monograph by W. I. B. Beveridge entitled *The art of scientific investigation*. Alan Parkes read and reviewed this book in 1950 and was much impressed by it because in many ways it reflected his own philosophy of the scientist and his work. Beveridge regarded scientific investigation, as did Parkes, as a creative art and he stressed the need always to look out for the unexpected.

The unexpected was not difficult to recognize in the case of the cryoprotective properties of glycerol. Nevertheless, it was a breakthrough that Alan Parkes pursued with great vigour and it led to his own work and that of his colleagues being channelled almost exclusively into the field of low-temperature biology for the next 10 years.

At first the fertilizing ability of fowl sperm in the presence of glycerol was found to be severely reduced, but it could be restored if the glycerol was removed by dialysis. The chicks that were then obtained in 1951 were the first vertebrates in the world to be produced from eggs fertilized with sperm preserved by freezing. Alan Parkes was acutely aware, however, of the growing importance of artificial insemination in cattle breeding, and he arranged for Audrey Smith and me to undertake some work on bull semen at the laboratory of his old friend S. S. Folley at the National Institute for Research in Dairying, close to the Reading AI Centre. We discovered that few bull sperm survived if frozen relatively quickly, as was successful for fowl sperm, but good survival was achieved after much slower freezing in the presence of glycerol. Alan Parkes was impatient to push the work forward and, in the face of some scepticism, he persuaded the Agricultural Research Council (ARC) and the MRC to fund a small

mobile laboratory—in fact a converted caravan—and this was taken to the Cambridge AI Centre. He arranged that I should go and work there for two or three months. In the course of this work several modifications to the technique of semen freezing were introduced that increased sperm survival, and this then enabled insemination experiments to be carried out. These proved to be remarkably successful and I well remember telephoning Alan Parkes to tell him the results of pregnancy diagnosis on the first batch of 38 cows inseminated with frozen semen. Nearly all of these were pregnant. His immediate response was 'this is it!' And so it was, because, as he foresaw, this result heralded dramatic developments in cattle AI. After it had been shown that the fertility of semen was undiminished even after prolonged storage for up to a year at −79 °C, the technique became almost universally adopted. Within 10 years the preservation of bull semen by deep freezing became practically the only method used in AI worldwide. The growth of AI in cattle breeding became a big business involving millions of cows each year, and the use of frozen semen enabled many improvements in the service to be introduced.

However, all this was for the future. Meanwhile, laboratory work in Parkes's Division at the NIMR was making rapid progress. Audrey Smith succeeded in freezing red blood cells in media containing glycerol; although these haemolysed when transferred directly to normal media after thawing, they survived if the glycerol was removed slowly by dialysis. This work was then developed by Henry Sloviter, a visiting scientist from Philadelphia, and, in collaboration with H. A. Mollison, he found that red blood cells that had been preserved by freezing and from which the glycerol was removed retained a normal lifespan in the circulation after transfusion. The preservation of blood by freezing was too time-consuming and expensive to use in routine practice, but was feasible to use in blood banks for the preservation of rare blood groups.

In collaboration with John Smiles, a gifted microscopist in charge of the Institute's Optics Division, Audrey Smith and I designed a microscope slide on which specimens could be directly observed during the process of freezing and thawing. This represented the first step into the field of cryomicroscopy. Red blood cells and sperm in glycerol solutions were seen to be pushed into small spaces left between the growing ice crystals as the specimens were cooled. These observations were recorded on cine film and used on numerous occasions by Alan Parkes and ourselves to illustrate lectures. Nevertheless, they conflicted with the accepted theory at that time, developed mainly by B. J. Luyet in his book *Life and death at low temperatures*, that cell survival at very low temperatures was dependant on the avoidance of ice crystals by using processes of vitrification rather than freezing.

Alan Parkes was the first to recognize his limitations in knowledge and that additional scientific expertise was required if explanations were to be found for the results of our empirical experiments. At this time, therefore, an important and welcome addition to the staff was that of James (Jim) Lovelock (FRS 1974). He was a biophysicist who had a quiet and unassuming manner but a brilliant and innovative mind. It did not take him very long before he came up with the simple, but logical, explanation that the damage to cells during freezing and thawing was due principally to the increase in salt concentration that occurred when ice separated as pure water. Glycerol acted as a salt buffer and prevented salt concentrations from rising above a critical level. This theory was developed while he was working with red blood cells, but was later also shown to hold true in experiments on sperm.

