2ND ISSUE AUGUST, 1962

ORBIT

THE JOURNAL OF THE RUTHERFORD HIGH ENERGY LABORATORY

THE ELECTRON LABORATORY

In the Annual Report for 1960-61 the National Institue, considering the future needs in this country for high energy accelerators, concluded that there was a 'pressing need' for an electron synchrotron of a few GeV. That need will now be met. Lord Hailsham, Minister for Science, announced in the last week of July that government approval has been given to the National Institute to establish a second Laboratory which will house a 4 GeV electron synhrotron.

The new Laboratory will be smaller than the Rutherford Laboratory with a staff of around 250 and a capital expenditure of about £3½ million. The site has not yet been chosen but will be in the Liverppol-Manchester area and the Laboratory will have specially close ties with the Universities of these two cities and with Glasgow University. Professor A.W. Merrison of Liverpool University has been chosen as Director and will be seconded from the University for five years to take up this post.

The first electron synchrotron, the Cambridge Electric Synhrotron at Harvard, began operation in March of this year and is designed for 6 GeV output energy. Similar machines at Hamburg in Germany and Yerevan in Russia are due for completion in 1963. The British machine will be of lower energy but will probably achieve greater output beam intensity.

Electron machines produce high energy gamma ray beams to investigate photon reactions. Also the elctron-nucleon interaction is much simpler to understand than the proton-nucleon interaction thus making some investigations of the fundamental structure of the proton and the neutron easier with electron beams. A 4 GeV electron synchrotron can produce most of the fundamental particles but more intense beams of these particles can be achieved on Nimrod which can also provide all the particles so far discovered. The two machines are therefore complementary and together will be able to cover a very broad range of high energy physics.

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THE ROYAL CHARTER OF THE

NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

Dr. Willis, Secretary of the National Institute, takes us through the Royal Charter in this article bringing out especially the 'objects' for which the Institute exists.

The formation of the N.I.R.N.S. was announced in Parliament on the 14th February, 1957 and the Members met from March, 1957 onwards, and immediately set to work. They were able to take decisions, for example the decision to set up the Rutherford Laboratory, and agents, particularly the Atomic Energy Authority could begin to put these decisions into effect for them. However, before the Institute could own property or undertake legal obligations and actions themselves they had to be formed into a "body corporate", which means a group of people legally united into a body so as to act as an individual.

The Royal Charter, dated 23rd June, 1958 incorporates the sixteen Members of the N.I.R.N.S. and their successors, as a body corporate. When they need to take action with full legal effect, their common seal is applied to the document concerned. It is not often that this has to be done, (only ten times so far). It is worth remembering that it is only the Institute themselves who have a corporate existence. The Rutherford Laboratory is not a body corporate (nor for example is the A.E.R.E.).

The Charter begins be declaring the incorporation of the Institute in splendidly old-fashioned language, and then in an important section sets out the objects "for which the Institute are established". (Note, by the way, the use of the plural. This is followed consistently throughout the Charter). The Institute and also the Treasury have to study the wording of this section very carefully whenever a new and different activity is proposed. The Atlas computer laboratory was a good example of this, but there have been other cases too where we had to seek legal advice. However the wording has so far proved to be broad enough. The statement of objects is in many ways the most important part of the Charter, and is best quoted in full:-

"(a) To carry out research of any nature in connection with nuclear science or any matter related thereto.

(b) To provide, equip and operate facilities of any description which may in the opinion of the Institute, be required for the purposes of any such research as aforesaid.

(c) Without prejudice to the generality of the foregoing, to provide, equip and operate, for common use by Universities and other institutions and persons engaged in research in nuclear and related matters, facilities which by reason of their size or cost or otherwise howsoever are beyond the scope of individual Universities, institutions or persons aforesaid.

(d) To permit and encourage scientists of Universities, Colleges and the United Kingdom Atomic Energy Authority and other institutions, as well as scientists of industrial laboratories, to make such use of facilities provided as aforesaid as the Institute may determine to be appropriate.

(e) To co-operate with the United Kingdom Atomic Energy Authority in the solution of specific problems in the field of nuclear or related research.

(f) To train scientists and engineers in matters relating to nuclear science.

(g) To disseminate scientific and technical knowledge in the field of nuclear or related research.

(h) To acquire from the United Kingdom Atomic Energy Authority or from any other body or person whatsoever any property, equipment or other assets of any kind which in the opinion of the Institute are requisite for or conducive to the carrying out of research in connection with nuclear science or any matter related thereto and to enter into any contracts or agreements in furtherance of any such research.

(i) Generally to do all things necessary or expedient for the proper and effective carrying out of any of the objects aforesaid."

(cont'd on page 3 ....)

We offer our congratulations to the following staff at the Rutherford Laboratory who recently passed a first aid examination sponsored by A.E.R.E.:-

Mr. A. Dobbs,	Mr. E. Fitzharris,	Mr. E. Gourley,
Mr. I Hunt,	Mr. R. Lawes,	Mr. C. Sutherland,
Mr. I Spencer,	Mr. T. Stewart,	Mr. P. Eager,
Mr. D. Tansley,	Mr. J. Timmins,	Mr. R. Ward.

