QUEST

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QUEST

House Journal of the Science Research Council

Vol. 2 No. 3

July 1969

contents

Cover caption.

Beautiful thoughts . . .
A computer's eye view of the well developed peripherals forming the software of its working environment . . . or could it be a mirror image of the 'Beauty with the Brains' picture in the January issue?

Published by the Science Research Council, State House, High Holborn, London, W.C.1. Set in Univers and printed by The Kilburn Press Limited, Wallingford, Berkshire.

profile

Professor H. A. Brück,

CBE, DPhil, Ph.D, Astronomer Royal for Scotland

The life of the dedicated scientist, although intellectually rewarding, often runs a serious risk of becoming a social desert. The special demands of research and academic life offer little to the extrovert, so that a gradual process of withdrawal is often inevitable.

The subject of our profile may therefore be regarded as being somewhat unique; he has, on the one hand, the task of running the Royal Observatory, while on the other, as Regius Professor of Astronomy and Dean of the Science Faculty at nearby Edinburgh University, he is deeply involved with the education of students and intergrated with the social life of the University. He also has a young and talented family, and these three elements, plus a life-long appreciation of music, combine to fulfil and mellow a career which has been crowded with achievement and incident.

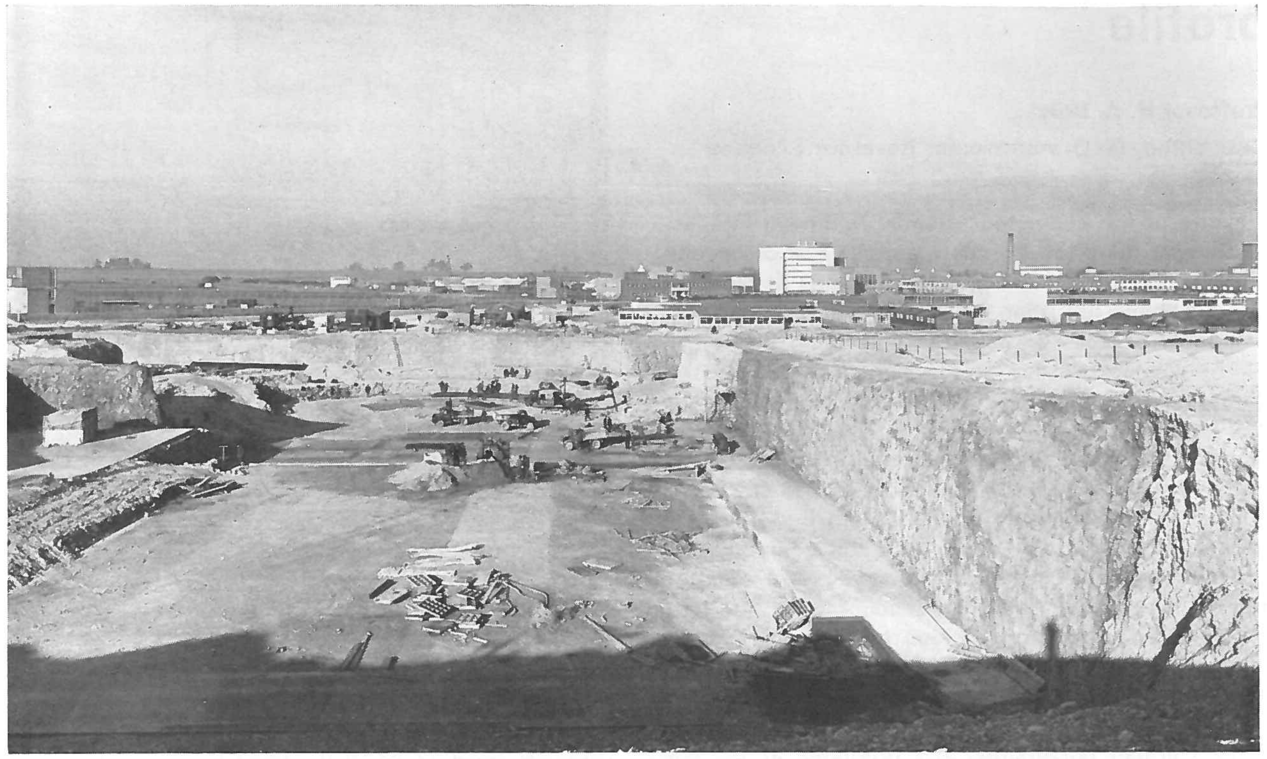
Born in Berlin in 1905 Professor Brück attended three German universities and produced at the age of twenty-two his first doctoral thesis, under Professor Sommerfeld in Munich, on a problem on the then new, wave mechanics; two further doctorates were later to be conferred on him by Berlin and Cambridge universities.

From his Berlin period he recalls Einstein's attendance at physics seminars where the great man seemed often to be half asleep. At a critical moment, however, he would 'wake up' and put a question which cut right to the heart of the subject . . . 'just the kind of question I would love to have put'. But the Professor did have one thing in common with Einstein, 'we both loved sailing and often used to meet on the lakes near Potsdam'.

His Berlin University activities brought him into contact with other famous names such as Nernst, von Laue, Hertz, Planck and Schrödinger whose future movements were to be very similar to the Professor's, in that both obtained posts in England and Ireland in order to get away from the insidious influence of the emergent German nationalists. At the end of the nineteen twenties there existed at Berlin University 'a concentration of genius which has hardly ever been equalled; how sad that politics was allowed to disperse it'.

It was in his student years at Munich that new life had come to astrophysics, and it was the exciting vistas opening up in this field which determined Professor Brück's career. In 1928 he joined the Potsdam Astrophysical Observatory where he stayed until 1936 when the political atmosphere made him decide to leave Germany. From Potsdam he went to the then newly equipped Vatican Observatory at Castel Gandolfo where he worked for a year – with a research grant of £150. In 1937 he secured a position as Assistant Observer at the Cambridge Solar Physics Observatory where he remained for the next ten years to become John Couch Adams Astronomer in the University and Assistant Director of the combined Observatories. In 1947 he was personally invited by the then Irish Prime Minister, de Valera, to take charge of the Dunsink Observatory near Dublin. This old Observatory, once directed by the 'Astronomer Royal for Ireland', had been closed following 'the troubles', and Professor Brück was charged with the task of re-establishing it as an active research centre and part of the Dublin Institute for Advanced Studies. At Dunsink the Professor 'lived like a country gentleman, enjoying a stimulating intellectual atmosphere and involvement in new post-war problems of astronomical research'.

Professor Brück took up his present appointment in 1957, and the ensuing years have witnessed a major expansion of the work, staff and research facilities in the Royal Observatory and the Astronomy Department of Edinburgh University. His interest in questions of stellar evolution and the formation of stars from diffuse interstellar material led to a systematic attack in Edinburgh on problems of data processing and the introduction of new automatic methods of astronomical measurement and computation. And his experience of the effect of the British weather on astronomical observations made him champion the cause of observing stations in good climates such as Edinburgh's Italian station at Monte Porzio.



heading photograph is a view looking North of excavations for Nimrod, in the background AERE Harwell.

research at Rutherford

A. P. Banford

Part 1: Origin and growth

> *'There are therefore Agents in Nature able to make the Particles of Bodies stick together by very strong Attractions. And it is the Business of experimental Philosophy to find them out.'*

These words, written some three centuries ago by Isaac Newton, epitomise the prime function of the Rutherford Laboratory, for it certainly is our Business to find out these Agents. The Particles that we are concerned with are known as 'elementary' or 'fundamental' and the study of their properties and interactions constitute the science of high energy physics. The development and present status of the subject has been well covered in Dr. Rand's article in the January 1969 issue of Quest; a complete survey is therefore unnecessary here.

In any scientific investigation, it is desirable to be able to predetermine as many of the experimental conditions as possible, and it is therefore hardly surprising that almost all elementary particle physics research is carried out with controlled sources of particles, which is what particle accelerators are. These devices, commonly but erroneously known as atom smashers, are large, complex and expensive. It should be realised that accelerators are only particle sources, and that the high energy physics can only start when the accelerator has become operational. At the Rutherford Laboratory, the major accelerator is Nimrod, a 7 GeV proton synchrotron, which became available for high energy physics experiments in 1964. The remainder of this article will be devoted to an account of the setting up of the Laboratory, the design, construction and commissioning of Nimrod, and the preparations for the first experiments. Part 2 will deal with the achievements of the past five years and will attempt a look ahead.

The Rutherford High Energy Laboratory came into formal existence 12 years ago, though its origins can be traced back to the early 1950's. At that time, experiments with the first artificially produced pions (π – mesons) had shown that these particles played a central role in the nucleon – nucleon interactions – that is, the system of forces that bind atomic nuclei together and which determine the details of nuclear structure and many other phenomena. United Kingdom workers in this field needed a high quality source of pions. The first step towards providing this would be to build a new machine capable of accelerating protons to an energy of several hundred MeV: pions being produced when such protons strike a suitable target. Existing accelerators in this energy range (synchrocyclotrons) had external beam intensities and other characteristics which severly limited the scope and precision of the experiments. Discussions among university physicists were initiated by the Atomic Energy Research Establishment, Harwell, and a decision was taken to build a 600 MeV proton linear accelerator. A group of accelerator designers was assembled, and a site was selected to the south of AERE and outside its security fence so as to facilitate visits by university scientists.

It was realised from the start that the 600 MeV linac would be a formidable undertaking. The machine itself would be 900 feet long and would require almost a hundred megawatts of radio-frequency power at 200 and 400 MHz. Valves capable of delivering such outputs were not then commercially available, and had therefore to be specially developed. There were also many unknowns associated with features such as beam focussing, accelerator control, dimensional stability and manufacturing techniques, since the only other proton linac then working was a comparative dwarf of 32 MeV. Nevertheless, by 1955 the detailed design was far advanced and the construction of buildings and machines got under way.

Then two events which completely changed the picture occurred in quick succession: a newly-developed method of beam extraction for synchrocyclotrons so improved their performance as to put them into the forefront of pion physics; and experiments on the 6 GeV Bevatron in California showed that artificially produced strange particles (hitherto seen only in cosmic rays) exhibited properties not only excitingly novel but also likely to be of great importance in explaining the basis of the structure of matter. It was realised that resources at Harwell should be re-allocated so that the research facilities that would eventually be made available would be better suited to the changed needs of the users. Accordingly, it was decided to terminate the proton linac at the 50 MeV point; it could then be used for nuclear scattering and reaction studies in an energy region in which little work had been done. This decision enabled a large fraction of the design group to be switched to a detailed study of various types of accelerator capable of reaching energies of several GeV.