Audrey Smith then attempted to freeze fertilized rabbit eggs, but only a very few survived. By contrast, the ovarian cells surrounding the eggs continued to grow in culture after freezing

and thawing and this led to experiments with ovarian tissue. The work on ovarian tissue was of special interest to Alan Parkes and he became more personally involved in this. He also started work on other endocrine tissues such as testis and adrenal cortex. It was found that subcutaneous grafts of frozen ovarian tissue in ovariectomized rats soon restored the vaginal cycle, indicating that endocrine function had been retained, but histological examination revealed that all the larger oocytes in developing follicles had been destroyed. Nevertheless, small primordial oocytes seemed to survive and developed later into normal-sized follicles. The determination of whether such oocytes were fully functional involved an elegant series of experiments devised by Parkes. Inbred strains of mice, which showed little intra-strain homograft reaction, were selected. Then, harking back to his work of the 1920s, he used X-irradiation as the most effective way of sterilizing the ovaries of prospective recipient animals without damaging the ovarian capsule. Orthotopic grafting of frozen ovarian tissue was then skilfully carried out by Delphine Parrot and this led eventually to the birth of normal young derived from the frozen grafts of mice of a different strain. Alan Parkes was disappointed that the severity of the homograft reaction precluded the use of this technique in farm animals, where it might have been possible to use it to replace embryo transfer. Nevertheless, some 40 years later, similar methods have been used in humans to preserve ovarian tissue from women having to undergo radiation therapy. Needless to say, it has been heralded as a revolutionary new therapy!

An interesting episode in the low-temperature work was a brief diversion into the realms of deep hypothermia. This was started by R. K. Andjus, a visiting scientist from Belgrade, and was later extended by Audrey Smith. Andjus found that, although heartbeat and respiration of rats ceased at temperatures below +15 °C, they could in fact be cooled to temperatures as low as +1 °C and maintained in a state of suspended animation for periods of up to an hour without loss of body function on reanimation. His methods of resuscitation involved applying local heat to an area above the heart with a hot spatula and giving artificial respiration by blowing into their lungs with a rubber tube. This method was greatly improved when Jim Lovelock developed a diathermy apparatus for warming the body from within. Audrey Smith obtained even more surprising results with Syrian hamsters, which were originally a hibernating animal. She found that they could be resuscitated even after cooling to temperatures as low as −5 °C for 1 hour, when up to 50% of the body water was frozen. A most dramatic demonstration of this was to see a hamster frozen so stiff that it could be suspended by the tip of its tail and nose without sagging when a 100 g weight was placed on its abdomen. Later the same animal could be seen running around normally after it had been reanimated.

One unfortunate spin-off from this work was the formation in the USA of organizations that offered to freeze whole human bodies after death and store them in liquid nitrogen with a view to reanimation at a later date. Needless to say, Alan Parkes declined an invitation to become the first President of one of these organizations.

Through all the time that I knew Alan Parkes he was the leader of an enthusiastic team in which he sometimes initiated but always facilitated and promoted the work of his colleagues. Gone were the times when he himself used to spend long days and nights immersed in practical work at the laboratory bench. Nevertheless, he was still a familiar figure in the laboratory when he was at the Institute. He always wore a white lab coat with the back of the collar turned up, and on most days he would drop in to our laboratories to see how things were going. At these times he usually came out with one of his characteristically shrewd remarks. But he used to say that for him ‘the pen had now become mightier than the test tube’ and he spent a great

deal of his time in his office writing. This he did with great ability. He used to compose his lectures and articles on A4 paper with a wide margin. He wrote on every other line leaving space for corrections and changes, which he made in green ink.

In those days, the media were less intrusive and persistent than today, but not surprisingly the subjects of reproduction and the preservation of living cells and tissues for long periods at very low temperatures provoked a lot of general interest. Alan Parkes was very effective in presenting this work on the radio or TV. He was also keen that all of us should be proficient at public speaking and he made us listen to recordings of our own lectures, which was a salutary exercise. He himself generally kept quite closely to his script when giving lectures because he maintained that this was the only way to convey the necessary information in a given space of time. Although this reduced spontaneity, he was still a very popular lecturer at home and abroad and he undertook several world tours.

