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BIOGRAPHICAL MEMOIRS

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Arthur Mourant had an unusual career in which he managed to combine his first passionate interest in geology and prehistory with his subsequent medical training and interest in the geographical and racial distribution of human blood-groups. Although it was the work associated with blood-groups that was to bring him international recognition, it was undoubtedly the anthropological rather than clinical aspects of blood-transfusion medicine that most appealed to his imagination. He was devoted to his native island of Jersey and throughout his life continued to take a lively and active interest in the geology and archaeology of the island.

Background and early education

Arthur Mourant was born on 11 April 1904 on Jersey on a farm, situated two hundred yards from the megalithic tomb of La Hougue Bie, with which he was later to be closely associated. The families of both his mother and his father were devout Wesleyan Methodists of some generations' standing. The Mourant family have lived in Jersey since at least the year 1309 and in more recent times have nearly all been farmers. Arthur Mourant's grandfather, Charles Mourant (1814–1920), of Croix es Mottes, St Saviour, was one of the leading breeders of the now world-famous Jersey breed of cattle. He married Jane Elizabeth Bisson, who was said to be a woman of remarkable character. She had eight children and although she herself had not had an extensive education she understood the value of learning. Her son, Ernest Mourant,

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Arthur's father (1872–1958), apparently did not share her love of learning in his early years. At school he showed little interest in literary subjects and when his teachers wished to promote him to the top form he asked that this should not happen as it would give him too little time to help on his father's farm! He was a practical man who, throughout his life, was interested in all aspects of farming and horticulture, but most of all in cattle. He left the Channel Islands on only three occasions, once to visit Southampton, once to visit London and once to visit the great International Exhibition in Paris. He married Emily Gertrude Bray in January 1903. She was descended from a colony of immigrants who, in about 1800, came from Devon and Cornwall to the then prosperous little seaport of St Aubin. Because of their relatively recent English descent Arthur's mother's family spoke only English and belonged to the English circuit of the Wesleyan Church, whereas his father's family attended a chapel that was part of the French Wesleyan circuit, where all the worship was conducted in French. Only a chance interchange of choir members led to the meeting of the two families.

Arthur had two siblings: a brother, Wilfred, born when he was two years and seven months old, and a sister, Leslie, born when he was nearly seven. The life of the family was dominated by the work of the farm and the Wesleyan Methodist Church, and the religious atmosphere in the home was very strong. Despite loving parents, the extreme puritanical morality based on the Wesleyan evangelical doctrines, including the ideas of hell-fire preachers, was accepted in the home and inculcated into the young children in chapel and at Sunday School. From the age of five Arthur was taught to read and write at home. It was apparent that he was a gifted child and he soon became a fluent reader. His formal schooling started when he was seven, when he attended a small private school where he received a very thorough grounding in arithmetic and French grammar. Early on, he experienced feelings of guilt when he found that he preferred day-school to Sunday School and chapel, both of which to him seemed rather boring and frightening. His introduction to natural science came when he was about nine years old through publications such as Arthur Mee's *Children's Encyclopaedia*, which his maternal grandmother bought for his older cousins. At the age of twelve he moved from the local dame school to the Jersey Modern School in St Helier. The headmaster, W.L. Clift, was a BA of London University and a Fellow of the Royal Geographical Society but none of the other masters held university degrees. Nevertheless, Arthur had fond memories of one teacher, C.J. Piquet, who taught him algebra and introduced him to the delights of solving first simple and then quadratic equations. Elementary science, chemistry and heat-and-light he learned mainly from books and experiments done at home. He rapidly outstripped his peers and when at the age of thirteen Arthur sat the junior examination of the College of Preceptors he took third place in the UK. This success persuaded him that he wanted to pursue an academic career rather than follow the family tradition of farming; in January 1919 he was sent as a day boy to Victoria College, the local public school. He was not good at games and fervently disliked the Officers' Training Corps (OTC), two aspects of public school life that, in that immediate postwar period, were very conspicuous parts of the public school curriculum. In consequence he did not as a whole enjoy his time at college. However, the great compensations for all the unpleasant experiences were the science lessons. One of his masters, A.J. Robinson, who taught physics and chemistry, was particularly influential. He was appointed during the war because he was unfit for military service; he had a lisp, a quick temper, was almost blind in one eye and was a poor disciplinarian. Nevertheless, those boys who had any interest in science received great encouragement from him both at school and outside it in geological and botanical rambles. He encouraged Arthur to learn from books

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and inculcated the importance of laboratory work. The two men were to remain lifelong friends.

University education

In July 1922, Arthur Mourant left school full of academic honours, having won a Channel Islands (King Charles I) scholarship to Exeter College, Oxford, to study chemistry. Hence in September that year he left Jersey for the first time and soon settled into the academic life of Oxford, where the atmosphere was more to his liking than that at school because he was now able to devote himself to science, free from what he saw as the unpleasant distractions of games, the OTC and less relevant studies. His tutor was H.R. Raikes and he attended lectures by such eminent chemists as C.N. (later Sir Cyril) Hinshelwood (F.R.S. 1929) and F. Soddy, F.R.S. However, among the many lectures he attended, those given by T.V. Barker on chemical crystallography were to be particularly influential, and in his autobiography Mourant (13)* described the first of these as 'perhaps the most exciting intellectual experience of my whole undergraduate career, revealing a completely new world to me'. Chemical crystallography became his special subject in his final examination and, in parallel, he was developing an interest in the geology and archaeology of Jersey, an interest sparked off by his old teacher, Mr Robinson, and the influence of Dr R.R. Marrett, a prominent personality in Jersey and a Fellow of Exeter College with whom, during the summer vacation in 1924, Arthur participated in the excavation of the great mound of La Hougue Bie. This tumulus, situated two hundred yards from Arthur's birthplace, is considered to be one of the finest Neolithic passage graves in western Europe. He was among the first to enter the tomb and, being a keen photographer, took the first photographs of the interior.