It soon became clear that the new machine should be a proton synchrotron, a type of accelerator of which a few examples were already in existence, the oldest (now closed down) being at Birmingham University. In a synchrotron, the particle beam is bent round into a circle by the application of a magnetic field, and, as the particle energy increases during the acceleration process, the field strength is also increased so as to keep the radius of the circular path constant. (This is in contrast to a cyclotron in which the field is constant and the particles move outwards on a spiral as their energy increases). The field has to be provided only over an annular region; the accelerator electromagnet is therefore in the form of a ring, the diameter (determined by the particle energy and the magnetic properties of steel) being about 150 feet. The choice rested between two types of synchrotron, differing in the method of focussing used to keep the beam together in the face of disturbing influences such as magnetic field inhomogeneity, and scattering by residual gas in the vacuum chamber. In a weak-focussed or constant gradient machine the magnetic field is shaped so as to provide both horizontal and vertical focussing at all times. In the alternative strong-focussed or alternating gradient system, there is a periodic change between strong horizontal focussing with vertical defocussing, and the reverse. This gives an overall focussing effect that is stronger than in the constant gradient system, with the result that the magnet can be made more compact and therefore more cheaply. The alternating gradient system does have its drawbacks, notably the need for much greater constructional accuracy and more trouble from resonances (the disastrous build-up of beam oscillations caused by repetitively encountering magnetic disturbances). Although the principle has been successfully applied to later machines (e.g. the 28 GeV CERN PS and NINA), there was not sufficient confidence in its suitability for a high intensity machine at the time when it became necessary to freeze the main parameters. The project chosen, in early 1957, was a 7 GeV weak-focussing proton synchotron, soon named Nimrod after the mighty hunter of Genesis.

It had always been the intention that the major users of these new research facilities would be teams of visitors from university physics departments, since it was recognised to be financially impracticable for individual universities to acquire and maintain their own large accelerators. Since the scale of these centralised research facilities had now grown considerably beyond that initially envisaged, it was felt to be no longer an appropriate responsibility for the Atomic Energy Authority. In February 1957, it was announced that a new body, the National Institute for Research in Nuclear Science, was to be set up. This was duly done, with Lord Bridges as the Chairman and with representatives of the universities, the UKAEA, the UGC, the DSIR, and the Royal Society on the Governing Board; after an appropriate period the Institute became the employer of the few hundred Authority staff engaged on the accelerator projects.

This period of organisational change also saw the erection of the PLA and the beginning of the civil engineering work for the building that was to house Nimrod. This is 200 feet in diameter, and since it is sunk below ground level for radiation shielding reasons, its construction involved the removal of some 4 million cubic feet of chalk which was subsequently formed into an artificial hill.

The PLA produced its first full energy beam in July 1959, and became available to nuclear physicists the following April. After a further two years it was operated round the clock, and each successive year's operation has outdone the last in terms of annual operational hours and reliability. Special facilities such as a polarized proton source and time-of-flight instrumentation helped to make this machine into a versatile research tool. There are, however, certain fundamental disadvantages associated with a proton linear accelerator and as a result of recent developments in tandem Van de Graafs and cyclotrons, it can no longer be regarded as truly competitive. It is scheduled to cease operation in October of this year. The opportunity will be taken to survey its achievements in a special article, and for this reason the remainder of the present article will be confined to Nimrod and associated projects.

In addition to settling the dimensions of the building, the freezing of the main parameters of Nimrod in 1957 enabled detailed design work to begin. It had been established that the ring magnet would be built in eight sectors or octants, each separated from the next by a straight section which would be used for beam injection, the radio-frequency accelerating unit or for other purposes. The injection energy was chosen as 15 MeV, the magnet pulse repetition rate as 25–30 per minute and the beam intensity aimed at was 10^{12} protons per pulse.

The machine chosen as injector was a linear accelerator, similar in principle to the 50 MeV linac, but differing in a number of detailed respects on account of being designed as a synchrotron injector rather than as an accelerator in its own right. It consists basically of a horizontal copper cylinder 44 feet long and $5\frac{1}{2}$ feet in diameter which is electromagnetically resonant at 115 MHz. 48 drift tubes spaced along the axis shield the protons from the radio frequency electric field at times when it would have a decelerating effect; the drift tubes also contain electromagnetic quadrupole focussing lenses. The injector produced its first full energy beam in 1961, and since that time there have been substantial improvements in intensity, energy spread and optical quality.

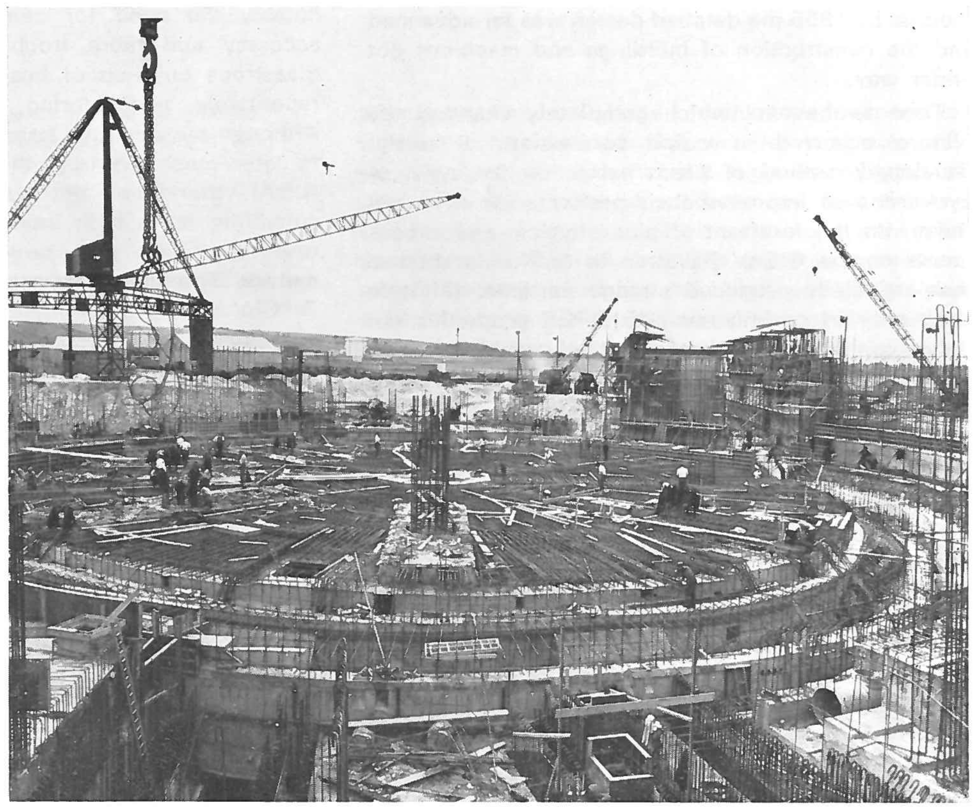


fig. 2
July 1958. Construction of the 160 ft. dia., 15 ft. thick, 14000 ton magnet bearing monolith has almost reached final floor level. The walls of the magnet room have been started and those of the injector room (right back ground) are more advanced.

The magnet design chosen involved building up each octant from forty-two magnet blocks, each weighing twenty tons, the approximate dimensions being ten feet square by one feet thick. Each block is a multi-decker sandwich of a half inch and a quarter inch thick steel plates, this laminated construction being necessary to avoid any current losses since the magnet is pulsed. The plates were carefully annealed and randomised in order to make all the blocks as alike as possible, and, after stacking and clamping together the requisite number, the throat aperture was machined out. When the production process was in full swing, magnet blocks were arriving at the Laboratory at the rate of one a day. They then underwent a detailed dimensional and magnetic survey, the results of which determined which of the 336 possible positions each block would occupy. The actual installation of the blocks in the magnet room was done in a carefully predetermined order so that the concrete monolith on which the magnet rests would be evenly loaded to minimise the possibility of tilting.

The powering of the magnet involves generating current pulses of over 9,000 amps at 14 KV; since this implies power surges of the order of 120 MVA (i.e. roughly equal to the power consumption of the city of Oxford), it is impracticable to have a direct connection to the public supply system. Some form of energy storage is needed, and the system chosen consists of a double motor-flywheel-alternator unit connected to the magnet energising coils by a system of transformers and grid-controlled mercury arc converters. These converters function as rectifiers when the magnet current is rising during acceleration, and as inverters when the magnet is being de-energised in readiness for the next cycle. During this period, energy previously fed into the magnet is being recovered and returned to the rotating plant. Some power is lost in resistive heating; this causes a 4% variation in the nominal 1,000 r.p.m. shaft speed of the rotating plant and the 10 MVA needed for 'topping-up' is what the electricity mains see as the load. The alternating stresses set up as a result of the continual pulsation imposes a severe duty on the rotating plant. There have, in fact, been two occurrences of mechanical failure in the alternators which have put Nimrod off the air for periods of months. Similar troubles have plagued other proton synchrotrons and consideration is now being given to replacing the rotary plant by static devices. (See D. A. Fox's article in the October, 1968 issue of Quest).

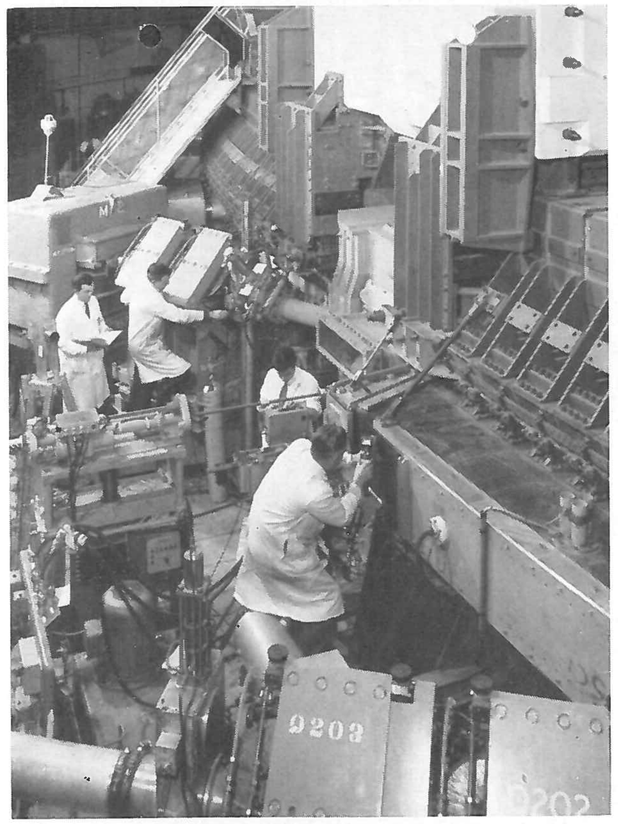


Fig. 3
April 1964. Final checks on the high energy beam lines emerging from Nimrod.

