MPS/Int. DL. 61-28
23.8.1961.

Report on a visit to the Rutherford Laboratory of the National Institute for Research in Nuclear Sciences - NIRNS - Harwell (Gt. Britain).

---

by F. Bonaudi and K.H. Reich

16.8.1961 to 19.8.1961

The main purpose of our visit was to discuss the requirements and special problems pertaining to the installation and use at CERN of the British National Bubble Chamber (BNBC, 1.5 m. hydrogen). The results of this discussion, in which A. Burger also took part for the TC Division of CERN, are summarized in a separate report (see MPS/Int. Mi. 61-57).

The present paper is concerned with the organization of the Laboratory, the state of the proton synchrotron project (NIMROD - 7 GeV) and various other activities which were of interest to us.

1. The Rutherford Laboratory

Most of the nuclear research at Harwell will ultimately be conducted at the Rutherford High Energy Laboratory of the National Institute for Research in Nuclear Sciences (NIRNS). This laboratory is directed by Professor T.G. Pickavance and has a staff of about 600. It is located about 1 km. from the main Harwell A.E.R.E. laboratory and access is completely free.

The experimental research will eventually be centered around two accelerators, the 50 MeV proton linear accelerator (P.L.A.) and NIMROD.

The organization of the laboratory is as follows. Under Drs. Pickavance and Mullet (Deputy) there are seven divisions, viz. :

Theory	(Walkinshaw)
P.L.A.	(Stafford - J.B. Marsh)
NIMROD	
Injector	(Hebbes)
Magnet and Beam Handling	(Wilkins)
R.F.	(Dunn)
Vacuum	(Cross)
Chief Eng.	(Bowles)
Design +Services	(Simonds)
(Electrical)	(Hadley)
(Mechanical)	(Ashburn)
Bubble Chambers	B.N.B.C. - P.B.C. (U.C.L.) - He. B.C. (Oxford)
Estimates and Sanction	(Finance, etc.,).

For several services, main workshop, canteen facilities etc., the Rutherford Laboratory still leans on A.E.R.E. Harwell; they are however building their own facilities.

2. P.L.A.

The 50 MeV P.L.A. is of similar design and make as the CERN one, except that the duty cycle is 1% (50 Hz repetition rate). The pre-injector (which stands in a large room in contrast to the CERN Faraday Cage) is run roughly half the time with a source of polarized protons.

The experimental area is about 200 m^2 and an extension is being built up. The main steering magnet bends the 50 MeV beam into any one of half a dozen or so beam channels each for a separate experiment.

The research work concentrates mainly on nuclear structure in the energy region between van-de-Graaf and larger cyclotron energies. It is carried out by about 50 physicists, 5 of whom are from the laboratory itself, about an equal number from the A.E.R.E. Harwell and the great majority from 13 British Universities interested in this work. Experiments are discussed in the physics seminars before being put on the schedule. Scheduling is not too difficult with

the present two running shifts and is expected to be eased further when the planned 3 shifts operation starts.

3. NIMROD

We had discussions with Professor T.G. Pickavance, Drs. Egginton, Hadley, King and Wilkins, and visited the injector, the synchrotron, the vacuum test laboratory, the experimental hall and the power house.

The present state is as follows :

-	15 MeV linac (home designed and partly home built)	working
-	inflection system	under design
-	ring magnet (without pole pieces)	erected
-	single r.f. cavity	on test
-	vacuum chamber	prototype on test
-	main magnet supply	being assembled on site
-	Piccioni type ejection scheme	under design

The problems with the outer vacuum chamber are linked to the fact that it should meet the stringent specifications both for

(i) mechanical tolerances (and smoothness) and

(ii) tightness.

Two walls of this chamber are located between the magnet yoke and the pole pieces. If these walls are not quite flat, the pressure and motion of the pole pieces will eventually provoke leaks. Point (ii) is particularly important for this type of design. For this reason repairs during manufacture should be made with a hot setting resin, which is apparently not easy : it is however hoped to overcome these difficulties soon. About 9 months are required from that date to finish the 8 chambers for all octants. Next the pole pieces could be mounted followed by the inner vacuum chamber and injection and acceleration.