In 1925 Arthur sat his final chemistry examinations with chemical crystallography as a special subject and obtained a BA degree. However, to qualify for honours he spent a further year doing research on the dehydration of the zeolite mineral thomsonite, and his thesis earned him first class honours. This success brought the award of a senior King Charles 1 (Channel Islands) Scholarship and the Burdett–Coutts University Scholarship in geology. He chose geology as the subject for his DPhil degree and decided to work on the Precambrian volcanic rocks of Jersey; later, however, he extended his work so as to map the rocks of all the Channel Islands, as well as to examine related rocks in Normandy and Brittany. He also took time to investigate the earthquakes that were then affecting the Channel Islands and he added to his thesis a chapter on their seismicity. His investigations were typically thorough; he diligently searched the records of Channel Islands' earthquakes and used the local papers to solicit information from the islanders, an activity that resulted in his being referred to locally as 'Earthquake Mourant'.

For some time before going to Oxford, Mourant had been wrestling in his mind with conflict between his strict Methodist upbringing and how to reconcile this with the facts of the geological and biological sciences. At Oxford he came to accept the scientific account of nature and rejected the miraculous teachings of Christianity. He trod carefully, however, out of respect for the views of his family; his sister Leslie was a lifelong Methodist and a respected lay preacher.

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

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Brief career in geology, 1928–31

In 1928 Arthur Mourant applied for the post of Demonstrator in Geology at the University of Leeds. He was successful in his application but did not find the position satisfying and in December of that year he secured one of two posts offered by the Geological Survey: the other was taken by Dr G.H. Mitchell (F.R.S. 1953). He took up his appointment in 1929 and was sent to work at the Manchester office under W.B. Wright, the District Geologist. After instruction in the techniques of geological mapping, Mourant was put to work on part of the Lancashire coalfield around Chorley. He found the work dull, largely because there were few exposures of solid rocks in the blanket of boulder clay, in marked and depressing contrast to the magnificent coastal exposures of the Channel Islands. It was also very lonely work. He sought relief by exercising his research talents and following up points of interest, but he did so at the cost of the area of ground surveyed and this was ultimately to count against him.

Arthur Mourant was seconded to the Geological Survey's Geophysical Unit in 1930, which at that time was undertaking a gravity survey in Charnwood Forest in Leicestershire. It was a period of intense physical and intellectual activity, performed in the company of two Scotsmen, W.F.P. McClintock and J. Phemister, who drove themselves and their staff very hard. Personal relations between Arthur Mourant and the two men became strained and the immediate outcome was that he was informed by Sir John Flett (F.R.S. 1913), the Director, that his work was unsatisfactory and that his services would not be required at the end of the customary two years' probationary period: Arthur resigned his post in 1931. The quality and thoroughness of his work was never in question and the main reason for dissatisfaction was that while working on the Lancashire coalfield he had not surveyed a sufficiently large area.

The economic recession of the 1930s was at its deepest when Arthur left the Geological Survey and, surprisingly for one of his abilities, he was unable to find employment. It was a major setback in what had been, until leaving Oxford, a glittering career; he felt a failure and returned to Jersey to live with his parents. However, freed from other responsibilities he set to work to complete his doctoral thesis and was awarded his DPhil by the University of Oxford at the end of 1931.

It was at this time that Alfred Wegener's hypothesis of continental drift, first advanced in 1912, was re-emerging in the English-speaking countries. While at Oxford in 1923 Mourant had encountered the idea from Milan W. Garrett, an American Rhodes scholar who, unlike many other geologists, was convinced of its validity. Accordingly, drawing on the knowledge of British Upper Carboniferous rocks and their faunas that he had acquired during his service with the Geological Survey, he submitted in 1932 a proposal for a Commonwealth Fellowship that would test the continental drift hypothesis. The plan entailed a study of the 'Pennsylvanian' (Upper Carboniferous) rocks of the eastern USA and a comparative study of the non-marine bivalve fossils from both sides of the Atlantic. Dr Carl O. Dunbar of the Peabody Museum of Natural History at Yale agreed to his working in his department but the American geologists were, if anything, less receptive to the idea of continental drift than their British counterparts; his application was unsuccessful. He was decades ahead of his time but he lived to see even staunch opponents of the continental drift theory concede its validity, and the study he had proposed in 1932 came to fruition at the hands of Dr R.M.C. Eagar, who showed in 1970 that many Carboniferous non-marine bivalve fossils were of the same species on both sides of the Atlantic.

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His pursuit of geological employment continued. Initially he had an academic post in his sights but he also applied unsuccessfully for many posts as a schoolmaster; unfortunately he was perceived to be overqualified and was not wanted. He never again held a position in geology, although he retained an absorbing interest in the subject. It was most unfortunate that neither of his two posts in geology suited his abilities. He had the lively questing mind of a natural research worker, and neither the tedium of teaching elementary geology nor the dogged task of geological mapping in an area of poor exposure appealed to him. The geological sciences thereby lost a gifted scientist who, given the right conditions, could have made an outstanding contribution.

The intermediate years, 1933–38

In 1933, through the Oxford University Appointments Committee, Arthur Mourant obtained a post as travelling tutor to an American student and accompanied him on a year's tour of Italy, Germany and France. During this time he added German to his fluent French and saw at first hand the onset of the Nazi regime in Germany, even going to a meeting in Munich addressed by Hitler. His experiences in Germany alerted him to some of the complexities of the history of the Jewish people, in which he was years later to be scientifically involved.

On his return to Jersey, still unemployed, an old school friend who had become the Mourant's family physician, Dr Graeme Bentliff, suggested that on the strength of his qualification in chemistry Arthur should set up a private chemical pathology laboratory. The laboratory was to be in Dr Bentliff's house, in which there were several other specialist medical clinics. At that time there were neither public nor private laboratories in Jersey able to perform the relevant tests. After a short course in chemical pathology techniques at the Middlesex Hospital, Mourant returned to Jersey and for the years 1935–38 settled down to a steady routine of laboratory work, providing a service on the island that had not previously been available. It is fitting that the new pathology laboratory at the General Hospital in St Helier, which was opened just before Arthur died in 1994, was named after him.