After some years of working in the field of low-temperature biology and thinking of a term to describe our activities, Alan Parkes coined the word 'cryobiology'. This word stuck when a Society for Cryobiology was later formed in the USA and a journal was published with the same name.

His direct involvement in cryobiology finally came to an end when he moved from the NIMR to Cambridge in 1961. But this period had been one of the most productive in his life and the work was continued by Audrey Smith when she became head of a new MRC Division of Low Temperature Biology. She herself had by now moved on to work on the preservation of tissues for therapeutic grafting such as cornea and chondrocytes, the precursor cells of cartilage. She had been one of the most dedicated and innovative members of his staff involved in developing the work on low-temperature biology. She had also written a most comprehensive and authoritative review of the whole field, which she entitled *Biological effects of freezing and supercooling* and to which Alan Parkes had written the preface. He paid her a great tribute after she died when he wrote that 'he never knew a more gifted research worker or had a more welcome colleague'.

Pheromones

Alan Parkes liked to discover the broad uplands and reveal new vistas in any field of research that he undertook. This he did with spectacular success in cryobiology. He was less interested in getting embroiled in the nitty-gritty of the ensuing detail that might be described as dotting the i's and crossing the t's. He used to say that scientists should change their research interests every so often in the same way that leopards change their spots. And so it was that by the late 1950s he was already looking around for new ideas to challenge his inquisitive mind. He was therefore extremely interested when Hilda Bruce told him of her finding that pregnancy could be blocked in recently mated mice by the introduction of a strange male. Hilda Bruce had worked with him since the early 1940s on the development of new diets for laboratory animals, but by now she had become more involved in areas related to animal breeding. In the common run of events, her discovery of this block to conception in mice might have gone down in the literature as just another interesting observation. But Alan Parkes had the ability and influence to raise it to a higher plane of significance. He saw it as an intriguing new field of research and became involved in discovering how the strange male exerted its influence and the mechanism of the response in the female.

It was soon found that the smell present in their urine was the operative factor in males and, because castration abolished the effect, it seemed likely that it was due to an odoriferous steroid or breakdown product produced in the testis. However, despite considerable efforts, the exact nature of the substance was not discovered. In the female it was found that the duration of the response was from one to five days after mating, which was before implantation. It was therefore clear that the smell of the new male led to a failure of mechanisms responsible for the maintenance of pregnancy and this led to a subsequent return to oestrus in four to five days. This became known as 'the Bruce effect'.

Anyone who has entered a room containing mice in an animal house knows that they certainly do have a strong smell, but few would be able to distinguish between different mice. It was only someone such as Parkes who could think of persuading some of the most eminent perfumiers from the famous perfume houses to come to the NIMR and smell material exposed to urine of a variety of male mice. They had no difficulty in distinguishing between the smells of different strains. It became clear, however, that the olfactory block to conception was limited specifically to mice. But this did not prevent the publication by several popular newspapers of the day of cartoons depicting smell and scent as a possible form of contraception in humans.

The work on pheromones set Parkes off thinking about wider aspects of external secretions as chemical messengers and effects caused by different odours produced by different externally secreting glands in mammals. He developed his ideas even further to delve into thoughts about the importance in man, animals, birds, fish and insects of different external stimuli such as sight, sound, smell and taste. In fact it was not due to any lack of interest in the subject so much as his move from the NIMR to Cambridge that led him once again to further changes in his field of research.

Cambridge

Alan Parkes had been a close friend of F. H. A. Marshall during the later years of his life and was well aware of his wish to leave his entire estate on his death to the University of Cambridge to establish a Chair in the Physiology of Reproduction. This was subject to a life interest for his brother. Marshall died in 1949, but it was not until 10 years later that his brother died and the university was in a position to establish the Chair, which was to be known as the 'Mary Marshall' Chair after Marshall's mother. Parkes was the obvious candidate and was offered the appointment, but the move that this would entail caused him much thought and considerable heart-searchings. Leaving the NIMR would mean giving up the exceptionally good laboratory and animal house facilities that he had enjoyed for many years, as well as losing the strong support of the MRC. However, when it became clear that Peter (later Sir Peter) Medawar FRS would be succeeding Sir Charles Harrington as Director of the NIMR in 1962, it was obvious to Parkes that his position at Mill Hill would be incompatible with another biologist as Director, so he accepted the appointment in Cambridge and moved there in 1961. The facilities that the university was able to provide for him were a complete contrast from those that he had been used to. They were a small set of laboratories and animal house at the top of the Physiological Laboratory and not much technical assistance. However, Parkes was able to obtain a substantial grant from the Ford Foundation and another one from the MRC, and with these he established a small Unit. He revived his interest in comparative aspects of the phys-

