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ORBIT

THE JOURNAL OF THE RUTHERFORD HIGH ENERGY LABORATORY

VARIABLE ENERGY CYCLOTRON

A recent press release announced that construction of the Variable Energy Cyclotron will shortly begin on the site of the old bus car park by the South Gateof A.E.R.E.

The Rutherford Laboratory Cyclotron Group, under Mr. J. D. Lawson, have been concerned for some time with the design of this machine and will continue to be responsible for the construction and commissioning. The total cost of the machine is estimated at £1,600,000 and it is expected to come into operation in 1965. This cyclotron has been known locally as the 'Chemists Cyclotron', since it is destined for the Chemists at A.E.R.E., and a number of other names are used throughout the world for this type of particle accelerator, the most usual being A.V.F. (Azimuthally Varying Field) Cyclotron or Sector Focused Cyclotron.

The machine will be handed over for use by A.E.R.E. when it is completed and it will also be available to University teams. Its chief fields of research will be in radiation chemistry, radiation damage, radiochemistry and solid state physics with emphasis on the nuclear fission process.

A significant feature of the Variable Energy Cyclotron is the versatility in particles and energy which it will have. It will be capable of accelerating many types of positive particles (from protons to argon ions) to a range of energies (up to 50 MeV for alpha particles and 10 MeV per nucleon for the heavier ions). Output beams of up to 100 micro-amps will be available.

In the near future we hope to carry an article on this type of cyclotron and to give some more information on this project in the hands of the Rutherford Laboratory Cyclotron Group.

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A 1000 GeV PROTON ACCELERATOR

At the 10th Internation Conference on High Energy Physics held in New York in September, 1961, scientists from the American accelerator laboratories and from CERN reported on their design studies for very high energy accelerators. Soviet scientists have recently published a number of papers which show that similar studies have been in progress in Russia. The Russian proposals, though they have many features in common with those from America and Europe concentrate on a particular technique.

The Soviet scientists have worked out the principles and carried out initial design studies which could allow a proton accelerator to be constructed with an output energy as high as 1000 GeV. The technical difficulties involved are considerable but if they can be overcome, a machine with such high energy, some thirty times greater than the present Brookhaven and CERN machines, would penetrate unknown regions in the world of elementary particle physics.

The chief problem involved in attempting to reach such high energies is that of keeping the particle beam focused on its circular track. In the conventional particle machine the magnetic field is set up to be as perfect as possible in accordance with the focusing properties required. But for beams of much higher energy any slight imperfection in the magnetic field would result in the particles deviating seriously from their focused paths, as they make many more revolutions in the machine, and eventually being lost to the walls of the vacuum vessel. To reach energies as high as 1000 GeV, while still keeping the accelerator an economic proposition, needs a new conception of the focusing mechanism for it is difficult to visualise such energies being achieved by refinement and extension of conventional techniques without involving very heavy expenditure.

The Russian work on this problem is based on the idea of 'autocorrection' and the proposed accelerator is often referred to as a 'cybernetic accelerator'. The word 'cybernetic' comes from Greek meaning 'steersman' and was used 100 years ago by Maxwell as the title of a study on feedback mechanism. Now it is used to mean 'the study of communication and control mechanisms in living beings and machines' in which feedback plays an important part.

The autocorrection principle is applied as follows: A series of detection devices (electrostatic electrodes for example) are set up in the vacuum chamber around the magnet ring. These devices record any deviation of the particles from their focused paths, due to such things as imperfections in the magnetic field, and feed the information to a computor. The computor calculates in 1/10,000 of a second the extent of the deviation and the correction which must be applied to the magnetic field to return the particles to their correct paths. This correction signal is fed back to the magnet ring adjusting the particle trajectories as is required. The time constant involved in correction to the magnetic field may be about 1/1000 of a second.

The application of this new system of control would make it possible to relax substantially the requirements regarding the accuracy of individual elements and would also considerably reduce the cross section of the required vacuum chamber and correspondingly the size and weight of the magnet.

Two technical reports describing how injection, control of equilibrium orbit and control of the number of betatron oscillations per turn might be achieved are -

'Circular High Energy Accelerators with a Self Adaptive Magnetic Field'
Soviet Physics Doklady Vol.6 No.11 May 1962
and 'Use of Autocorrection Principle for Magnetic Field in Cyclic Accelerators designed to produce very high energies'
Atomnaya Energiya Vol.12 No.2 February 1962.

Both reports are by E. L. Burshtein, A. A. Vasilev, A. L. Mints, V. A. Petukhov and S. M. Rubchinskii.

(cont'd on Page 3 ...)

'Atom News' brought a story concerning E. O. Lawrence, the pioneer of the cyclotron to our attention: when asked what he expected to discover with a larger cyclotron he replied 'Why if we knew that, there wouldn't be any sense in building the damned thing!'