The component of Nimrod that gave most trouble was the vacuum vessel. This is a double-walled structure of glass fibre reinforced epoxy resin. The outer vessel is assisted in its task of withstanding almost all the pressure differential by being sandwiched between the magnet and the pole pieces, which are specially shaped to give the required field gradient for focussing. The material for the outer vessel is chosen mainly for its mechanical strength while the inner vessel, having to withstand a negligible loading, is made of a resin with good vacuum properties. Considerable difficulties arose during manufacture mainly due to uneven wetting of the glass cloth by the uncured resin and in ensuring even curing of such a large and geometrically complex unit. Vacuum testing at Rutherford Laboratory proved to be a time-consuming process. Many small leaks had to be found and rectified, a large fraction of these being due to the fact that about 10% of the glass reinforcement fibres were hollow instead of being solid. The meticulous attention paid to locating and correcting all such faults before the vessel was installed has proved to have been well spent. Not only has the vessel been trouble-free in service, but also the good pressures achieved have contributed significantly to the final beam intensities achieved, by minimising the loss of protons due to scattering by residual air along the 100,000 mile acceleration path.

The above items of hardware plus many others were being assembled during the early 1960's, which naturally was a period of intense activity and interest for the many people who were seeing the ideas and decisions of past years coming to fruition. Each unit had to be coaxed into operation, and much midnight oil was burned by many groups of people each intent on ensuring that their particular component would not be the last to be ready. The first occasion on which everything worked properly at the same time was in August 1963; the design energy of 7 GeV had been reached with a beam of about one-hundredth the design intensity. The ensuing twelve months were taken up by detailed investigations of beam behaviour, improvements to machine reliability and stability, and the long process of winning many small improvements in beam intensity. The design value of 10^{12} protons per pulse was finally reached in September 1964 and has subsequently been exceeded. A limited amount of experimental high energy physics was possible in early 1964, and a full schedule operated from the middle of that year, which also saw the official inauguration of Nimrod by Mr. Quintin Hogg, the then Minister for Science.

During the design and commissioning phase of Nimrod, the prospective users had been making their own preparations. In addition to assembling the particle detectors and targets that constitute the experiment proper, they shared with the machine builders the problems of the beam lines. These beam lines can in some cases be over 200 feet long. They are built up from components such as quadrupole lenses, beam bending magnets and velocity separators, and they serve two inter-related purposes – to filter off particles of unwanted species or energy and to guide the wanted particles to the experimental position in as compact a form as possible.

The stage was now set for the experimental high energy physics programme to get under way. Some organisational changes were also imminent as a result of the Trend Committee's Report on the organisation of civil science. These matters will be dealt with in part 2 of this article in the next issue.

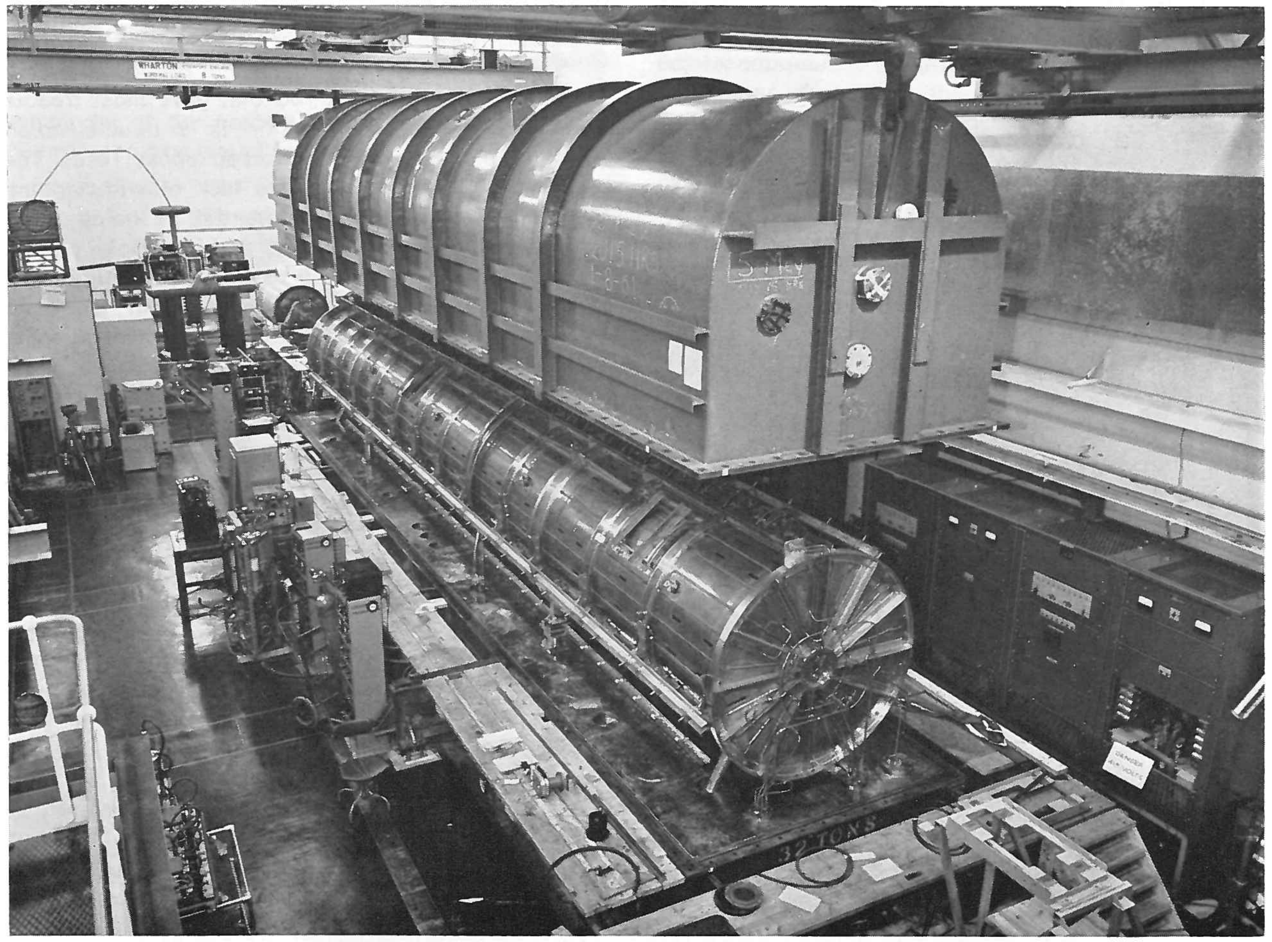


Fig. 4. Injector with lid of vacuum vessel raised to show the copper liner in place. This view is from the output end; the pre-injector can be seen in the background.

the old way

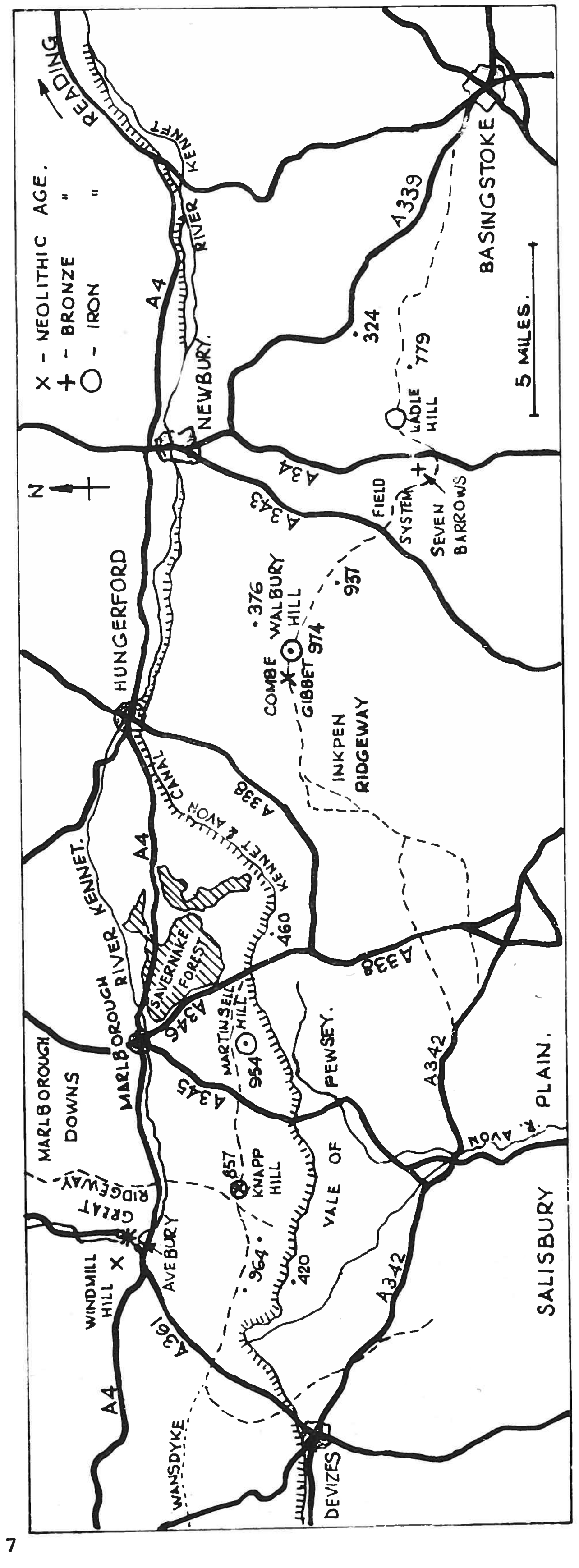
J. D. Davies

For the last 3,000 years of our English pre-history most of the people lived on the chalk uplands of Wessex with the plateau of Salisbury Plain as their 'megapolis'. Their relics today are of great interest and some even of use; in fact the Great Ridgeway, which pases one mile south of the Rutherford Laboratory, is being made a linear National Park.