During the period in which he ran the laboratory Arthur got to know the local doctors well and became interested in medical problems. He also became aware of the shortcomings of his own emotional life and sought to diagnose his condition by reading works on psychology. He had a few sessions with psychoanalysts; these influenced his plans for a future career. Early in 1938 he decided to become a medical student with the ultimate aim of becoming a psychoanalyst.

Medical studies, 1939–43

Encouraged to pursue a medical career by the doctors in Jersey, Mourant obtained a place at St Bartholomew's Hospital Medical College and he moved to London in January 1939. To defray in part the costs of medical training he taught chemistry for two days a week in the biochemistry department. The German invasion of the Channel Islands in 1940 meant that Arthur Mourant was on his own in England, cut off from his family and with very limited funds. He led a very frugal life but one of the compensations was that, freed from the religious

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and social restraints imposed by his family, he was able to develop much more satisfying social relations with his fellow students than had been possible when he was a student in Oxford. Nevertheless he was greatly worried as to how the Germans were treating his family and was pleasantly surprised years later to learn that the treatment of the islanders had been, for most of the time, correct and humane.

In March 1940 Mourant passed the examinations in anatomy and physiology and became a clinical student. At the end of 1940 he also began a course of psychoanalysis with Dr Dorothy Burlingham and although this helped him to understand himself better he was informed that he was not considered suitable for further training as a psychoanalyst. It is unclear whether this decision came as a great blow to him but he qualified in medicine in March 1943 and decided turn his mind to a career in medical research.

North London Blood Supply Depot, Luton, 1944–45

Arthur Mourant's introduction into the blood-group field took place immediately after he had completed posts as house physician at Chase Farm Hospital, Enfield and as house surgeon at Friern Hospital, New Southgate. When World War II had broken out in 1939, the British government's medical advisors foresaw that large numbers of blood transfusions were likely to be needed for military and civilian casualties: several blood transfusion centres were set up to cope with this eventuality. In February 1944 Arthur Mourant was posted under wartime regulations as a junior medical officer to the North London Blood Supply Depot at Luton, Bedfordshire, which at that time was directed by Dr H.F. Brewer, who had been seconded from his peacetime post as haematologist at St Bartholomew's Hospital. Arthur was assigned various duties, including driving vans with portable bleeding equipment to local hospitals and collection centres, bleeding donors, and performing ABO grouping on donated blood. Professor David Finney, F.R.S., recalls that, as a young mathematician working at Rothamsted Experimental Station during the war, he first met Arthur Mourant when he was bled by him during a blood donation session at a Luton hospital. The two discovered a mutual interest in blood-group genetics and thereafter remained on friendly terms.

The Rhesus blood-groups had been discovered by Levine & Stetson (1939) and Landsteiner & Wiener (1940) in the USA and shown to be of considerable clinical importance in relation to haemolytic disease of the new-born. However, in 1944 Rh tests were performed at the Luton depot on only a limited number of donor samples with what is now known as anti-D serum. In an article in *Vox Sanguinis* (12), written in 1983, describing how he came to identify the Rhesus antibody 'anti-e', Arthur records that Rh tests at Luton were performed by the chief technician, a Mr Hudson, who also conducted compatibility tests if these were demanded by the hospital performing the transfusion. Arthur persuaded Mr Hudson to teach him how to do Rh testing and he also studied closely the literature then available on the Rh blood-groups. The hypothesis put forward in 1944 by the distinguished Cambridge geneticist, Professor R.A. (Sir Ronald) Fisher, F.R.S., together with Robert Race (F.R.S. 1952), who had performed fundamental work on antibodies associated with the Rh system, postulated that the system resulted from expression of pairs of alleles *C* and *c*, *D* and *d*, *E* and *e* at three closely linked loci. At that time, antibodies corresponding to four of the proposed alleles *C*, *D*, *E* and *c* had been identified (although not given those names) and Fisher recognized that two of them, subsequently called anti-C and anti-c, gave antithetical reactions with red blood

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cells and therefore were probably detecting the products of simple alleles. The other two antibodies, anti-D and anti-E, did not bear any simple relationship to each other and Fisher assumed that they were reacting with the products of genes whose alleles, *d* and *e*, had not yet been recognized. This simple explanation has served well over the years for Rh grouping, although it is now known to be only partly correct. An alternative nomenclature for the relationship between the various antibodies associated with the Rh system had been devised in the USA; controversy over the different notations had led to considerable confusion before the Fisher hypothesis was advanced. Unfortunately the problems concerning nomenclature were not to be resolved in the lifetimes of any of the major players in the initial discoveries of the Rh system. Arthur Mourant records (12) that, although he had grasped the basic points of the Fisher hypothesis, it was during an attack of influenza in the winter of 1944/45 that he clearly came to understand the Rh system. He had become unwell while out from Luton with a mobile bleeding team; during a fifty-mile return journey at the end of the day in the wartime blackout, wrapped in blankets on the floor of a converted Ford delivery van, he found that his mind had become particularly clear. He mentally reviewed the genetics of the Rh system and discovered he was able to relate the Fisher theory and notation to other theories and notations advanced by A.S. Wiener in the USA and from then on he was able to discuss the subject without hesitation. At about the same period a transfusion-dependent patient suffering from chronic haemolytic anaemia was under investigation at St Bartholomew's Hospital and was found to have in his serum an agglutinin that failed to react with the red cells of about 4% of group O donors. Arthur requested permission to investigate this antibody and eventually concluded that the serum contained the anti-e predicted by Fisher and Race (3). According to this hypothesis, eight different gene complexes *CDe*, *Cde*, *cDE*, *cde*, *cDe*, *cdE*, *CDE* and *CdE* can be assembled; with the identification of anti-e all the expected interactions were confirmed. Thus this discovery provided important support for the Fisher hypothesis. The serum was used for investigations of genetic problems and for clinical cases of haemolytic disease of the new-born and for some years was the only available source of an antibody with this specificity. The patient gallantly allowed himself to be re-immunized to maintain the titre and was awarded a special grant by the Oliver Memorial Fund for his services to blood transfusion. The sixth antibody, anti-d, predicted by the Fisher hypothesis, has never been found and now that the molecular genetics of the Rh system are finally being unravelled in the 1990s it has become clear that although the D antigen is indeed the product of one of two closely linked structural genes encoding the Rh antigens (the other gene encoding *CcEe*), the *d* allele at this locus does not give rise to an antigenic product.