In reply to a recruitment advert. we received a postcard request for details from Dublin's fair city. The card was a 'Guinness for Strength' cartoon (the one with the frogman, his aqualung replaced by a Guiness bottle, casually supporting a whale on one finger). And. not content with betraying allegience to the demon drink, the stamp was marked 'Support the Freedom from Hunger Campaign'.

A 1000 GeV PROTON ACCELERATOR - (Cont'd)

The latter report gives some figures from the Russian design calculations for a 300 GeV and a 1000 GeV machine. They involve a triple cascade accelerator arrangement - a linear accelerator, a preliminary accelerating ring and the final autocontrolled accelerating ring. Some of the figures are reproduced here -

Auto-controlled ring	300 GeV machine	1000 GeV machine
Injection energy from preliminary ring	6 GeV	20 GeV
Maximum magnetic field	12 KG	12 KG
Cross-section of vacuum chamber	3 x 2.4 cms !	3 x 2.4 cms !
Radius of ring	1000m	3300m
Weight of Magnet	3000 tons	10,000 tons
Number of betratron oscillations per turn	25.25	40.25
Maximum amplitude of betatron oscillations	4 mm.	2.5 mms.
Gain in energy per turn	6.3 MeV	6.3 MeV
Duration of accelerating cycle	1 sec	11 secs
Number of particles per output pulse	10^{12}	10^{12}

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Mr. Walkinshaw, who has been concerned in the design studies of American and European very high energy accelerators, will write on the Western proposals in a future issue.

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THE EXPERIMENT

The 29th August, 1962 will be entered in the annals of this laboratory as the day in which the suns rays were successfully harnessed by the inhabitants of R.20 to produce flammability by means previously unknown to man.

A rumour had been circulating the Laboratory that fire could be caused by methods other than rubbing two boy scounts together, and R.20 personnel decided that here was a field of research in which they were well qualified to delve. The Board Room, being ideally situated geographically for the experiment envisaged, was modified to contain the costly experimental apparatus consisting of a water carafe and a cork table mat.

Working from the equation that SUNS RAYS X CARAFE X y = FLAME (where y and the Board Room Candidate are unknown quantities) the apparatus was critically aligned in April. Unfortunately research could not proceed until August 29th as sunshine was an essential part of the experiment.

The morning of 29th August dawned fine and the Selection Board assembled with an air of expectancy. Success came during their interview with the second candidate (who must have been of a fiery nature) when the Board Members actually witnessed smoke coming from the cork table mat. After a hurried consultation the Board came to the conclusion that the mat was on fire. After congratulating themselves on the success of the experiment the members of the Board quickly extinguished the flames and the candidate.

It has therefore been proved that the suns rays can successfully be harnessed, using a glass vessel full of a clear liquid as the focussing agent, to produce fire.

Attention of all Laboratory Staff is drawn to this fact

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Another Parkinson-type equation has been unearthed -

$$\frac{\text{Number of Typists x Average Typing Speed}}{\text{Number of Engineers}} = \text{Typing Output}$$

It will be realised that as the number of engineers tends to zero, typing output tends to infinity. Is this sufficient reason for their abolition?

INTIMATIONS OF MORTALITY

Mr. P. P. Eggleton, who has gained M.A. and B.Sc. at Edinburgh University, spent July and August at the Rutherford Laboratory as a Vacation Student. This is a reflection from his stay with us.

The most conspicuous feature of the Rutherford Laboratory is its newness. The spirit of this pervades the whole establishment and gives an atmosphere of enthusiasm for even the most humdrum tasks. The Laboratory, like a recent bride, is proud of her new home and is pleased to show guests over it, from the kitchen where the very latest gadgets are being built in, to the places in the sitting room where the furniture will be when the decorators move out. Perhaps her marriage to the Universities, sanctified in Whitehall by the Minister of Science, will lead to dis-illusionment, to a bitter disgruntled middle-age; curlers-in-hair, couldn't-care-less abandonment to the drudgery of house-keeping. Or else, and I hope this will be so, the first rapture may never be lost, until the couple be parted by death.

I lower my voice to speak of death, and perhaps it is tactless of me to mention it at all. Human-beings do not need to be, often do not like to be, reminded of our mortality. We know that of the hundred thousand million men and women who have lived on this planet 97.5 per cent are dead, and this is usually accepted as adequate evidence for the proposition that all men are mortal.

Probably the same ratio applies to institutions; and so are we still at liberty to hope that the next one we build will stand for all time?

Birth, marriage, death and decay have all inspired great work from poets, philosophers and the medical profession. Research institutions are not so likely to give a stimulus to the artistic faculties of the mind, but there is certainly a field here for a new medical profession, who will study the paediatrics, obstretrics and geriatrics of groups of scientific workers. Maybe an institutional monkey-gland will be found to prolong the working-life of laboratories; or maybe with a graceful acceptance of the impermanence of the material world, laboratories will prepare themselves to go to their final reward.

I do not want to be a spectre at the wedding feast, a memento mori casting a momentary chill over the excited crowd. Therefore I beg to wish the National Institute for Research in Nuclear Science a long and happy marriage to the Universities of Britain, much wealth, many children, and a benign old age.