THE ROYAL CHARTER - (Cont'd)

Undoubtedly the Institute regard (c) as the main object, and were intended to do so, bit it will be noticed that there are also other quite different objects such as (a), (f) and (g) which are important though lesser.

As regards the main object, much depends on the meaning "nuclear science". Although this is not defined it has always been held to include nuclear physics and elementary particle physics, and also research involving the use of a nuclear reactor.

The later sections of the Charter lay down specific rules about the appointment of Members, and then a few very general rules about the conducts of business including the employment of staff. As far as the Charter is concerned, the Institute are given very broad freedom indeed to act as they think fit within their prescribed objects, with one curious exception, which is however not actually important: although the Institute are authorised in simple language to pay their employees what they think fit, the authority to pay pensions or superannuations is given in a sentence of extraordinary complexity, and includes a specific requirement for Treasury approval. What-ever may be the reason for this, it is not something aimed at the Institute, for the same extraordinary sentence occurs in the Charters of other bodies and also in the A.E.A. Act.

The Charter down not say where the Institute's funds shall come from. It merely provides that all money received by the Institute including any voted by Parliament, shall be applied solely towards the promotion of the objects of the Institute (and not for instance transferred to the Members!) But in fact the money comes from the Treasury, through the Minister for Science's office and the A.E.A., so that the Institute have to conform to Treasury requirements in the expenditure of public money, and are not such free agents as a reading of the Charter alone would suggest.

References to A.E.A. recur throughout the Charter. The last two of them in particular give an indication of the close links between the Institute and the Authority. They provide that the Institute's accounts, and also their annual report are to be submitted to the Authority.

Finally there are clauses allowing for amendment.

The Charter is sealed with the Great Seal, 6½" in diameter, which shows the Queen on horseback on the obverse side and enthroned on the reverse side. The Charter is signed by Sir George Coldstream, the Clerk of the Crown in Chancery. I hope that someday we may have opportunity to ask the Queen if she will sign it.

'The hierarchy of a company can often be noted visually by inspecting the name posted before each parking space in the parking lot reserved for management. At an Ohio Rubber Company's home office, the President's space is near the door (in case it rains) ..... and so on down the hierarchy.

Extract from

'THE STATUS SEEKERS'

by Vance Packard.

'There was I, diggin this ole,
Ole in the ground,
Big and sort of round it was....'

Rumour has it that the above hit song was composed by a member of the Construction Group.

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HOLE IN THE HEART ?

Staff are asked to note that access to the Bubble Chamber Annexe .....

can now only be obtained through the watchman in the Bubble Chamber Plant Room.

Rutherford Laboratory Bulletin, 30th July.

THE DIRECTOR'S GARDEN PARTY

It was a perfect day for a Garden Party with the sun not too hot but shining brightly. We made our way through Coseners House to the terrace where Dr. Pickavance and his wife received their guests with welcoming handshakes. Just a brief word and away so as not to hold up the assembly line of hands waiting to be shaken. Then down a couple of steps under the awning onto the lawn, where groups of people were clustered, looking very colourful in the dress the sun had allowed. We would probably have looked like flower beds on an aerial photograph.

Coseners House is a glorious setting. Apparently Cosener (from Cuisinier) refers to the Abbey kitchener who was always a senior monk in charge of food supplies. Even so, a splendid site like this for a kitchener seems to indicate that career prospects as a monk were pretty good, I.P.C.S. or no I.P.C.S. The rambling house sits surrounded by splendid trees which would tax Constable's range of green paints and a long lawn slopes down to the river. On the opposite side a quiet backwater, ex-mill stream, I think, seems to cut all links with the rest of the world. It is crossed by an amorous rustic bridge where I'll bet in days gone by many a likely kitchener dallied with many a buxom kitchen lass.... Perhaps not, they were monks, I forgot!

It is a lovely olde worlde spot with its own quiet peace set away from the bustle of the new Abingdon with its gift stamps and its hot dog stand. The sort of place I dream of retiring to. There I would fritter away my superan. surrounded by grandchildren, the fruits of my life, all looking up to me as a wise kindly old man, heavy with learning and generous in the mellow tolerance by years in the company of men.

Oh yes, the garden party. Well you see it was the sort of warm, leisurely afternoon that excites drowsy delusions of impending granduer. Things were a bit awkward at first and maybe one versatile conversationalist per group kept the topic of weather running for twenty minutes or so, which is not a talent to be dismissed lightly. Everyone seemed rather conscious of others being conscious of them. You could sense thoughts like - "I'll bet her dress and hat cost him a packet. Still he can afford it."

However as the afternoon progressed the early uneasiness modified, conversation became less stilted and limbs relaxed into more natural poses. The sun continued to breathe heavily on the gathering and the lawns filled with people enjoying a pleasant afternoon. Dr. and Mrs. Pickavance descended from the terrace to mingle with their guests who were feeling progressively more appreciative of their benevolence.

