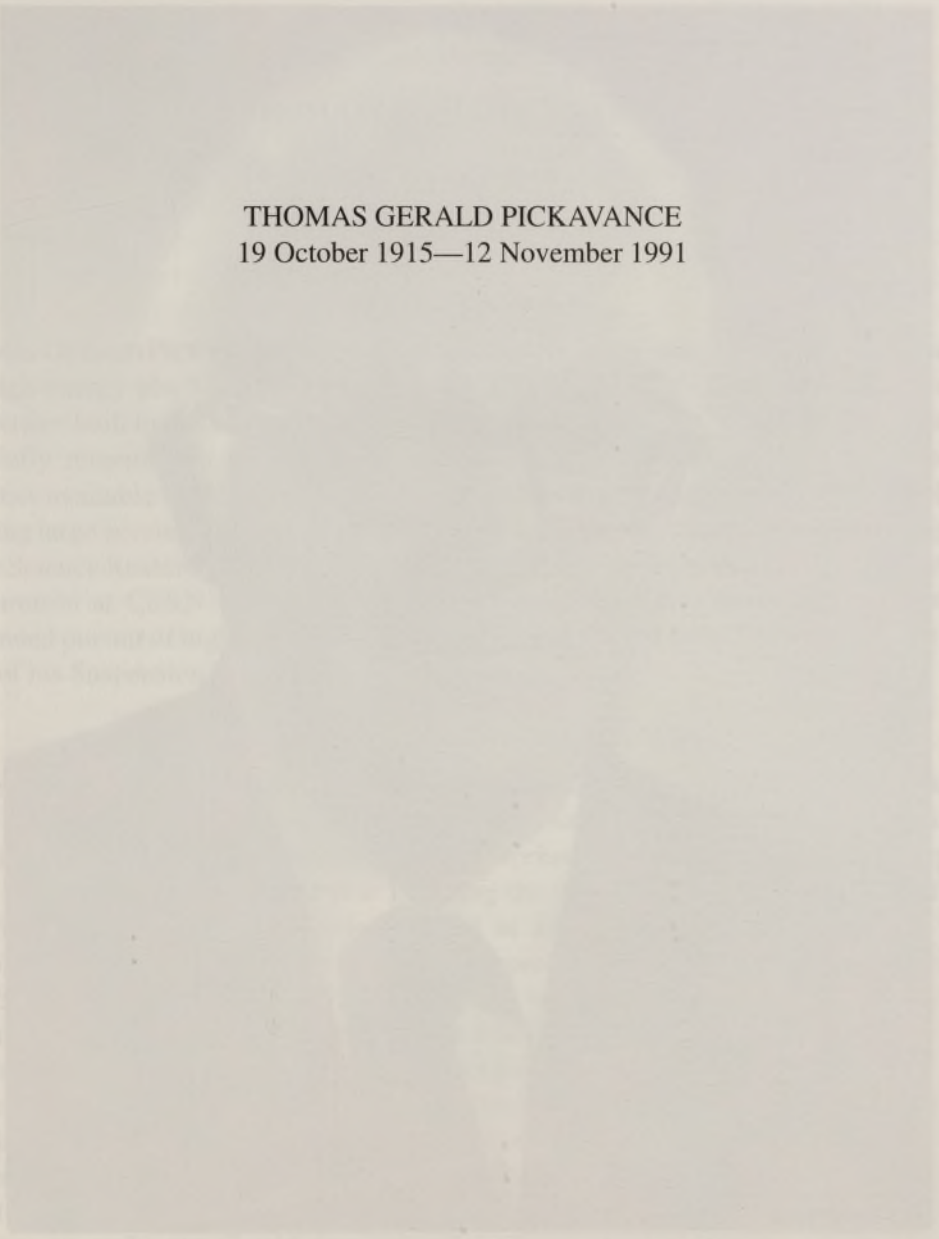

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BY J.R. HOLT, F.R.S.

THOMAS GERALD PICKAVANCE was a leading authority on the design of particle accelerators for high-energy physics and was responsible for the construction of the most powerful accelerator built in this country, at the Rutherford Laboratory of which he was Director. He is chiefly remembered for the skilful, unselfish and unsparing way he made research facilities available for his fellow nuclear physicists and helped them to solve the problems of using large accelerators away from their universities. While Director for Nuclear Physics of the Science Research Council he played a major part in ensuring that the 300 GeV proton synchrotron at CERN was supported by this country and thus made available for the continued pursuit of high-energy physics here. He was elected to the Fellowship in the first year of his Suspension.

EARLY LIFE AND LIVERPOOL UNIVERSITY

Gerald Pickavance, known to his friends and colleagues as Gerry, was born on 19 October 1915 at St Helens in Lancashire. He was the eldest of four children, with two younger sisters and a brother. His father William Pickavance worked for the Royal Insurance Company until the outbreak of the World War I. During the war he served with the Royal Welsh Fusiliers in France and afterwards qualified as an Estate Agent and Valuer. He then established his own business in St Helens, which prospered and eventually included several branches in South Lancashire and in North Wales, where the family had a second home. He became a highly respected and well known business man. Although opportunities were offered to him, he was never inclined to accept any public office.

Gerald's mother Ethel (née Leyland) came from a St Helens family and was one of seven children. One of her brothers became a Town Councillor, another emigrated to the United States. Her father, Thomas Leyland, was an engineer who is said to have invented a substance to repair a ship's boiler without having to remove it from the ship.

From an early age Gerald was intensely curious about the modes of operation of manufactured devices and spent much time building working models to his own design with Meccano. The family obtained one of the early crystal radio sets and this led to a period of fascination with making and designing radios and associated equipment. These included valve sets capable of operating a loudpeaker and even the construction of the loudspeaker itself. His sister relates how she was pressed into service to help with the construction of a

microphone and recording apparatus which was used to record music and conversation on aluminium discs from one room to another.