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We would like to congratulate Mr. C.W. Trowbridge who is with Electrostatic Generator Group, on gaining his B.Sc. in Special Physics after several years of night school and day release study. A fine achievement.

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Newly Wed: our best wishes to Hilda Dell from R.12 Admin. Office who was married on 8th September. Hilda is now Mrs. New.

Congratulations also to Shirley Marshall on her recent engagement.

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COMINGS AND GOINGS

Dr. R. L. Clarke and Dr. L. K. Raglan have joined us on fixed term appointments.

Dr. O'Connel joins Nimrod Magnet Group; Mr. Denny joins Theoretical Physics Group.

Messrs. Blowers, Fisher, Knight, Wells and Patten join Central Engineering (Services).

Mr. Ellictt and Miss Cottingham join Bubble Chamber Group.

Mr. Brady joins Vacuum Group; Mrs. Wichmann joins Nimrod R.F. Group.

Mr. Briscoe, Mr. Sarll, Miss Sturrock, Miss Foster and Mrs. Tame join Administration.

Miss Cotter and Mrs. Cowen join the Atlas Laboratory.

Mr. Barren joins us and will be at the Training School.

Mr. Weeks joins PLA Engineering; Mr. Abbott joins Nimrod Engineering.

Mr. Smith joins Injector Group

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EDITORIAL

We have entered the last year in the construction of Nimrod. On the present machine programme the coloured lines, which represent all the different stages of the supply, the testing and the installation of the components for Nimrod, come to an end on 1st September, 1963. Over the past year this programme has been held very closely and if the same steady progress is maintained in the coming months we may beat the programme date. Within twelve months from now Nimrod should be 'on the air'.

Much hard work remains to be done but the end is in sight and an air of excitement is growing as the culmination of years of effort approaches.

The Injector has delivered a 10 milliamp. beam and has produced beams reliably for some months.

Vacuum vessels continue to arrive regularly and after testing are installed in their positions on the machine.

The Magnetic Survey is behind us and indicates that we have achieved all that we wanted from our Magnet.

Pole piece installation and allied work on the Magnet forge steadily ahead.

The second motor alternator set was one of the obstructions on the A34 on 10th September en route for us, so that the Power Supply team can now attack the final assembly and proving of the Power Supply.

The R.F. equipment is coming together in its final form.

And the cabling and panel installation in the Main Control Room is going ahead.

A commissioning team has been meeting at the Laboratory for some months, sorting out the early work to be done to test and optimise the performance of Nimrod, as it is completed and nuclear physicists are thinking about, or working on, the first experiments they will carry out when, at last, they are handed their own accelerator.

We have already come a long way from the days of the pioneers who waded through chalk mud as the first magnet hall excavations were in progress and the chalk mound that has been made, will soon hide one of the finest achievements of this country's scientific and technical knowledge. The day is not far distant when the Main Control Room will resound to the popping of champagne corks as a flash on a T.V. screen tells us that a proton beam has been successfully accelerated to an energy of 7 GeV.

When this day comes we can really begin the work we exist to do. We will have two high energy proton accelerators - the P.L.A., which has been yielding 50 MeV beams reliably for a long time, and Nimrod providing us with 7 GeV beams for the first time. Then we can begin to make our mark as an accelerator laboratory and let us hope that we rapidly become established as one of the most vigorous centres of nuclear physics research in the world.

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LETTERS TO THE EDITOR:

Letters may be addressed to "The Editor, ORBIT, Building R.1".

Psuedonyms are accepted provided the author's name is known to the Editor.

Sir,

The issue of "Why build accelerators?" can never be argued out and conclusively settled. The opinions will be as many as we who enter into the correspondence. We shall all be guilty of overstatement, under-statement and distortion, in the view of others. I shall therefore review my personal position only.

There was a considerable element of accident in my getting into the accelerator business as a result of war-time experience ir radar, but that I stayed in the business for any appreciable time was not accidental. I got married and needed the money, but I think I could have made money elsewhere. I could have gone to at least two universities, one to work on accelerators and the other to work on something entirely different. Perhaps I was held by the attractions of living in Malvern, but I did eventually move to Harwell. That I continued to work on electron accelerators was basically because I and some others,, perhaps equally misguided, found it to be a mentally satisfying scientific exercise. It really was mentally satisfying in those early days and some of the satisfaction, but by no means all, was because we led the world. I did have some vague feeling that I was doing something for nuclear physics but this was remote. I got a great deal of satisfaction from burning holes in lumps of lead with 4 MeV

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electron beams and with supplying cloud chamber people from Oxford and chemists from A.E.R.E. with particles. I was thus early introduced to the cussedness of the 'users'. We found that we had to do far more than just run our machine. The former group were not at all impressed with our several kilowatts of beam power. We had to cut a foot square hole in our reinforced concrete shelter so that they could retreat from our background and then devise ways of reducing the output far below the normally reliable minimum level. The latter group had us practically melt the accelerator and flooded it with water and vile concoctions of uranyl things and nitric acid. They got some significant results and it was great fun. We contributed greatly to medical applications and no one can deny the satisfaction in this.