There is an 'observation platform' at the end of the garden looking out over the river and over the municipal swimming pool to the left. Perhaps used in days gone by to warn the Abbot of Henry VIII's soldiers galloping across the Oxfordshire fields with dissolution in mind, it served a rather less glamorous purpose this afternoon. Parents clambered up intermittently to survey the swimming pool region, where their offspring had been deposited. When these had been duly sighted and cleared as having all limbs still intact the solicitous parent rejoined the murmering groups on the lawn.

It was getting to be thirsty work, what with the sun and the talk and an almost audible sigh of approval was heard as the Director sat at a tea table. People moved with as much dignity as their eagerness would allow to that longed for cup of tea. Large metal tea-pots, with accomodation for dozens of cups of tea, emptied rapidly and people became still happier as the tea slaked their thirst. Sandwiches and iced cakes were consumed with singular disregard of the current diet. And the strawberries and cream. Exquisite. Certainly there was something very relaxed and charming and English about the scene - strawberries and cream and cups of tea in glorious sunshine on green lawns beside the river.

Then people began gradually to drift away, duly recording their thanks to the Director and his wife.

The afternoon was over. It was all very pleasant.

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WE WOULD LIKE TO CONGRATULATE ! Rod Morgan and Janet Partington both of Magnet Group on their recent engagement.

Also of Magnet Group, Bob Bennet and his wife on the birth of a second son on 13th August.

EDITORIAL

The past month has been a very busy one in the accelerator world, so much so that, in order to provide the news while it is still topical, we have held back several articles we intended to publish this month.

Government approval for the electron synchrotron project is great news for the National Institute and we make no apology for giving this topic star billing in this issue despite the fact that some of us have heard the details already.

Perhaps we have come to associate the National Institute exclusively with the Rutherford High Energy Laboratory. Certainly the Rutherford Laboratory is frequently referred to as 'NIRNS' in conversation and in writing. The advent of the second major Laboratory should correct this. Also a look as the 'statement of objects' given in Dr. Willis's article on the Royal Charter of the National Institute, will make us realise how broad is the possible scope of activities for the National Institute. Our accelerators are just one field of interest, though one of the most obvious and essential.

We are privileged to be at the Laboratory housing the first major projects of the Institute and will watch with great interest the progress of the Electron Laboratory and probably to some extent be involved in it. Also it is hoped that in the fairly near future ORBIT will carry news of the National Institute support for University use of research reactors, which will be a further extension of the Institutes activities. As these activities grow to take their full part in the scientific life of the country we can expect that 'The National Institute for Research in Nuclear Science' will take its place in the nation's vocabulary as 'The Atomic Energy Authority' does today.

Comment on our 1st issue has been generally very favourable, which is encouraging. It is however, comparatively easy to generate enthusiasm for something new; it is more difficult to establish the solid foundations for ORBIT which will sustain this enthusiasm for years to come. We are not satisfied that as yet we have struck the correct balance between our function of relaying scientific and technical news in an interesting way and our function of projecting human interest. At present the scales are tipped towards the former but we are working on it.

In line with the Pilkington Report we may say that we see ourselves in the role of the B.B.C. publishing a good deal of what we ought to have. But certainly does not mean that there is no scope for suggestions. ORBIT is the Journal of the Rutherford Laboratory and should gradually take the form which serves and stimulates Laboratory life best. All personnel are welcome to make suggestions on its content. We have already received requests for photographs of Miss Nimrod 1962, and one enquiry concerning a colour supplement. Unfortunately these suggestions are not practicable at present!

The major criticism of the 1st issue centred on the presentation. Many people felt that ORBIT looked a very poor relation of the established 'glossies' which come our way from the U.K.A.E.A. and elsewhere. The most pithy expression was 'it is rather like drinking beer from a cracked cup.' But we have deliberately begun in a modest way so that we can find our feet before moving to more ambitious schemes of presentation and we feel that within the limits we set ourselves ORBIT looked and read reasonably well. Before very long we may be presenting the beer in a pewter tankard. In the meantime, we think it is better to persevere with the 'cracked cup' rather than let the beer go flat.

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LETTERS TO THE EDITOR:

Letters should be addressed to 'The Editor, 'ORBIT', Building R.1'.

Pseudonyms may be accepted provided the author's real name is known to the Editor.

Sir,

It was with feelings of incredulity and dismay that I read in your excellent journal of the proposal to blow up the canteen. That your first issue should be marred by such a monstrous suggestion is a saddening thought for all eating members of staff, and the callous way in which the timing of this outrage was discussed indicates that the decision has been taken at the highest official levels.

The nameless, faceless clique of administrators behind this scheme obviously have great powers of persuasion over those who control our destinies, and if allowed to go unchecked would embark on the biggest orgy of destruction and desecration since the days of Oliver Cromwell.

We in the Rutherford Laboratory can, however, take pride in the foresight used in the construction of our own little Reichstag. The bold open architecture, devoid of walls and windows, will permit rapid and inexpensive reconstruction when the evil day comes, whether it be a Thursday or Friday.

