

The views of the Appleton Laboratory staff

on the

Report of the SRC Working Party

that considered

the future of the Appleton and Rutherford Laboratories

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Appleton Laboratory

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1. INTRODUCTION

The question of the possible closure of the present Appleton Laboratory (AL) site in Ditton Park, and the major implications this has for the SRC budget, for the AL programme of work and for the lives of the 300 families involved, merits careful consideration. We are, however, completely confident that the SRC will weigh all aspects of the problem before coming to a decision on the matter.

We regret that the present document submitted to Council is rather long, but we do not consider that issues of such gravity can be disposed of without full discussion. Sections 2 to 9 examine various matters raised by the SRC Working Party (WP) Report, while Section 10 contains a summary of these discussions and also our views on the recommendations of the WP. It is no secret that nearly 90% of the AL staff do not wish to move to the Rutherford Laboratory (RL), but this is not only because of human inertia; there is a widespread and deeply-held conviction amongst the Appleton staff that, for the reasons given in the following Sections, a merger of the two Laboratories would not only be expensive, but would be a pointless and scientifically disastrous exercise. The detailed facts, we believe, constitute an overwhelming case against closing the Ditton Park site.

2. COSTS

2.1 Introduction.

In this Section the financial costs of moving the AL are estimated. The conclusions reached are very different from those of the WP, and the reasons for this are given.

We believe that a financial question of the magnitude with which we are concerned merits more detailed and reasoned estimates than those in the WP Report which contains (see WP Report p.9) only "first estimates" of the possible savings and of the capital and non-recurrent costs involved. (Certainly the SRC Boards would not accept a grant application for several million pounds that contained only first estimates of costs.)



We conclude below that the WP has underestimated the non-recurrent costs involved by well over £2m, and that the proposed move would represent a serious financial loss for the taxpayer (the capital equivalent of the Ditton Park site, estimated at £2.5m, WP Report p.10) and for the SRC itself (at least £1.9m over and above the £2.5m from the sale of Ditton Park).

## 2.2 Cost of transferring staff

The WP Report assumes that "Mr Average", used in calculating the costs of transferring staff from AL to RL, will be an HEO but, since there would be a higher-than-normal proportion of senior staff to be moved (because 100 non-mobile staff would not move), it seems more appropriate to consider Mr Average to be an SSO. For this reason, and in view of the fact that the RL is now in an area of high-cost housing, our estimate of the staff transfer costs are as follows:

(1) Redundancy payments:	£220k	(As estimated by the WP)
(2) Transfer of pension rights for non-mobile staff:	£200k	(As estimated by the WP)
(3) Removal expenses:	£360k	(As estimated by the WP)
(4) Excess rent allowances:	£263k	(Not £220k, because an average SSO would be entitled to a maximum of £363 p.a. and we have used £300 as a reasonable average instead of the £250 used by the WP)
(5) Interest-free loans:	£375k	(Not £300k, because an average SSO would be entitled to a maximum of £3362 and we have used £2500 as a reasonable average instead of £2000 used by the WP)
TOTAL £1418k		(Not £1300k as estimated by the WP)

## 2.3 Cost of accommodation

The WP Report assumes that only 500 m<sup>2</sup> of new laboratory/office space will be needed at RL if the AL is moved there. This estimate, however, was prepared at a time when the projected RL staff figures showed a large reduction that would have freed a lot of accommodation that could have been used by AL staff. The current situation is as quoted on p.6 of the WP Report,



however, and shows that the RL staff will run down by only 14 over the next five years; very little permanent accommodation will thus become available.

Two hundred AL mobile staff will be transferred and 60 new staff will be recruited locally to replace essential AL non-mobile staff who will not move (WP Report). Accommodation will thus be required at RL for  $200 + 60 - 14 = 246$  additional staff.

The Table below lists the special facilities that will have to be provided at RL, showing the existing areas and the costs of building them calculated using the CWU estimate of £310 per  $m^2$  (WP Report, Annex 2):

<u>Facility</u>	<u>Existing Area</u> ( $m^2$ )	<u>Estimated Cost</u> (£k)
Satellite control centre	160	50
Balloon integration area	293	91
Solar observatory	65	20
Vibration facility	47	15
Anechoic chamber	60	19
Space simulation chamber	40	12
Photographic section	190	59
Totals	<u>855 <math>m^2</math></u>	<u>£266k</u>

The cost of providing these facilities was estimated in the WP Report as £165k, presumably because inaccurate estimates of the areas were used. A total of 35 staff will be associated with the facilities listed above and will require, as at present,  $193 m^2$  of additional accommodation adjoining the facilities for desk space. It will thus be necessary to provide normal office/laboratory accommodation for  $246 - 35 = 211$  other staff of which 60 will be support staff. A careful assessment of the space occupied by staff at AL at present (assuming a ratio of office to laboratory space appropriate to the 211 staff to be housed) reveals that an average of  $20 m^2$  will be required per person; this does not include corridors, toilets, canteen space, etc. Using a cost of £310/ $m^2$ , the accommodation required

will cost  $211 \times 20 \times 310 = £1308k$ . The  $193 \text{ m}^2$  of office space around the facilities will cost a further  $193 \times 310 = £60k$  and the overall total cost of providing the facilities and the necessary office/laboratory accommodation will thus be  $£266k + £1308k + £60k = £1634k$ . This has been grossly underestimated in the WP Report, presumably because the out-of-date projection for the RL staff was used.

#### 2.4 Opportunity cost of under-utilized accommodation

It should be appreciated that even if the area required to accommodate the AL staff could be provided somehow in existing RL buildings, the opportunity cost of the space must be included in the cost calculation because, if existing accommodation were available, it would be an SRC asset that could be used for some other purpose instead of for transferred AL staff. The time is likely to come when, if the space is used for AL staff, new buildings will have to be erected for other purposes and the real costs of the accommodation will be incurred.

#### 2.5 Factors not considered in estimating building costs

The estimate of  $£1634k$  arrived at in para. 2.3 must be seriously qualified as follows:

- (1) The calculations were made using the cost per  $\text{m}^2$  for new office/laboratory accommodation quoted in the WP Report. However, a report by CWU (Report No.3, Scheme B, Phase 2 Development Appleton Laboratory, dated 29 September 1975) quoted costs/ $\text{m}^2$  of  $£342$  for a Balloon Payload building and  $£317$  for an office/laboratory building at July 1975 prices that did not include the costs of providing services such as water, electricity, sewerage etc. The estimate of  $£310/\text{m}^2$  is thus substantially too low even by 1975 prices and, if allowance for three years' inflation is made to bring it up to 1978 prices, a very much higher figure will be obtained.



(2) No allowance has been made for the costs of corridors, toilets or similar space, for experimental facilities such as temperature-controlled areas and clean areas, or for space for the AL World Data Centres, magnetic tape stores and archives.