His early interest in cars was one which remained with him for the rest of his life. The family always had a car which was usually an up-to-date and uncommon model and the young Gerald knew all the details of the specifications of these and of every new model as it was brought out. He had several exercise books in which he drew futuristic models showing streamlined bodies together with their engine specifications, tyres, etc. Sometimes the bodies resembled those of new models brought out later. He learned to drive on Southport sands and had a driving licence from the age of 17. The family had two cars and two homes and went at weekends and in the summer to and fro between St Helens and North Wales. During the summer the family went touring for several weeks each year and Gerald planned the routes, worked out mileage and petrol consumption and listed all items of interest, geographical, historical or literary in the areas to be visited. It was a close knit and happy family and Gerald received every encouragement from his parents in the pursuit of his many activities and interests, which also included photography and the accumulation of a large collection of gramophone records ranging from classical music to the most popular of the current hits.

Gerald attended the local Cowley Grammar School, which had an excellent reputation. Here he was stimulated by the atmosphere of interest in learning fostered by the Headmaster Mr G. Dowse, a classicist who nevertheless strongly encouraged the teaching of science. In the sixth-form he was very impressed by the teaching and ideas of two of the science masters, Mr Webb in physics and Mr Hayworth in chemistry. Academically he was successful in all the subjects studied and usually came top of the class in each. He took little interest in sport, his usual relaxations being reading or playing chess.

Taking mathematics, physics and chemistry for the Higher School Certificate he was awarded a St Helens Borough Scholarship in 1934 and entered the Physics Department of Liverpool University. Here he was fortunate with the arrival at the end of his first year of James Chadwick who was appointed to the Lyon Jones Chair of Physics. The Department had become very run down with few facilities for research and the University had promised to support Chadwick with his plans to establish research in nuclear physics centred around a 37-inch cyclotron. New staff were appointed and the teaching courses reorganized. Soon after his arrival the news of Chadwick's award of the Nobel Prize was announced.

To the students Chadwick was an impressive figure, treated with admiration and respect. He had a rather austere and forbidding presence, but on closer acquaintance this was seen to be only a mask which hid a naturally shy and sympathetic nature. Pickavance developed a real admiration for him, not only for his scientific genius, but also for his complete command of the English language. He demanded precision and economy of writing from all his students. Chadwick was his mentor in this skill and was his model for the writing and presenting of reports throughout his career.

Among his fellow students Pickavance was well known as a 'wireless' expert as well as a car enthusiast. Only three cars were usually parked outside the physics department, Chadwick's Canadian Packard, E.J. Williams's Ford with its special open body and Pickavance's Ford Eight Saloon. On the occasion of the annual social evening when the

student Physical Society arranged entertainments and demonstrations, he was in demand to design and construct any electrical circuitry which might be needed. It was at such functions that he met his future wife Alice Isobel Boulton, who was studying for an honours degree in mathematics. They were married in 1943.

In 1937 Pickavance obtained a first-class B.Sc. Hons degree and registered for the research degree of Ph.D. At that time the construction of the 37-inch cyclotron was proceeding and Pickavance, together with another student F.C. Thompson, were initially given the task of helping with this.

The main components of the cyclotron were provided by industry, the magnet and vacuum chamber by Metropolitan Vickers and the high voltage set for the radio frequency power supply by Siemens. All the auxiliary equipment, small power supplies and control circuits, even the valves supplying 50 kilowatts of radio frequency power to the dees were produced in the laboratory. Pickavance's main responsibilities were the design and construction of the various control and monitoring systems and setting up and testing the radio frequency power supply. With only a small workshop staff and an engineer and two research fellows working on the construction, two research students could make an important contribution and Pickavance enjoyed the responsibility and the opportunity to exercise his knowledge of electronics.

The cyclotron came into operation towards the end of 1939 and Pickavance helped with the final adjustments. Before that he had been given another project by Chadwick. This was to assemble and bring into operation a high-pressure cloud chamber which had been brought from Cambridge by Feather, who came to Liverpool with Chadwick but returned after one year. The object was to use the chamber to examine the penetrating component of the cosmic radiation, about whose nature there was considerable controversy at that time. A high-pressure chamber had the advantage of a long sensitive time and large stopping power for the particles, so making it more probable that a particle might be observed to decay in the chamber.

There was much to be done. Coils to produce a magnetic field were wound and operated with a current of 120 amps at 460 volts; they had to be switched on and off at each expansion with a suitably designed oil-immersed switch. Timing circuits and relays had to be designed and manufactured, as well as a powerful mercury flash lamp. The chamber was usually operated at a pressure of about 40 atmospheres with nitrogen, hydrogen or argon. After many trials to determine the best operating conditions, about 1600 photographs were taken.

It was known that most of the cosmic ray particles at sea level with energies greater than about 3×10^8 eV are mesons, constituting the penetrating component, and attention was concentrated on these. At that time the mass of the mesons was not well known, and it was suspected that there might even be a spectrum of meson masses. By making measurements on recoil electrons produced by collisions with the penetrating particles Pickavance was able to determine the masses of several as about 200 electron masses.

Bringing the unusual chamber into successful operation in a comparatively short time with little help or supervision is a considerable tribute to Pickavance's skill as an experimenter. He was awarded his Ph.D. in 1940.

When the cyclotron came into operation Chadwick was keen to see some nuclear physics experiments started as soon as possible. To this end he had arranged for a collaboration with Powell from Bristol. Powell had been studying cosmic radiation with special photographic emulsions produced by Ilford and he designed a camera using these plates to detect and measure particles emitted from a target in the cyclotron. Pickavance and Chadwick were to be the Liverpool members of the collaboration.

Thus Pickavance became responsible for setting up the apparatus in the beam and organizing the running of the cyclotron. He learnt the technique of developing the plates and measuring the tracks with the help of a microscope. The target elements under investigation were held in the body of the camera in gaseous form either as elements or compounds. Eleven different elements were exposed to the beam of protons and many excited states of the various nuclei identified through the energies of the inelastically scattered protons. The experiments were terminated when the cyclotron was pressed into service to study various problems in connection with the fission of uranium and Pickavance was also closely involved with these studies.

