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Dear Francis,

Many thanks for your letter of 23rd June. I much enjoyed our dinner and the lively discussion.

You confirm that ACARD plan to take a more detailed look at the Defence R&D programme with special emphasis on how greater civil spin-off might be secured. I would indeed welcome this, and I suggest that the Committee might find it helpful to be briefed by the MOD on our general approach to R&D in the Defence Budget and the steps we have taken or are planning to increase the contribution made by it to the wider economy. The briefings could include, if the Committee wished, a visit to one or more of the MOD Research Establishments, to see some of the activity "on the ground". If you would like to take up this invitation, please let me know and the arrangements will then be made.

As to the ground which the Committee's study might cover, I hope that you will be able to look in particular at the scope

Sir Francis Tombs
Chairman of ACARD

for private industry making a greater financial contribution to Defence R&D itself; and I feel perhaps that you could find some way in which Rolls Royce might be able to show industry the way forward. Your dual responsibilities could thereby invest the programme with great authority. An analysis of the importance attached by companies to civil exploitation of their defence R&D activities, whether funded by government or privately, and the means by which exploitation is pursued within companies, would also be very useful. I would also welcome any assessment the Committee might make of the mobility of skilled resources within industry between defence and civil activities, and the determining factors of such mobility.

Meanwhile, it may be helpful to me to set out some of the main elements of the MOD's approach, particularly as our talk over dinner did leave me with the feeling that we in MOD have not managed to put across exactly how much we already do to achieve the objectives we both discussed. The primary function of defence procurement must be - and I would hope this is common ground between us - to obtain the weapons and equipment needed for the Armed Forces at the best value for money. But having said that, defence procurement accounts for a substantial slice of government expenditure and I fully accept the onus on my Department to ensure, consistently with its primary functions, the maximum benefit for the economy at large from these funds.

We seek to achieve this in a variety of ways. MOD's procurement strategy in recent years has placed increasing emphasis on close involvement of industry from the earliest stages of equipment planning, even before Staff Targets are framed. This reflects the Government's overall public purchasing policy which requires public sector purchasers to use the influence their purchases give us to help develop the design, technology and competitiveness of their suppliers. Staff targets themselves are now made shorter and simpler than previously, stating the military work which the equipment is required to perform without necessarily specifying the nature of the equipment itself. In this way industry is encouraged to use its initiative to develop equipment solutions which have good sales prospects overseas and draw on civil work. There is also a constant dialogue between MOD and individual firms, bringing in military operational requirements staff as well as the staff of the Procurement Executive. We are increasingly making use of cardinal point specifications which define key performance features but otherwise allow industry the maximum scope to innovate, to cut costs and enhance the export potential of the equipment. These procedures have to date been used in about 50 different contracts worth nearly £1 billion. We are now planning to include in defence contracts specific provisions to cover export possibilities.

More generally, machinery and procedures are already in operation which should enable industrial interests and concerns to be taken into account in MOD decision-making. This includes standing consultative machinery, such as the National Defence Industries Council, periodic meetings between MOD officials and Trade Associations and regular informal meetings between Ministers, senior MOD staff and senior managers from defence industry. You emphasised the importance of links between MOD and DTI, and I agree very much with this, but those links do exist and they are closer than you seemed to imply. MOD and DTI Ministers meet regularly, and the DTI Chief Scientist and Engineer is a member of the central management board for Defence Research. In addition DTI officials are represented on MOD's Equipment Policy Committee (EPC) and there is a wide range of contacts between the industry sponsor divisions of DTI and different parts of MOD.

In international collaboration, the drive is for collaborative development and production of weapon systems, especially on a European basis throughout the Independent European Programme Group (IEPG). The member Governments of the Group have committed themselves to:

a. greater discipline in not launching a national development programme where one already exists elsewhere, nationally or collaboratively, in Europe, and

b. greater readiness to adopt an equipment already in production in Europe or, where otherwise acceptable, to adopt a US project for licensed production in Europe, preferably in conjunction with European allies;

c. greater pooling of effort in research and technology and the provision of research and test facilities.

Within the Ministry of Defence itself the post of Chief of Defence Equipment Collaboration has been established to develop a systematic approach to collaboration which will secure the maximum advantage for the United Kingdom.