Uplands Wessex was hemmed in by an almost continuous expanse of clay forest impossible for pre-historic man to clear easily and with the added dangers of wild animals and epizootic disease. However the light soil of the downs, which nowhere top a thousand feet, resulted in light woodland and patches of scrub or gorse; these could be easily cleared and kept under control with grazing beasts. Thus the Neolithic or New Stone Age started here, circa 3500 BC, with the infiltration of long-headed, 'Mediterranean people who brought with them agriculture and the domestication of cattle, sheep and dogs. There was probably little competition with the indigenous Mesolithic hunters and fishers and eventually their cultures united to form the economically self-sufficient Secondary Neolithic.

Our first visible monuments date from this period and are chiefly concerned with religion and mass burial of the dead in imposing, earthen long barrows. The circular monuments with or without stone settings known as henges and the causewayed camps used for periodic assemblage are peculiar to Southern England. Associated with the former are the mysterious cursuses, pairs of parallel banks and ditches often several miles long.

About 1800 BC immigrant bands of the round-headed Beaker Folk (named after their characteristic pottery), began infiltrating and invading our eastern and southern shores. Although aware of metal, they were probably sub-Neolithic. However they assumed the position of a dominant minority, imposing a cultural unity on the existing population and harnessing local resources to build the many stone circles, standing stones, avenues, stone rows and above all, to develop the principle henges, notably Avebury and Stonhenge, to the originals of their present form. Their most obvious feature was their insistence on individual burial, with grave goods, under round barrows and cairns. However



what is more significant, to the writer, is the change from worship of a mother-goddes to that of warrior gods, possibly brought over by the later Warrior Culture of the Battle Axe.

The rise of the Mycenæ empire with its glorification of the chieftain class created a social market for the gold, tin and copper of Ireland and for the industrial activities planted there from Iberia. The Bristol Avon–Salisbury Plain–Hampshire Avon formed a vital part of the trade route and this resulted in the temporary and almost fabulous enrichment of local chieftains and mercantile aristocracy. Incapable of such themselves, they stimulated artisans and craftsmen to bring in the brilliant early Bronze Age about 1500 BC.

Population pressures on the Continent (and later Julius Caesar) probably cause the many, complex waves of Celts that, between 600 BC and the arrival of the formidable and war-like Belgæ and Veniti in 60–50 BC started the English Iron Age. Their outstanding relics today are the many fortified sites, often on the tops of hills, whose lines of circumvallation rose from one to three or even more to overcome the range superiority of slings over spears. However, land hunger and the use of iron ploughs of improved design lead to the clearing of forests and a move away from the downs.

Contributing to the dominance of the Wessex uplands were its excellent communicatons formed by the three river routes of the Thames and the two Avons. The land routes followed the chalk or limestone belts that are flung off or touch the central area. Thus the Harrow or Hardway, follows the North Downs from the Kent coast to Stonehenge. The Great Ridgeway lies on the North Berks Downs to the Thames gap in the chalk at Goring and then becomes the Icknield Way on the Chilterns. Another major route follows the Jurassic Zone on the hard limestone from the Cotswolds to Yorkshire. Bronze-Age trade goods provided the first concrete evidence of the actual location of tracks; those used in early Iron Age can often be traced in the field e.g. where they connect hill-top forts, and there is written evidence in the Anglo-Saxon land chronicles.

As a contribution to increasing outside leisure activities, a network of long-distance paths is being established throughout the country. In the Wessex area these tend to follow the ancient trackways that were in continuous use from the ancient neolithic farmers to the sheep drovers of the nineteenth century. These tracks lie on the watersheds along the crests of chalk ridges and pass through relatively unspoilt and lonely country. They link together country-wide successions of the great prehistoric earthenworks as well as other habitation sights and the fading outline of what were their cultivated fields. Field systems can be traced back to the late Bronze Age and from the ground their appearance now ranges from the banks and ditches of cross-dykes and ranch boundaries to the slight terracing found on slopes too steep for present day cultivation; the latter were formed spontaneously by the method of ploughing used then.

The sections of Ridgeway track have been long enjoyed both for superb walks and for their archaeological and ecological interest; the Inkpen or North Hants Ridgeway starts near Basingstoke and then goes west along the chalk escarpment overlooking the Kennet Valley before bending south-west towards Salisbury Plain. The other is called after the Wandsdyke, since that huge and mysterious bank and ditch follows the track for several miles east from Devizes, until the latter takes to another escarpment high over the Vale of Pewsey. It is very probable that these two tracks formed a branch of the Harrow Way that lead to the Marlborough Downs and Avebury and then on to Salisbury Plain. The creation of the Royal Forest of Savernake caused the route to be lost as it crossed the water divide between the Kennet and Hampshire Avon near the village of Burbage.

If the two tracks were re-linked and recognized as a long-distance route, then this 'Old Way' would form what could accurately be described as the finest walk in southern England. Accordingly the chairman of a local group of the Ramblers' Association persuaded fellow physicists in the K12, Birmingham–RHEL, team on Nimrod to attempt the 50 miles between Devizes and Basingstoke. As our K12 group leader was worried he might have the word 'group' deleted, the first weekend in February was selected for its absence of machine running and for possibilities of favourable weather.

So a sceptical wife left Chris Adams, John Davies, Geoff Greyer, Mike Hotchkiss and Tom McMahon at Devizes early (?) on the Saturday. Within a few miles it became evident that the group could be split into those having legs longer or shorter than 31 inches; the former were always half a mile per hour faster but the leader had short legs and delayed shouts of 'wrong . . . way' somehow kept the party together.

A heavy hailstorm terminated the efforts of two members on Saturday evening and a bull nearly finished off the remainder as they struggled towards their camp on Ham Hill – we hadn't noticed in the gloom that the fence twixt us and the bull had petered out.

Jim Homer in his rugby boots augmented the battered remnants in the brilliant sunshine of Sunday. With ten miles to go, blisters finally defeated Mike who hitch-hiked to Basingstoke to collect the rescue car and then acted as cheer leader at each road junction.

With four miles to go, Tom, blister-free, way out in front and going like a bomb, decided that there was no pleasure in going on alone along a well-known track in the gathering gloom and he too retired. This left Jim to encourage John to finish in the dark, ten minutes before it began to snow heavily – however he had cheated by having a tolerant wife to ferry him home the previous night.

This 'Old Way' will amply repay the great amount of work required to make it into a long-distance route. Where signposted as a right-of-way, it was crowded; elsewhere we managed to walk seven miles without crossing a road or seeing a single person. As a final observation the two 'finishers' were the only ones not to suffer from blisters and only they wore ordinary shoes.

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council commentary

The big subject at the March Council meeting was the NP Board's policy review. The Secretary of State for Education and Science, Mr. Edward Short, with Mr. D. W. Tanner his private secretary, attended the meeting for the discussion of this item. The NP Board re-confirmed its conviction that while the present facilities would provide for first-rate research for some years ahead, the 300 GeV or some similar machine must be the basis of any satisfactory high energy physics programme in the 1980's. Although the Board had to plan within a falling proportion of the Council's funds, its plan provided for joining the 300 GeV project if the Government's decision were reversed, the funds being found mainly by closing down Nimrod in six or seven years' time, and by a reduction in the total number of experimental high energy physicists and nuclear physicists supported in the universities. An alternative plan was provided in case the Government's decision were not changed. The effect of the first plan on the work and staff use of the Rutherford Laboratory was discussed, and the Council was also glad to hear that the Chairman would visit the Laboratory, and that in the course of the visit he intended to discuss with the staff the problems which participation in the 300 GeV project might raise.

The April meeting was a long and varied one. The Council, exceptionally, agreed to receive a delegation from the Staff Side of the SRC Whitley Council, to present their views on the proposals to phase out NIMROD and reduce the staff of the Rutherford Laboratory, should the UK decide to join the 300 GeV project. The Staff Side, leaving aside scientific questions as being wholly the Council's responsibility, presented a challenge to the Nuclear Physics Board's plan on other grounds.

The next item was the consideration of the financial Forward Look for 1970–1975. As approved by the Council this shows the alternative NP programmes with and without the 300 GeV, no decision between these two being necessary for a further year. The programme shows a rather higher proportion than in recent years of expenditure on large projects to provide for the needs of the future, and there is further development of the policy of special encouragement of selected fields of research. In this connection the Council also considered the UST Board's revised policy review, which besides dealing with purely UST matters, made recommendations on several matters of general Council policy, such as the selection of fields of work for special encouragement, and the provision of grants for more ancillary professional and technical posts. These will be more fully reported in the Council Annual Report.

Professor Hoyle introduced the full review of optical astronomy in the southern hemisphere which had been carried out in 1968 under his chairmanship. The recommendation, accepted by the ASR Board, would provide for an impressive and exciting programme within a reasonable expenditure. Facilities in Australia would be concentrated at the site of the Anglo-Australian telescope, and in South Africa and it was hoped that a good programme could be arranged in collaboration with the CSIR (South Africa). At the March meeting, exploratory negotiations in Australia and South Africa had been reported. The Council was informed that these were proceeding well, and authorised their continuation.

Large individual items approved by the Council at the April meeting were the completion of development of the Stage 5 (star-pointing) stabilisation of the Skylark rocket, the total approval now being £705,000; necessary spares for the Nimrod magnet power supply, costing £290,000; and grants totalling £330,000 to Imperial College, Reading and Oxford Universities for experiments in satellites HEOS A-2, Nimbus-D and Nimbus-E. The Council also approved at the Rutherford Laboratory the design study costing £50,000 of a high field bubble chamber and for the Radio and Space Research Station, equipment costing £60,000 for a new collaborative programme with the GPO on radio-meteorology and millimetre wave propagation. The Council welcomed this collaboration, one of the first to be undertaken under the policy that establishments should devote more of their allocated resources to work of practical application.