As a postgraduate student he had gained a wide experience of a range of techniques, had had to organize his own work and also collaborate with others. Although only a junior member of the cyclotron construction team he, together with Michael Moore, an engineer who was Chadwick's technical assistant, were to a large extent responsible for the successful completion of the work. Moore's instruction in the skills of practical engineering provided a good foundation for some of Pickavance's future work in the accelerator field.

There were no well established designs for all the auxiliary equipment of the cyclotron or procedures for setting up, and Pickavance's practical sense could sometimes be a useful corrective to the more theoretical but unsound ideas of some senior colleague. This was the more important because Chadwick himself, due to his many other commitments was not able to take a close interest in everyday operations. In any case it was his policy, once responsibility had been delegated to someone, not to interfere but to seek an account at the end.

In fact the progress of the work did not go smoothly and many problems had to be overcome. Chadwick's presence, if not at the cyclotron, then often at teatime when staff and postgraduates would sit together at a long table outside his office, was a constant source of inspiration and advice. This was a time for general discussion of many topics, scientific or otherwise, but it was not a time for idle comment. Chadwick never made an ill-considered remark and he expected others to adhere to the same standards of conversation.

In 1939 two events occurred which were significant for the future of the laboratory. The first was the observation of uranium fission in January and the second the outbreak of war in September. Although the possibility of a chain reaction in uranium was quickly appreciated, its application to the production of a bomb was at first discounted and many of Chadwick's senior staff left to work on projects such as radar development. However, the situation was completely changed in June 1940 by the famous memorandum written by Frisch and Peierls which pointed out that only a small quantity of the rare isotope uranium-235 would be required to produce a bomb.

It then became necessary to determine the values of many quantities connected with the fission process and Chadwick resolved to use the cyclotron for this purpose. Pickavance was joined by another postgraduate, Rowlands, and the two of them together with Moore were in charge of operating it. Frisch, who joined Chadwick in 1940, was mainly responsible for the experimental programme, and was helped by his assistant, the author of this memoir. Rotblat, who had come from Poland the previous year, also took part in the programme. One of his experiments, in which Pickavance collaborated, was to determine the spectrum of the uranium fission neutrons by using photographic emulsions in which the tracks of the proton recoils were measured.

Most of the research staff took part in the teaching programme of the department. One important feature was the electronics school in which physicists and non-physicists alike were trained to enable them to play a part in the development and use of radar techniques. Here again Pickavance's knowledge and skill were invaluable and in 1942 Chadwick appointed him to the post of lecturer.

Later in the war when work on the separation of uranium isotopes was progressing it became necessary to have the means of measuring the degree of separation. One instrument for doing this was the mass spectrometer and Chadwick asked Pickavance to set one up. To this end in 1944 he visited Columbia University, New York, to learn the necessary techniques. On his return he built a spectrometer which was used to analyse samples prepared by ICI.

Harwell

Cockcroft became the Director of the new Atomic Energy Research Establishment at Harwell in November 1945. Although primarily a laboratory devoted to the practical development of atomic energy, Cockcroft was determined that it should not neglect fundamental research. Research in nuclear physics in the universities was strongly encouraged at that time and a Cabinet Advisory Committee on Atomic Energy was set up with a Nuclear Physics Sub-Committee under Chadwick's chairmanship. This Committee eventually recommended that the DSIR should support the construction of a 1000 MeV proton synchrotron at Birmingham and a 350 MeV electron synchrotron at Glasgow. The provision of cyclotrons at Harwell and elsewhere was given special consideration by the setting up of a small committee called the Cyclotron Panel. This included four members from Liverpool, among them Pickavance, with Rotblat as chairman. It also included Adams and Snowden from Malvern, Skinner from Harwell and representatives from Cambridge. The Panel met during 1946 and discussed possible designs of cyclotrons for Harwell, Liverpool and Cambridge. These designs were provided by the Malvern group and Pickavance. The Harwell design was based on Cockcroft's requirements for the provision of neutron beams of high energy and intensity.

In the summer of 1946 Cockcroft appointed Pickavance to take overall responsibility for the construction of the Harwell cyclotron, and the Malvern group moved to Harwell. Pickavance quickly established himself as the leader of a harmonious team of engineers and physicists, including Adams, a man without professional qualifications but with natural engineering talents who, with Snowdon, was to carry out the detailed design of the cyclotron.

Adams learned much from Pickavance and was deeply influenced by his qualities of leadership. In 1953 he went to CERN at Cockcroft's suggestion and in a few years rose to become Director General of that laboratory. Later he became Director of the Culham Laboratory and was elected F.R.S. in 1963.

The Harwell synchrocyclotron first operated in 1949. Pickavance played a full part in the experimental programme as group leader, being particularly concerned with the design and provision of apparatus, while the main driving force for the physics programme was J.M. Cassels. They were a formidable pair and soon established a small group of enthusiasts who worked together for several years. According to Stafford: 'Gerry was splendid in organizing everything and making sure that we had all the equipment that we needed. When it came to data taking and analysing the results we all took part and I found it a very happy and stimulating period. Gerry had the knack of getting on well with everybody.'

The team, which in addition to Cassels and Stafford also included Randle and Taylor, carried out an innovative programme of experiments. Many of these were concerned with the interactions of high-energy neutrons with matter, experiments which were complicated by the continuous energy spectrum of the neutrons from a target in the cyclotron. Total cross-sections for neutrons of well defined energies in a wide range of elements were measured. High-energy protons were used in precise measurements of differential and total cross-sections for proton–proton and proton–deuteron scattering in a series of cleverly designed experiments.

Cockcroft had always intended that the cyclotron should be available for basic research by Harwell staff and other physicists from outside. Massey had moved to the physics department at University College London in 1949 and approached Cockcroft with the idea of Harwell collaboration. Pickavance and Cassels accepted the idea with enthusiasm and thus began many years of fruitful collaboration between the University of London and Harwell. Later, physicists from other universities also came to work on the cyclotron. Pickavance was responsible for the integration of their experiments into the overall programme and this was a pointer to later developments on a much larger scale.