The MOD's Research Establishments already have extensive and close links with industry and cooperate with DTI and other Government Departments in substantial joint military and civil and purely civil programmes. Of the total annual expenditure on research of some £400 million, some £150 million is placed extramurally with industry and the Universities in itself providing a continuous and often daily dialogue with scientists and engineers outside government. Current practices and recent initiatives cover a wide span, including:

a. the appointment of outside industrialists, not restricted to a defence industry background, to the management board of the MOD's Controller of Research at the

MOD and to the boards of the Research Establishments, so as to bring an added industrial dimension to consideration of the defence research programme and to reduce overlap between industry and our own activities;

b. the development of joint military and civil research programmes based on the research establishments and including industrial participation, notably in information and space technology. This has recently been reinforced by a programme of 'National Electronics Research Initiatives', centred on the Royal Signals and Radar Establishment, with the costs shared between the MOD, DTI and the industrial participants. The aim is to establish collaborative research activities within industry to achieve an international standard of excellence in chosen areas of high technology;

c. the setting up of Defence Technology Enterprises Ltd (DTE) to identify and market technology developed in the Research Establishments for application by civil industry. I was glad to hear Mr Bullock speak up so strongly over dinner for this initiative. Defence Technology Enterprises is now well established at three major establishments, the Admiralty Research Establishment, the Royal Signals and Radar Establishment at Malvern and the Royal Aircraft Establishment, Farnborough. It has been building up its

portfolio of potentially exploitable material - there are already 400 items on its database - and recruiting firms as associate members - more than 100 firms have already joined. DTE let its first major licence at the beginning of the year for a software package developed at RSRE Malvern. Both DTE and the Research Establishments themselves will have displays at this year's TECHMART exhibition. The MOD is considering the establishment of Science Parks adjacent to the Research Establishments, again to facilitate the flow of technology into industry, both defence and civil;

d. MOD support for the national science base at the Universities has recently been enhanced by our participation with the Department of Education and Science and the Research Councils in funding joint research grants; we are also seeking to widen the scope of joint programmes with Universities and Research Councils and to promote common use of facilities and staff exchanges with the Universities.

Some examples of the actual and potential cooperation between the Research Establishments and industry are enclosed.

I look forward to hearing from you in the near future.

Yours sincerely, George Younger

George Younger

EXPLOITATION SUCCESSES AND PROSPECTS

LINKS BETWEEN MOD RESEARCH ESTABLISHMENTS AND INDUSTRY

Royal Signals and Radar Establishment (RSRE)

(a) Awards

- A recent Queen's Award for Technological Achievement (to the Electronic Materials Division at RSRE) was for the research and development of high resolution X-ray detector crystals for application in body and brain scanners. The award was shared with Hilger Analytical Ltd (HAL) who now manufacture the crystals and export the whole production.

- An early Queen's Award was for Liquid Crystal materials for displays. These were invented at Hull University in cooperation with RSRE and are covered by MOD patents. More recently, coloured dyes were invented jointly by RSRE and BDH Chemicals and also jointly by RSRE and ICI to give coloured displays.

- Queen's Awards for Technological Achievements for Advanced Semiconductor Crystal Growth Equipment, for a System of Sensors for Intruder Detection and for Semiconductor Detectors for Infra-red Imaging.

- Rank Price Fund Awards for Semiconductor Materials for Infra-red Detection, Liquid Crystal Materials, Integrated Semiconductor Infra-red Detector and Pyroelectric Infra-red Vidicon.

- McRobert Award for Photon Counting System for application of Lasers to the Measurement of Fluid Flow.

(b) Direct current electroluminescent displays were originally developed at Thames Polytechnic in cooperation with RSRE. Work has continued at Phosophor Products of Poole (a firm formed originally by the staff at Thames Polytechnic) and high hopes are held for eventual exploitation.

(c) The CORAL 66 programming language was designed and developed at RSRE. It was the first attempt to create a high-level structured language for real-time control applications. Industry has developed compilers and related tools and applications include a traffic control system which was developed as a product in its own right.

(d) RSRE designed and implemented the world's forst ALGOL 68 Compiler which now forms the basis of current commercial implementations with continuing sales.