(3) No consideration has been given to the question of whether existing RL facilities such as meeting rooms, the library, the canteen, car parks and bus services will be able to cater for the extra 246 staff without incurring additional expenditure.

(4) The estimate of  $20 \text{ m}^2$  per person used above was for the provision of space to the same standard as now exists at AL. Certain areas there, however, are overcrowded and it is estimated that an additional  $100 \text{ m}^2$  costing £31k will be required to bring existing accommodation to a level that would avoid safety hazards currently caused by cramped conditions.

The qualifications listed under points (1) - (4) above are clearly of such a fundamental character that the estimated building costs (£1634k) could be too small by 30%.

## 2.6 Cost of site services

The WP Report used a figure of 15% of basic building cost for the provision of site services, roads, pathways etc. for new buildings and, since the total cost of these is now estimated at £1634k, the cost of the site services will be £245k.

## 2.7 Cost of re-locating ionosonde

The cost of providing a new site for the ionosonde and the atmospheric laser experiment is estimated to be £114k. The latter experiment, now at Winkfield, could not be housed at RL because of sky illumination. If the laser is not moved and the ionosonde is located on a site by itself the cost will be £54k.

## 2.8 Local housing

The WP Report did not consider the availability of local housing, nor the fact that house prices have escalated significantly since JET and the Metal Box Company stimulated the demand for housing in the area. The prospects of housing the 200 AL staff who would move, with their families, are bleak. The extra demand will boost house prices even further and numerous requests can be expected from staff for the SRC to supply housing for employees unable to meet the high prices. The SRC already has about 100 houses near RL in order to ease recruiting problems, and the capital costs of increasing this number to house some AL staff could be significant.

## 2.9 Other non-recurrent costs

No reference was made to any of the following items in the WP Report:

- (1) The tracking station developed at AL for IRAS is a valuable facility that may well be needed to provide support for SRC space projects after IRAS. The cost of moving the antenna to Chilton is likely to be more than £100k.
- (2) The need to duplicate certain support staff during the move will result in some overbearing; detailed consideration suggests that this will amount to 21 man-years, or £84k using the £4k per man-year quoted in the WP Report.
- (3) A replacement for the electric power and signal ring main laid out around the Ditton Park site will be needed at Chilton and/or other sites if a move takes place.
- (4) If Chilbolton or some other site is to be used for a significant number of experiments that cannot be operated at RL, additional facilities (library, canteen and computing facilities etc. and possibly even private housing) will have to be provided there.
- (5) The cost estimates have been based on the assumption of a move to a single site; if a move resulted in dispersal over several sites, some of the non-recurrent costs incurred will be higher than the estimates quoted.



- (6) Some of the AL workshop machinery may need to be transferred to Chilton and installed there if the number of craftsmen at RL increases to offset the loss of the 22 AL craftsmen.
- (7) It will require some time to recruit and train the 60 additional support staff at Rutherford and this will result in a long-lasting shortage of experienced craftsmen, for example, which will mean that more work will have to be done on external contracts. This will entail considerable difficulties with the Trade Unions who are already unhappy about the work being let out to contract by RL.
- (8) The cost of physically moving the AL laboratory equipment (much of which is delicate electronics) and office furniture.

#### 2.10 Cost of disrupting the AL work programme

Group leaders of AL projects that are expected still to be in existence in 1983 were asked to provide estimates of the amount of time that would be expended on moving their projects to Chilton; the estimated minimum total effort amounts to 28 man-years which, at £4k per man-year plus overheads, will cost £291k. This does not include the cost of re-writing the AL computer programs which is very difficult to estimate; most AL programs are incompatible with the 360 system and it is likely to cost somewhere between £100k and £500k to re-write them. Before this could be done all the programming staff would have to familiarise themselves with the new system. The effort of re-programming (which would be highly unpopular) would require specialists who are in short supply and who are essential to the AL service work and research programmes. Although it could be argued that the staff will be paid whether a move takes place or not, and that disruption is therefore not a direct economic factor, it must nevertheless be appreciated that the loss of time by the scientific and computing staff in this way will cause delays (totalling about 30 man-years) in the Laboratory's programme and in the provision of assistance to Universities.



## 2.11 Cost of temporary loss of public funds

The direct costs of the move estimated in paragraphs 2.2 to 2.7 total considerably more than the £2.5m which will be recouped by the sale of the site. Although the costs will be spread over a period of about four years before the AL site is sold, it seems reasonable to assume, for purposes of estimating the delay between incurring the expenditure and the sale of the site, that the money will be spent, at one go, two years before the proceeds of the sale are received. This means effectively that £2.5m will be lost to public funds for two years and, using an interest rate of 10% p.a., this will cost the Government £500k.

## 2.12 Summary of non-recurrent costs

The Table below gives a summary of the non-recurrent costs (£k) estimated in the paragraphs above:

	<u>Our estimate</u> <u>(to nearest £10k)</u>	<u>WP estimate</u>
Transferring staff (Para 2.2)	1420	1300
Special facilities (Para 2.3)	270 <sup>(1)</sup>	165
Laboratory/office accommodation (Paras 2.3, 2.4)	1370 <sup>(1)</sup>	155
Site services (Para 2.6)	250	45
Re-locating ionosonde (Para 2.7)	50	35
Re-locating atmospheric laser (Para 2.7)	60 <sup>(2)</sup>	-
Other items (providing screening, dealing with interference, radiometer services, re-locating HF systems)	190 <sup>(3)</sup>	300
Direct costs total ...	3610 <sup>(1,4,5)</sup>	2000
Disruption (Para 2.10)	290 <sup>(6)</sup>	-
Cost of temporary loss of public funds (Para 2.11)	500	-
Grand total ...	4400 <sup>(1,4,5,6)</sup>	2000

(1) This estimate could be very much too small because of qualifications listed in Para 2.5.



- (2) Provided it is re-located on the same site as the ionosonde; it will cost £90k to move it somewhere else.
- (3) Our estimate is different from that of the WP because we have assumed that the £110k estimated by the WP as the cost of housing the radiometers has been included in our estimate for laboratory/office accommodation.
- (4) Expenditure on additional family housing near Chilton has not been included (para 2.8).
- (5) No allowance has been made for the items listed in Para 2.9.
- (6) No allowance has been made for the cost of computer re-programming (Para 2.10).

#### 2.13 Savings in salaries and wages

After a close study of the WP Report, the following interpretation of its assumptions was reached :

- (a) 180 scientific staff will transfer to RL.
- (b) 20 support staff directly associated with scientific projects will transfer.
- (c) 100 non-mobile support staff at AL will lose their jobs.
- (d) A total of 60 staff will be recruited at RL to replace the non-mobile AL staff.
- (e) There will be a net loss of 40 posts (i.e. 100-60).