In 1953 Cockcroft, in pursuit of his aim to provide the best equipment for the general use of the universities, obtained the approval of the Atomic Energy Board for the construction of a 600 MeV proton linear accelerator. His proposal to the Board had been made on the basis of its use as a potent source of neutrons for the production of fissile materials. Figures from Berkeley had indicated that each high-energy proton would produce about 30 neutrons although later results showed that this number was too high. Cassels had also suggested such an accelerator as a potent source of high-energy mono-energetic pi-mesons from the reaction $p + p \rightarrow \pi + d$. It had an advantage over a synchrocyclotron since it had not proved possible up to that time to extract the beam from the latter.

At Malvern a group under Mullett had been working on the design of the 600 MeV proton linear accelerator and in 1953 they moved to Harwell. The group was placed under the direction of Pickavance and included a number of physicists and engineers who were later to play an important role, with him, in developments over the coming years. Walkinshaw was the group theoretician and did some very original work on the design. In keeping with Cockcroft's intention that the machine was to be primarily for university use it was to be

outside the fence at Harwell, and University College and Imperial College, London, were to help with the design. The main contractor for the project was Metropolitan Vickers and by 1955, under Pickavance's coordinating role, and not without numerous setbacks, had almost completed three units of the accelerator to provide an energy of 50 MeV. In that year Pickavance was appointed Deputy Head of the General Physics Division at Harwell.

However, in December 1954, soon after the Liverpool synchrocyclotron had been brought into operation, it was shown by LeCouteur and Crewe, following a suggestion of Tuck and Teng in Chicago, to be possible to extract up to 10% of the proton beam. Thus one of the main advantages of the linear accelerator disappeared. Also there were second thoughts about the usefulness of this accelerator as a source of neutrons and the further development of the machine was stopped. The first 50 MeV stage of the accelerator, to which the AEA was already committed with Metropolitan Vickers, was continued and proved to be a useful machine in its own right.

This left a major hole in the plans for new machines of high energy for the nuclear physics community and there were many discussions, not only about the type of accelerator to build but also about the nature of the laboratory to house it. The question of the funding of the laboratory and of the university accelerators led to extensive discussions between the University Grants Committee and the AEA. There was also discussion of the role of the universities in the management of the national laboratory. However, by early 1956 proposals for a national laboratory had been submitted to Treasury ministers and had won their approval in principle and by the middle of that year it had been generally agreed that the site for the laboratory should be at Harwell.

Some in the universities were not at all happy at the turn of events. The universities in this country had always been the centres of fundamental research, with freedom from outside pressure, and the close relation with teaching activity was considered vital. The idea that research in an important frontier field should be diverted to an institute run by the AEA and quite separate from the universities was most unwelcome. Others took the view that this was an inevitable development and that organizational arrangements could be made to minimize the separation between the institute and the universities.

National Institute for Research in Nuclear Science

It was generally agreed, in view of these various problems, that the eventual success of the institute would depend very heavily on the choice of person to fill the post of Director. The formal establishment of the institute occurred in February 1957 when the Government announced its decision to set up the National Institute for Research in Nuclear Science (NIRNS). Its main object was 'to provide for common use by universities and others, facilities and equipment which are beyond the scope of individual universities and institutions carrying out research in the nuclear field'. The Rutherford High Energy Laboratory at a site adjacent to AERE Harwell was to be the Institute's first laboratory.

The Governing Board of the Institute contained a preponderance of university members. The Chairman was Lord Bridges and there were seven members representing the universities and two representing the University Grants Committee out of a total of fifteen, the others being from the AEA, the DSIR and the Royal Society. It started work immediately and Lord

Bridges turned out to be the best friend the Director and the universities could have had. He had recently retired from being head of the Treasury and of the Civil Service and was very highly regarded in Whitehall. His understanding of Government procedures and his extreme efficiency in the dispatch of business were of great value to the Board during its whole life. He was no scientist himself but, in the words of Merrison, the Director of the Daresbury Laboratory, 'One had no need to convince Bridges of the essential virtue of intellectual endeavour. So although he cheerfully had no understanding of what we try to do in laboratories like Daresbury or the Rutherford Laboratory, he knew that any intellectual endeavour in which young men were prepared to drive themselves to the point of exhaustion needed no justification.'

During the first year of its existence the Institute appointed only three members of its own staff, relying almost entirely on staff of the AEA. The first two were the Secretary (Dr J.A.V. Willis) and Stafford, who had moved from the cyclotron group to take over responsibility for the proton linear accelerator (PLA), from Pickavance, who by then was fully occupied with plans for the new accelerator Nimrod. Stafford had been appointed by NIRNS to be the group leader responsible to the Director for the operation, maintenance and determination of the experimental programme of the PLA. The appointment of the Director himself was evidently one which proved more difficult. Pickavance was the obvious choice, but his appointment was not a foregone conclusion. As an AEA employee there was some doubt about his acceptability to the universities. Stafford recalls that 'in spite of his own deep personal involvement Gerry was able to consider issues such as this with full detachment and a full understanding of the point of view of the universities'.

In the event his appointment was greeted with relief and acclaim by the majority of nuclear physicists. Although a member of the AEA staff he had made a great effort to foster an atmosphere of university research in his role as Director of the Harwell synchrocyclotron and had done everything he could to facilitate the use of the accelerator by teams from the universities. Nevertheless it was recognized that he would have a difficult task in maintaining a necessary independence from the AEA in administrative matters while depending on them for funds.