iology of reproduction and got together a variety of animals to study including coypu, mink, dormice and chinchillas. Parkes had several PhD students and started to give lectures in the university. He found it difficult to establish much empathy with the Part I students, but got on better with the small group of those in Part II. However, he was greatly assisted by C. R. (Bunny) Austin, who had come to the Marshall Laboratories from Mill Hill in 1962, primarily to continue to edit the *Journal of Reproduction and Fertility*, but he also enjoyed lecturing. He and Bob Edwards took over much of the lectures and practical classes, which they made a great success. This was a good thing because Alan Parkes's interests and commitments outside Cambridge were progressively taking over more and more of his time. These extramural activities meant that he did not really make a very significant contribution to the life and work of the university but they were nevertheless an important part of his career. He retired from the University of Cambridge in 1967.

The Nuffield Unit in Uganda

At about the time that Parkes was due to leave the NIMR to take up the Marshall Chair in Cambridge he heard about plans that were afoot to set up the Nuffield Unit of Tropical Animal Ecology (NUTAE) in one of the National Parks in Uganda. This was of special interest to him because he had a long-standing interest in large African mammals. The Unit was going to be financed for the first 10 years by a grant from the Nuffield Foundation and it was to be supervised by a committee of scientists in Cambridge. Parkes was invited to join this committee. The suggested site was at Mweya on Lake Edward because Makerere College in Kampala already operated a small field station there. Parkes went out in 1961 to survey the prospects, and the Unit was duly established. This led to his spending much time in East Africa over the next 10 years. The committee appointed Dr R. M. (Dick) Laws (FRS 1980) as Senior Investigator, and with research students and other scientists several projects were soon established, particularly on hippopotamus and elephant. Parkes arranged for Gerald Clough to spend a year at the Unit. A graduate in zoology, Clough had joined Parkes's Division shortly before he left the NIMR, but it turned out he was more in his element working on large African mammals than in restricted laboratory confines. Parkes had some graphic descriptions of his harvesting reproductive material from hippos that were made available as a result of culling. This was no mean feat with such large animals!

Things seemed to go quite well with the Unit for several years under the able direction of Dick Laws, but ran into complications in 1966 as a result of organizational and human problems. First, Dick Laws indicated that he wished to leave after his five-year contract was completed; there were also other staffing changes. Parkes went out to Uganda in 1966 to try and sort things out and, after much skilful negotiating and planning, succeeded in stabilizing the situation principally by establishing a Co-ordinating Committee representing the various interested parties. The Co-ordinating Committee appointed Keith Eltringham as the Director of NUTAE in 1967 and he remained there until the end of the Nuffield connection in 1971. The Unit was then taken over by Makerere College and the Uganda Parks Trustees.

The green sea turtle farm

Even when he was well over 70 years old Alan Parkes was still extremely active and full of enthusiasm for new challenges. It was no surprise, therefore, when he became much involved during the 1970s with a project on the captive breeding of green sea turtles. On a visit to Grand Cayman Island in 1971 he was interested to see that a turtle farm was being established along one of the bays. On further inquiry he found out that it was being run by a company called Mariculture Ltd (MCL), an offshoot of Buxted Chicken. By chance he discovered that his old friend, Professor Emmanuel ('Amo') Amoroso FRS, had already been invited by one of the directors of MCL to help with the turtle breeding project and Amo asked Parkes to join him. This led to Parkes's becoming responsible for advising on breeding and husbandry while Amoroso dealt with incubation and embryological problems. The turtle farm certainly needed help because none of the turtles kept in captivity for the previous 3 years had shown any sign of breeding. On further visits to Grand Cayman the first thing Parkes did was to autopsy a number of animals. He found that the testes and ovaries of a few turtles that had been caught in the wild were very active, whereas those of animals kept in captivity were quite quiescent. This made him wonder if the problem lay in the unstimulating conditions and lack of competition in the breeding pool, where the turtles were kept in close confinement for long periods. He was well aware from his earlier involvement with the Breeding Policy Committee of the London Zoo that social environment was extremely important in the sexual activity of other animals kept in captivity. And this indeed proved to be true for the turtles as well. He found that by introducing a few adult males caught in the wild into the breeding pool, the wild males soon started mating with the females, and previously inactive captive males were stimulated to do the same. This led to the production of many fertile eggs and hatchlings. In later years, Parkes was able to develop a breeding strategy in which males and females were first separated and then introduced into the breeding pool in small batches. This led to very successful breeding among the captive turtles and produced results comparable to those achieved in the wild.