The WP Report used the assumed net loss of 40 posts as a basis for calculation, and thus arrived at a saving of £160k per year. The assumption that 40 posts would be lost has not been substantiated by any evidence in the WP Report, and several questions can be raised about the estimated savings arising from the loss of the posts :

- (a) The Treasury (who will be interested in the economics of the move because they will be asked to waive their right to the proceeds of the sale of the AL site), or the DES, may take note of the planned reduction of 40 in the number of SRC employees and reduce the size of the SRC grant correspondingly. If that happens there will be no financial benefit to the SRC.



- (b) If 40 support posts are in fact saved and the SRC complement is not reduced, the SRC will presumably appoint new scientific staff (and support staff for them) to fill at least some of the vacancies so, once again, there will not be £160k of savings that could be used, for example, to increase grants to Universities. Of course, the extra staff may be used to provide additional services for Universities, but this additional activity will require funding if it materialises.
- (c) The 40 support posts will only all be saved if there exists beforehand some appropriate underemployed effort. In support areas such as the design office, workshop, photographic section etc. (where the WP Report, p.9, claims that savings of posts will be made) one person can only do one job at a time and, since all the jobs now being done will still have to be done after the move, there will in fact be no scope for reducing these support staff. It is not clear precisely which 40 posts the WP believe will be saved.

In view of these three queries, we cannot see how 40 posts will be saved, and we regard the estimated annual savings of £160k as highly unrealistic.

#### 2.14 Savings on overheads other than salaries and wages

The WP Report states that estimates between £106k and £261k were received for the annual savings on the total Appleton overheads (excluding salaries, wages, travel and subsistence) that would be occasioned by a move, and they concluded from these that annual savings of £200k should be attainable. We prefer to use the middle of the range of estimated savings, viz. £184k p.a., modified to take account of the fact that the WP Report made no allowance for the maintenance costs of the new accommodation at RL. Enquiries reveal that maintenance costs for the type of structures involved are about  $2\frac{1}{2}\%$  of the capital cost which is £1634k (Para 2.3), so the annual maintenance costs will be £41k. The savings will thus be £184k - £41k = £143k p.a.



## 2.15 Factors not considered in estimating overheads savings

The following items of recurrent expenditure were not allowed for in the WP Report:

- (a) The fact that the AL experiments will not all be accommodated at RL, but will be spread over several sites will involve considerable additional expenditure on outstation services, travelling and extra staff. The ionosonde, for example, is now operated by one member of staff with part-time help from several others but, when it is situated on its own site, it will require two full-time staff.
- (b) The new accommodation to be built at RL or the other sites may mean increases in the rates payable.

Although we have not estimated the cost of these additional items, they will clearly absorb much of the £143k saved on overheads each year.

## 2.16 Summary of savings in recurrent costs

The Table below gives a summary of the savings (£k) in recurrent costs estimated in the paragraphs above:

	<u>Our estimate</u> (to nearest £10k)	<u>WP estimate</u>
Salaries and wages (Para 2.13)	160 <sup>(1)</sup>	160
Other overheads (Para 2.14)	140 <sup>(2)</sup>	200
Total ...	<u>300<sup>(1,2)</sup></u>	<u>360</u>

- (1) This figure should be significantly reduced (perhaps by as much as £160k) in view of the qualifications raised in Para 2.13.

- (2) No allowance has been made for the items listed in Para 2.15.



#### THE NEED FOR AN EXPANDED NATIONAL PROGRAMME IN RADIO PROPAGATION

In 1977 the SRC invited the Electronics Research Council (which, although based in the Ministry of Defence, takes a national view of problems) to consider the future programme of research in radio propagation at the AL from the point of view of national user organisations. The ERC Working Party Report was presented in March 1978 and has been summarised in only five lines in the SRC WP Report. It seems desirable, however, to note the views of the ERC in more detail because we believe that it will be very difficult (for reasons given in Section 4) for the AL to carry out the national programme envisaged by the ERC if it is moved to Chilton.

The ERC Report stated "The AL has continued to maintain a high international reputation for its research within the field and ..... it is our opinion that this role needs to be expanded to support the work of the user organisations which were investigated." The ERC Report concluded "The AL enjoys a world-wide reputation in the field of propagation research and the (ERC) Working Party believes that it is in the National interest for this position to be maintained into the future. The (ERC) Working Party believe that if the AL were to become involved in a Programme directed towards the requirements of the principal National users then it would be natural for the AL to contain a National Centre for Propagation Research."

In its written evidence to the ERC Working Party, the Directorate of Radio Technology in the Home Office stated "The Home Office consider that the Appleton Laboratory has a vital function as a national centre for research into radiowave propagation. As a permanent centre, the Laboratory is able to maintain continuity in its work on the important basic studies of propagation mechanisms and effects. Newly discovered phenomena may have far-reaching effects on the utilisation of the radio frequency spectrum and it is important that the scope of the research should continue to be wide-ranging."



These comments demonstrate that there is a national need for a continuing and indeed an expanded programme of radio research in the general area of that currently being undertaken at AL. It is clear, however, that if AL is moved to Chilton the radio noise environment there will cause such problems, including the dispersal of the radio experiments over several different sites (see Section 4), that it will be immeasurably more difficult for the Laboratory to fulfil its national role in the radio propagation field as successfully in the future as it has done in the past.

4. THE EFFECTS OF THE RADIO NOISE ENVIRONMENT AT RL

It is now known that the fears expressed by the AL Staff Side to the WP in 1977 that the high levels of radio interference generated at RL would cause insuperable difficulties for parts of the AL radio propagation work were justified. An extensive series of noise measurements at RL (described in a 43-page report submitted to the WP in March 1978) has led to the following conclusions:

- (1) "Technical considerations rule out locating the ionosonde and HF receiving systems on the RL site or adjoining areas. The ionosonde and HF receiving systems must be located on a site several km away from the RL site: Chilbolton is possible for the HF receiving systems (but is unsuitable for the ionosonde)."
- (2) "The 15 AL microwave radiometers would be vulnerable to VHF interference on the RL site. The problem might be solved by careful siting on the land to the south, combined with measures to screen the radiometer heads (outdoors) and the associated laboratory, which would have to be built adjacent to them. Technically it would be much preferable to relocate the radiometers on a radio-quiet site, e.g. Chilbolton."

These conclusions were specifically endorsed in a letter to SRC London Office from the Electromagnetic Interference Department of the Electrical Research Association at Leatherhead. The general conclusion arising from the noise measurements was also endorsed by the Electrical Research Association and is simply that there is a "fundamental incongruity" between the Rutherford programme of work, involving machines with a potential for generating radio interference, and the AL programme which involves highly-sensitive receiving systems.