However, there were some who would have preferred a more narrowly academic person to head the establishment and considered Pickavance's talents to be of a more practical nature. In a sense this is true but he knew where to turn to for advice on academic matters and had excellent judgement in reaching his decisions and usually backed the right horses. In Wilkinson's view: 'Gerry was absolutely right for the job; it could have been disastrous, as some wished, to bring in an academic figure from outside to be responsible for the complex construction programme that Nimrod turned out to be and for the delicate relationships between NIRNS and AEA. Gerry, being an AEA insider, knew how to do things and showed both courage and skill in his managing of those relationships; this, of course, did not show publicly and was known only to very few of the client community who therefore did not properly appreciate him for it.'

Pickavance applied himself early to the problem of organizing the laboratory in a manner conducive to its use by university teams. The aim was to arrange matters so that the laboratory would be viewed as an extension of the university laboratories to which the teams

would have access as of right rather than as visitors to an old-style government establishment. One of the first acts of the Governing Board was to set up a Visiting Committee composed mainly of senior university scientists to advise and help in the development of the Rutherford Laboratory.

In 1966 Pickavance and Stafford described the arrangements which had been evolved, partly though experience with the PLA, to accommodate university teams working at the Rutherford Laboratory. At that time the total staff at the laboratory was 1100. The number of high-energy physicists on the staff was 23, of which only four had permanent appointments, while the number of visitors was 89. They write:

> It has been possible to operate the Laboratory with such a small proportion of resident research physicists by integrating the university physicists very closely into the activities of the Laboratory. For example, a Nimrod Users Advisory Committee exists to advise the Laboratory on all matters relating to the effective conduct of research on Nimrod. The committee is chaired by a university physicist and all teams and universities are represented.
>
> Final approval for an experiment by any team is given by a Selection Panel which is composed not only of physicists from within the Laboratory, but also from the universities. Once an experiment is on the programme, the Rutherford Laboratory accepts the responsibility to provide all the necessary funds to carry it out. The only exception is that we do not normally provide salaries . . .
>
> The Laboratory has hostel accommodation and both furnished and unfurnished houses are available for use by visitors and it reimburses visitors with their travelling and other incidental expenses incurred when visiting the Laboratory. We have done out best to alleviate the considerable personal inconvenience that is involved in working at a national laboratory.

Also of importance was the establishment of the in-house team of physicists who initiated experiments themselves or collaborated with university groups in carrying out experiments. They were of great help to the universities in maintaining their experimental programme in face of the frequent absences of some members of staff due to the demands of their university teaching duties.

Nimrod

The curtailment of the construction of the 600 MeV proton linear accelerator early in 1955 led to intensive discussions about the nature of the accelerator to replace it. At CERN a 25 GeV alternating gradient proton synchrotron was under construction, as was a similar machine at Brookhaven. Pickavance's accelerator group at Harwell had been considering the designs of possible machines which would provide a national facility and which could be built quickly. In order to try to reach a consensus Cockcroft called a meeting in May at Harwell which was attended by most of the prominent nuclear physicists in the country. Pickavance was able to lay before the meeting several alternatives. The general view was in favour of a proton accelerator as being more versatile than an electron machine, but opinion was divided between a high intensity 2–3 GeV sector focused cyclotron type machine and a 12 GeV alternating gradient proton synchrotron.

John Adams, who was in charge of the design and construction of the CERN proton synchrotron, had recorded a tape which was played at the meeting and gave an account of problems which had arisen in the design studies. The new strong focusing principle allowed the use of magnets with much smaller apertures than in the conventional type of proton

synchrotron such as the Bevatron. However it turned out that the machine was very sensitive to slight variations in magnet properties or alignment of the magnets which could lead to rapid build-up of beam oscillations. He concluded that the construction of such a machine was much more difficult and required much more manpower than any machine already in service in the UK. It also appeared that the intensity of the beam would be severely limited by the fact that only single turn injection could be employed since after one turn the magnetic field would have increased beyond that for a stable orbit. Nevertheless it seems that Pickavance and Cockcroft were in favour of the 12 GeV option while many of the other members favoured the lower energy, high intensity machine.

The record of the meeting, written by Pickavance, was circulated to the participants and they were asked for written views about the options. The balance of opinion was in favour of the high intensity machine. It was felt, since there would already be an accelerator of much higher energy at CERN, that it would be more useful to have a machine of higher beam current, albeit of lower energy. Many years later Pickavance was to write:

> The only sure way in 1957 to get high intensity was the weak focus machine. The alternative 12 GeV machine was rejected in discussion with the users. With the knowledge at that time the decision was right. It has since been found that the strong focusing method is extraordinarily efficient and in reality quite simple and has achieved similar high intensity beams. Today no one would consider building a weak focus machine.

In fact the problem of the single turn injection was solved in a few years by the simple expedient of ramping up the energy of the beam injector to follow the increase of the magnetic field of the accelerator.

At the second meeting of the NIRNS governing board in May 1957 the decision was made to build a 7 GeV proton synchrotron at the Rutherford Laboratory at an estimated cost of £7 million. Within three months Treasury approval had been obtained and work had started. The new accelerator was given the name Nimrod from Genesis 10, v.8; 'Nimrod began to be a mighty one in the earth'.

Development of the design of the machine and its construction turned out to be major problems in engineering. The aim for much higher intensity than previous accelerators of its type meant greater current from the injector, better vacuum in the chamber and a higher repetition rate. All these required improvements over previous practice and led to many difficulties. As a consequence progress was at first very slow and it became clear that the choice of accelerator was not one that was going to provide an early solution to the need for a new machine. In the event the first beam from the accelerator was obtained in August 1963. The design intensity of 10^{12} protons per pulse was reached the following year and was steadily improved thereafter.

Pickavance was fortunate in having a highly professional and enthusiastic team of physicists and engineers working with him. The group was led by Mullett and included Bowles, Dunn, Hobbis and Wilkins with Walkinshaw responsible for theory and computing. There were also several physicists from University College and Imperial College working under a collaboration agreement following the pattern established with the PLA. Mullett has written as follows regarding Pickavance's role as leader:

Gerry's overall control was a balance of formal and informal. He ran monthly steering group meetings but his door was ever open for discussion in any way and any level. He delegated formally but allowed people to develop their individual degrees of autonomy. I rarely recall him taking notes (Sir John Cockcroft, by contrast, was noted for his little black book) and he had a phenomenal memory. Gerry took the lead in the negotiation of each major contract with industry; he would then attend the major progress meetings. Though much went very well, some things went wrong as in any endeavour, but there was never any panic. Indeed I cannot recall Gerry ever 'blowing up' about anything.