The Galton Serum Unit, Cambridge, 1945–46

A few years before World War II a group of workers that included G.L. Taylor, Robert Race, Elizabeth (Jan) Ikin and Aileen Prior, highly respected names in the annals of ABO blood-group serology, had begun work on blood-group genetics in R.A. Fisher's Galton Laboratory at University College, London, supported by the Medical Research Council (MRC). At the outbreak of war in 1939 they were transferred to the Department of Pathology in Cambridge with the remit of selecting, processing and distributing ABO grouping sera. The group was known as the Galton Laboratory Serum Unit and became part of the Emergency Blood Transfusion Service, although it was still administered by the MRC.

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Dr Taylor was made Director of the Unit; when, in 1940, the news of discoveries by Levine and Wiener relating to the Rh groups reached England, members of the unit, particularly Race, began intensive work on this new blood group. In 1943 Fisher moved to Cambridge as Professor of Genetics and, as mentioned above, on the basis of the Rh antibodies identified by the workers in the Serum Unit he proposed his three-allele hypothesis. Arthur Mourant's investigations on the antibody that was subsequently to be identified as anti-e led him to consult Taylor and brought him into contact with Robert Race and R.A. Fisher. Dr Taylor died suddenly in 1945 and Race was made director of the Serum Unit. Fisher was anxious for Race to continue with the Rh work and requested that an additional medically qualified assistant should be appointed to the unit. Arthur Mourant's knowledge of the Rh system and previous association with the Serum Unit made him an ideal candidate for the post; he moved to Cambridge in June 1945. At almost the same time as Arthur was making his move to Cambridge, the news came through of the liberation of the Channel Islands and he was greatly relieved to be able to renew contact with his family, although it was some months before the relaxation of government regulations allowed him to visit Jersey once again.

Arthur Mourant's arrival in the Serum Unit coincided with another discovery that continues to have a very important role in blood-group serology and clinical transfusion medicine, especially in relation to the Rh system. Race had shown that in addition to the supposedly normal form of anti-Rh, which agglutinated D-positive red cells directly, there existed a variant form that coated the red cells but did not cause them to agglutinate. Such antibody could be detected only in a blocking test and was called 'incomplete antibody'. This type of antibody was discovered independently in the USA by Louis Diamond and Alexander Wiener, and its existence offered a solution to the puzzle concerning the serum of mothers of children with haemolytic disease of the new-born that seemed to lack anti-Rh when tested by standard haemagglutination methods. A young veterinary immunologist, R.R.A. Coombs (F.R.S. 1965), who was working in the Department of Pathology in Cambridge, became interested in the 'incomplete antibody' and by what Arthur Mourant, in a second article written in *Vox Sanguinis* in 1983 (10), described as 'a brilliant feat of imagination' conceived the principle of the anti-globulin test. Recounting a story not dissimilar from Arthur Mourant's sudden enlightenment about the Rh system, Coombs recalls that he was travelling in the guard's van in wartime blackout on a train from London to Cambridge and, unable to read, he visualized the free-floating red blood cells coated with molecules of incomplete antibody becoming linked together by molecules of a second antibody, an anti-globulin reagent. Although as he later discovered, and readily acknowledged, the general principle had been proposed early in the century by Moreschi (1908), this work was little known and no practical application had followed. Coombs realized that his idea could be the basis of a useful method and formulated the possible applications as the 'direct' and 'indirect' globulin tests. These formulations were followed by weeks of intensive activity by Coombs, Race and Mourant and the results were published in two classic papers (1,2). In this effort the greater part of the laboratory work was performed by Mourant. In the initial stages they were fortunate in that Dr Muriel Adair, who worked in the neighbouring Physiology Department, had sera from rabbits immunized with human globulin, which they used to test cells sensitized with incomplete anti-D: the cells were agglutinated! A wide range of positive results and of negative controls established the effectiveness and specificity of the test and it soon proved to be of great clinical significance in its direct form by demonstrating that the red cells of infants with haemolytic disease of the new-born had been sensitized *in utero.* The test is now widely

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known as the 'Coombs test' and in the years since it was introduced a vast literature has accumulated on its use and on the many and varied modifications. The 'incomplete' antibody mainly responsible for positive anti-globulin tests is now known to be IgG, whereas the 'complete' antibody is IgM. Because IgM antibodies do not readily cross the placenta it is understandable that the red cells of many of the infants with haemolytic disease of the new-born are coated with the IgG form.

The war was drawing to a close when Arthur Mourant joined the Galton Laboratory Serum Unit in 1945; after the death of Dr Taylor in March of that year the future of the group had to be reconsidered. Fisher was anxious that the work on Rh should continue and would have liked to retain Robert Race and Arthur Mourant in his department in Cambridge. However, the MRC had alternative plans that in 1946 were to result in both of them moving to London. The Galton Serum Unit, set up largely for the routine supply of antisera, had developed during the war into a major research unit and the MRC decided to split the two activities. An MRC Blood Group Research Unit was created under the direction of Race; a separate Ministry of Health Blood Group Reference Laboratory (BGRL) was set up under the direction of Arthur Mourant. Thus, although he had embarked on his medical studies as a mature student, Arthur had made remarkably rapid strides in his medical career and his new appointment gave him the equivalent of consultant status within three years of gaining his medical qualification.