The WP, noting these difficulties, concluded that as far as the location of the relevant AL equipment (i.e. most of the radio propagation experiments) was concerned "an acceptable solution can be found at Chilbolton or Winkfield. These alternative sites could accommodate the microwave radiometers which might also be adversely affected by the interference at the Rutherford Laboratory although sites nearer Chilton could be technically suitable. One problem, the siting of the radio ionosonde, remains. The ionosonde as well as being sensitive to interference also generates interference for short periods and this could affect the operation of some Rutherford Laboratory equipment. It would be preferable for the ionosonde to be located on its own site". It may be worth pointing out that it will not be easy to find a new site for the ionosonde because the local population everywhere is likely to object to the sudden increase in radio interference that will occur when the machine is moved into their area.

This fragmentation of the radio propagation programme contemplated by the WP would clearly make it much more difficult for the Laboratory to play a successful national role in the radio propagation field.

The adverse effects of the radio noise environment at RL will in practice extend beyond the obvious problem of interference with sensitive receivers because the development of all highly-sensitive electronics, on which much of the AL work depends, will also be affected. The present AL site was chosen (when the Laboratory constituted the Radio Division of the NPL) because of the need for a radio-quiet site; it does not appear sensible now, when much more sensitive radio equipment is used, to move the Laboratory to Chilton.

Those projects that are re-housed at Chilbolton or Winkfield will be at relatively remote sites (especially Chilbolton), difficult for visitors to reach and separated from the workshop and data-processing facilities and from the main body of staff with whom there needs to be regular contact.



Mr J B Visser, when referring to the conclusions of the ERC Report in a letter dated 21 April 1978, wrote "The message of this Report for the AL/RL Working Party is simply that there is likely to be a continuing external requirement for propagation research which needs to be taken into account in any decisions reached on the location of the work." The WP recommendation to divide the programme among several sites does not appear, however, to take the requirement into account.

The dispersal also appears to be in conflict with the expressed view of the WP that the move of AL should "not result in an undue fragmentation of the existing Appleton Laboratory" (p.11 of the WP Report), and also with the desire of the WP to unite the two Laboratories "on one site" (p.6 of the Report). The fragmentation will obviously make it difficult for one of the two major objectives of moving the Laboratory, viz: "to increase University participation in the radio programme" (p.7 of the Report), to be achieved. How will the dispersal of the radio experiments and the associated expertise lead to increased University participation in the radio programme?

Any re-location which separates closely-related groups will be detrimental to the scientific work of the groups concerned. There is currently a set of AL projects with common technical backgrounds and overlapping scientific interests which form a coherent unit; most of these projects are concerned with the advancement of mm and infra-red techniques and their application to various atmospheric studies, but they have much in common with the radio techniques used in the space support work. The relevant projects are:

- (1) 16/12. Millimetre wave propagation studies using satellites.
- (2) 16/07. Millimetre wave propagation.
- (3) 16/08. Joint work with the Post Office on the effects of precipitation.
- (4) 16/13. Joint work with Heriot-Watt University.
- (5) 16/10. Radiometer studies of the atmosphere.
- (6) 31/02. Millimetre solar astronomy and its relation to terrestrial effects.
- (7) 16/11. Studies of tropospheric constituents in relation to millimetre and sub-millimetre propagation.



- (8) 20/07. Radar experiments at Chilbolton. (The development work on this project is done at Ditton Park.)
- (9) 1/21. Studies of the middle atmosphere.
- (10) 32/01. Laser investigations of the upper atmosphere.

There is close collaboration between the groups numbered (1) to (8) above, particularly in the interchange of expensive equipment and components and also of technical ideas and scientific knowledge, and, if their effectiveness is not to be seriously reduced and their international standing jeopardized, they and the relevant scientists should be located on one site. The projects cannot all be located at RL because of radio interference problems, and it seems that the only possible location other than Slough for this amount of effort would be Winkfield or Chilbolton. It should be pointed out, however, that Chilbolton is sometimes used for powerful radar transmissions (600 kW peak pulses at 10 cm and 25 kW peak pulses at 3 cm) that will interfere with certain radiometer experiments, and it is by no means certain that all the radiometric work that AL may need to do would be compatible with the Chilbolton radar.

If eight or ten of the closely-related projects listed above are not housed at RL, it is clear that the whole AL programme of work (which comprises only 31 projects including service projects) will be fragmented to such an extent that the Laboratory will be effectively destroyed as a unit. Will the benefits of the move constitute sufficient justification for doing this? Is it the wish of the SRC that this should be done?

##### 5. THE QUALITY OF THE AL SUPPORT WORK

The high calibre of the support work carried out by AL is demonstrated in this Section. The fact that the Laboratory has discharged acceptably the obligations placed on it is relevant because the supposition that it would provide very much better services in the future if amalgamated with RL is only valid if it has failed dismally to do what was desired of it in the past. Is there any



evidence that the services requested would have been provided more satisfactorily by any other laboratory? Are there such serious complaints about the achievements of the Laboratory that it deserves to be closed? Would the AL staff have been able to achieve more if they had been based anywhere else?

The quality of some of the services provided by AL is indicated in the following four extracts from the many letters written about various projects:

(a) Passive sounding from Spacelab

(Letter dated 30 June 1976 from the Chairman of SRC, Sir Sam Edwards, to Director, AL)

"This is to congratulate the Appleton Laboratory .... on the study which the Laboratory led for ESA on passive sounding experiments for Spacelab. The final bound version of the report has just arrived from ESA, and Harry Atkinson tells me that the Agency's Executive is delighted with the way in which the UK tackled the task and the result. Indeed, I understand that the exercise compares more than favourably with similar ones carried out by other member states; and that the Executive would like SRC to do more studies of this sort for them."

The fact that this contract from ESA was fulfilled so excellently has resulted in the award to AL of two further ESA contracts which were competed for internationally. These are for £312k and about £100k respectively, and involve work in the field of image processing in which the Laboratory is known to have considerable expertise.

(b) Ariel V and Copernicus

(Letter dated 9 February 1976 from Dr J L Culhane at University College London to Director, AL)

"The success of the UK X-ray astronomers is due in no small measure to the excellent work being done by the Ariel V control centre staff at Appleton and I would like to thank you and your colleagues for the effective way in which you are handling the Ariel V in-flight operations.



The continued success of our Copernicus experiment is of course also due to the support provided by your laboratory and for which we are also extremely grateful. In view of the outstanding work done by your laboratory in support of Ariel V and Copernicus I am sure that we can look forward with confidence to a similarly successful post-launch operation of UK-6 and of the International X-ray Explorer should the latter project go ahead."