When Nimrod came into operation there were ten universities interested in counter experiments together with staff from the Rutherford Laboratory and Harwell, and seven film analysis groups working with film from the bubble chambers. Altogether there were 13 university departments working with the Rutherford Laboratory.

Writing about the work of the Rutherford Laboratory soon afterwards Pickavance stated:

This is a good example of the service which a national laboratory can give to universities. A particular department need not be deterred by the very high threshold expenditure below which it is impossible to work in elementary particle physics . . . Success depends upon smooth administration, easy travelling arrangements and, most important, the creation of a good scientific atmosphere in the national laboratory itself, which should not be a mere service station. There are good reasons to believe that these problems can be solved; the 50 MeV proton linear accelerator has been successfully used by many university departments for over two years. This accelerator was accepted and completed by NIRNS with the idea that it would be useful in establishing a preliminary service to universities some years before the completion of Nimrod. It would enable the solution on a readily manageable scale of some of the human and technical problems involved in integrating a national laboratory with freely determined and directed university research groups. It was recognized also that the PLA was a valuable research tool in a rather neglected energy range. The success of the operation in all its aspects has exceeded expectations.

On another occasion he expressed the opinion that:

There is little doubt that fundamental research prospers most when associated with teaching, but there is no doubt that teaching at the most advanced level must be done in institutions actively engaged in research.

Burcham was a visitor at the Rutherford Laboratory for the session 1962–63 and was able to see at first hand how Pickavance and his staff, particulary the NIRNS secretary J.A.V. Willis, were doing all they possibly could to encourage university activity. He writes:

One immediately gained the impression of a well-run laboratory in which there was a strong sense of community. Gerry's main task was a major scientific one but he never lost interest in individuals and he knew and helped to mitigate their problems. Civil Service rules of course had to be observed in a national laboratory but Gerry was ingenious in preventing them from becoming onerous. I felt that he had achieved a university atmosphere to a considerable degree. One little thing that I remember was that although he had built a first-class restaurant at RHEL he would sometimes prefer to take friends and visitors to a cosy but crowded pub in Steventon. It was typical of his intimate personal approach to so many of his affairs.

In spite of its late arrival on the scene, the impact of Nimrod on the progress of high-energy physics was considerable. Its main contribution has been in the field of the nucleon resonant states where, with several long programmes of experiments, order was introduced into a somewhat chaotic situation and careful and precise measurements enabled the properties of many resonances to be determined. These results were important in helping to establish the quark model of the baryons and mesons on a firm basis.

George Kalmus has written:

> The particle physics programme at Nimrod was a very professional one – it recognized the need for precise measurements in an era where the number of claimed resonant states was growing explosively. Beautiful experiments using state of the art technology in pion-nucleon scattering and kaon-nucleon scattering were performed and analysed. The programme recognized the limitations of the accelerator, since it came on stream later than the Bevatron and the higher energy accelerators at CERN and Brookhaven by concentrating on good instrumentation and continuity of effort. A generation of UK particle physicists cut their teeth on Nimrod and have gone on to lead groups and departments.

An important aspect of the work of the Rutherford Laboratory, which was strongly supported by Pickavance and still applies at the present time, is its role in facilitating the use of the CERN accelerators by university groups. Particle physicists on the staff of the Laboratory work at CERN with university physicists and help with the development of apparatus both at the Laboratory and the universities. Thus the tradition of close cooperation between the Laboratory and the universities continues and is particularly important now that this country has no high-energy accelerator of its own. Similar arrangements also apply to the use of accelerators in other countries such as Germany and the United States which have high energy machines.

A LEADER OF THE NUCLEAR PHYSICS COMMUNITY

Pickavance was involved with numerous committees of both NIRNS and DSIR and through these was able to exercise an influence on the direction of future developments. During the years between the setting up of NIRNS and its absorption by the Science Research Council in April 1965 he enjoyed the close support and friendship of Lord Bridges and the encouragement of Cockcroft as well as the backing of a loyal and devoted staff. He had a clear aim at the Rutherford Laboratory and succeeded in its achievement and these years were probably the happiest of his whole career.

In a real sense he was a leader of the nuclear physics community as far as the provision of facilities were concerned. Through these committees and visits both in this country and abroad he became familiar with what was happening in the universities, the AEA and Europe. Burcham remembers a particular occasion when the Nuclear Physics Board wanted a mechanism for the use of AEA accelerators by university people. This was potentially a difficult matter because of the two sovereign bodies involved. Through Pickavance's knowledge and tact a satisfactory procedure was evolved and the resulting Experiments Selection Committee operated successfully for a number of years and brought considerable help to many university groups through the Rutherford Laboratory organization.

In a similar way he was able to facilitate the use by several universities of the neutron beams available from the Harwell reactors and the Herald reactor at AWRE Aldermaston.

Again quoting Burcham:

> In 1966 as a member of the SRC Nuclear Physics Board, he interacted strongly and positively with the university community in the matter of the siting of the proposed national film analysis units and their associated large computers. I well remember the positive encouragement he gave to all of us at that time and how we always consulted him in difficulty.

During the period of construction of the accelerator and of the buildings to house it Pickavance was concerned with major pieces of experimental equipment for use by the universities. Chief among these were three large bubble chambers. The British National 1.5 metre hydrogen bubble chamber was funded by the DSIR and constructed by a group from Imperial College, Liverpool, Birmingham and Oxford. It was assembled at the Rutherford Laboratory in special buildings with ancillary plant provided by NIRNS and taken at first to CERN to provide data for the universities pending the operation of Nimrod. It was operated by a NIRNS team and started to produce photographs in July 1964.