TRIUMF on the PLA

W. D. Allen

The Rutherford High Energy Laboratory is known chiefly for its 7 GeV proton synchrotron, Nimrod. Less conspicuous, but widely used by many university teams, is the Proton Linear Accelerator, referred to locally as the PLA. (The appellation 'Ramrod' was fiercely resisted by the PLA community). The PLA produces beams of protons of energy 30 MeV and 50 MeV, and has until six months ago been exclusively used for nuclear physics. During May–October 1968, however, an experiment was mounted which differed in many respects from normal. For one thing, it was an experiment in atomic physics; for another, the stripping cross sections sought were of interest because they were the basic parameter in a machine magnet design; for a third, it was carried out by a team of Canadian visitors. A brief account of the motivation of the experiment, and of the use of the PLA to achieve a rather novel result, may be of interest.

meson factories

It has been known for 20 years that beams of protons in the energy range 200–500 MeV have sufficient energy to produce mesons from target material: the period 1948–56 saw many experiments reported on meson and proton scattering in the energy range of a few hundred MeV. After 1956, high energy physics raised its sights with the advent of machines in the range of thousands or ten of thousands of MeV, and the range we have been speaking of has been relegated to the realms of classical high energy physics. Now the cyclotrons of 'classical' high energy physics were relatively low current machines: an extracted beam of one microampere was regarded as good. If, howeved, we had not one microampere but one thousand microamperes in the incident beam, then one would have a powerful machine for a wide variety of purposes. Thus, one could repeat, with much greater precision, the 'classical' experiments on proton and meson scattering in this energy region: and one could, with a high flux of relatively slow pions, produce beams of relatively slow muons which would be far more intense than any existing source. In addition, however, a 500 MeV beam if brought to rest in a solid will liberate about 25 neutrons for each incident proton, so that one would have a powerful neutron source, either in terms of total flux or in terms of a pulsed source: and so on. The case for a multi-purpose facility, described in popular literature as a meson factory, is impressive (see, for example, Physics Today, Snell & Zucker 1963 or Rosen 1968).

but what kind of machine?

The last sentence is of course a subjective judgement. The case may be impressive to some, but the fact is that until the last few years, no proposal has been funded. There are various reasons for this, not the least being the fact that a multipurpose powerful machine is very expensive. Another consideration has been the fact that machine physicists have been divided in their advocacy as to what machine to build. Cyclotrons in general suffer from the major disadvantage that efficient beam extraction represents a diffcult problem. In a cyclotron, the ions execute a spiral path in a magnetic field, being accelerated twice per revolution, i.e. each time they pass the edge of an electrode appropriately called the Dee, carrying radiofrequency power. In the beginning, the gain of energy per turn is large compared with the particle energy, and the separation between successive turns is large. When the particle energy is high (several hundred MeV) the relative energy gain per turn is small. The turns of the spiral are therefore close together and it is difficult to prise them apart in such a way as to extract the beam without disturbing the preceding orbits. In practice, this means that one can get about half the beam out: the remainder is deposited in the extraction system. For a high power machine, the radiation problem that this poses is formidable. An attempt to avoid the problem, the Separated Orbit Cyclotron, originally urged by F. M. Russell of the Rutherford Laboratory, has been thoroughly studied, but has found no sponsors except for a small scale test model at Oak Ridge.

The linear accelerator suffers from no such problem: the beam, accelerated in a straight line, comes straight out through a thin window. Here however the problem is different: the radiofrequency power driving the accelator is very high, and the valves supplying the power are normally operated with a low duty cycle (i.e. the ratio of 'on' time to total time is small). The consequence is that the objective of a high mean current is difficult to achieve.

Despite these difficulties, two 'meson factories' are in the course of construction. In Zurich, Switzerland a special type of ring cyclotron is going together, while in Los Alamos, New Mexico, a meson facility is being developed from a linear accelerator with a 6% duty cycle. A third project, the Intense Neutron Generator at Chalk River, a linear accelerator with 100% duty cycle, aiming at 65 mA at 1,000 MeV, has recently been turned down.

TRIUMF

There is, however, an alternative to the normal type of cyclotron which, while accepting a rather lower mean current, neatly sidesteps the problem of extraction. This proposal originated in Los Angeles, and has been taken up by a group of Universities in Western Canada, who have given it the acronym TRIUMF – Tri-University Meson Facility. The proposal is this. Hydrogen (neutral) atoms can lose an electron to form a proton; they can also attach an electron to form a negative hydrogen ion. The 'glue' that holds the electrons on is relatively weak, so that when the ion passes through matter at high energy, for example a thin foil, it loses both electrons and becomes positive – a principle long in vogue in tandem electrostatic generators. In a cyclotron accelerating these ions, the particles are deflected towards the centre of the machine by the magnetic fields: when the sign of the charge on the ion changes, the force on the particle reverses in direction, so that the (now positive) ions are actually pushed out by the magnetic field. The stripping by the foil is effectively 100% efficient: the beam is only very slightly scattered by passage through the foil, and therefore emerges from the machine without loss. Extraction is therefore approximately 100% efficient, and – relatively speaking – no radiation problems arise.

In addition, however, to the modesty of the current – 100 microamperes is aimed at in TRIUMF – a second problem arises. The force that deflects the negative ion in the cyclotron magnetic field is the force on the attached electron: and, as we have said, the glue holding this electron to the residual neutral atom is relatively weak. There comes a time, therefore, when the forces of deflection are such that the electron is prised off the atom, which is thenceforward lost to the system. By suitable design, the system can be organized to give a maximum ion energy of the 500 MeV. However, a knowledge of the electron loss cross section; i.e. the rate of loss of particles of adequate energy in a known field, is an important factor in the machine design. This 'stripping' cross section can be estimated theoretically, but not with high accuracy; it has been determined experimentally on the Los Angeles cyclotron, but again not with with accuracy. Since the machine performance (in TRIUMF) and the magnet design depend on this cross section, an accurate determination was essential, and, soon after the project was funded, a request was made for a fresh experimental determination at the RHEL.

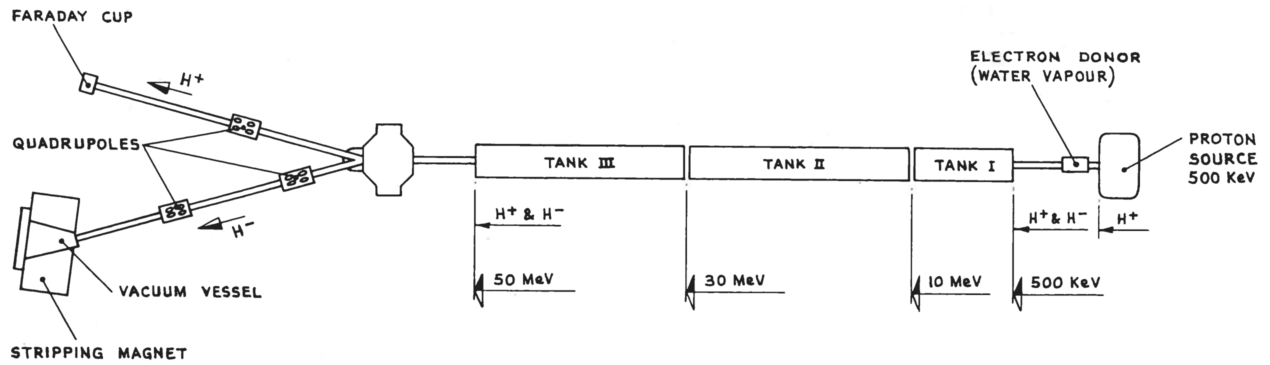


Fig. 1. Schematic of the PLA with the experimental layout for the TRIUMF Experiment

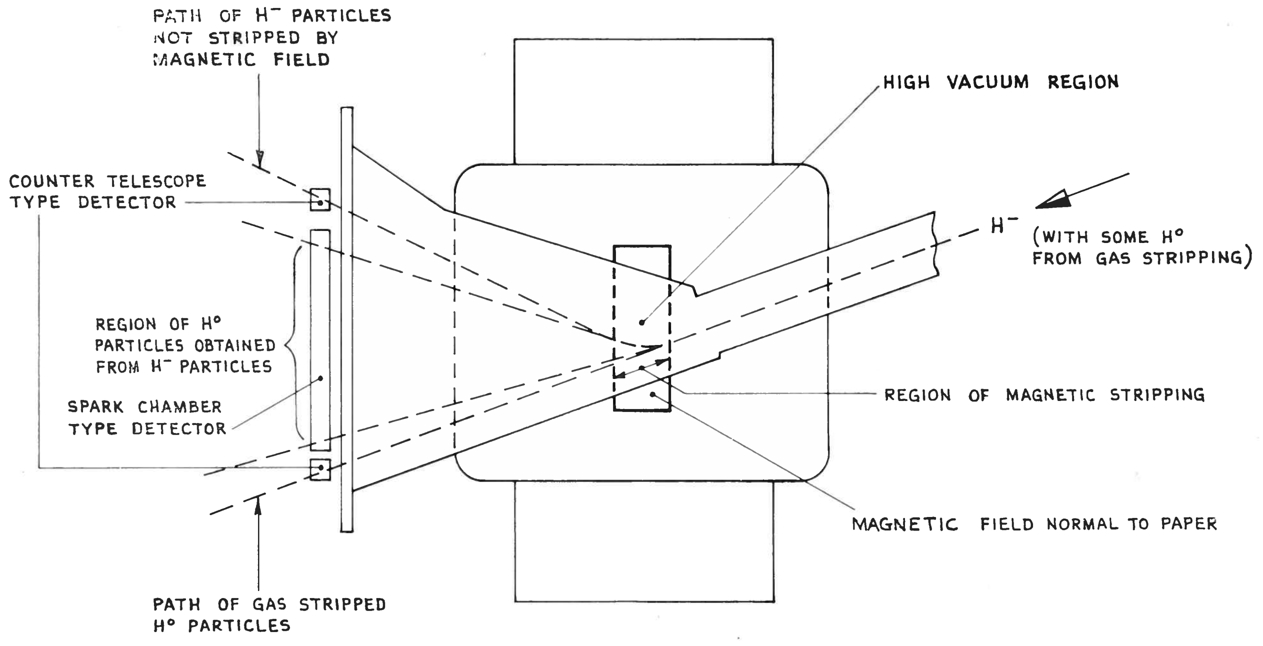


Fig. 2. Schematic of H– Stripping Apparatus

PLA experiment

Ideally, one could seek to carry out the test with a beam of 500 MeV negative hydrogen ions in a magnetic field of 6 Kilogauss maximum. Since no such beam is readily available, an alternative is to establish the stripping of a 50 MeV negative ion beam in a magnetic field of at least 20 Kg: in principle, the determination at one magnetic field only is necessary, as the uncertainty in the theory is mainly in the parameters chosen. In the PLA, negative ions are accelerated as easily as positive, by virtue of the linear path and the fact of the alternating character of the accelerating voltage – provided that enough negative ions can be produced. The injector of the PLA operates (Fig. 1) at 500 Kilovolts, and passing this beam through carbon foils was expected to give enough negative ions for the experiment (i.e. about 10^5 per second). In the event, the carbon foils burnt out too rapidly; however a tube carry water vapour proved sufficient to yield an adequate negative ion beam. The attraction of the method was that, apart from the mechanics of inserting or withdrawing the tube, no change in the operation of the accelerator was required, so that the TRIUMF experiment was scheduled for the machine with effectively no interference to the nuclear physics programme.