- (c) International Ultraviolet Explorer, IUE  
(Letter written in May 1978 by Mr R St J Walker to Director, AL)

"We are well aware of the many difficulties and crises which had to be surmounted by dint of long hours of sustained hard work by your staff. The resounding success which we can now expect from IUE is a tribute to their skill and determination which the Council greatly appreciates, and which I am sure will be equally appreciated by the astronomers who will use this new and powerful instrument."

- (d) Stabilized Balloon Platform

(Telex dated 21 September 1978 from Dr H H Atkinson to Director, AL)

"This is to give the congratulations of ASR Division (and Central Office) on the successful flight of the Stabilized Balloon Platform, with Dr. Bates' experiment. Praise must go to all those concerned at Appleton Laboratory for rescuing this facility with such evident success."

## 6. THE EXTENT OF THE AL SUPPORT WORK

The first reason advanced by the WP for merging the Appleton and Rutherford Laboratories is "that the effectiveness of the Appleton Laboratory, with its long experience in the management of space projects, would be enhanced if a similar pattern of working could be developed" at AL as currently prevails at



RL where there has been "long experience in collaborating with University research groups in the design and preparation of experiments". Apart from the illogicality of assuming that collaboration between the AL staff and the University community is dependent on whether or not the staff are moved to Chilton, this particular opinion of the WP has produced both astonishment and in fact deeply-felt resentment amongst the AL staff. The statement is remarkable because on p.2 of their own Report the WP recorded that "about two-thirds of the direct staff on the ASR Board programme are engaged on work in support of University space projects" and also "In both areas most projects involve University collaboration".

During the past few years the AL has contributed substantially to the experimental hardware and/or management of the following major projects or facilities: Ariel IV; Ariel V; IUE; UK-6; IRAS; the Chilbolton radio telescope (where eight Universities are engaged on different projects); the Winkfield tracking station; the Concorde Eclipse Project; the Trans-Atlantic Balloon Project; EISCAT; the mm-wave telescope; the national and high-latitude rocket programmes; the balloon programme and the Stabilized Balloon Platform.

The possibility of participation by the British University community in some of these projects only arose, in fact, because of initiatives taken by members of staff at AL. In addition, AL has carried out a number of important feasibility studies for satellite projects, and at the present time is doing so (jointly with NASA) for the Multidiscipline Refurbishable Satellite, MRS.

The work undertaken at AL in connection with most of the projects listed above has involved "the design and preparation of experiments" (which the WP regards as the forte of RL), and goes far beyond "the management of space projects" (which the WP highlights as the major contributions which the AL has to offer). For example, on the IUE project, AL worked on the camera development and calibration, the camera electronics (assisting MSDS when their electronics design was found to be unsatisfactory) and the image processing software. On the mm-wave telescope project,



AL is committed to 62 man-years of effort about half of which will be spent on developing mixers for the mm-wave receivers and in developing a machine for measuring the telescope shape. The Satellite Control Centre at Slough is a particularly important facility for which AL has provided the hardware.

It is difficult to see exactly how any of the projects listed above might have benefited if the contributions of the AL staff to them had been arranged from the Chilton site instead of from Slough.

In the recent past, the services undertaken by AL have involved the universities of Aberdeen, Belfast, Birmingham, Bristol, Cambridge, Durham, Glasgow, Heriot-Watt, Kent, Leeds, Lancaster, Leicester, London (Imperial College, UCL including MSSL, QMC), Manchester, Oxford, Reading, Sheffield, Southampton, Sussex, Ulster and Wales, and have necessitated interaction with contractors at AWRE (Aldermaston), B Ae (Bristol), HSD (Stevenage), MSDS (Chelmsford, Portsmouth and Frimley), RAE (Farnborough), RPE (Westcott). Apart from the service work for the university community, the AL also has a large number of collaborative projects with universities. These are summarised in the Laboratory Triennial Reports and the last one (1974-76) listed 41 collaborative projects with 23 colleges in 19 different universities; over the period 1971-73 there were 44 collaborative projects with 18 universities.

## 7. THE OPTIMUM SIZE OF RESEARCH LABORATORIES

In this Section we examine the size of laboratories that have responsibilities broadly comparable with those of AL; we shall consider, in particular, the Max-Planck-Institutes in Germany, where the Max-Planck-Gesellschaft is in many ways the equivalent of the SRC. The terms of reference of the Gesellschaft include the carrying out of scientific activities "which require specialised facilities so large or sophisticated, or funds so high, that they will only be undertaken by universities very hesitantly or not at all" (Max-Planck-Gesellschaft, 1977 p.12). The Gesellschaft operates 50 Max-Planck-Institutes having a median total staff, including visitors, of well under 200 (see Fig. 1 opposite which contains a histogram of the total staff