SHEPHERD'S PIE

LETTERS TO THE EDITOR - (Cont'd)

2nd August, 1962.

Sir,

May I congratulate you on an excellent article by Mr. Southworth in your first issue? "Why Build Nimrod?" is a very good question; but I found the answer in the last paragraph inadequate. Times have changed since the days of Rutherford and his work can no longer be pushed forward without large and expensive pieces of equipment. Rutherford was very conscious of the competition in his field - on January 5th 1902 he wrote to his mother "... I have to keep going, as there are always people on my track. I have to publish my present work as rapidly as possible in order to keep in the race...."

I suggest that this experimental equipment has acquired an importance entirely out of proportion to its true value; that the sense of competition has been largely transferred to the building of equipment; that the scientific results obtained are less obviously 'worth it".

A large accelerator is a piece of scientific apparatus, a tool, and machine builders are tool makers. Of course the tool should be a good one, it should serve its purpose well - but it's the purpose that matters. There seems to be the notion that the big machine has some value in its own right, that the cost, complexity, difficulty of building and impressive size somehow confer value. But have these things any intrinsic worth? There's nothing in complexity - and who are we trying to impress anyway? Aside from its scientific purpose, the big machine has little value. To our illustrious scientific predecessors, the idea that their apparatus was in anyway important would have seemed absurd.

Furthermore, the intense competition leads to a strong sense of urgency in our work, often approaching panic. Time scales are short and jobs often behind hand so that an atmosphere of "non-success" is generated.

Nuclear physics cannot be done without big machines. Therefore, to justify the machine nuclear physics must be very important. Will somebody please tell us, in powerful, convincing terms, why this is so? The reasons for building big accelerators should be more widely known and the actual scientific results produced should be made clear in lay form so far as this is possible. Many people put part of their lives into the machine and they should see something of the end product, which is the important thing.

I suggest that an establishment committed entirely to big projects is on dangerous ground where its scientific life is concerned and runs a risk of early fossilisation. Can we not do something to put back some emphasis on scientific ideas and remove some from "hardware"? We should be better for it.

H. WROE.

Dr. Stafford was invited to reply to the foregoing letter.

Editor.

Sir,

Your correspondent is obviously raising a very important issue about which he feels deeply and which concerns the whole existence of the Rutherford Laboratory. It will, therefore, not be easy to give a convincing answer in the space of a few paragraphs but I feel that I should try.

I am sure that he will not question man's desire to seek to understand the nature of the physical universe of which he is part, and I am sure that he will agree that nuclear and elementary particle research goes deeply to the roots of the nature of our universe. It is also true that by its very nature this field of physical investigation is the most fundamental that remains to be understood. The prospect of doing research in this field is, therefore, a very exciting possibility and the reason why many young physicists are attracted to it. Certainly if Britain did not have these huge machines, generally speaking these young physicists would prefer to go elsewhere to pursue their research than to take up another subject in which they had less interest.

When we talk of building "big" accelerators we are really speaking very loosely. What we really mean is that we are building accelerators which produce highly energetic particles. The high energy is essential if we are to obtain more detailed information about the nature of nuclear matter. In many ways it is sad that high energy research requires so much initial effort from so many people in so many disciplines but, although it may well be true that "a large accelerator is a piece of scientific apparatus", before the protons have reached 7 GeV the building of this accelerator has involved us in a very great deal of physical, mathematical and engineering research and development which should not be decried. Research in high energy physics has become a collaborative effort involving many people in many disciplines. This is the new physics. It differs from the old but it should not be condemned just because it does differ.

The laboratory is still engaged in building "Nimrod"; it is a very tedious and at times soul destroying job. Until it works and until this "tool" is being used to produce new facts about nature we shall not be able to experience the true pleasure of working in a research laboratory. The people who have "put part of their lives into the machine" should then indeed "see something of the end product". The emphasis

(Continued on page 7)

LETTERS TO THE EDITOR - (Cont'd)

will then start to be removed from the "hardware" and will go on to the "scientific ideas". We are still building our tools to do our experiments and that is why the emphasis is on the hardware.

It is interesting that in laboratories similar to our own (CERN, BERKELEY and BROOKHAVEN) where the "hardware" is already working, the atmosphere is tremendously stimulating scientifically. Everybody has an important part to play in this scientific work, there is no emphasis on the building of the "hardware" for the sake of building it and as the Rutherford Laboratory grows through adolescence to maturity I am convinced that the same situation will apply.

G.H. Stafford.

Rutherford High Energy Laboratory,
Harwell,
Berks.

8th August, 1962.

Sir,

There is no indication on the main road of the existence of the Rutherford High Energy Laboratory and visitors often stray onto the Berkshire Downs in search of us. Might I suggest that a simple sizeable plaque announcing our presence, accompanied by a suitably directed arrow, be erected. The cost could be negligable; the various advantages considerable.

Yours,

LITTLE BOY LOST.

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COMINGS AND GOINGS

Dr. D.J. Clark has a fixed term appointment with the Clycotron Group.

Mr. Maskell and Mr. Smith joins Electronics Group and Mr. Taylor the Electrostatic Generator Group.