The Blood Group Reference Laboratory, London, 1946–65

The newly established BGRL was housed in London in the Chelsea buildings of the Lister Institute of Preventive Medicine. The Institute had been established in 1891 by a group of public-spirited Victorians who were determined that Britain should have an Institute for medical research comparable with the Institut Pasteur in Paris. Before World War II the Lister Institute had achieved international renown in the fields of bacteriology, virology, nutrition and biochemistry and had been admitted as a postgraduate school of London University in 1905. The many changes in staff that took place during the six years of war, and the realization that the diagnostic services that had been in place up to 1939 were no longer needed, led the institute to take some new directions when the war ended. The theme of blood was to be a dominant one in the Institute for the remaining thirty years of its existence. Work had begun early in the war in the Biophysics Unit on the freeze-drying of human plasma for therapeutic use, under the direction of Dr A.S. Macfarlane and Dr R.A. Kekwick (F.R.S. 1966), and studies on the chemical nature of blood-group antigens had been initiated in the Biochemistry Department by Dr W.T.J. Morgan (F.R.S. 1949) in 1940. The subsequent appointment of Dr (later Sir) Alan Drury, F.R.S., as Director in 1943, in succession to Sir John Ledingham, F.R.S., brought into the institute someone who had close connections with transfusion because, as chairman of the Medical Research Council's Blood Transfusion Committee, he had been actively involved with the organization and development of the Emergency Transfusion Services in the United Kingdom. Under his influence three units concerned with various aspects of blood were allotted space in the Lister Institute's Chelsea laboratories. In 1944 an 'MRC Unit for Research into, and filtration of, Blood Plasma and Serum for Transfusion' (given the less tortuous title of 'MRC Blood Products Research Unit' in 1947) was set up under the supervision of Dr Kekwick and Dr Margaret Mackay, and in

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1946 the Blood Group Research Unit and the BGRL moved into the institute. The Blood Products Research Unit expanded rapidly as the demand by the newly formed National Health Service for plasma products increased; in 1954 this unit moved to new laboratories on the Lister Institute's Elstree, Hertfordshire, site. The concentration of blood-group-related work performed in the Biochemistry and Biophysics departments and in the other two MRC units continued on the Chelsea site until they were forced to find other accommodation on the closure of the institute in 1975. However, in 1946 the Lister Institute was just stirring into active life after the war and Arthur Mourant found himself surrounded by colleagues whose scientific interests were close to his own and at a time when the increasing use of blood transfusion in clinical medicine was leading to an explosion of discoveries of new antigens and blood-group systems on the red blood cell surface.

The initial remit of the BGRL was to continue the work of the Cambridge Laboratory as far as the supply of standard blood-group A, B and Rh antibodies were concerned and in addition to provide a reference service for solving difficult blood-grouping problems. In the Annual Report of the Lister Institute in 1947, Arthur Mourant wrote:

> during this year the unit examined 8,700 tubes and 3,500 bottles of serum for suitability for blood-grouping serum. Seventy five litres of grouping serum were issued. Full Rh genotyping tests were carried out on 2,230 specimens of blood and 1,070 specimens of serum were tested for anti-Rh and other abnormal antibodies, supplies of anti-Rh and other special grouping sera were obtained from human donors and from immunized rabbits. One litre of such sera was distributed.

The BGRL became the first laboratory to prepare rabbit anti-human globulin on a semi-commercial scale for clinical use, although they were soon overtaken by the American pharmaceutical companies. In the early days Arthur performed many of these tasks himself but he soon recruited a scientific assistant, Elizabeth (Jan) Ikin, who had left the Galton Serum Unit during the war to return to London for family reasons but who already had some ten years' valuable experience as a blood-group serologist. He also appointed a few technicians, who gradually took over the routine work. Kathleen Garner and Patricia Brooks were two who came straight from school, were trained by Arthur and remained as senior technicians in the BGRL for many years; indeed, Kathleen Garner spent the whole of her working life in that laboratory. Throughout Arthur's stewardship of the BGRL the laboratory continued its routine work of selecting, preparing and supplying blood-grouping sera of all kinds to users in Great Britain and abroad. Although much of this work was of a routine nature, Arthur valued the opportunity for developing the supply organization as part of the newly formed National Health Service. He had welcomed the Beveridge report and considered that the proposed service was the ideal way of providing the nation with health care. Other British, Commonwealth and foreign laboratories were helped to start up blood-grouping services by BGRL members' giving personal instruction in techniques and supplying test sera, as well as grouping the laboratory staff so that a panel of red cells with known blood-group specificities was available for use as controls. In those days, before HIV had become a consideration, blood was freely taken by finger prick from any colleagues or visitors who strayed into the laboratory and, with several different units working on aspects of blood throughout the Lister Institute, people were frequently better known for their blood-groups than for any other characteristics! The free issue of grouping reagents to overseas laboratories by the BGRL was rewarded by the return supply from them of rare antibodies and red cells carrying unusual antigenic specificities. The administration of the laboratory was transferred from the Ministry of Health to the Medical Research Council in

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1950 and the overseas activities were recognized in 1952 by the appointment of the BGRL as an International Reference Laboratory of the World Health Organisation.

Although he ensured that the semi-routine duties of the laboratory were conscientiously performed it was not in Arthur's temperament to ignore the research potential of the material passing through his hands. Shortly after his appointment in 1946 he investigated an antibody in a Mrs Lewis that reacted with red cells of about 22% of the English population and did not correspond to any of the blood-group antigens previously described (4). The antigen recognized by this antibody was subsequently called Le^a, and is part of the system that has become known as the Lewis blood-group system. Isolated examples of antibodies with this specificity had doubtless been encountered previously, and indeed the Le^a antigen had been described earlier by Japanese workers in papers that were not available in the UK at this period so soon after the end of the 1939–45 war. However, there is no doubt that systematic studies on this blood-group system stemmed from Arthur's discovery. The system is of minor importance from the point of view of blood transfusion but it is of considerable fundamental genetic interest because of its complex interactions with the classic *ABO* and *secretor* gene systems and because of the function of some of its component antigens as receptors for adhesion molecules involved in inflammation and in the attachment of certain bacteria. A visitor from Sweden, Rune Grubb, working with Walter Morgan in the Lister Institute's Biochemistry department in 1948, followed up Arthur's discovery to show that the Le^a antigen, as well as occurring on red blood cells, could be present in a soluble form in secretions such as saliva. Moreover, he demonstrated a relationship with the secretion phenomenon in that secretors of Le^a were invariably non-secretors of A and B blood-group activities. Arthur did not himself make any further contributions to unravelling the genetics of the Lewis system but he retained a lifelong interest in these antigens, especially in later years because of the associations of infectious diseases with Lewis groups and the secretor phenomenon.