The intelligent reader who has struggled thus far will be justified in wondering how the claim of 100% efficiency in stripping electrons from negative hydrogen ions by passing through a foil, can be reconciled with this reverse assertion: the **production** of H- ions from protons by passing through foil or vapour.

It all depends on the proton velocity. At 12 KeV energy, a proton has the same velocity as an atomic (orbital) electron. As the protons of this energy pass through matter, many electrons, initially attached to stationary atoms in the matter, execute a sort of 'excuse me' dance and switch their attachment to the fast protons, which become fast neutrals. If this happens twice, one has a fast negative hydrogen ion. A 12 KeV, two in a hundred fast particles is a negative hydrogen ion. At 500 KeV, the proportion is very much less, but still adequate: at 500 MeV, all the fast particles are protons.)

The rest of the experiment was straightforward (Fig. 2). The beam was bent into a spare experimental area and passed between the jaws of a large magnet (22 Kilogauss maximum) borrowed, with modifications, from Nimrod. This bent the ions through an angle of about 30° in a path of some 12 inches. A small fraction of the ions were stripped en route, and the resulting fast neutral atoms – still, of course, retaining their 50 MeV energy – were detected by an extended spark chamber system borrowed from the PLA spectrometer. The ratio of the number of ions recorded in the spark chamber to those in the counter telescope gave the stripping cross section required. The results are exhibited in Fig. 3, where the ordinates are in terms of time for stripping in the field, i.e. related to the electron loss cross section, and the abscissa is the electric field in M.V/cm, equivalent to the deflecting magnetic field. The curve marked 'Hiskes' is one of the original theoretical estimates, which appeared to agree with the original measurements, shown by crosses, taken at the Los Angeles cyclotron. The other curve and the theoretical expression shown is of the same form, but modified to fit the points taken on the PLA, shown by circles and dots. Although the two curves might appear close to each other, the scale is logarithmic, so that the PLA figures for the stripping cross section are one-third smaller than the previous values.

The outcome? That the TRIUMF magnet needs to be slightly larger than originally expected. However, it can now be designed in the confidence that the parameters on which the design is based are firmly established.

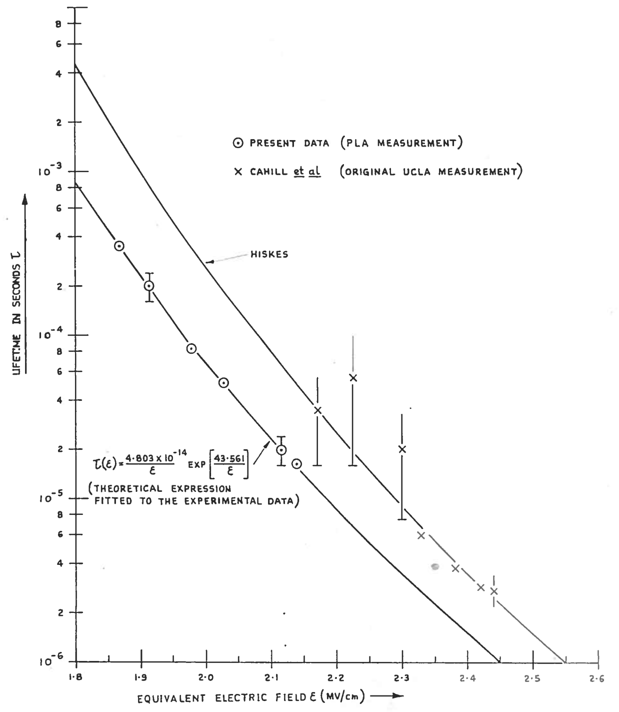
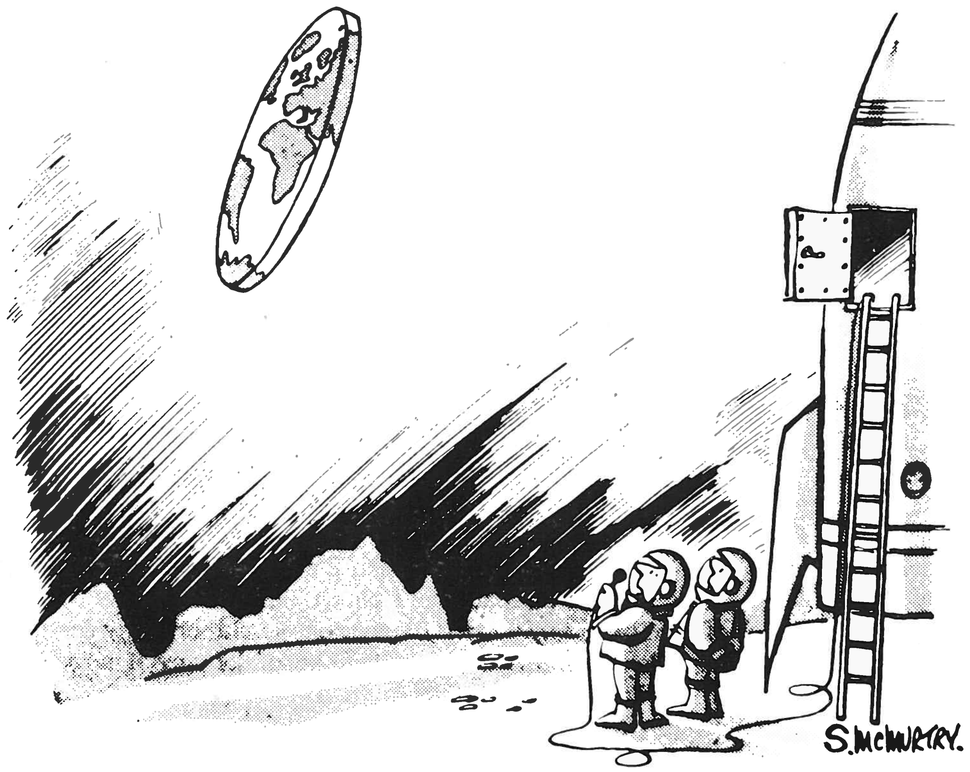


Fig. 3



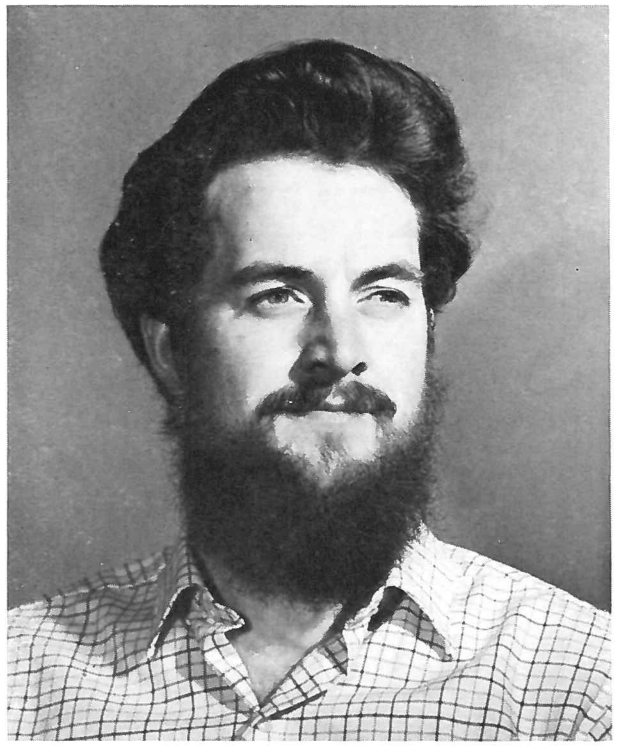
"Hello earth . . . look, I'm not quite certain how to put this . . ."

with acknowledgement to Times Educational Supplement

people and their pastimes

motorcycle sprinting

E. N. Walker
RGO



Beneath, and almost part of you is the machine, a throbbing 1,000cc twin cylinder Vincent, barking a raucous percussion into the grid area cacophony, but sounding very sweet to ears tuned by anxious experience to detect this one note from a full orchestra of almost identical instruments.

In front stretches the course, a strip of tarmac, a seafront promenade, or a disused aircraft runway.

The right hand tweaks the throttle spasmodically and the body vibrates to the answering rise and fall of engine revs. A signal . . . 'go when ready' . . . left hand claws down the goggles and grips the clutch lever, toe of right boot lifts gear into first. Slide back in seat; rev to seven thousand; exhausts blast staccato flames into the inferno of sound; smoothly release clutch lever.

Front wheel paws the air, rear wheel fights for grip, fails and spins crazily, bites, and you're away. 100 yards out and 80 on the clock, rev. counter shows seven thousand, hand and foot co-ordinate to flick into second gear. Revs die then swing up again to seven thousand; into third and again to seven thousand; 110mph now, the engine note, muted by the speed, is sweet and regular.

If its a half-mile sprint, the throttle stays open in top gear and you cross the line at about 135mph; if its a kilometre run, then you'll be at 140 plus. At this speed the wind blast is like a physical blow, differing only from a punch on the jaw in that the whole of the body suffers the same treatment. The air pressure is so great that cheeks flap like paper. Once over the line, the right wrist, which is holding the throttle open, eases back, and if the run-out distance is short, there are anxious moments of swift gear changing and hard braking.

You've just covered a quarter of a mile in thirteen seconds, or a half-mile in about twenty seconds; you've worn a visible amount of rubber off the rear tyre, but you MIGHT have made the fastest time of the day, which would really make the journey worthwhile. But whether you have won or not, you are still alive, so you return to the paddock hoping to do better next time. That's what sprinting is all about . . . a man/machine combination against a clock calibrated in one thousandth of seconds.

Motorcycle sprinting must be the least commercialised of all the mechanised sports. An almost complete lack of cash prizes, coupled with a truly competitive attitude and the friendly cooperation of organisers and competitors, makes for a very amicable sport. There are, of course, varying degrees of involvement: on the one hand there are the professionals, probably dealers, whose commitment is almost total, they use their success at speed events as advertising. Their specially prepared machines wear flat tread slick tyres and drink £25 per gallon high explosive fuel at a rate of two miles to the gallon. These men are the fastest on two wheels in the world; speeds of up to 200mph are attained for a standing start kilometre; a standing start quarter mile will be covered in ten seconds, with a terminal speed of 135mph.