Nevertheless, in succeeding years the turtle farm became much criticized and aroused a great deal of antagonism from environmentalists and conservationists, particularly in the USA. This was strengthened by a visit from a specialist group acting for the International Union for the Conservation of Nature, who concluded that MCL were making little positive contribution to conservation. Parkes himself became much involved in this controversy and pointed out that little recognition had been made of the fact that the first successful breeding of green sea turtles in captivity had been achieved. He maintained that captive breeding was probably the only lifeline for this interesting and ancient species, which was becoming progressively threatened by hunting and the growth of tourism destroying the nesting beaches. These problems and also some mismanagement of the turtle farm led to its eventual demise.

Societies and journals

Many of those who knew Alan Parkes will remember him best for his close association with the Society for the Study of Fertility (SSF) and as the driving force behind the establishment and management of the *Journal of Reproduction and Fertility* (*JRF*). In the late 1930s he and some of his colleagues, particularly Solly Zuckerman, had successfully launched the *Journal*

of Endocrinology and later founded the Society for Endocrinology, which had close links with the journal. But he was even more deeply involved in founding the SSF and establishing the *JRF*.

The origins of the SSF can be traced to the summer of 1944 when six or seven people, with common interests in problems of reproductive physiology in humans and animals, met for a small informal meeting at Exeter. This was supported by the Family Planning Association. The principal organizers were Margaret Jackson, who was a gynaecologist and was the first to practice artificial insemination by donor (AID) in humans, and Arthur Walton, who was much involved with the development of AI in farm animals. A second meeting was held a year later at the Animal Research Station in Cambridge, and Alan Parkes joined the group at that time. These informal meetings continued on a yearly basis until 1949, when it was decided to form a more structured society to be known as the Society for the Study of Fertility. An inaugural meeting was held at the Zoological Society of London in 1950, and Alan Parkes was elected as the first Chairman. The membership grew from about 50 at the inaugural meeting to over 1200 at its peak in 1990. The interests of the Society changed also. Initially the main emphasis was on clinical and veterinary aspects of infertility, but as the number of people working in the field expanded so the interests of the Society became much more broadly based on the physiology of reproduction in animals. Alan Parkes worked hard for the Society, overseeing its early growth and acting for two terms as Chairman and one as Secretary. During this time he established the Marshall Medal in honour of F. H. A. Marshall, the 'father' of reproductive biology. This was awarded annually by the Society to a recipient who had made a notable contribution in reproductive biology. He also established an important series of international conferences on comparative aspects of reproductive biology in animals.

The proceedings of the early meetings of the Society were published in various forms, but by the mid-1950s there were growing discussions about establishing a more formal quarterly journal that, with the help of a Wellcome Trust guarantee of £2000 towards any probable early losses incurred by a new journal, became known as the *Journal of Reproduction and Fertility*. Parkes drew on his previous experience with the *Journal of Endocrinology* to establish a structure for running the *JRF*. It was incorporated in 1960 as The Journals of Reproduction and Fertility Limited, a company limited by guarantee but which had no share capital. The first members of the company were a few senior members of the Society who became the Council of Management. Parkes became the first Company Secretary, and C. R. Austin was appointed the first editor of the *JRF* supported by 12 members of an editorial board. Later, J. S. Perry, who had worked on the editorial staff of the *Journal of Endocrinology*, was appointed associate editor. The journal grew successfully, particularly during the time that Barbara Weir was editor and Margaret Herbertson was Company Secretary. On the initiative of Parkes it was extended to include supplements, which were mainly proceedings of specialist meetings and conferences. Subsequently, it was arranged that the Journal Company should act independently as its own publishers and appoint separate printers and distributors. By now, Parkes decided that after 15 years he should retire from direct involvement with the company and journal. Since its inception he had been responsible for guiding its early growth and had worked extremely hard to establish a financially sound company running a successful and prestigious scientific journal.