In the end something went wrong with this happy situation. The scientific satisfaction in playing with Maxwell's equations and the resulting hardware was not enough. There were things which could and should have been done with extensions of our linear accelerators but our work did not come to fruition. Maybe it was because we were too much fascinated by our own cleverness, but we were certainly too remote from the nuclear physics applications.

My personal reasons for moving to Harwell were simply twofold. I wanted to exercise my brain in somewhat different accelerator problems so as to get away from the "inward seeking" rut that I had got into, and I wanted to identify myself with the nuclear physics end product. As the years have gone by I have found at Harwell and in the Rutherford Laboratory that I have been able to fulfil both these aims. Of course I am not a creative nuclear physicist but I desperately want to know the nature of our existence. Without the detailed knowledge of the professional nuclear physicist I can appreciate the search for the nature of nuclear forces, and I can revel in the strangeness of "strange particles" and "pion resonances". As an ordinary physicist I hate not knowing even what is the nature of a force with the same kind of intensity as the "ancients" who disliked "action at a distance". The field of work which one choses to identify oneself with in the search for the nature of our existence is a personal matter, at least it is to me. Astronomy worries me since I am unhappy with the infinite both in space and time. Bio-chemistry reminds me somewhat of the limitations of the body and in any case I always felt that chemistry was a "messy" subject. In nuclear physics there is nothing like these factors which detract from the savouring of the details. The infinitely small holds no terrors for me.

The contributions which we make to the fields of general physics and engineering in the course of this work are obvious. Our endurance with industry doubtless leaves some benefit for later customers. Without being pious, these things do result in benefit to mankind, but of course one does not necessarily need to be engaged on accelerators in order to exercise these capabilities. These things happen because we are that kind of people and the results would be much the same if our activities were aimed at any object different from nuclear physics.

The urgency with which we try to do things does get out of hand at times. It is a general human failing that being firstest with the mostest is highly sought after, but I think we have in some measure more laudable motives. I don't think there is anything to be ashamed of in striving to be first in some new extension of our knowledge and receiving the scientific reward of the admiration of one's fellows, provided of course that Christian principles are not violated in the process. A feature perhaps of approaching middle age is that I feel some personal urgency in this search for the nature of matter, and maybe regret that I was not better equipped or had better opportunity to make a violent and fundamental impact.

In the course of satisfying myself I hope that I have satisfied and will continue to satisfy the "users", because without them we should not build the machines. I admit that there are times when we lose sight of the objective but the fact that we argue about the situation reveals that we are well aware of why we are in this business. I know an eminent accelerator physicist at a prominent accelerator laboratory who provokingly said that he didn't mind what happened to the machine because he had had his fun in building it, indeed he went further and said he hardly minded if machines got built because he had had most of his fun in designing them. He really didn't mean it. Were it not for the nuclear physicists I would choose to find my interest in physics (both theoretical and experimental) and in the development and construction of fantastically wonderful things in some other field with a satisfying end product of knowledge.

One's life is what one makes of it, and to people like ourselves our work is a major part of life. We are all therefore vitally concerned with the nature of our own

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KEEP IT FREE!

Friday night, December 7th, is Rutherford Laboratory Dance Night

Two Dance Floors Two Bands Two Bars

And One Large Buffet

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laboratory and it will be entirely what we make it to be. No matter what our individual circumstances may be no one has the right to say in all things, "Look what the other people have done". I find the awareness of the situation as demonstrated in this correspondence most encouraging, and a fine justification for having a journal such as ORBIT.

L. B. MULLETT.

Sir,

In his defence of the "new physics" Dr. Stafford has perhaps inadvertently implied that Mr. Wroe is condemning it simply because it differs from the old. If I understand Mr. Wroe rightly he was not implying this, but rather that the majority of people involved have no adequate motive for what they are doing, and therefore those that have motives should communicate them more convincingly to the rest. Unfortunately this communication is very difficult because the lure of scientific ideas is so highly personal. The vitally important experiment of the scientists may look like a sheer waste of time to another person even when he has some understanding of it. This poses one of the most challenging problems to the leaders of to-day's scientific organisations; how to engage the enthusiasm of the rank and file.

One of the greatest difficulties, I believe, lies in the fact that there has been some dilution of the scientific motivation itself. Most of the momentum of the old physics came from the creative activity of the scientist, whereas to-day too much derives from the career of the organisations themselves. Organisational development is ousting scientific development. Elsewhere in the last issue of ORBIT, Dr. Stafford reported on a conference at which, after stringent selection, 323 abstracts of papers were submitted. One is tempted to ask if this is not a situation in which the average level of "scientific significance" must necessarily be low. 323 papers at one conference can not all be significant. Quite rightly only a small fraction was read and a smaller fraction discussed. Perhaps there is a phenomenon in science which is the equivalent of "inflation" in economics; too many scientists chasing too few significant facts. If the young physicists go where their elders lead them we cannot blame them, but we are entitled to question whether their elders are following the right road themselves.