The research activities of the workers in the BGRL inevitably paralleled to a certain extent the investigations in progress on new blood-group antigens in the Blood Group Research Unit and there was much interchange of materials and ideas, together with some friendly rivalry. However, Arthur was anxious to branch out into a field of his own. The blood-group characters associated with the classic ABO system had provided the first examples of single inherited human polymorphic characters that could be used for anthropological studies, but together with the antigens belonging to the MN and P systems these had been the only single-gene characters known up until 1939. Arthur Mourant recognized early that the discovery of the Rh system, together with the rapidly increasing number of other inherited blood-group antigens, provided additional factors for anthropological studies on human populations. He considered that he could combine the blood-group data with the detailed knowledge of human prehistory acquired in his earlier geological training to follow up the work of Ludwig Hirszfeld and William Boyd on the statistical distribution of the ABO and MN groups and thereby to extend knowledge of the distribution and movements of different populations. Determining the blood-groups of panels of blood sent to the BGRL from various parts of the world, first for clinical purposes and later for general scientific reasons, thus started Arthur Mourant on the line of work for which he was to become internationally recognized. As early as 1949 he reported that over one thousand specimens of blood from Africa, Iceland, India, Siam and other places had undergone detailed blood group testing as a contribution to the ethnological investigation of the populations concerned. These studies

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were followed the next year on samples from Ceylon, Egypt, Northern Sudan, Ethiopia, Kenya and Spain. As new blood-group antigens were discovered, the repertoire of tests performed was increased and detailed investigations on blood from different ethnic groups continued steadily. Between 1949 and 1954 over 50 articles were published from the BGRL on anthropological aspects of blood-group surveys; the work was summarized in Arthur Mourant's book *The distribution of the human blood groups* (5), first published in 1954. This book was an immediate success and established that characteristics of single genes could be used with much greater effect for studying the origins and evolution of human populations than the measurements of bones and skulls that had been the major criteria used in the past by physical anthropologists. The response to the book convinced Arthur that a second edition would be needed and he immediately set about acquiring further data, although in fact more than 20 years were to elapse before the next edition was published.

Probably the most important of Arthur's early anthropological studies related to the blood-groups of the Basques (6). Other blood-group workers and geneticists investigating the possible effects of haemolytic disease of the new-born on natural selection had concluded that deaths from this disease would remove equal numbers of both *D* (Rh-positive) and *d* (Rh-negative) genes and hence whichever gene was initially the most common would be the ultimate survivor. Because both genes are still present in western European populations, with the frequency favouring the *D* allele, the inference had to be drawn that the populations were in an unstable state with respect to these alleles. Arthur deduced from this that the general population had probably arisen in relatively recent times from one population that was mainly homozygous *DD* and a second population that was mainly homozygous *dd*. An observation by a French anthropologist that the skeletons of the Basques resembled those of late Palaeolithic man led Arthur to develop the hypothesis that possibly the Basques were the Rh-negative (*dd*) population who had descended from late Palaeolithic man and that the present hybrid population had arisen from interbreeding between the Basques and Neolithic Rh-positive (*DD*) peoples who had migrated into Europe from the near East. Great excitement was generated in the laboratory when tests on blood samples from Basque refugees in the south of France revealed them to be Rh-negative. Unfortunately the impact of these observations was slightly lessened by the fact that while Arthur was waiting for more samples from the Spanish Basques before publishing his theory, a statistical analysis was published by Dr M.A. Etcheverry on the Rh status of various populations in Argentina. In this study the Basques were shown to be largely Rh-negative, although no anthropological conclusions were drawn from the observations. Many years later, Dr L. Cavalli-Sforza combined a much more detailed examination of the dates of arrival of Neolithic cultures throughout Europe with analysis of Rh and other blood groups; his results gave further strong support to Arthur's hypothesis and became the basis for postulating a more complex system than hitherto of the origins of early European populations.

Arthur Mourant was ably assisted in the anthropological studies by his colleague, Jan Ikin, who, with Kathleen Garner and Pat Brooks, coped gamely over the years with the samples of blood that flowed into the unit, many, in the early days, not in the peak of freshness after their journey through the mail, unrefrigerated, from some remote part of the world. The data were analysed and the papers written by Arthur Mourant but he left Jan Ikin to perform and supervise the benchwork. She also performed some work in the field in the 1950s, travelling to the Andaman Islands and to Arab countries to collect and test blood samples. In the Chelsea laboratory she took charge of serum production and investigated methods for producing

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blood-grouping sera from rabbits with special reference to the MN blood-group system. She remained an active bench worker and a loyal and dedicated member of the BGRL staff until her retirement in 1979. Dorothy Parkin, a medically qualified co-worker, joined the laboratory in 1951 and remained until 1960; she studied blood-group antigens of familial occurrence and the relationship between blood-groups and the life-span of skin homografts. Another long-standing member of the scientific staff of the BGRL, Carolyn Giles, who entered the laboratory in 1956, discovered, in the course of tests performed for clinical purposes, a number of rare blood-group antigens including E^u, a variant of the E antigen in the Rh system; Yt^b, an allele belonging to the genetically independent Yt system; the Cs^a antigen; and later Rg, an antigen of particular interest because of its location on the fourth component of human complement. Inevitably the number of new antigens remaining to be discovered on the red blood cell diminished with the years but, although the unit never aspired to the pre-eminence in this field of the Blood Group Research Unit, the work of the BGRL under Arthur Mourant's direction made substantial contributions to the discoveries that led to the red blood cell being for many years the human cell with the most thoroughly mapped cell surface.