Mr. Banks and Mr. Holmes join Nimrod Injector Group.

Mr. Reeve and Mr. Hodges join P.L.A. Nuclear Physics.

Mr. Judd joins Bubble Chamber Group.

Mrs. B. Powell joins Accounts, Mrs. Goodwin and Mrs. Pepperell join Administration.

Messrs. Packer, Campling, Chauhan, Dixon, Ferrari, Humphries, Ross, Rowe, Atlawes, Baker, Chicken, Brooks, Flippance and Gebhart join Nimrod Engineering.

Messrs. McRobson, Calvert, Hanks and Lovell join Central Engineering (Services).

Mr. Sandford joins Nimrod Vacuum and Mr. Studart joins Administration.

Messrs. Cartwright, Tanner, Pinkey, Porter, Henderson, Harris, Humphries and Joslyn have left us.

Also leaving this month are Messrs. Cunningham, Eaglestone and Gleave.

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ARE'NT OUR POSTMEN WONDERFUL ! !

A postcard date stamped 1.30 p.m. Hartlepools reached us first post next morning despite the following address -

Messrs. Rutherford,

Nuclear Science Sect.,

Harwell,

Buckinghamshire.

And it was for us !

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"The cost of running experiments in fundamental physics is twice as high as that of the Building programme of the laboratory where they take place"

Dr. M.G.N. Hine, CERN Directorate member for applied physics, on opening the 1962 International Conference on Instrumentation for High-Energy Physics.

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"The world within the nucleous proves much richer than we thought and this shows that the efforts of the past two years to find out what that common universe of our is made of, have not been made in vain."

Prof. V.F. Weisskopf, Director General of CERN in his concluding address to the 1962 International Conference on High Energy Physics.

THE 11TH INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS

Dr. Stafford, Head of the P.L.A. Group, represented the Laboratory at the Conference and presents this summary of the main events.

The 1962 conference was held in Geneva between July 4th and 11th. The first three days were occupied with Parallel Sessions at which selected papers were read by individual contributors and the last three days were used for Plenary Sessions at which Rapporteurs had the difficult task of analyzing and summarizing the more important and significant work presented during the earlier Parallel Sessions. This International Conference is accepted to be the most important one in the field of high energy physics. The volume of research now being done in this field makes the organization of such a conference a formidable task. In spite of the most stringent selection of delegates eventually 360 received invitations to attend, the number being determined entirely by the capacity of the available lecture theatres and other facilities at CERN. Abstracts of 323 papers were sub-mitted, only a small fraction of these were read at the conference and a further small fraction selected for discussion by the Rapporteurs. With such a large volume of experimental and theoretical work to summarize I shall only be able to select a few of the more important results and attempt to point out how the present state of the subject may effect what we might be doing on Nimrod in two years time.

Two types of Neutrino

It was generally accepted that this was an "Experimenters" Conference. In my view it was a success primarily for the large Hydrogen bubble chambers now in operation in most high energy physics laboratories. Nevertheless, the most important result was obtained using counter techniques. This was the experiment carried out at the Brookhaven National Laboratory to test whether the Neutrinos ν_e produced with electrons in radioactive decay processes were the same as the neutrinos produced with muons ν_μ in the decay of the π mesons. (See footnote 1). This hoped for symmetry in weak interactions would have greatly simplified the theoretical situation. As things have turned out, the evidence of this one experiment strongly suggests that the ν_e is not the same as the ν_μ. This masterly experiment involved the measurement of cross-sections about 10^{10} times smaller (i.e. 10^{-38} cm2) than those experienced in most experiments. It required the construction of a 10 ton spark chamber and the neutrinos passed through the equivalent of 42 feet of iron to remove the neutron and muon background. The total experiment used 3.5×10^{17} protons and about 30 neutrino induced events in the spark chambers were identified. This is only the first of a number of neutrino experiments that will be done in the next few years as several questions remain to be answered. For example, does the Intermediate Boson(W) exist; what is the mass of the ν_μ; what is the nature of neutrinos associated with K electron decay?

Weak-Interaction Theory.

In the field of "Strangeness-non-conserving" weak interactions experimental evidence was presented at the conference which gave a strong indication that two further selection rules which were of great value in simplifying the theory of weak interactions cannot be substantiated. These are the $\Delta S = \Delta Q$ rule (S = Strangeness and Q = Baryon charge) and the $|\Delta I| = 1/2$ rule (I = Isotopic Spin). (See Footnote 2). Our hopes of understanding weak interactions must now depend on the accumulation of further experimental results to guide the theory and in this field much will remain to be done when Nimrod is working. In the strangeness-conserving weak interaction, however, the theory now appears to be in very good shape and hardly any new theoretical developments were reported.

The Mu meson and Resonances.

There were a number of experiments reported in the field of muon physics, the most beautiful being the CERN g - 2 experiment. (footnote 3). The sum total of all this work is that the muon, except for its mass, looks more and more like an electron - but why it exists at all remains a mystery.