The ejection scheme involves an additional quadrupole lens for overcoming the horizontal defocussing of the main magnet. Thus two (of the eight) straight sections are needed for this scheme. At present only apparatus for ejection into the main experimental hall (area about = CERN South Hall) is being built; however, space in the two s.s. is reserved for doubling up in view of a second experimental area.

The 1 ton ejection magnet should be brought into position in about 200 ms (stroke about 30 cm as a guess).

4. Experimental facilities.

Specifications (see report PS. 3033-125) have been sent out for a set of DC power supplies (stabilized rectifiers, 2 sizes, i.e. 50 and 100 Kw, all 500 A). One prototype of the larger unit is being manufactured by Westinghouse and should be available by the end of the year. The number considered is around 30; current measurements and stabilizer input by DC current transformers, which we understood are currently produced by Westinghouse; the same firm produces, as standard items, small portable supplies of the same type.

The plans are to install the majority of the rectifiers in a power house, a few being kept for installation along the walls of the experimental halls.

Elaborate system of DC current distribution by standard semi-flexible cables (0.4 sq. in) some 2/3 of which will end up in two or three separate terminal boxes; all these boxes to be in the floor. Two rectifiers will be grouped with one common return pole. This seems to us to create trouble, as change of polarity must take place at the same time on the two supplies thus coupled.

Water cooling (beam transport magnets only) at low pressure (some 5 kg/cm^2); for the magnets of the large bubble chambers (BNBC and a ca. 1 m. propane; a large He chamber is being talked about), a separate high pressure system exists.

Model and design work is going on on beam transport quadrupoles and bending magnets, both of these following closely CERN design. Oerlikon have been

given an order for about 10 lenses. Model work goes on on separators (Berkeley/ Cresti type); theoretical work has been done on this by N. Marshall King (see report No. NIRL 12-2).

5. National British British Bubble Chamber.

The 300 t~ magnet has been energized up t~ 5 MW, a field map measured (10 and 5 cm. grid) and it is at present dismantled waiting for shipment to CERN. The vacuum tank is under rough vacuum; the operation "bridge" carrying expansion/recompression valves, vacuum pumps, etc., is being fitted with all its equipment. The chamber body is ready machined and polished, but not pressure and vacuum tested yet. Optical equipment (lenses, cameras, etc.,) are still at Imperial College, London. We have not seen the windows; the vacuum coating plant for treating them is ready for use.

The various compressors are nearly ready for final tests; the refrigerator unit (built at Denver, and tested at Boulder, USA) is ready to undergo tests on a dummy thermal load (this test should in fact be under way at present).

6. C.T.R.

Work on controlled thermo-nuclear reactions, at present scattered over several laboratories, will eventually be concentrated at Culham (situated roughly between Harwell and Oxford) under the directorship of J.B. Adams. We saw the Culham buildings when passing; they are expected to be finished by 1964. At Harwell, T.E. James showed us the techniques employed, e.g. the 1 MJ condensor bank, a 80 cm. diameter ceramics tube, etc., The general impression is that something can be learned there, which is useful for designing power supplies for pulsed ejection and beam transport magnets., etc.

7. Liverpool N.P.R.L.

One of us (F. Bonaudi) went subsequently to Liverpool (19.8.1961) to visit the NPRL (Nuclear Physics Research Laboratory). He met Prof. J.M. Cassels, Prof. A.W. Merrison, Drs. D. Collinge, M.J. Moore, etc.,

The following things may be of interest :

a). 156" Synchro-Cyclotron (ca. 390 MeV). A long burst (3 to 5 ms) technique has been used satisfactorily by synchronizing the R.F. switch-off with a rotating target. Only one experiment is run at a time (9.00 a.m. to 10 p.m. 6 days per week).

b). v. d. Graff. This accelerator, built by High Voltage Eng. - Holland, is being assembled and should undergo preliminary testing within two months or so.

c). 4 GeV electron synchrotron. Preliminary plans for this accelerator are being prepared, a possible site, some 20 km. from the town is being considered.

F. Bonaudi K.H. Reich

Distribution (open)
MPS Committee Members.