Arthur was always interested in new findings from other members of the Unit and helped to prepare reports for publication when staff were inexperienced but, when he felt they were ready, he left them to get on with the work by themselves. He frequently seemed diffident and socially ill at ease with strangers, and hesitant in speech, but his eyes would light up and his speech become very much more fluent and rapid when he came to discuss a subject that interested him. His diffidence, together with his shortness of stature, failed to give him a very commanding presence; he was certainly not a born administrator or manager in the mould of the 1990s, but he was respected as Director and succeeded in getting things done according to his wishes by persuasion or gentle cajoling. Although as the size of the unit increased he came to seem remote to some of the staff, those who had worked with him for a long time were aware of his genuine concern for their welfare. As his anthropological work came to be recognized he received many invitations to speak at meetings and give seminars in various parts of the world. He enjoyed travel and the evidence of recognition of his work that was implicit in the invitations. He was thankful in view of his earlier setbacks that when his father died in 1958 he had seen Arthur settle into a career that was both stable and becoming increasingly successful. In 1961 he was invited to give the prestigious Huxley Memorial Lecture of the Royal Anthropological Institute and was presented with the Huxley Memorial Medal, which is the highest accolade awarded to an anthropologist.

The continued increase in the UK in the use of blood for transfusion that occurred in the postwar era was reflected in the yearly increase in demands made on the BGRL for liquid grouping serum and anti-human globulin serum. In addition, the growing practice of blood transfusion in the former British colonies and in other laboratories overseas led to a further increase in the requests for dried serum. The ready supply of blood sent to the unit offered wonderful material for research but its exploitation was limited by the time that staff could spare from the routine work. Thus the increasing demands for reagents and the possibility of performing a greater range of research projects brought forward the need for extra space and increased staff. Plans were made to build new premises within the compound of the Lister Institute on ground that had served as a tennis court before the 1939–45 war. These plans met with many administrative delays but eventually came to fruition in 1963. Arthur Mourant oversaw the move to the new laboratories in February of that year and continued as Director

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for a further two years. An important activity in 1964, which he initiated with the help of Mrs Jean Shimell, who was his secretary at the BGRL from 1960 to 1965, was the organization of the International Blood Donor Panel. This consisted of a panel of donors from various countries who had been typed for some 10 blood-group systems. The existence of this panel has made it possible to find donors for patients world-wide needing rare types of blood.

Kenneth Goldsmith had been given a senior appointment in the unit in 1960 and had taken over much of the day-to-day responsibilities, as well as performing research on antibodies against leucocytes and platelets. The emerging use of organ transplantation by clinicians had opened up new aspects of tissue compatibility and the BGRL received increasing demands for standardization of reagents. Arthur began to feel that he would never complete his task of preparing a detailed population atlas of human blood-groups if he remained as Director of the BGRL, so in 1965 he relinquished his post, having previously made Goldsmith his deputy and groomed him for succession. The reference service that was begun in 1946 continues to this day, although the International Blood Group Reference Laboratory is now housed in the Bristol Institute for Transfusion Sciences under the directorship of Professor David Anstee, and the responsibility for providing blood-group reagents for the National Blood Transfusion Service passed to the Bio-Products Laboratory at Elstree in 1986.

In 1966, shortly after Arthur Mourant had retired from the Lister Institute, his contribution to serology, and particularly to studies of the world distribution of human blood-groups, was recognized by his election as a Fellow of the Royal Society.

The Serological Population Genetics Laboratory, 1965–76

The Medical Research Council established a new laboratory for Arthur Mourant in 1965 to enable him to devote his time entirely to his anthropological studies on blood-groups. With the help of Hermann Lehmann (F.R.S. 1972), who at that time was Head of Clinical Biochemistry at St Bartholomew's Hospital, space for the new Serological Population Genetics Laboratory was found in property belonging to the hospital in Boundary House. Arthur's interest in population genetics had brought him into contact in the late 1950s with the statistician Dr Ada Kopeć and secretary Mrs Kasimiera Domaniewska-Sobczak, at the Nuffield Blood Centre. They had assisted him by scouring the world's blood-group literature and extracting the relevant population data and in this way began to lay the foundations for the long-awaited second edition of the book on human blood-group distribution. In the mid-1960s, at about the same time as Arthur was preparing to move to St Bartholomew's Hospital, the lease of the premises occupied by the Nuffield Blood Centre expired and he was able to incorporate the statistical section of this unit into the new Serological Population Genetics Laboratory. Donald Tills, a man with considerable experience in blood-group serology, was appointed as senior technician and he, together with another technician and a graduate serologist, formed the staff of the blood-group testing section of the unit. Studies on new populations were initiated partly through the International Biological Programme (IBP), which was started up in 1969 as a five-year project by a number of national academies. Genetic data were to form part of the programme and Arthur was appointed as a member of the Royal Society's IBP Committee. Among other studies the laboratory undertook investigations on the blood groups of Jewish populations; this work was later combined with

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historical and other genetic information on the origins and characteristics of Jewish people in a book *The genetics of the Jews* (9) by Arthur Mourant in 1978.

The Serological Genetics Unit continued in full activity until 1971 when support from the Medical Research Council was withdrawn for the testing laboratory. The Nuffield Blood Centre carried on as a statistical laboratory until the end of 1976 and Arthur Mourant continued to work with Dr Kopeć and Mrs Domanieska-Sobczak on the completion of the second edition of *The distribution of human blood groups* (7). This edition, which brought together 20 years' work, was finally published in 1976 and had grown from a 400-page octavo first edition to a 1000-page quarto volume that included 600 tables and maps. The book has remained the definitive reference work on the subject and will not be supplanted until someone has the time and courage to re-examine diverse populations with the use of the more accurate DNA techniques that are now available for determining inherited blood-group characters.