To illustrate the sort of speed involved, imagine a man travelling at 140mph in an 'E' type Jaguar. He pases an expert motorcyclist as he drops the clutch on a standing start sprint. The dot in the rear view mirror recedes for about a quarter of a mile, but at 0.6 of a mile, nineteen seconds after passing the stationary bike, it flashes past the Jaguar and **leaves** it at up to 50mph in excess of the speed of the car.

At the other end of the scale there are the hundreds of enthusiasts who, like the author, compete in standard production machine events. Here, the machines must be fully equipped for the road, with lights, dynamos, mudguards, etc. Engine tuning is permitted, but special fuel, super-chargers, special tyres, etc, are out. The speeds are in a different order to those of the experts, but competition is none-the-less keen. The author, with his own machine has consistently clocked times of under 13.5 secs. for quarter mile events, and has a 'best time' of 13.06, which has been bettered by very few people in the world on production machines.

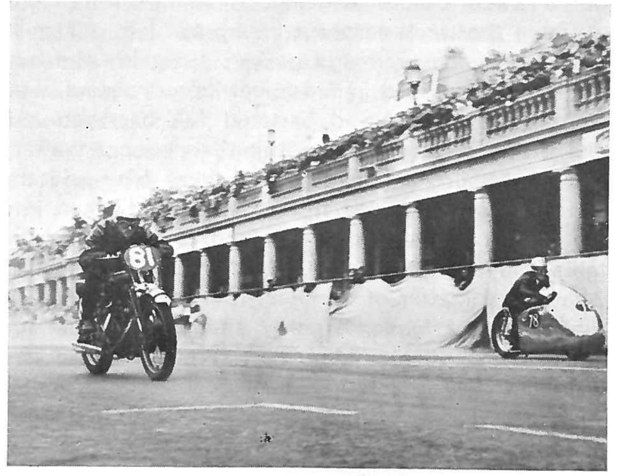
For anyone wanting to take part in a motorised sport, motorcycling is probably the cheapest ticket; even so, it is still a fairly expensive hobby. Entry fees usually cost £1 and £5 for petrol for the day; all for a total of six runs, which, if they take much more than thirteen seconds, means that you've wasted your time. Add to this the cost and time of tuning the machine, frequent tyre changes and special clothing . . . not to mention the cost of buying the bike in the first place. The prizes, if you are lucky enough to win them, won't help the exchequer one little bit, they usually consist of an engraved trophy or a pint tankard!

The author has tried motorcycle sprinting, road racing, hill climbing and sidecar racing (as a passenger). Having been terrified on a wet, sheepdung-covered potholed hill in Westmorland in a hill climb event, and crashing heavily in a solo motorcycle race at Cadwell park, he decided that these events should be left to the more heroic element. For those who need the occasional adrenalin injection however, passenger riding in a racing sidecar can be recommended above all else. Not for them the impersonal battle with a clock; instead, the deathly hush of the starting line, desparate pushing to start and the frantic grab and scramble to get aboard. Once on the move and in the race proper, all connection with sanity is severed. The cosy environment of modern society is replaced by a hard, bucking platform which seems determined to throw you off or beat you to a jelly. One's path is defined by a tortuous strip of concrete, spinning past at speeds up to 120mph. When it bends to the left, it is imperative to lean out as far to the left as possible in order to keep the sidecar wheel on the ground, or at least as close to it as possible. In this precarious manner one rounds corners at three figure speeds with one's rear end literally scraping the ground. With right hand turns, one has to lean over the rear of the bike in an effort to keep the rear wheel in contact with the ground. The vibrations of the engine and frame are transmitted through the ribs to the viscera, and within inches of one's ear, the driving chain wines a tortured protest with the recurrent snatch, jerk, snatch, jerk as the power is fed on and off. The nostrils are assailed by the smell of burning rubber as the rear tyre slides around the corners. It is necessary to anticipate these abrupt changes of direction and to shift one's weight at precisely the right time, but little or nothing can be seen of the course, so one has to rely on the experience gained from trial runs. Even on the straights, when prone on the floor of the chair, the roar of the engine and howl of the wind combined with the view through the transparent nose cone as the road rushes up at 120mph only three inches from one's face, makes for an environment which defies description; experience is the only teacher here.

This is total commitment in the grand manner, indeed it's no place for anyone **but** the totally committed; if one should hesitate, even for a fraction of a second, to lean either to right or left, then you will assuredly crash.

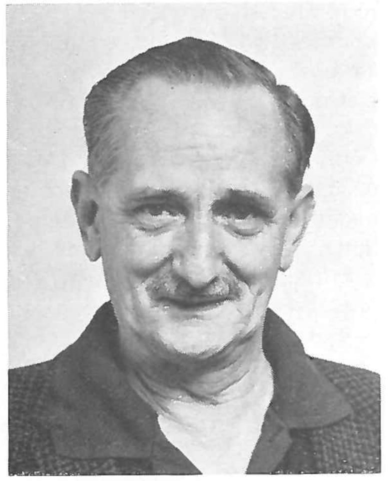
Why do it . . .?, well there are probably as many answer as they are competitors. No doubt a Freudian would find evidence of overt sexuality; an Adlerian would suggest a power complex; and the riding of a shiny, black solo motorcycle would offer considerable scope to any student of Jung's archetypal symbolism.

For my own part, I would suggest that there **are** no words to explain why . . ., the same urge makes people climb mountains, sail boats, grub around in potholes, etc. In fact it's all a part of living life to the full; a life which might be much safer if you didn't indulge in such pastimes, but, oh so very dull.



One hundred yards out from the start, 80 mph on the clock and into second gear.

Bill Stewart joined the staff of the Royal Observatory Edinburgh as a Handyman in 1960, at a time when the Observatory was expanding rapidly. He became a Driver/Handyman for a time, but reverted to his old grade when the transport situation became more stabilised. Now, at the age of 67 years, he is a Nightwatchman, a job he hopes to keep until he becomes an 'elderly citizen'.



a day on the river

W. D. STEWART

Come with me along the left bank of one of our famous Border rivers on a bright early morning in early October. The air is cool after a sharp night frost which has dusted the earth with a fine silvery powder. On our right the ground, which slopes sharply away from the bank, has been planted in alternate strips of Larch and Douglas Fir, the dark green in sharp contrast with the gold-bronze of the Larch can be seen for quite a distance away. On our left, the mainly arable ground is divided into a patchwork of fields of various shapes and sizes, blending into the range of rolling hills that forms the sky-line. October is a time of colour in the country and here we find it at its best; hawthorn and rose-hips glisten dark red and the bright rowans contrast with jet black elderberries which hang like bunches of small grapes.

Walking along a rough track leading from the main road, we come to a hut and seated in its open door are two men, lean and weatherbeaten, who are gazing intently at the river; they are boatmen, or Ghillies, who, in the season, earn a living by imparting some of their long inherited fishing skills to the visiting city dwellers.

They both have old Border names; James Anderson and Peter Young, and we find them discussing their 'Gentlemen' for the day. In a heavy brogue Jim says 'Ah've got a Mr. McArthur, he's a whusky traveller frae Glesca', Pete, 'Ah aye kent ye was yin o' the Lord's annointed, Ah've got a lawyer frae Edinburry, he'll no be that hot; he's a Mr. Naysmith'. Jim acknowledged this with a slight grin and said no more.

The two men have been friends since their schooldays and started work as young gamekeepers, until the youthful call to adventure made them apply to enlist in the Regiment. Pete was bitterly disappointed when the army doctors discovered an astigmatism in his left eye and pronounced him unfit. This did not prevent him from becoming an expert with the twelve-bore shotgun, and he was a regular winner at clay pigeon shoots in many parts of Scotland and over the Border. Jim was accepted and served with distinction for full term of twenty-one years, rising to the rank of Colour Sergeant.

Down the track comes a blue-grey 'Jag', which is expertly manoeuvred and parked alongside the hut. The owner, dressed in faded corduroy trousers, well worn sports jacket and battered felt hat, gets out and with a cheery 'Good morning' announces the fact that McArthur had arrived. Jim takes over and the gear is soon offloaded from the car and taken into the hut. A small hamper of food is placed on the table and the tackle and rod taken out to the boat, where in a matter of minutes, it is 'set up', the line run out and a leader expertly attached. 'What's the killer today' queries McArthur. 'Well ye could dae waur than pit on a Hairy Mary, no ower big' replies Jim. 'OK, you're the doctor', and from a well stocked box, Jim selects his 'flee' and with a style of his own, attaches it to the leader.

Meanwhile, Mr. Naysmith had arrived, driving a mud-stained Cortina, which he parked alongside the other car. A quiet 'Good morning, gentlemen' seemed to imply that he was not one to waste words. Pete gave him quick service and in a short time, both boats were ready for the day's fishing.

The two men tossed for first drift and Jim pushed off quickly with McArthur into quiet water and allowed the boat to drift slowly downstream. McArthur wasted no time and was soon flicking a lovely long line across the river. After about twenty minutes, with a splash and a hefty pull he was playing a fish that took about eighty yards of line with its first rush. 'Rush and Recovery' soon subdued it, however, and it was brought alongside and expertly netted by Jim, who gave it the 'last rites' – a sharp blow on the head with a small wooden baton called a 'Priest'. On the scales it showed eighteen and three-quarter pounds. 'A beauty' grinned McArthur, 'a gey guid fish' agreed Jim, stowing it carefully in the bottom of the boat. McArthur reached into his bag and brought out a bottle of whisky and a tumbler. Removing the foil and cork, he poured about four fingers and handed it to Jim who downed it in a oner. Returning the glass, he remarked appreciatively 'By, that wis a stiff yin'. McArthur poured again and with a muttered 'Cheers' followed Jim's example. After a moment's attention to the line, McArthur began to cast again and soon hooked another, lesser specimen, which received the same treatment and fiery blessing, before Jim turned the boat upstream for lunch.

In the other boat, poor Pete was getting a rather thin time. Naysmith had made it plain from the outset that he did'nt need any advice on the selection of flies. I've been advised to try a 'Jock Scott' he said, to which Pete replied with a non-committal 'fair enough'. Naysmith began to cast, first rather awkwardly and then with a steady swing, but he achieved no success. After an hour's fruitless casting, Pete remarked, 'Ye could try anither flee'. Despairingly, Naysmith agreed and turning back the lapel of his coat, Pete selected one of three which weer stuck into the cloth; 'try that yin' he said and quickly tied it on.