In order to have a bubble chamber at Nimrod without curtailing the programme of the hamber at CERN, negotiations with French physicists at the Saclay Laboratory led to their 2 cm chamber being transferred to the Rutherford Laboratory from their 3 GeV proton nchrotron Saturne. A particularly complex beam line was designed for this chamber to ve a very pure beam of K mesons. It was a source of pride to Pickavance that the chamber as installed and working before the formal agreement was signed.

Another project was the provision of a high voltage electrostatic generator for Oxford niversity. This was a two-stage machine with a vertical section to give 8 MeV designed y the Rutherford Electrostatic Generator Group under W.D. Allen followed by a mmercial horizontal section for 6 MeV.

Wilkinson has pointed out that this was a major example of Pickavance's willingness to lp universities in ways that could have attracted criticism. As he says, it was not at all vious that this project was the business of the Rutherford Laboratory at all, given its ission in high-energy physics, but Pickavance willingly took Cockcroft's wink and spoused the project enthusiastically. It was also important in illustrating that there could e effective collaboration between the two largely separate agencies DSIR and NIRNS. SIR was the primary agency and the Rutherford Laboratory was, in effect, DSIR's agency getting the job done. But really DSIR just supplied a fixed sum of money for the ought-out items and the Rutherford Laboratory carried all the responsibility for design, onstruction and commissioning.

Pickavance was immensely helpful to the work of the universities. According to Wilkinson, when he felt that the activities in question were of high quality he would make ll kinds of facilities available to them, both material and in professional help, on the ground hat the activities, within the universities for which they were supplied were also of interest nd value to the Rutherford Laboratory. He was generous in his encouragement of weaker niversity groups, which he helped to build up, giving them support that in the early days might not be thought to have been justified except by hope and trust.

He was also very supportive of efforts which eventually led to the establishment of the Nuclear Structure Facility at Daresbury. It is possible that but for his support this might well have been sacrificed as part of the economies suggested in 1968 in the discussions about entry to the new CERN 300 GeV laboratory.

Another development was the purchase of Cosener's House, a pleasant building in Abingdon on the banks of the Thames, for use by university visitors and as a conference centre. As Burcham relates:

Pickavance lost no opportunity of bringing physicists together there for socially friendly if scientifically controversial weekends. From such meetings he derived an intimate knowledge of the aspirations of the nuclear physics community which strengthened his position in logistic arguments with conscientious but obdurate officials.

The scientist administrator

Cockcroft's appointment of Pickavance to head the construction team on the Harwell synchrocyclotron in 1946 was one of the most important he made. During the next 25 years Pickavance was to exert a growing influence on the development of high-energy physics in the UK and in Europe.

A few years after his appointment Pickavance was beginning to turn his attention to the provision of future facilities for research in high-energy physics. He and Cassels were early and vocal supporters of the fledgling CERN organization in face of some indifference among the senior physicists in the country. The latter felt, understandably, that the UK had made a large investment in several large accelerators which were still to be exploited fully and that CERN membership was more appropriate for other European countries which at that time soon after the war had no facilities of their own. Nevertheless Pickavance realized that in the future the UK by itself could not hope to afford the larger accelerators which would be required to advance the subject and which were already being planned in America. He was strongly of the opinion that the UK should be part of the CERN organization from the start and in this he was very much in tune with Cockcroft's feelings.

In November 1952, largely through Cockcroft's advocacy, the British Government decided to become a member of CERN. As well as sending Adams to CERN, Cockcroft arranged for Hine and Goward to move from Harwell to help with the design of the proton synchrotron. Pickavance was also involved with the plans for the new laboratory and served as Deputy Director of the synchrocyclotron advisory group.

His influence and responsibilities were considerably extended with the decision by the Board of NIRNS in 1962 to establish a second laboratory which was sited at Daresbury in Cheshire. With the advent of the new laboratory, the Rutherford Laboratory no longer had a monopoly of the funds allocated to NIRNS and conflicts of interest could well have arisen. Pickavance never allowed such conflicts to cloud his judgement and his overriding consideration was always to determine what was best for the advancement of high-energy physics.

The new laboratory was very closely connected with universities in the north of the UK right from the start. Not only was Liverpool involved with the design of the accelerator but representatives from the universities of Glasgow, Manchester and Liverpool served on the various planning committees. The pattern of organization established at the Rutherford Laboratory was followed at Daresbury and the Director, Merrison, like Pickavance, ran the laboratory in a manner very friendly towards the universities. In this he was greatly aided by the Secretary, Harold Rothwell who headed an administration which was helpful and unobtrusive and ensured a smooth passage through all the necessary formalities concerned with University Agreements and financial arrangements.

In 1962 the Government set up a committee under the chairmanship of Sir Burt Trend to advise on the organization of civil science. Among various proposals the committee

recommended the extinction of NIRNS and the setting up of a Science Research Council which would include six divisions with nuclear physics contained within a Physics and Mathematics division. The Board of NIRNS was asked to comment on the proposals and Pickavance was concerned to establish a more prominent position for nuclear physics. Largely as a result of his lobbying the SRC was divided into three Boards: Astronomy, Radio and Space; Nuclear Physics; University Science and Technology.

The SRC was set up in April 1965 under the Science and Technology Act. Serious misgivings were felt by the high energy physicists about the changed organization, and these were shared by Lord Bridges. During its eight years existence NIRNS had achieved much with a minimum of administration.