During his collection of population genetic data related to human blood-groups, Arthur Mourant had encountered many papers on associations of inherited blood-group factors and diseases such as pulmonary emphysema, hepatic cirrhosis, diseases of the immune system and pregnancy-associated disorders, in addition to the previously well-documented associations with cancer and duodenal ulcer. Realizing that he had collected a unique source of information, he and his statistical colleagues surveyed the world literature for these associations and this information constituted the basis of another book, *Blood groups and disease* (8), that was published in 1978 and also remains a classic in its field.

In 1972, with the closure of the testing laboratory, Donald Tills moved to a laboratory for Blood Group Genetics of Human Populations in the Sub-department of Anthropology in the Palaeontology Department at the Natural History Museum in London. The accommodation at St Bartholomew's Hospital was withdrawn in 1977; concerned about financial support for his colleagues, Arthur moved, together with Dr Kopeć and Mrs Domaniewska-Sobczak, into a room in Dr Tills's unit. Their stay there was a comparatively brief one and towards the end of 1977 Arthur left London to return to his native Jersey. To the surprise of many of his colleagues, who thought of him as a confirmed, although somewhat reluctant, bachelor, he had become engaged to his former secretary, Jean Shimell, and they were married early in 1978.

Retirement, 1977–94

Arthur and his wife moved to Jersey to live in a newly renovated annex of the family house; he settled down to a life of writing and a return to his earlier keen interest in the geology and archaeology of the island. In addition to the two books, *Blood groups and disease* and *The genetics of the Jews* that were finally published in 1978, he wrote one other book on blood, a semi-popular account of blood-group anthropology called *Blood relations* (11), which appeared in 1983. Arthur's 85th birthday was marked in 1989 by the dedication to him of a volume of *Federation of European Microbiological Societies: Microbiology and Immunology Journal*, which was devoted to 'Blood groups and disease' in recognition of the extensive data that he had collected for his book on this subject and his discovery of the Lewis blood groups. However, it was geological aspects that occupied most of his energies in his retirement years. In truth, his interest in this subject had never left him and during the time when his main

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professional life was associated with blood-groups his publication list is liberally interspersed with papers on the geology and archaeology of the Channel Islands. Those travelling with him to conferences in mountainous areas were frequently asked to stop to allow him to obtain samples of rock. In his bachelor existence he was never overburdened with worries about sartorial elegance: the pockets of his crumpled suits were frequently seen to be sagging under the weight of pieces of rock and his geological hammer. On one memorable occasion his hammer came in useful when he attended a crowded genetics conference in Princeton, USA, and was asked to share a room with an eminent geneticist, Arno Motulsky, whose name happened to fall next to his on an alphabetical list. The two men were somewhat dismayed when they saw that the room contained one large bed composed of two firmly joined singles. On surveying the situation Dr Moltusky observed that if only they had a hammer the beds could be parted whereupon Arthur produced his geological hammer from his suitcase and was able to make short work of the separation.

In 1961, many years before Arthur retired, he had been elected a Membre d'Honneur of the Société Jersiase in recognition of his contribution to local geology and archaeology. He ran the Geological Section of the Société while in London and on retirement became Chairman of that section. The first official geological survey of the Channel Islands was performed between 1972 and 1977 under the auspices of the Institute of Geological Sciences (now the British Geological Survey) and, although living in London at the time, Arthur was involved in both the field work and with the publication of the map of Jersey in 1982 and the memoir in 1989. On his return to the island he remained as physically active as possible and enjoyed regular field trips, often with much younger geologists and archaeologists. He was involved in the re-excavation of La Hougue Bie, in which some exciting clues about Neolithic people and their architecture were revealed. He was also delighted to meet, in Jersey, Professor Keith Runcorn, F.R.S., whose work on residual magnetism in rock samples of different ages confirmed that continents did indeed move during geological time with respect to the Earth's magnetic pole, thus confirming Arthur Mourant's earlier conviction about continental drift. This last phase of Arthur's career was recognized by the R.H. Worth Prize of the Geological Society of London in 1982, which is given to an amateur geologist who has gained distinction in the field, and also, to his evident pleasure, by the commissioning of a bronze bust of him in 1990 by the Société Jersiaise to mark his long and devoted service to that organization.

Arthur Mourant's shyness and diffidence had prevented many of his former colleagues in London from getting close to him but he was widely respected for his integrity and scholarship. The tributes paid to him after his death (13) attest to the fact that he was not only respected but held in considerable affection by friends and professional colleagues in his native Jersey and it is evident that it was there that he felt most relaxed and able to be himself. After his marriage, Arthur's former colleagues could not help noticing that his suits no longer had the same crumpled look and at least on more formal occasions the rocks and hammer seemed to have been banished from his pockets. He proudly attributed his changed appearance and mood to his wife's influence and care.

Honours and distinctions

1953 Oliver Memorial Award for Services to Blood Transfusion
1955 Honorary Membership of the Sociedad Peruana di Patologica

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1956 President, Section H (Anthropology) British Association for the Advancement of Science
1961 Honorary Membership of the Société Jersiase
1961 Huxley Memorial Medal, Royal Anthropological Institute, London
1966 Elected Fellow of the Royal Society of London
1970 Foreign Member of the Academy of Sciences and Letters of Toulouse (France)
1973 Landsteiner Memorial Award, American Association of Blood Banks
1975 Honorary Membership of the International Society for Blood Transfusion.
1976 Honorary Membership of the British Society for Haematology
1978 Marrett Memorial Lecture, Exeter College, Oxford
1978 Honorary Membership of the Society for the Study of Human Biology
1980 Osler Memorial Medal, University of Oxford
1982 R.H. Worth Prize of the Geological Society of London
1985 Honorary Citizenship of Toulouse, France
1987 Honorary Membership of the Human Biology Council

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