Multipion resonances were reported in very great number. (Footnote 4). In fact the bulk of the work which was reported at the conference was in this field. This work has all developed in the two years since the 1960 conference and is a major success for the theorists who found it necessary to predict the existence of some of these multipion systems to explain the magnetic and electric charge distribution in the nucleon.

Studying the properties of these resonances will keep many physicists occupied for many years.

Regge Poles.

The most discussed new theoretical idea at the conference was the concept of Regge Poles (generalized bound states of complex angular momentum) but in spite of a large number of papers on this topic considerable doubt appeared to exist as to how far this new "pology" would take us. However, it certainly can explain the fact, and this is one of Nature's new surprises, that when a proton is bombarded by another proton of very high energy (10-20 GeV) it behaves as if it were bigger than it is at lower energies!

In conclusion then, one might summarize by saying that this last conference was one of exceptional interest, many knotty problems being thrown up to be tackled by high energy physicists over the next few years. But it is a highly competitive field and although Nimrod will possess many desirable features,

(Cont'd on page 9)

to establish our laboratory as a high energy physics research institute comparable with Barkeley, Brookhaven or CERN will require every bit of effort we can devote to it. But it is a very exciting prospect.

G. H. Stafford.

P.L.A. Group,
Building R12,
N.I.R.N.S.

27th July, 1962.

Footnotes:

1. The neutron in a radioactive nucleus decays into a proton an electron and a neutrino (this is called 'beta decay')

$$n \rightarrow p + e + \nu$$

The experiment at Brookhaven investigated neutrinos coming from the decay of a pi meson into a mu meson and a neutrino

$$\pi \rightarrow \mu + \nu$$

and the indication is that these neutrinos are not the same as the neutrinos from the beta decay process.

2. Weak interactions are interactions such as decay processes involving 'weak' forces which are of the order of 10^{11} weaker than electromagnet forces (such as the Coulomb force). In the weak interactions where a property of elementary particles known as strangeness is not conserved two selection rules were thought to hold. They said that if the selection rules - change in strangeness equals change in Baryon charge and change in isotopic spin equals $\frac{1}{2}$ are not fulfilled the interaction cannot take place.

The latest evidence indicates that in fact these selection rules can be violated.

3. A lucid account of the g - 2 experiment can be found in Scientific American July 1961.

4. Resonances (also known as excited states or isobars) are unstable states adopted by some particles or groups of particles staying together for a very short time (10^{-22} second for example).

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A VISIT TO THE RUTHERFORD LABORATORY

On July 23rd, Mr. John Horrex who teaches Physics at Abingdon School, led a party of 6th form students on a visit to the Laboratory.

From the A 34 there is little to be seen of the Rutherford Laboratory. AERE is stark, almost urban, and obvious to all, but the Laboratory lies tucked away from the road and might easily be taken at first sight as part of AERE. That it is not, is clear the moment one arrives at where the gate would be if there was one. Here, one is waved on with a genial smile instead of being whisked into the Guardroom. This feeling of independence is everywhere - "Of course, you know, we are absolutely nothing to do with AERE - we are outside the wire".

A map of the establishment is a necessity unless one wants to spend the first half-hour in a frustrating attempt to find who or what one wants. Added to this is the confusion of having the front entrance at the back, having both upper and lower floor of some of the buildings at ground level, and a lift which has a mind of its own. The entrance has something of a 'palm-court' appearance and one almost expects a small string group to 'strike-up' at any moment.

With so much topical research and construction work going on everywhere there is a constant stream of visitors, and on arrival there is a distinct probability of being mistaken for a guide, or of being confused with any of the other ninety-nine visitors expected at the same time.

The atmosphere of the place is fascinating. There is a business-like feeling of 'getting on with the job' and a pervading friendliness everywhere. Nothing seems too much trouble for the hosts, and whatever one is being shown, one can be sure of amicable courtesy and infinite patience - almost as if one was being sold an accelerator: "Would you prefer the big round one, madam, or the long, thin one?". For visiting parties there is always the explanatory talk in the Conference Room, just to make sure that one is in the picture of what is going on. Here, one first notices the noise - pneumatic drills, engines, pumps and whatnot seem to run continuously throughout the day, and if one finds

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A VISIT TO ACCELERATORS IN THE U.S.A.

Mr. Bowles and Mr. Simmonds recently toured some of the accelerator laboratories in the U.S.A. Mr. Simmonds here presents an account of their visit.

The outward journey, direct to Los Angeles by B.O.A.C., with a refuelling stop at Toronto, took fourteen hours, which, because of the eight hours difference in time was only six hours by the clock. Clear sky from about mid-Atlantic almost to Los Angeles gave fine views of the southern part of Greenland with snow covered mountains 70 miles to the North, the St. Lawrence river and sea-way, part of the Great Lakes and the Rocky mountains.