The fly was very similar to the one chosen by Jim and was one of Pete's own dressing. Within about ten minutes the fly was taken strongly by a good fish which took Naysmith by surprise. He attempted to rise to play it, but was curtly ordered to 'sit doon and let it rin'. After a lot of vocal help, Naysmith brought the fish in close to the boat for Pete to net. 'My first salmon' he exulted, 'Ah thocht as much' grunted Pete, and after a pause, 'ye micht 'ave tellt me ye wis a beginner'. 'I'm sorry, I should have said so' apologised Naysmith, 'I did'nt think'.

Pete was slightly peeved by the non-appearance of the 'dram', but did not let it show. A somewhat subdued Naysmith started fishing again, but not for long; as Jim's boat passed them, Pete turned in behind and followed them to the hut, where the boats were run up onto the shingle and the catch taken in for inspection.

McArthur opened his hamper and set out food and cans of Bass Export for each man. 'Right lads, dig in' he invited, and they fell-to, Naysmith included and he seemed to become more amenable as the meal progressed. There followed a pleasant hour, talking about fishing, shooting and the countryside in general; Naysmith listening intently, but saying little, leaving the conversation to McArthur who was a good talker and seemed to have a good knowledge of the countryside.

After lunch, Pete was first back on the river, followed after a short interval by Jim. Naysmith soon hooked, but lost a small fish, then landed an acceptable ten-pounder. McArthur landed one about twelve pounds in weight, but a chill wind had sprung up and with it, the fish evidently decided to seek other, more sheltered water, because neither men had any more luck and shortly, by mutual consent, they decided to call it a day.

On arrival at the hut, the rods were 'taken down', the catch packed in polythene bags and, with the gear, stowed in the boot of the cars. As this was being done, McArthur turned his back, extracted a pound note from his wallet, folded it neatly, and on shaking hands with Jim, deftly palmed it. He answered Jim's thanks with a grin, slid under the wheel of his car and was off. Naysmith was equally appreciative and dexterous and he moved off leaving Pete in a slightly astonished state. Thus ended a routine day in the lives of two of my friends.

newsfront

Knighthood for the Chairman

Professor B. H. Flowers, FRS, receives a knighthood in the Queen's Birthday Honours List.

OBE

Professor I. N. Sneddon, member of the UST Board and the Computing Science Committee.

BEM

G. E. A. G. Barnett, Senior Scientific Assistant, RSRS.

BRITAIN FIRST TO ACCEPT CERN CONVENTION CHANGES

MEYRIN-GENEVA : CONTINUING A TRADITION ESTABLISHED IN 1954 WHEN THE U.K. WAS THE FIRST MEMBER STATE TO RATIFY THE CONVENTION ESTABLISHING THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, THE BRITISH DELEGATE HAS DELIVERED TO THE DIRECTOR-GENERAL OF CERN THE OFFICIAL NOTIFICATION THAT BRITAIN HAD ACCEPTED THE AMENDMENTS TO THE CONVENTION PROPOSED BY COUNCIL.

THE EXISTING CERN CONVENTION EXPLICITLY PROVIDED FOR THE ESTABLISHMENT OF A FUNDAMENTAL NUCLEAR PHYSICS RESEARCH CENTRE NEAR GENEVA WITH TWO ACCELERATORS SERVING AS PRINCIPAL EXPERIMENTAL TOOLS - A SYNCHRO-CYCLOTRON OF 600 MEV AND A PROTON SYNCHROTRON OF MORE THAN 10 000 MEV (CURRENTLY CAPABLE OF 28 000 MEV).

FOR EUROPE NOW TO PROCEED WITH ITS PLANS FOR A 300 GEV PROTON SYNCHROTRON WITHIN THE FRAMEWORK OF THE SAME ORGANIZATION, THE CONVENTION NEEDS TO BE MODIFIED - REQUIRING THE ACTIVE AGREEMENT OF ALL THE PRESENT 13 MEMBERS. THE REVISIONS TO BE RECOMMENDED TO GOVERNMENTS WERE AGREED BY COUNCIL IN DECEMBER 1967.

THE REVISED CONVENTION PROVIDES FOR THE SETTING UP OF OTHER LABORATORIES.CONTAINING ONE OR MORE PARTICLE ACCELERATOR AND ASSOCIATED EXPERIMENTAL EQUIPMENT EACH WITH ITS OWN DIRECTOR-GENERAL RESPONSIBLE TO A COMMON COUNCIL IN TURN ADVISED BY A COMMON SCIENTIFIC POLICY COMMITTEE AND FINANCE COMMITTEE.

BRITAIN IS NOT ONE OF THE SIX COUNTRIES (++) WHO HAVE ALREADY STATED THEIR WISH TO PARTICIPATE IN THE 300 GEV PROJECT. THEIR BEING FIRST TO AGREE THE CONVENTION CHANGES DOES, HOWEVER, DEMONSTRATE THE ACTIVE SPIRIT OF COLLABORATION THAT IS IN EVIDENCE AT CERN.

(++) LETTERS OF INTENT HAVE BEEN RECEIVED FROM AUSTRIA, BELGIUM, FEDERAL REPUBLIC OF GERMANY, FRANCE, ITALY AND SWITZERLAND.

EDWIN N. SHAW
CHIEF-INFORMATION OFFICER
CERN GENEVA

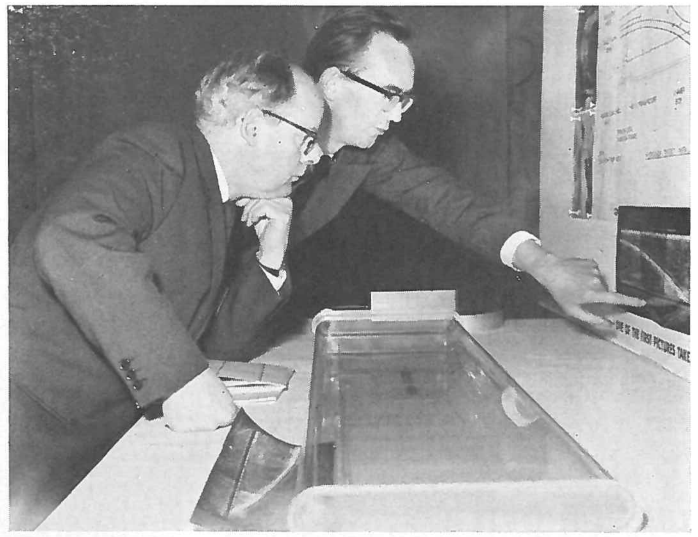
The picture shows (r) Mr. J. Cemow, Head of the Nuclear Physics Division with the Director-General of CERN, Professor B. P. Gregory.

Lord Halsbury listens intently while Dr. David Thomas, Group Leader of the High Field Bubble Chamber Group describes an aspect of the Applied Physics Division's work.

Mr. B. Jones of the ARU Division, Culham, describing solar physics results to (l to r) Mr. Hosie, Professor Hoyle, and Dr. Gavin.

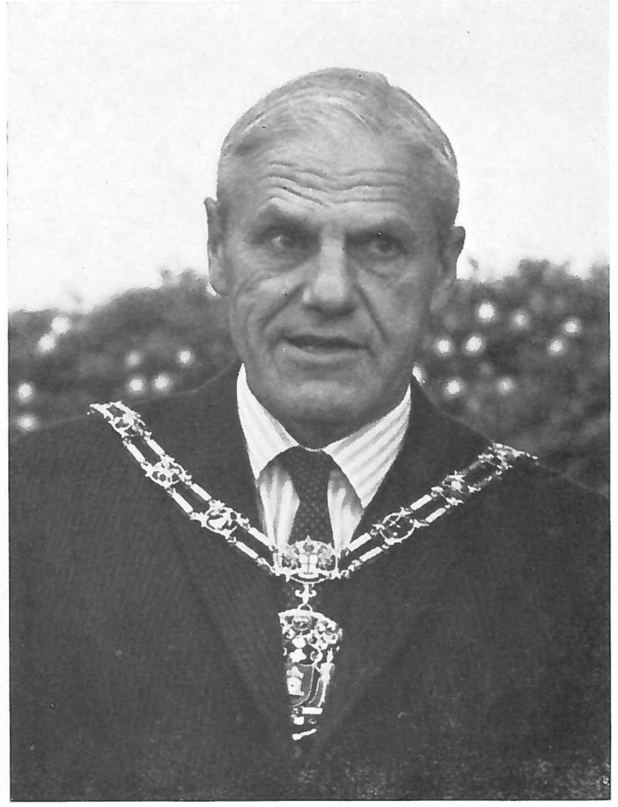
Dr. Francis (l), Lord Halsbury, and Professor Gunn, deeply interested in an explanation of the function of the High Energy Bubble Chamber, given by Dr. David Thomas.

Tea Break
Groups of Council members talking to laboratory staff during a break for tea in the PLA conference room.
In the background, the Chairman can be seen talking to Dr. Pickavance and Dr. Gavin.



Dr. Francis, the Secretary of the SRC, being shown one of the first pictures to be taken of an event in the new 1.5 metre bubble chamber. Explaining the print is Dr. P. R. Williams, Head of the Bubble Chamber Group.

Whatever else it may look like to the uninitiated, the object in the hands of J. R. Stokoe of the Engineering Design and Development Department, is the tailpiece of the liquid hydrogen target.



The Astronomer-Royal wearing the badge and chain of the Master of the Worshipful Company of Clockmakers, at the garden party held in the grounds of Herstmonceux Castle on June 6th. Sir Richard is this year's Master of the Company and is the fourth Astronomer-Royal to be so honoured.

Photo David A. Calvert

Atlas support for Atlas

Manchester University's Atlas computer was damaged by fire on the evening of Sunday May 4, but a very swift first-aid programme was arranged between Professor Sumner of Manchester and Dr. Howlett of the SRC's ACL, whereby at least part of the Manchester work could be continued until repairs could be effected.

A telephone call to Dr. Howlett on the Sunday night produced quick results and on Monday it was arranged to allow one hour in twenty-four for the University's work, and a full eight hours on Saturdays.

The first programme was run through within twenty-four hours of the fire and the results available at Manchester on the following morning.

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