His involvement with scientific publications did not end with the *JRF* because in 1968 he was also responsible for launching the *Journal of Biosocial Science*. For many years he had been associated in one way and another with the Eugenics Society, which used to publish

Eugenics Review. In the late 1960s it was decided that this publication should be superseded by a new journal. It so happened that at about that time Parkes had been fortunate in putting together quite a substantial sum of money to establish a fund in memory of his father and brother, the E. T. and R. Parkes Fund. Income from this fund was used in part to support a new journal. This was done by creating a new body known as the Galton Foundation, now the Parkes Foundation, with the objective of promoting biosocial sciences, and it was the Galton Foundation through which the *Journal of Biosocial Science* was published. Parkes was responsible for running both the Galton Foundation and the journal, of which he was Executive Editor supported by an editorial board.

In 1962 Parkes gave much help and advice to Don Casey in establishing yet another journal. Don Casey was a young man, the son of the Governor-General of Australia, who, after completing his degree in agriculture at the University of Melbourne, decided that he wanted to do 'the big thing'. He chose to get involved in work on the world's population problem. He met Parkes by chance in India and mentioned that for some time he had been thinking about publishing a list of literature on reproduction but did not know how to go about it. Parkes invited him to come to Cambridge, where he might be able to help. This led to the establishment of Reproduction Research Information Services Ltd, a company set up on similar lines to that publishing the *JRF*. The company published a monthly listing of the world's literature on reproduction in vertebrates including humans. It was a very successful venture for many years until it was overtaken by the age of the computer.

Committees

It was perhaps Alan Parkes's propensity to 'have a go' at anything that seemed interesting that led him to become a member of 35 different committees and advisory groups over the years. He said himself that he did not think he was a particularly effective committee man, but what he was good at was a propensity for hard work, organizing ability and the development of innovative and constructive ideas. He could often best promote his ideas through the office of secretary or chairman.

The interests of the committees on which he served ranged over many topics from the MRC's committees on the sex hormones in the 1930s to the British Egg Marketing Board's Scientific Advisory Committee in 1961. Here his experience in having already established several scientific journals enabled him to give much help and advice on starting the publication of British Poultry Science and the Directory of Poultry Research. After World War II he served on several ARC Technical Committees on Infertility in Cattle, Poultry Research Problems and Endocrinology. Of special interest was his membership of the Zoological Society's Breeding Policy Committee, which set up the Institute of Comparative Physiology at the Zoological Society, London, with funds from the Wellcome Trust. His old friend and colleague, Idwal Rowlands, was appointed the first Director. This committee was also much concerned with work on the conservation of rare breeds and was the forerunner of the Rare Breeds Survival Trust.

In 1962 he became involved with the work of the World Health Organization's Scientific Groups. This marked the WHO's first involvement in family planning matters, which had previously been blocked by countries with a strong Roman Catholic tradition. Alan Parkes was asked to give advice on establishing specialist groups to report on topics related to

reproduction, especially in humans. He was particularly pleased when R. T. Hill, an old friend and colleague, was appointed a full-time member of the Maternal and Child Health Committee to advise on human reproduction work. Parkes also served on the WHO's Advisory Committee on Medical Research and led discussions on family planning and contraception.

The Royal Society set up a Population Study Group in 1965. The Chairman was Lord Florey (FRS 1941), then President of the Royal Society; Alan Parkes and Geoffrey Harrison served as joint secretaries. Bob Edwards, who was a member of the Study Group, remembers that Lord Florey was somewhat embarrassed by the ironic situation of chairing a group to consider population problems when he himself, through his work on penicillin, had been responsible for saving millions of lives and enabling a larger number of people than hitherto to live long enough to reproduce. Bob Edwards also remembers that it was Parkes's hard work and commitment that was the driving force behind this group. Parkes's association with Geoffrey Harrison led to the development of much mutual respect and friendship and resulted finally in Harrison giving an excellent and thoughtful oration on Alan Parkes's life and work at his funeral in 1990.