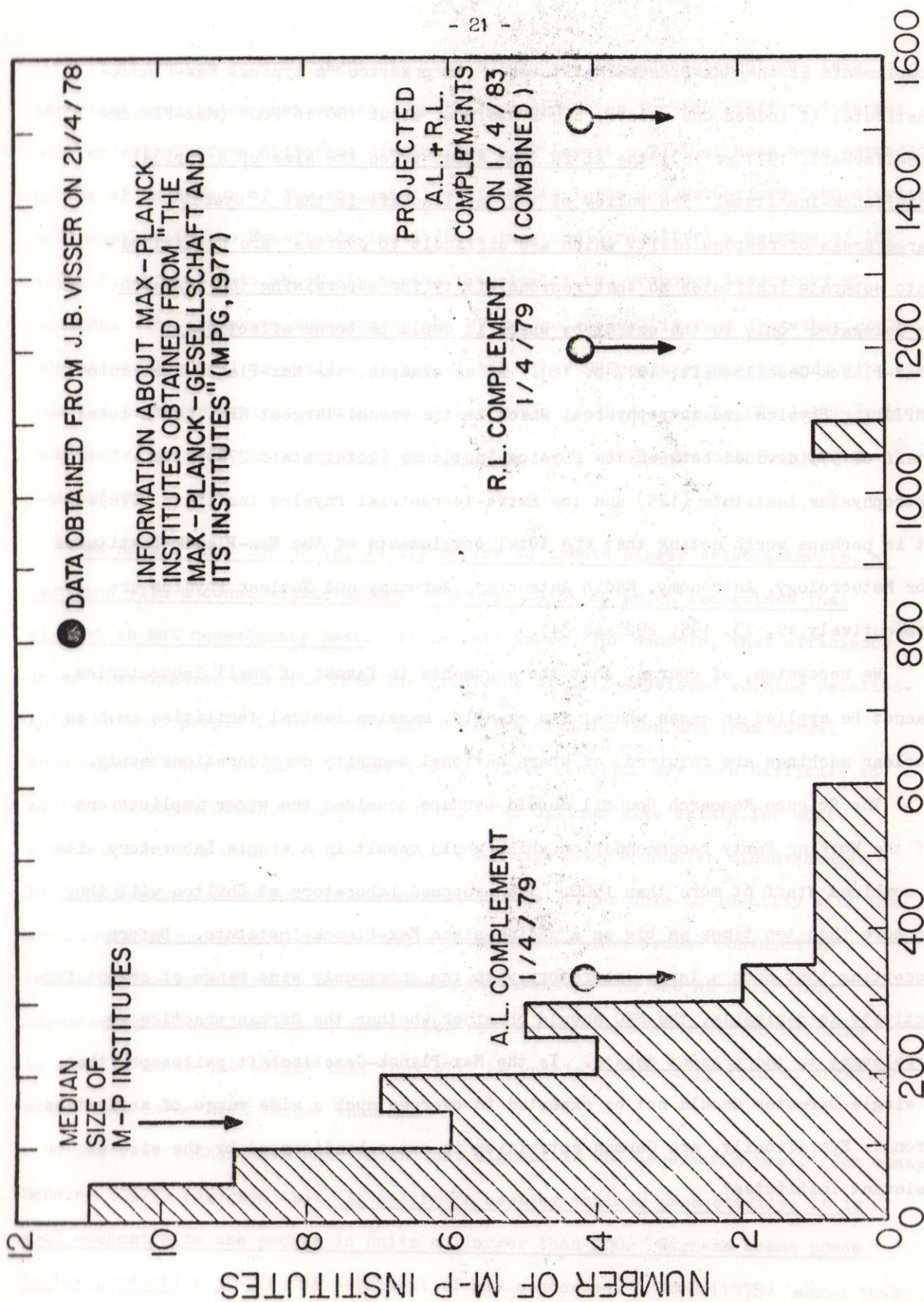


FIGURE 1 TOTAL STAFF (INCLUDING VISITORS) IN M-P INSTITUTES



complements at the Max-Planck-Institutes). In practice "a typical Max-Planck-Institute, if indeed one exists, has a staff of about 150 to 200" (Max-Planck-Gesellschaft, 1977 p. 15); the AL is thus about twice the size of a typical Max-Planck-Institute. The policy of the Gesellschaft is that "overly large areas of responsibility which are difficult to oversee" are subdivided into separate Institutes so that responsibility for supervising the research is delegated "only to the extent by which it could be borne effectively" (Max-Planck-Gesellschaft, 1977 p. 13). As an example, the Max-Planck-Institute (MPI) for Physics and Astrophysics, which is the second-largest MPI, has a total staff of 573 divided between the Physics Institute (total staff 272), the Astrophysics Institute (125) and the Extra-terrestrial Physics Institute (176). It is perhaps worth noting that the total complements of the Max-Planck-Institutes for Meteorology, Astronomy, Radio Astronomy, Aeronomy and Nuclear Physics are respectively 45, 73, 195, 292 and 341.

We recognise, of course, that the arguments in favour of small laboratories cannot be applied in cases where, for example, massive central facilities such as nuclear machines are required, or where national security considerations apply.

The Science Research Council should perhaps consider the wider implications of the Working Party recommendation which would result in a single Laboratory with a combined staff of more than 1500. The proposed Laboratory at Chilton will thus be more than ten times as big as a median-sized Max-Planck-Institute. Before accepting that such a large laboratory with its enormously wide range of scientific activity is desirable, the SRC should consider whether the German practice is irrelevant to the present debate. Is the Max-Planck-Gesellschaft philosophy that a single Director should not be expected to oversee such a wide range of activities wrong? Specifically, are German activities in space handicapped by the size of the relevant Institutes?



If the three general arguments (including "the imponderable but no less important advantages that derive from the opportunities for the staff to interact with scientists from different disciplines", WP Report p.7) that have been advanced by the WP in favour of the amalgamation of the Appleton and Rutherford Laboratories were applied to the Max-Planck-Institutes, they would result in a merging of the fifty Institutes into about six having the size of the proposed laboratory at Chilton. The arguments advanced by the WP are so general in fact that they could almost equally well be applied to any of the other SRC establishments and, if carried to their logical conclusions, they would lead to a single SRC Laboratory somewhere, or even, as a reductio ad absurdum, to a single British Government Laboratory.

We submit that the WP is, in its desire to create bigger establishments, at variance with a considerable amount of modern thinking which recognises that biggest is not necessarily best. It is well known, for example, that efficiency in an organisation benefits from the existence of well-developed working relationships between people in different parts of the organisation and from mutual knowledge of other people's capabilities. These benefits are more difficult to achieve in organisations that are too big. An optimum size exists for most organisations and when they grow beyond that size they encounter disadvantages - the staff become disaffected because they are no longer able to identify with the organisation, and general accountability and supervision become confused as a result of the multiplicity of management hierarchies. As the AL Staff Side reported to the WP last year, one of the reasons why most AL staff do not wish to move to RL is the belief that they will be unable to identify with an organisation that is so much larger than AL.

Numerous authorities have shown that biggest is not necessarily best. For example, Madeley (1977) reported that "If a firm is seeking maximum productivity, it is good economics to use people in units no larger than 200. Bigness seems prone to low productivity - to the detriment of all concerned." Gorb (1978) shows that



it is better to support small units and Willatt (1977), discussing efficient management techniques, draws attention to the fact that in a small organisation mistakes can be corrected quickly while in a large one an error of judgement can be extremely costly in time or money. He reports that, contrary to the theory that progress depends on large organisations, "the invention of new products and processes continues to be in great part the work of small and medium-sized enterprises". The Racal Electronics Organisation in the UK believes (according to their Technical Director, Mr. Lomer) in keeping their units down to about 200 people; they have found that bigger units offer no advantages over the smaller units.

The general trend of modern thinking on the size of organizations prompts us to ask the following questions. What evidence is there that the existing Appleton Laboratory is too small? Is the flexibility associated with maintaining two separate Laboratories, each excelling in its own field, not worth just as much as the supposed benefits of merging the Laboratories? Will it not be difficult to provide adequate scientific direction for major programmes of work carried out for four SRC Boards (Astronomy, Space and Radio, Engineering, Nuclear Physics and Science) in one Laboratory? We submit that questions such as these have not been properly addressed by the WP which has not considered the wider issues involved in merging two organizations that are already both large enough to carry out their designated responsibilities.

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8. THE PERSONAL VIEWS OF THE AL STAFF AND THE HARDSHIP THAT WOULD BE OCCASIONED BY A MOVE

A recent ballot of the AL staff carried out by the local Staff Associations showed that 87% of the staff are positively opposed to a move to Chilton. It is obvious, as the WP Report says (p. 8), that "the success of the move will greatly depend on retaining the goodwill of the Appleton staff", but it is equally clear that this goodwill will certainly not be retained unless the staff feel that compelling reasons exist for the move. This document, representing the views of the staff, shows that they do not believe there is a good case for moving.