Mr. Wroe has raised an issue which must be unwelcome to some extent, and I have alluded to one aspect of it which causes me some concern. I hope the whole subject will receive the frank discussion it merits, and that Mr. Wroe's letter will be received in the constructive spirit in which it was written.

T. R. WALSH

Sir,

In a letter in your last issue Dr. Stafford points out that the purpose of Nimrod is to enable experiments to be made which will help us to understand more fully the nature of the physical universe, and that the prospect of such work presents "a very exciting possibility" to young physicists.

I should like to enquire into two questions which arise from this letter and the preceding one by Mr. Wroe. First, why do physicists find the work exciting? Second, accepting the fact that they do, is it reasonable to support them on the present scale?

To the first question there is no single answer. On the purely intellectual level, increased understanding of one's environment, and the perception or creation of significant relationships (as also in music, painting, poetry) is, and always has been, a stimulating experience for civilised men. Many other forms of satisfaction are however present; as an example I shall consider the recent discovery that there are two types of neutrino. Certainly the number of physicists on whom this fact could have made a genuine intellectual impact, as defined above, is rather limited. Nevertheless, I am sure that all the physicists, engineers and technicians on the project found it an exciting and stimulating experience, even though many of them could not themselves perceive much of its significance. They believed it to be important as a matter of faith and accepted the whole as a technical challenge, "man against nature". Probably the fact that the experiment might be done elsewhere contributed to the excitement. Other basic human needs are catered for in this work too, (perhaps someone can enlarge on "Scientific Papers as Status Symbols", or "Nobel Prizes and National Prestige"). Added to this there is the generally held belief that all this new knowledge and technology will untimately enable men elsewhere to enrich their lives.

All these reasons would be quite adequate ones for doing physics in the days when the cost was negligible, and was borne by patrons, universities, or the physicists themselves; as is the case with archaeology for example at the present time.

These days, however, when substantial Treasury grants are required, the taxpayer has a right to be consulted. He may feel that high energy physics is a cultural activity worth supporting for its own sake, or he may expect it to bring material benefits, such as cheaper power or the conquest of disease. On the other hand he may think that it would be better to use the money to raise the pay of nurses and old age pensioners, or to relieve misery in underdeveloped countries.

Whether or not it is right that the work should be supported on its present scale is then a matter of individual judgement. Everyone must make up his own mind; there can be no "absolute" or "correct" answer to the question.

J. D. LAWSON.

Sir,

I would like to comment on one aspect of the several problems raised by Mr. Wroe, namely, national priorities.

As he said, times have changed since the days of Rutherford, but it is just this change which makes it possible to pursue a modern programme in high energy physics. The present state of knowledge in this, as in many other branches of science, could not have been attained without progressive industrialisation and the accompanying increase in wealth, and it is these very elements which allow us to entertain the possibility of advancing further.

The division of money and effort amongst the many worthy enterprises open to the nation is an extremely serious task but we may all feel some reassurance in that the problem is receiving the attention of many eminent persons. Most of us welcomed Sir John Cockcroft's recent warning against the adoption of expensive projects for reasons of prestige and power politics, and it is notable that for many months editorials and other articles in "Nature" have been discussing means to improve where necessary, the organisation and support of, for example, scientific research, education, technology, and technical aid to under-developed countries.

Probably too little is known by us all about the processes leading up to the policy decisions in such matters. These decisions are political ones, at least in the case of science. It was pointed out recently in an Editorial in Nature (18th August, 1962) that the Advisory Council on Scientific Policy are the main advisers of the Minister for Science on general scientific policy - on the basis of expert evidence, they can represent the form any scientific activity should take, what is required for the effort to be effective and the implications of any particular effort. Attention was drawn to the importance of ensuring that the relevant scientific and technical aspects of a problem are correctly presented to the Government as a basis for their decision. The arrangements for marshalling and conveying this information are at present under investigation by the Trend Committee.

We must not expect to find universal agreement with these political decisions; everyone who gives honest thought to the purpose of his life is going to have a valid personal viewpoint. Indeed it is only this diversity that admits the possibility of a proper balance in our total effort.

All of who feel concerned about this balance should seek to influence national (and international) policy however modest the channels available to us may appear to be. Then again, most of us having consciously chosen to work in the Rutherford Laboratory, we share a considerable responsibility to make it successful, primarily in its contribution to nuclear physics but also in broader roles of science and human affairs.

LEO HOBBIS.

Sir,

Whilst being full of admiration for the initial editions of 'ORBIT', may I suggest that apart from the editorial matter penned by your own fair hand, the standard of the prose contained in this journal affords only too much ammunition for those aesthetes who claim that scientists can not express themselves in good English. Perhaps contributors might be reminded that they are not conversing, but writing.