Population and family planning

Parkes's involvement with the WHO and the Royal Society's group on population problems was a reflection of his long-standing interest in population studies and in practical and social issues of human reproduction. He became particularly concerned with the prospect of a 'population explosion' resulting from rapidly increasing birth rates in several parts of the world. He could see that naturally limiting factors to population growth were being eroded, especially by the advance of medical science in overcoming many diseases. There was growing anxiety about the effects on food supply and also a growth of understanding that the only long-term solution lay in birth limitation. He became a member of the Biological and Medical Committee of the Royal Commission on Population in the 1940s and was involved with the Committee on Contraception set up by the Royal College of Obstetricians and Gynaecologists. He was introduced to the work of the Family Planning Association (FPA) in the 1950s. He considered that his most effective contribution to the FPA was in setting up the Oliver Bird Trust, which was concerned with clinical assessment of the acceptability and effectiveness of contraceptives as well as sponsoring a series of important lectures on fertility control. He also became very much involved with the work of the International Planned Parenthood Federation (IPPF) and its conferences. His first introduction to these conferences was in 1955, when Gregory Pincus heralded the birth of oral contraception. He took an active part in most of the subsequent conferences on global population problems and was Chairman of the Basic Science Committee. The IPPF sponsored a series of Biomedical Workshops started in Cambridge in 1972 and also sponsored a short but informative monthly review on 'Research in reproduction' edited by Bob Edwards.

Looking back on his involvement with population problems, Alan Parkes considered that his main contribution was as a catalyst through his thinking and writing on this subject for over 40 years. He did claim, however, that his early work in endocrinology had laid the foundations for the depot administration of anti-ovulatory steroids and to methods for post-coital contraception. Some of his ideas were somewhat controversial because he supported the use of induced abortion as a back-up when other methods of contraception had not worked or were

not used for one reason or another. He also questioned the morality of developing expensive methods of curing infertility in individuals in the context of wider community concerns on population growth.

For some years he had been collecting data and organizing his ideas about effects of human population growth, particularly on the environment, which he intended to publish as a monograph. He never finished this manuscript, but after his death Frances Dennis, who had been a member of IPPF, was able to pull it together and update the data. This was published with his chosen title of 'Backlash'.

Publications

Alan Parkes had what he termed an 'itchy pen', and he was a prolific writer. His collected works comprise 12 large volumes, which are housed at the Royal Society. These papers range over a wide area from his work in the early days to the much wider and more philosophical areas of interest that he developed in succeeding years.

He wrote several books. The first, published in 1928, was *Internal secretions of the ovary*. In 1966 he published a free-ranging collection of some of his addresses, lectures and articles, which he entitled *Sex, science and society*. This was delightfully illustrated by A. G. Wurmser. In 1976 he published a monograph entitled *Patterns of sexuality and reproduction* and in his last years he published two large autobiographical books, *Off-beat biologist* and *Biologist at large*. The first was about his life and work and the second was about his travels and other interests. One of his largest tasks was to edit the third edition of Marshall's *Physiology of reproduction*. Marshall, who died in 1949, had had plans to publish an updated version of the second edition of his book that had last been revised in 1926. But the war intervened and it was not until the early 1950s that Parkes took on the major work of editing a third edition. Much had happened since the mid-1920s and work on reproductive physiology had greatly expanded. It was a huge task therefore to get authors to produce chapters for an updated version that eventually ran into three volumes and was published over several years.

Personal

Some people thought that Parkes was so much involved in the many activities associated with his work that he had little time or inclination for other interests. But this is very far from the truth. Even when he was working extremely long hours in the laboratory at UCL, he and a friend would find time to go off on some unusual sort of holiday. At one time they took a trip on a fishing trawler in the North Sea. At others they went on freighters calling at ports around Europe. He records that on one occasion when in Barcelona they went to a night club that had a band and dancing. For some reason the drummer in the band had to leave and Parkes volunteered to take his place. Although he had no special musical skills, he had a very good sense of rhythm and he was also familiar with drum sets. He acquitted himself well, which got him much applause. He and his friend were told later, however, that the music and dancing were only a front for the club, and other activities took place in the back. This prompted him in later years to suggest that he was probably the only Fellow of the Royal Society to have played the drums in a brothel in Spain!