At Pasadena near Los Angeles, the California Institute of Technology has a 1.5 GeV electron synchrotron undergoing partial rebuild at the time of our visit. A new linear injector has been installed and the new inflector was being assembled. The controls for the machine and the beam transport system were being partially rebuilt and transferred to a control room on a first floor overlooking the machine, thus freeing more space on the main floor for experiments. This machine and a horizontal tandem generator under a research contract for the U.S. Navy, are integrated with the Institute, which is in effect, a University. The older buildings in Spanish Renaissance style are placed along a central avenue with trees, some of them palms, creating a very pleasant setting.

The air journey between Los Angeles and San Fancisco of about 400 miles was complicated by information from United Air Lines to the effect that the flight on which we had been booked had been cancelled. We subsequently found that one of the party had travelled on it!

The Lawrence Radiation Laboratory at Berkeley, near San Francisco, is a part of the University of California. As reported in the July issue of 'ORBIT' the Bevatron is undergoing major reconstruction. This involves providing a new ion source, linear accelerators and R.F. system, improvements to the shielding of the magnet ring requiring underpinning of the existing foundations, and the provision of new external beam paths. The programme for this enormous task has been determined by a method known as critical path scheduling. Another interesting machine is an 88" cyclotron which has been built to do similar experiments to those envisaged for the Variable Energy Cyclotron which a team of physicists and engineers at the Rutherford Laboratory are currently designing for A.E.R.E. This machine was undergoing minor modifications to the R.F. tuned circuit and to the dee, after commissioning runs.

The Laboratory, which besides its activities in High Energy Physics, also has departments dealing with Physics, Chemistry and Chemical Engineering, has a total staff of about 3,000. It is located in the hills which rise steeply behind the fairly flat ground on which the University stands. The major buildings stand on excavated plateaus joined by roads which wind steeply up the hillside and there are magnificent views across the bay to San Francisco and the Golden Gate Bridge.

During the weekend the "California Zephyr", a pullman car train with observation "vista domes" gave us fine views of the Feather River Valley in the Sierra Nevada Mountains, and,

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A VISIT TO THE RUTHERFORD LABORATORY (Cont'd)

the Conference room stuffy it is simply because opening the window makes the speaker inaudible. I suppose that there will always be more building to be done, but the atmosphere of the place will surely change when at last NIMROD is complete. To have seen this gigantic machine at any stage of its involved and exacting construction is an experience not easily forgotten. I have tried several times to convey a picture to my pupils of this enterprise and of its size, but there are still many gaping mouths when they actually visit the monster in his den.

But NIMROD is not all there is to see, by any means. Less spectacular perhaps is the Proton Linear Accelerator, but this machine is in operation, and apparently working extremely well, and anyone visiting the P.L.A. department is royally entertained.

It is a very salutory thing for young people at school to some and see this unique establishment with its dedication to pure research, for it certainly gives them some idea of the trouble, time and money involved in the building and running of a modern research centre using the best equipment of its kind which the State can provide. Physics text-books make the great discoveries of the past sound far too easy, and in school laboratories there has to be much 'organised research' where the 'results' are almost a foregone conclusion. It is indeed refreshing for both pupil and teachers alike to visit places such as the Rutherford High Energy Laboratory.

after a nights sleep during which the train passed over the Nevada desert, of the Rocky Mountains with the Colorado River running alongside the train for about 150 miles. We left the train at Denver and continued by air to Chicago.

Situated some 20 miles from the centre of Chicago is the Argonne National Laboratory where a 12.5 GeV proton synchrotron is being constructed known as ZGS (Z is pronounced zee not zed). The injector for this machine is at an advanced stage of construction and is probably now undergoing commissioning trials with an accelerated beam. The construction of the inner vacuum vessels which is made from stainless steel 'space' metal cemented by epoxy resin is well advanced. Delivery of the main magnet blocks which also form the outer vacuum vessel, and of the magnet coils, is uncertain due to manufacturing difficulties. When deliveries of these items are assured, installation may well be a very rapid process. Installation of the Power Supply rotating machine and inverter equipment is complete as also are all the ancillary services such as cooling water. Very large experimental areas are available and the installation of a heavy steel plate shield between the machine and the experimental area was proceeding. Heavy rain fell continuously during the first morning of our two day visit here, this being followed by very hot and humid conditions, the relative humidity being 96%. The Argonne National Laboratory has a total staff of about 4,300 and has reactor installations and laboratories engaged in atomic energy research in addition to work on high energy physics.

Because it was impracticable to visit a laboratory on America's Independence Day, which is a national holiday, the journey by air from Chicago to Boston was broken about mid-way at Buffalo and the opportunity taken to visit the Niagara Falls. The Horseshoe Falls on the Canadian side is particularly impressive.

Situated in the heart of Harvard University and planned to use to the utmost the space which could be made available is the Cambridge Electron Accelerator, a joint project with the nearby Massachusetts Institute of Technology. This machine has a design energy of 6 GeV and is a strong focussing machine with a magnet excited at a repetition rate of 60 cycles per second. The power supply choke is being rebuilt with water cooled copper and cheeks to eliminate overheating and some modifications are being made to improve the accelerating R.F. system. The experimental area is being arranged for use when the modifications to the machine are completed. Cambridge is adjacent to Boston which is the most English of the American cities visited. This is evident not only in the style of the buildings, but also in the roads, which, in general, are narrower and more irregular than the very functional grid iron arrangement of numbered avenues in one direction and numbered streets at right angles to these which is usual in America.