Yours sincerely,

Gaderene Nutz.

Sir,

Many of your readers will probably know that Staff Side recently asked for recreational and sports facilities at the Rutherford Laboratory. The response of the Official Side was cautiously encouraging, i.e. they were willing to allocate land for this purpose but money would be more difficult. They also said that a certain amount of "self help" would show that the staff were really enthusiastic about such facilities. If, therefore, there are any members of the laboratory who would like sports facilities here and are prepared to do a certain amount of work in order to get them would they please contact me?

A. SPURWAY
Building R.1.

The matter of 'recreational amenities' to which this letter refers was raised at the Whitley Standing Committee on 29th May, 1962.

'The Staff Side said that although they were conscious of the advantages of being able to enjoy the facilities of the A.E.R.E. Recreational Association and wished to continue enjoying these facilities in the indefinite future, they felt that the time was approaching when the Rutherford Laboratory should give thought to the creation of its own facilities as well. They said that the Laboratory would, in this way, add to a general air of corporate feeling among the staff apart from the more obvious benefits.

The Official Side replied that this sentiment was most timely in that space was already becoming scarce and that it would be useful to have this thought in mind in planning for the future. There were, however, no funds immediately available for any such purpose. The Official Side thought too, that in a matter such as this a certain amount of 'self help' and enthusiasm on the part of the staff were essential for success.

The Staff Side were invited to crystalise their thoughts in this direction and raise the point again'.

Extract from the Minutes.

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SCIENCEHOOD AND RESEARCHMANSHIP

From an address by C. H. Leigh-Dugmore to the Institution of the Rubber Industry Conference. The following extracts are reproduced by kind permission of 'Rubber and Plastics Weekly'.

Sciencehood is the science of knowing little without seeming to.

Researchmanship is the science of knowing how to find out more without having to.

The First Law

The First Law of Researchmanship is very well known and is often referred to as the Law of Selection of Direction. It states quite simply that the Researchman should choose a field of work about which no one knows much or is ever likely to.

Here, incidentally, we have an illustration of one of the basic principles of Sciencehood. Take any simple, indisputable fact like the sun shines by day but not by night; dress it up in the longest words you can find, such as 'Solar illumination manifests itself as celestial revelations in alteration with nocturnal intervals' and you can then call it a law, for which you should also find a dignified title, say "The First Law of Solar Illumination" or 'Cole Porter's Law'. Even if you know only one law, it's a good thing to call it the First Law. It gives the impression that you are receptive and that you don't care how many laws there are.

Embodied in the First Law also is the Principle of Maximum Scope. It is obviously foolish for the Researchman to choose a field of work that already has been well explored. He will either have to agree humbly with those that have gone before, which will not get him anywhere at all, or he will be tempted to disagree with them, which may not get him even that far.

The Researchman must get in first and make his stand. Quite impregnable positions can then be built on very little foundation and with negligible effort. Use the First Law as your guide and choose a field whose existence no one previously has even suspected. There will be nothing to lose and little to find, but everything to gain.

Guarded Communication

Another of the Principles of Sciencehood is the Principle of Guarded Communication. When you speak or write, do so in a way that is intelligible without being understandable. Never make a statement that is capable of only one interpretation; it may be the wrong one. Leave yourself room for manoeuvre in any discussion that may follow and discourage the reader at every step. These are the golden rules.

Begin with a summary and use it intelligently, for it is your first line of defence against the unscrupulous and aggressive reader. The purpose of a summary is to show the reader how little he will miss if he proceeds no further. It is easy to achieve this if you write the summary of a paper or report before you write the paper itself. If you are then sufficiently unresearchmanlike to go back and read the summary again you will see how little relation the summary and report bear to each other.

Datamanship

Next comes Datamanship. The first rule is to talk of data; no Researchman worth his sodium chloride ever refers to results or numbers. The second rule is to avoid them, they can be a great hindrance.

The experienced Researchman, if he has been unable to dodge a collection of data, will use an artifice known as the Hunch. It is impossible to describe this, but the accomplished Hunchman will willingly demonstrate it. Hunching involves looking at the data with the eyes closed and assessing them against the Background of the Hunchman's Experience.

Hyphenophobia

Hyphenophobia is a necessary feature of the metabolism of Researchmen; it enables them to write easily in a way that prevents their readers pinning them down. The reader should constantly be faced with alternative interpretation. He may then, if he is not himself a Researchman, feel compelled to review each alternative against the context. Having to stop like this breaks his flow.

A good way of achieving this is to eschew adjectival clauses and employ strings of nouns and participles completely unhyphenated. Take, for example, the profound 'With the more usual resistance furnace heating gas accelerated initially catalyst promoted breakdown'. The Researchman's reader can amuse himself counting the different meanings which different hyphen-combinations will allow.