Bridges fears were well founded and the rapid decision-making processes of NIRNS were replaced with much more sluggish procedures. Pickavance was now faced with a much less sympathetic organization and worked hard to try to minimize the effect on the nuclear physics community and to calm the fears of staff of the former NIRNS who resented being absorbed into the SRC. The newly formed Nuclear Physics Board contained several university representatives with Powell as Chairman, and Pickavance had insisted that the two Laboratory Directors should be full members. The Board reported to the London Office of the SRC where, under the chairmanship of Sir Harry Melville, there were three civil servant Directors: for Finance, Establishment and Organizations; for University Science and Technology; and for Astronomy, Space and Radio, and Nuclear Physics. The third Director was thus responsible for the Rutherford and Daresbury Laboratories. During the first year almost half the financial allocation to the SRC was spent by the Nuclear Physics Board and more than half of that by the two Laboratories. At its first meeting the Nuclear Physics Board spent much time discussing the need for a full-time Director for Nuclear Physics, but this was not achieved until 1969. Pickavance usually represented the SRC at CERN rather than the third Director. In 1970 he was made Chairman of the European Committee for Future Accelerators. It was a fitting recognition of his work over many years in the field of particle accelerators.

When the SRC was set up plans for the future development of high energy physics in Europe centred around the proposed 300 GeV proton synchrotron. The UK Government did not agree to take part in this development, although a considerable effort went into producing a formal proposal for a site in Norfolk for the accelerator. The consequent uncertainty meant that any other plans for developments in this country could only be tentative. Moreover it was the avowed intention of the SRC, under pressure from other branches of science, to reduce the proportion of its funds being spent by the Nuclear Physics Board.

It was against this background that pressure was exerted on Pickavance to move to a position where he could exert a more direct influence on events. Consequently in 1968 Brian Flowers, the new Chairman of the SRC, arranged for him to work part time at the London Office. This cannot have been very easy or congenial for him though fortunately he had in Stafford a Deputy Director to whom he could delegate responsibility for the Rutherford Laboratory during his absences. However it soon became clear that he needed to spend more time at the London Office and in 1969 he was appointed full-time Director of Nuclear Physics.

Thus began two years during which he drove himself to the limit. He now had responsibility for all nuclear and high energy physics research, involving frequent visits to laboratories in this country and to Switzerland and other countries abroad. He was now in effect Director General of both the Rutherford and Daresbury Laboratories and continued his quiet and good-humoured control at a time of increasing competition for funds. At this time also the Government declared that it had decided not to support the CERN 300 GeV project, much to the dismay of the high-energy physicists.

His major challenge was to get this decision reversed and to this end he was in close touch with Adams who was making strenuous efforts to reduce the cost of the new accelerator. When this was achieved with Adams' plan to site the machine at CERN, Pickavance devised a scheme which would produce the necessary funds by a gradual run down of the national programme. This would eventually lead to the closure of both the national accelerators but he foresaw that the two laboratories would then find different roles. With persistent and energetic lobbying in Government circles and persuasive argument with his scientific colleagues he finally achieved acceptance in both quarters and early in 1971 the Government agreed to join the project.

It was only a few months later, when on holiday in Italy, that he suffered an attack of pneumonia followed by a stroke which left him partially paralysed and with little power of speech. It was a sad end to his career at a time when, at only 55, he would have had much to offer in an increasingly difficult financial climate for high-energy physics.

Personal life and attributes

Gerry Pickavance was fortunate in his family relations. His early years were very happy ones as a member of a close-knit family who did everything they could to support and encourage him in his interests in science. His marriage to Lal was equally happy and they had three children, a girl and two boys. Throughout his career he had the unwavering support of Lal, and her loving devotion during the long years of his disability was a source of inspiration to all who knew them.

Gerry had a very outgoing personality. He was never happier than when discoursing with friends or telling them stories, often spiced with a sometimes sly sense of humour. At a more serious level, he enjoyed the cut and thrust of argument with officials and colleagues over matters of policy. His patent sincerity and lack of concern for his own interests defused possible conflicts and turned potential enemies into friends.

Quoting Burcham:

> Gerry was in all senses a remarkable person, not perhaps a great innovator but a superb manager, a very sound physicist and above all an intensely lovable man. He was a person who restored confidence in times of difficulty and who contributed a stabilizing influence to the whole of the fundamental nuclear physics programme of the UK over a great many years.

Nicholas Lawrence, a junior secretary at the London Office during the time Gerry was there writes as follows:

> He used his own combination of clarity of thought, occasional well-directed anger, and a slightly mischievous sense of humour to get his proposals accepted by both the SRC and Government machines, and by the high energy physics community. I remember him as terrifying if you were

flannelling, but endlessly patient with fatherly advice to a then very junior official, and happy to tell me far more than I 'needed to know' about the great events then going on.

Gerry enjoyed travel and this was expressed in his lifelong interest in cars. In his younger days he was a frequent visitor to the races at Le Mans and Mullet remembers an occasion when, returning from a conference at Saclay, they camped beside the track with Gerry's Jaguar, in the year that that type of car won all the first places in the race.

It was in April 1971 when the Pickavances and Staffords were combining a holiday with a conference in Italy that Gerry suffered the serious stroke which incapacitated him and placed him in hospital. They were greatly helped in this emergency by the generous assistance of Antonino Zichichi and eventually Stafford was able to arrange for the RAF to fly Gerry back to England.

This was followed by long years of gradual improvement during which Gerry's indomitable spirit and determination led to a return of some ability to read and write and to coherent speech. He never lost his sense of humour or his interest in life and friends and he followed the activities and careers of his children with pride and affection. Although he was confined to a wheelchair Lal frequently drove him on visits away from home and he particularly enjoyed attending meetings and functions at the Rutherford Laboratory and the Royal Society.

Even the diagnosis of cancer did nothing to daunt his spirit and he delighted in his friends' visits with their discussions of the latest news and the opportunities for reminiscing. In the end he decided that he did not wish further treatment and he died in his own bed with Lal by his side, a place she had held for 20 years.

Honours and awards

1964	C.B.E.
1969	D.Sc. (Honorary), City University, London
1968	Fellow of St Cross College, Oxford
1976	Fellow of the Royal Society
1979	Glazebrook Medal and Prize, Institute of Physics
	Institute of Physics, Fellow
	European Physical Society, Founder Member

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The photograph was taken by the Godfrey Argent Studio in 1977.

This is a somewhat abridged version of a Memoir containing more details of the history of NIRNS and Nimrod which is deposited in the library of the Society.

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