The Brookhaven National Laboratory on Long Island, New York, has recently gained distinction from the experiments on neutrinos carried out there using the 30 GeV AGS (Alternating Gradient Synchrotron). This machine was shut down during our visit for the installation of new beam transport lines into the extended experimental area which is now available. This included the modification of the shield wall, partly concrete and partly steel plate, between the machine and the experimental area. An annexe has been constructed to house a 60" Hydrogen Bubble Chamber, all the major components of which are available for erection which was proceeding. The Cosmotron, a 3 GeV Proton Synchrotron which has been operating since 1952 is operating on a continuous basis (24 hour day - 7 day week). The Brookhaven National Laboratory has in addition to the Accelerator Department, (which is concerned with the AGS and the Cosmotron), Biology, Chemistry, Medical, Nuclear Engineering, Physics, and supporting administrative and engineering departments. The buildings are widely spaced on a very pleasantly wooded site.

A few general observations on a most interesting and instructive journey may be of interest.

Sauces and dressings of kinds are more liberally used with food than is customary in England and the enormouse size of American meals can be difficult for those accustomed to more modest fare.

Road discipline was better than in England. Speed limits, which are graduated from thirty to sixty miles per hour are more carefully observed. I do not recall seeing a traffic roundabout; traffic lights, many of them suspended over the centre of a road crossing, are more freely used. The major roads (state ways, thru ways, etc.) with four to six traffic lanes, clover leaf and fly over junctions, have an enormous traffic capacity and permit rapid travel right into the centre of major cities.

The broken journey eastwards, part of it by train, gave a much more realistic impression of the vast size of the U.S.A., than the un-interrupted outgoing flight.

The wise-cracking American humour was evident in the frequent display of notices such as "Be co-operative - do it my way" a few of which have percolated through into the Rutherford Laboratory.

At all the laboratories visited the friendly atmosphere and generous but exacting hospitality, together with a great readiness to provide all the information requested, made this visit profitable and enjoyable.

STAFF MEETING 25TH JULY.

A packed Cockroft Hall heard the Director, Dr. Pickavance, introduce the first Staff meeting of its scale to be held at the Rutherford Laboratory.

The opening announcement was the long awaited news that the Electron Laboratory has been approved. Information on this is contained elsewhere in the Journal.

On the Rutherford Laboratory the Director said that our number, now standing at about 800, is expected to grow to a maximum of 1000 over the next two or three years. Our annual budget is £6 million about half of which goes on permanent installation. Besides our own projects we are serving AERE and Oxford University with the Chemists Cyclotron and the Electrostatic Generator respectively. These machines will be handed over to the customer when they are completed.

The Atlas Computor Laboratory is unique among the projects in which the National Institute is involved as it can be used not only for computational work in Nuclear Research but by A.E.A. and others for suitable types of computation.

Dr. Willis spoke on some administrative topics. Perhaps the most topical in view of the advent of the second major Laboratory is the role of the Director in a National Institute Laboratory. The Board of the National Institute have stated clearly that they do not intend to act as a strong central office but that powers will be delegated directly to the Directors of the Laboratories.

Mr. Bowles said that construction of Nimrod is now about 80% complete and took a forward look at the allocation of engineering effort when the building of Nimrod is behind us. The machine will have to be maintained, operated and nourised and the estimated annual expenditure with the support programme operating will be approximately the same as it is now. Taking the engineering situation at the P.L.A. as a guide, far from cutting down on the numbers after the machine was built the problem has been to control the request for more.

Mr. Mullett, the Assistant Director, sketched the outline of the Nimrod situation. He is particularly pleased with the growth of team spirit around the machine and with the emergence of new, vigorous young people in the Laboratory. As the machine building stage approaches completion many scientists will occupy new roles at the Laboratory. Already two senior scientists are doing research independent of the main projects and another move in this direction is the recruitment of post graduates to do physics and engineering here for their Ph.D. This latter system has proved very fruitful in the U.S.A.

Dr. Stafford opened by recalling a lecture given to the Womens Institute at Weymouth under the title 'How to Face the Atomic Age'. It was subsequently headlined 'Baffled by Science'. The Cockroft Hall audience was not quite as baffled by the following exposition of the physics facing Nimrod and already underway at the P.L.A. Nimrod is capable of producing all the elementary particles so far discovered and is particularly suited by its energy and intensity to some experiments. It should add considerably to the data accumulating rapidly to feed our understanding of nature.

At the P.L.A. co-operation with the Universities is working very smoothly and we must hope to extend this to Nimrod in the near future. We can be justifiably proud of our position as the largest National Laboratory, outside the U.S.A. and Russia, devoted to the pure pursuit of knowledge. We will have all the facilities for great experimental work and Nimrod may one day have its Nobel prize winners, as do the major established accelerator centres.

The Director's concluding announcement of a 4% salary rise in line with the Civil Service was greeted with jubilant applause.

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