Once the reader has become accustomed to slipping in odd imaginary hyphens as he goes along, it will then be possible to trick him into putting one where he shouldn't, and so lead himself off on another completely wrong scent.

Beneficial Omission

The next law to consider is that of Beneficial Omission. Never state the obvious; it it isn't obvious, suggest that it ought to be, and you still need not state it.

(Cont'd on Page 12)

RESEARCH AND SAFETY

'The number of industrial accidents last year was 193,000 which is the highest figure for 11 years. Unofficial estimates put the economic loss between £100 million and £300 million.'

Editor.

Mr. Myers on Safety Section writes on the place of safety in research work.

Life from the very beginning is a hazardous business and man is unable to go about his daily work or make any progress in complete safety as all forms of progress involve some risk.

Progress is the result of endeavour and research and it would therefore appear to follow that research cannot be carried out in safety. This suggests a high accident rate at research establishments and a frequent turnover in research staff; however, research can be carried out in safety by ensuring that the only risks taken are calculated ones.

Safety should be planned as the integral part of design and development; it is easier to incorporate safety at the design stage than to subsequently carry out modifications.

Established factors of safety in design which are proved to reduce hazards to a minimum are well known for usual applications, but in research these may not be practicable. In event of departure from these accepted standards due consideration must be given to the risk involved and other steps should be taken to reduce the hazard. For example, when a hazardous phase is reached the process may be carried out where damage can be confined and personnel withdrawn to a place of safety.

When the hazard associated with any experiment cannot be assessed with any certainty and where the outcome of the work may be unknown precautions should be taken to ensure that personnel and other apparatus are not endangered. Entry to the area should be controlled, safety equipment should be provided to protect personnel and its use insisted upon, and the operation of the correct type of fire fighting apparatus and emergency procedures should be fully understood.

During development and commissioning, precautions should be considered beforehand and as the work progresses. Routine operations are best covered by written instructions which should be prepared so that they are easily understood, and there should be adequate control and supervision to see that they are applied. Training and instruction should be given whenever possible to encourage safe working as a matter of course.

In many instances risks are taken not because of recklessness, which is to be deprecated in any event, but due to ignorance of the hazards and their consequences. As an example the toxic and dermatitic effect of dust or fumes produced by many materials and substances, particularly solvents, plastics, and resins are not well publicised, and these effects may be delayed. It is important to obtain full information of all the properties of materials and substances used.

It is emphasised that in research, as well as in all other multifarious circumstances of life, one should feel responsible not only for one's own safety but for the safety of others. Caution is never unworthy and is preferable to the far reaching consequences of an accident.

MONKEY PUZZLE

Mr. Billinge offers the following with apologies to the late Gerrard Hoffnung:-

'There is a rope hanging over a pulley, a weight on one end and a monkey of equal weight on the other. The rope weighs 4 ounces per foot, and the age of the monkey and the age of its mother together equal 4 years.

The weight of the monkey is as many pounds as its mother is years old.

The mother is twice as old as the monkey was, when the mother was half as old as the monkey will be when the monkey is 3 times as old as the mother was, when the mother was 3 times as old as the monkey.

The weight of the weight plus the weight of the rope is half as much again as the difference between the weight of the weight and the weight of the weight plus the weight of the monkey.

What is the length of the rope?'

A prize will be awarded for the first correct solution in writing to reach the Editors's Office, Room 2.2., Building R.1.

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PRESIDENTIAL ADDRESS TO THE B.A.

Extracts from the Presidential Address to the British Association for the Advancement of Science by Sir John Cockcroft at Manchester on 29th August.

If we look forward to the prospects for pure science, we see that it is in an intensely creative phase. Rutherford's burning desire to learn the innermost secrets of the atom is shared by the generation of his grandchildren. The primitive nuclear particle accelerators of Rutherford's later years which produced hydrogen nuclei with energies of a few hundred thousand volts have been succeeded by enormous nuclear accelerators producing particles of 100,000 times greater energy at 10,000 times the cost. When these beams of very energetic protons collide with other nuclei, they create in the intense field of force of the collision many different members of the nuclear underworld ...

An understanding of these particles and events of the nuclear underworld, connected as they are with the basic forces of the Universe, presents a tremendous challenge to the human intellect. If we succeed, our understanding of the physical Universe will be greatly enriched as it has been enriched in the past by Newton's theory of gravitation, Bohr's theory of the nuclear atom, and by wave and quantum mechanics. The study of elementary particles is likely to continue to be in the forefront of physics for several decades and will continue to attract many of the world's best scientists. There is, therefore, good reason for maintaining our present heavy investment in this branch of science.

In considering our future investment in science, we have to take account of the increasing proportion of our funds for basic research which are going into international scientific organisations. We have long been familiar with international conferences sponsored by the scientific unions and the International Council of Scientific Unions and with the International Geophysical Year and other large-scale and world-wide activities. The cost of these activities has been small, relative to our overall scientific budget, and they have paid good dividends.

We have now, however, reached the stage where several forms of science are becoming so expensive that only by international co-operation can smaller countries take part.