It is well-known that the morale of staff will suffer if they are forced to move when they can see no benefits from the move. Their sense of loyalty towards their employer will be affected and, as Foster and Liebreinz (1977) have shown, the "psychic costs" of enforced re-location can be considerable.

Hitherto the loyalty and co-operation of the AL staff has surely been of considerable value to the SRC, and it is to be hoped that Council will not wish to risk losing this without good reasons. In the absence of a credible case for moving, the personal inconvenience and in many cases the hardship that staff will have to bear will become paramount in their minds. Apart from general problems such as interruption to schooling and loss of friends etc., about a third of the mobile staff at AL have working wives who are not expected to find suitable jobs if the Laboratory is moved to Chilton. The standard of living of these families will be significantly reduced. Also, 27 members of the scientific staff will experience problems with dependent relatives (other than children) if they move; these problems do not include minor inconveniences such as increased distance from non-dependent relatives. Several of these 27 staff have indicated that they will be unable to move to Chilton and will have to bear the considerable burden of travelling each day.

If the Laboratory is moved, therefore, numerous individuals and families who have to move will suffer personal hardship in order to achieve what seems to them a doubtful public gain. In addition to this, 100 non-mobile staff (industrial and non-industrial) will lose their jobs. Many enlightened organizations do not dissociate themselves from the private affairs of their employees these days (Foster and Liebreinz, 1977), and it is to be hoped that the SRC will give due weight in their deliberations to the personal circumstances of their staff at AL.



## 9. THE LONG-TERM DISADVANTAGES OF MOVING

Section 7 of the WP Report reads "Having considered the arguments on both sides the Working Party concluded that the long-term advantages of a move are sufficiently great to outweigh the short-term difficulties that are bound to arise." This section of the WP Report, quoted in its entirety, indicates that the Working Party chose to ignore the long-term disadvantages that will certainly accrue from a move. Apart from (1) the deleterious effect on staff morale and loyalty (Section 8) and (2) the inefficiency that will be introduced into the radio propagation programme by the fragmentation of the work (Section 4), the following long-term disadvantages will also result from a move :

- (a) The SRC will lose a number of key personnel who are not willing to move to Chilton. Many AL projects are small and highly specialized and the loss of even one staff member will be disastrous to them. The possibility of a move has already led to resignations of key people and if this continues the UK6 and IRAS projects, for example, will be so seriously affected that international embarrassment will be caused. Indeed, the ability of the staff to carry out the role envisaged for them in the merged Rutherford/Appleton Laboratory will be compromised if a significant number of key staff leave.
- (b) There is currently a shortage of about 30 skilled craftsmen in the RL workshop (caused partly by the relatively remote location of the Laboratory) and a move of AL, which will result in the 22 AL craftsmen (many of whom have highly-specialised skills) being lost, will only exacerbate the prevailing situation. There will then be a shortage of 50 craftsmen, and this will not enable very good engineering services to be offered to the University community. The value of the existing AL workshop expertise to radiometer projects (including the mm-wave telescope, for example) should not be underestimated. A letter dated



23 June 1978 from Queen Mary College to the AL Workshop Supervisor said  
"Since your workshop is now certainly the most competent in the UK with  
regard to the manufacture of extremely high accuracy mm-wave components,  
it would be greatly appreciated if several of our technicians could visit  
you on 29 June in order to discuss some of the problems they have  
encountered. I feel that the 140-220 GHz mixer block recently completed  
by one of your machinists is certainly the best example of its type so  
far produced in the world and clearly demonstrates that highly successful  
techniques have been developed in your shop." The loss of craftsmen  
capable of doing skilled work of this calibre would be a tragedy and  
would circumscribe the ability of the AL to carry out successful work at  
the frontiers of modern radio technology. The millimetre wave and  
microwave components manufactured in the AL workshop are not only better,  
but also cheaper, than those obtainable elsewhere. Another advantage of  
the AL Workshop that will be lost if the Laboratories are merged is  
that at present there is very close contact between the scientific and  
workshop staff; this system is much more efficient than the more  
formalized procedure operated in the bigger workshop at RL.

(c) The present AL site is, for various reasons, a convenient asset. The  
AL staff know that when meetings which could be held at either RL or  
AL are being arranged with university scientists, the visitors invariably  
prefer to travel to Slough. Surveys of visitors to the Laboratory in  
1975 and 1977 show that (apart from maintenance contractors, school  
parties, travelling representatives etc.) there are now on average eleven  
visitors to the AL each day. A high proportion of these are from  
Universities - 39 different British universities or polytechnics in 1975  
and 43 universities or polytechnics in 1977; there were, for example,  
96 visits by scientists from Imperial College and 74 from UCL during



the two years. Geographical considerations mean that almost all university visitors will find it less convenient to visit AL if it is moved to Chilton. Now that AL is the closest SRC establishment to London, meetings that would formerly have taken place in State House have been held at the Laboratory for the convenience of the attendees. AL is preferred to Swindon which, in turn, is preferred to RL for meetings.

(d) The WP proposals recommend that the Director of the merged Laboratories should "have the right to move staff from one Division to another" (WP Report p. 12). This arrangement, when coupled with the fact that the proposed merger is intended to benefit "the activities supported by the Engineering and Science Boards on the Chilton site which represent an increasing proportion of the Rutherford Laboratory's total programme" (Report p.7), raises the fear that the expertise currently engaged on the AL programmes will inevitably become dispersed throughout the merged laboratory. The remark about "the introduction of a management structure which will safe-guard the professional expertise of the Appleton Laboratory staff" (WP Report p. 9) appears to have been negated by the management structure actually proposed, and the continued survival of the relatively small Appleton Laboratory programmes in the environment at Chilton will thus be regarded by many people as by no means assured.

## 10. SUMMARY AND DISCUSSION

### 10.1 Summary of Section 2

The cost of moving AL to Chilton will be at least £4.4 million (Para 2.12), but this estimate may be significantly too small because of major factors referred to in Paras 2.5, 2.8, 2.9 and 2.10. The Ditton Park site is valued at only £2.5 million (WP Report p. 10) - and nobody knows whether it would actually raise that amount for the SRC - so it appears that Council will incur a loss of at least £1.9 million if AL is moved.



The annual savings on recurrent costs are estimated to be at most £300k (Para 2.16). For reasons specified in Paras 2.13 and 2.15, however, this estimate is quite unrealistic; the cash savings may well prove to be less than £100k p.a.

#### 10.2 Summary of Sections 3 and 4

A survey of the radio noise environment at RL led to the conclusion, subsequently endorsed by the Electrical Research Association, that there is a "fundamental incongruity" between the big machines at Chilton and the AL radio programme. This means, inter alia, that the radio propagation programme now carried out at Ditton Park will have to be dispersed over several sites. The fragmentation will have to be on such a scale, in order to co-locate experiments that share expensive mm-wave or microwave equipment, that the AL will effectively be destroyed as a unit and its ability to carry out successfully the national programme in radio propagation envisaged for it by the Electronics Research Council will be seriously limited.