By contrast, other holidays were taken nearer home and were less exotic. For many years he liked to hire camping punts on the Thames and he became very proficient at manoeuvring these rather cumbersome craft through many different conditions of waters. He said that over the years he had pushed a camping punt over practically every stretch of the Thames between Teddington and Cricklade. This experience with punting stood him in good stead when he and Brambell took a punt loaded with traps on an expedition to catch water voles for their comparative reproduction project. His love of boating remained with him for the rest of his life, and he and his family owned a motor cruiser, which they kept first on the Thames and later on the Cam when they moved to Cambridge.

Parkes was always a loner and for this reason he had very little interest in team games. He had enjoyed athletics at school, but he could see little sense in grown men getting pleasure from chasing a ball around a field. When I worked with Parkes at the NIMR I used to play a lot of hockey for a London Club. On one occasion I was unable to get to the laboratory for several days as a result of a bad knee injury. When I returned I heard Parkes murmuring under his breath, probably half in jest, something about injuries sustained at games being equivalent to a self-inflicted wound in the army!

He always enjoyed pyrotechnics and got a lot of fun from making loud explosions. This started when he was at school and he made a gunpowder known as 'Parkite'. The love for explosions persisted and I remember being invited to a fireworks party at his home in Mill Hill where the *pièce de résistance* was the firing of a magnificent brass cannon borrowed from a friend at the Institute. His son, John, also tells of his father's attempts to blow up a large tree stump in the orchard of a house that they owned in the country.

As his family grew up, and during the years immediately after the war when conditions were still extremely stringent, he became very proficient as a handyman. He would always have a go at doing things himself and he undertook quite large projects such as making chicken houses and a pig pen for the animals they kept. Later, when he wanted to lay some concrete paths, he did not hire a cement mixer as others might have done, but he bought an old derelict one, which he and John got going. He also became extremely interested in bee-keeping and built up quite a big apiary.

He liked to organize parties, both at his home and in the laboratory. I remember some of the laboratory parties best not only for the strong drink that was served but as occasions when the staff got to know each other in a relaxed atmosphere.

Although he had this sociable side to his character, he always retained a somewhat 'Victorian' attitude to etiquette and behaviour that was probably a result of his fairly strict upbringing as a boy. For example, I remember once when I knew I would be a little late coming into the laboratory in the morning, I left a note on my desk for my technician saying, 'David—please will you do [such and such] before I come in.' Parkes must have seen this note and later called me into his office, where he said, 'Polge, never refer to your technician by his Christian name as this leads to familiarity and lack of discipline in the laboratory.' Although this was standard practice at that time, I am sure he changed this attitude as the social structure was broken down after the war, but it was perhaps this stricter side to his character that sometimes made people quite scared of him. It was also due to the fact that he never suffered fools gladly and he was capable of being quite critical and making scathing remarks in his characteristically gruff voice. But to my mind all this was redeemed by his appreciation of good work and his overwhelming Lancashire sense of humour. He had a strong sense of justice and in 1952 led a campaign for equal pay for MRC staff whether or not they were medically qualified.

Parkes described himself as having been incredibly lucky in his career. He said, 'I stumbled into reproductive biology when it was in its infancy. Before this went sour on me I was stirred up by World War II, then by the freezing saga, contact with the FPA and IPPF, WHO, new Societies, new Journals, Bruce's olfactory block to conception, the move to Cambridge, NUTAE and finally the turtle farm in the Caribbean.' Be it luck or hard work, this description reflects the breadth of his interests and of his contribution to science.

During his life he received many awards and prizes, which culminated in his knighthood. But he never sought distinction although, above all, he valued his Fellowship of the Royal Society, of which he became one of the longest-serving members.

In his obituary notice to F. H. A. Marshall, Parkes wrote:

> Scientists are of many kinds, but inspiration flows most fruitfully from those who are able, by some gift withheld from other men, to define the richness of uncharted country and sense the vital landmarks. Thus do they avoid the barren places and the morasses of unimportant detail which engulf so many. To these, discovery is an art rather than a science, a matter of instinct rather than intellectual machinery. Such was Marshall.

This description applies even more aptly to Parkes himself, to whom there could be no better tribute.

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Bibliography

A full bibliography is available as electronic supplementary material at http://dx.doi.org/10.1098/rsbm.2006.0019 or via http://www.journals.royalsoc.ac.uk.