The foundation of CERN, the European Council for Nuclear Research, devoted to the construction and operation of two large nuclear accelerators, at a capital cost of over £15 million and an operating cost of £7-8 million per annum, of which we pay a quarter, is a portent of things to come. CERN has turned out to be extraordinarily successful both technically and scientifically, and has restored to Western Europe the possibility of working in the forefront of high energy nuclear physics ... We may, within two or three years, be faced with the problem as to whether to build a still more powerful nuclear accelerator at much greater cost to penetrate still deeper into the nuclear underworld. If these turn out to be strong scientific reasons for this, it may need, for economic reasons, to be built as a combined United States-European project or even a world project.

Men meet together for many reasons in the course of business. They need to instruct or persuade each other. They must agree on a course of action. They find thinking in public more productive or less painful than thinking in private. But there are at least as many reasons for meetings to transact no business. Meetings are held because men seek companionship or, at a minimum, wish to escape the tedium of solitary duties. They yearn for the prestige which accrues to the man who presides over meetings, and this leads them to convoke assemblages over which they can preside. Finally there is the meeting which is called, not because there is business to be done, but because it is necessary to create the impression that business is being done. Such meetings are more than a substitute for action. They are widely regarded as action.

The fact that no business is transacted at a no-business meeting is normally not a serious cause of embarrassment to those attending. Numerous formulas have been devised to prevent discomfort. Thus scholars, who are great devotees of the no-business meeting, rely heavily on the exchange of ideas justification. To them the exchange of ideas is an absolute good. Any meeting at which ideas are exchanged is, therefore, useful. This justification is nearly ironclad. It is very hard to have a meeting of which it can be said that no ideas were exchanged.

Extract from 'The Great Crash 1929'
by J. K. Galbraith

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SCIENCEHOOD AND RESEARCHMANSHIP (Cont'd)

The finest example of this appeared in the Researchman's Own Journal, Nature, a few years ago: 'Gastrulation of the blastula by invagination to form the archenteron is too well known to need comment'. The only possible reaction is 'Of course'. All cross-examination is barred by the Law of Tacit Acceptance.

Having established this bit about gastrulation and given it, virtually, the rank of an axiom, there are no limits to confine you. With judicious use of 'it is obvious that', or 'it follows that', or 'as was shown by Bloggins', you can reach whatever conclusion you like.

Abhorrence of Simplicity

Finally a law about words. This is the Law of Abhorrence of Simplicity and must be the most important of all the Laws of Sciencehood. 'Pity my simplicity' should have no place whatever in the Researchman's Liturgy. Why use one syllable when more will do?

Take the case of the plumber who wrote to the Bureau of Standards in Washington to tell them he had found hydrochloric acid to be good for cleaning out clogged drains.

The Bureau's Chief Researchman wrote back: 'The efficacy of hydrochloric acid is indisputable, but the corrosive residue is incompatible with metallic permanance'.

The plumber replied he was glad the Bureau agreed. Note his skilful use, though not himself a Researchman, of the Law of Tacit Acceptance.

The Bureau's Researchman tried again: 'We cannot assume responsibility for the production of toxic and noxious residues with hydrochloric acid, and suggest you use an alternative procedure'.

Again the plumber said he was pleased the Bureau agreed with him.

At this the Chief Researchman was stung into using most unresearchmanlike language: 'Don't use hydrochloric acid. It eats hell out of the pipes'.

When translation from one language to another is involved, this principle really comes into its own. Take the words 'out of sight, out of mind' - they have recently been translated as 'the invisible lunatic'.

And that is a fitting note to end on, for it provides the author with an appropriate nomme d'addresse de la chaise.

LECTURE COURSE

"FUNDAMENTALS OF ACCELERATORS"

A course of 13 lectures aiming to fill in some of the scientific background to the main Rutherford Laboratory projects will be held every Tuesday night at 5.30 p.m. in the No.1 Conference Room, R.1. They begin on 25th September, until 18th December.

The lectures will cover - Particle Dynamics; High Energy Physics; Linear Machines; Synchrotrons; Cyclotrons and High Energy Beams.

"ODE TO A SLIDE RULE"

O' magician logarithmic, thou hast never known defeat,
True comrade in adversity, accomplice in deceit
Never failing inspiration, consolation and salvation
With illicit information surreptitiously complete.
Nothing daunted by expressions of appearance pessimistic
Of convolutions serpentine, symbolic or statistic
Thou and I when its essential, solve equations differential
And connundrums exponential by manipulation mystic.
Thou art like an anaesthetic which deadens all sensation
As dimly through they cursor we perceive the operation
And even though thy skill leaves the patient feeble still,
We can make him what we will by discreet approximation.
So when my day is done and this frame of mine laid low,
Clasp my fingers round my slide rule as they clasped it long ago
Then my face shall lose deaths pallor, and I'll rise again in valour
To calculate the calorific values down below.

Anon.

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