#### 10.3 Summary of Sections 5 and 6

Over recent years the AL has provided a substantial number of major services for Universities; these have included the design and preparation of experiments as well as the management of space projects and, as far as is known, they have all been carried out to the general satisfaction of the large community that has been served. The WP has produced no evidence suggesting that the Laboratory has failed to provide specific services requested of it in the past, or that it will have to be merged with RL in order to provide the services desired by the University community in the future.

As far as collaborative research with Universities is concerned, as distinct from services for Universities, the AL was involved in 41 projects with 19 different Universities during the period covered in the last Triennial Review.



#### 10.4 Summary of Section 7

It is recognized by many different authorities that, as far as laboratories are concerned, biggest is not necessarily best. A scientific body as eminent as the Max-Planck-Gesellschaft in Germany, for example, has a firm policy of maintaining small Institutes so that responsibility for controlling its laboratories is delegated "only to the extent by which it could be borne effectively". The AL is already about twice the size of a typical Max-Planck-Institute, and the combined Rutherford and Appleton Laboratories would be more than ten times as big as a median-sized Max-Planck-Institute. No specific examples have been put forward by the WP to justify their belief that AL is too small to carry out the responsibilities that may be delegated to it in the future.

#### 10.5 Summary of Sections 8 and 9

If the Laboratory is moved, 100 non-mobile members of staff (industrial and non-industrial) will lose their jobs, and many families who are forced to move will suffer personal hardship in order to achieve what seems to them a doubtful public gain. A move to Chilton will thus adversely affect the morale and loyalty of the staff. A significant number of key people will leave, prejudicing the future ability of AL to carry out the role envisaged for it, and all the craftsmen (including several who are doing work as good as that anywhere in the world on radiometric devices) will be lost, exacerbating the shortage of craftsmen already prevailing in the RL workshop.

#### 10.6 The Extent to which the WP Fulfilled its Terms of Reference

The WP Report states on p. 1 that "The Working Party was set up in 1976 in a difficult financial climate ..... It therefore seemed sensible to consider combining the two laboratories with a potential saving in recurrent and overhead costs." These statements reflect the fact that the Terms of Reference of the WP were "To consider in the light of the SRC's financial prospects" the future of the two Laboratories. We have shown that a move



will involve substantial financial expenditure (at least £.4 million, less receipts from the sale of the site) and will produce insignificant annual savings so that, as far as the financial considerations that led to the whole discussion are concerned, the only possible conclusion is that a move is out of the question. Mr. J. B. Visser said in a letter to the SRC Staff Side on 21 April 1978 that the WP regarded the cost implications of the move as "secondary"; we believe, however, that they are a primary factor militating against moving AL.

The second Term of Reference of the WP was to consider what would be the most effective arrangements for siting the Laboratories in the light of the demands on them likely to arise in the early 1980's and beyond.

Section 5 of the WP Report (entitled "Desirability of a move on technological and scientific grounds") contains no reference whatsoever to the programmes of work for the 1980's, so the arguments employed by the WP for moving AL have not been validated by reference to any specific programme that might not be carried out if the Laboratories are not merged. We submit that the arguments for moving the Laboratory are merely unsupported assertions because the WP did not appear to have in mind any specific requirements for the AL staff that could not be achieved by leaving the Laboratory at Ditton Park.

#### 10.7 The Three Arguments Advanced by the WP for Moving AL

The first argument concerns the desirability of extending the range of services offered by AL to include work on the design and preparation of experiments for Universities. We have shown in Sections 5 and 6 that exactly this sort of service has been provided by AL for the University community on a considerable scale for many years, and the WP has produced no evidence which suggests that such services have not been satisfactorily provided whenever requested.



The second argument concerns the amalgamation of the engineering expertise of the two Laboratories. We contend that this argument is also a matter of unsubstantiated theory because not even one specific area of work or project was suggested that might benefit from the bringing-together of these two very different types of engineering expertise. A move of AL to Chilton would, in fact, result in the loss of all the AL craftsmen and the combined Laboratories would be less able to provide in-house support requiring workshop facilities than they are at present.

The third argument concerns the opportunities that will become available to AL staff, if they are moved to RL, to interact with scientists from different disciplines. The AL, however, is hardly an isolated establishment out of the main stream of scientific intercourse; the staff (which includes more than 50 Ph D's) is professionally sufficiently-well qualified to understand the need for interdisciplinary exchanges, and they take many opportunities for having these in London or elsewhere. Close relationships already exist between AL staff and Universities, Government establishments and industry in the UK and abroad in the fields of space research, radio propagation, atmospheric physics and astronomy, and in the relevant technologies. Particularly close links exist between AL and NPL, RAE and the Met. Office, all of which are much further from Chilton than from Ditton Park.

#### 10.8 Overall Conclusion

The conclusion of the WP that AL should be moved to Chilton appears to be dogma rather than the logical outcome of a convincingly argued and proven case. No specific justification has been advanced for recommending the effective loss of a Laboratory with the national and international standing of AL, and it would be surprising if the wider community that knows the work of the Laboratory is in agreement with the WP that this should be done. The AL staff consider that there are good reasons for believing that the



proposed merged establishment would not serve the nation as well as the existing laboratories do, and that the merger would merely destroy a vigorous Laboratory which is responsive to, and is currently fulfilling, many national requirements.

It is perhaps unfortunate that the WP did not hold a meeting at AL; the disadvantages associated with a move might have become apparent sooner if the WP had carried out an on-site examination of the establishment upon whose future they were deliberating.

The last two years have constituted a traumatic and demoralizing experience for the AL staff, and there is an urgent need for this to end. We hope that Council will agree that the time has now come to let AL get on with its work, including whatever new responsibilities may be assigned. The Laboratory is well-placed to help with the development of the national radio research programme, and is willing and able to play its part in providing support for Universities in space research. In 1977, in fact, the AL staff submitted a lengthy document to the WP containing many suggestions about how the Laboratory's role in the radio and space fields could be extended; we believe it is desirable for this topic to be considered further.

We very much welcome the comment of the WP that Council should "recruit an outstanding scientist to fill the gap that will be created by the retirement of the present Director," but we would like to point out that someone of the highest calibre is much more likely to be attracted if the Laboratory is an independent unit on its own site rather than merely a Division of the Rutherford Laboratory.

We have commented in detail on the arguments employed by the WP in favour of moving AL and we trust that, if additional arguments manifest themselves during the Council debate, we will be afforded an opportunity of commenting on them if they appear likely to result in a move of the Laboratory.



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