(e) SDS is a software package which provides a way of managing the large amount of design data generated during the development

of large software products. Written at RSRE, it is now a produ of Software Sciences Ltd and is to be developed further as part of an Alvey project.

(f) ELLA is a hardware description language. Used as a logic simulator, it can validate designs produced using traditional techniques, enabling early detection of errors. Used at the highest level, architectural specifications can be evaluated and optimised quickly, before effort is invested in detailed design work. ELLA is in the final stages of being licensed for commercial exploitation.

(g) ESPRIT. RSRE is leading the ESPRIT project to produce a super-computer for high speed processing. The aim is to achieve a marketable product with support in more than one European country.

(h) Industrial Consortia. RSRE has also led several industri consortia for the exploitation of electronic technology, for example the Gallium Arsenide Consortium, the Surface Acoustic Wave Consortium, the Liquid Crystal Consortium and the High Performance Silicon Systems Consortium.

(i) Links with DTI. RSRE participates in a number of DTI committees/policy bodies including:

(1) The Electronic Devices and Materials Committee

(2) Alvey

(3) Joint Opto Electronic Research Scheme (JOERS)

(4) JOERS Displays Advisory Committee (JDAC)

(5) Computer Requirements Board

(6) British National Space Centre

(j) Statistics

(1) the number of industrial visitors to RSRE to discus technology - 7000 per annum

(2) the number of confidentiality agreements signed wit UK companies - 25 since 1984

(3) the number of companies which have seconded staff to work within RSRE - 35 since 1983

(4) the MOD Patents Branch have negotiated 48 licences with industry for the use and transfer of RSRE IPR.

Royal Aircraft Establishment (RAE)

(a) Flow Field Calculations. RAE has made major contributions to the development of computer-based techniques for the calculation of airflow around aircraft. Methods developed by the Establishment have been used extensively by BAe in the design of the wings for the A310 and A320 airbus aircraft. The contribution of this work to the success of the former has been acknowledged by US industry when lobbying Congress.

(b) Helicopter Rotor Systems. Part of RAE's research programme on helicopters in recent years has been aimed at improving the aerodynamic design of the rotor blades, leading to new blade sections and tip shapes that give an increase in rotor lifting capability of about 30 per cent compared with that achieved in service today. Fabrication of the more complex blade shapes that result at an economic cost has been made possible by advances in composite material technology which also had their origins in RAE. The benefit of this work was confirmed by a technology demonstrator programme which has recently been brought to a successful conclusion in close collaboration between Westlands and the Establishment. The results are being applied by Westlands to the design of the main rotor of the Anglo/Italian EH101, which has both civil and military applications and to developments of the W30 helicopter.

(c) Aliuminium-Lithium Alloys. Early work on lithium-containing aluminium alloys in the USA and USSR led to the widespread belief that production of lower density aluminium alloys with acceptable properties for aeronautical application would have to await the development of suitable power metallurgy techniques, and would therefore result in an expensive product. However alloy research at RAE over the past 6 years has shown that this is not so and that Al-Li alloys can be produced by a conventional and inexpensive ingot metallurgy route to meet desirable target levels for density and mechnical properties. RAE worked closely with British Alcan during the development programme with the latter concentrating on establishing a viable commercial production process. Particular problems of handling lithium and of metallurgical control of the melt have been overcome and material in a variety of forms produced from 1000 Kg ingots has been evaluated by a range of potential customers in the UK and overseas. An agreement has been signed granting Alcan the necessary licences on the relevant RAE patents to produce, use and sell aluminium-based alloy products containing lithium in as-cast or semi-fabricated forms for defence and aerospace applications.

(d) Cover Glasses for Satellite Solar Cells. Solar cells constitute the primary source of power on artificial satellites. Cover glasses to protect these, although individual small components, make in total a significant contribution to the weight of the satellite. A joint programme by RAE and Pilkington has led to a significantly lighter product with a longer service

life. As a result the firm now has some 70% of the world market (excluding the Soviet Union). A joint Queen's Award for Technology was recently granted to the firm and the Establishment for this achievement.

(d) RAE developed carbon fibre composite materials and structure for multi-purpose aircraft application. The materials are now finding widespread use in general engineering.

Royal Armament Research and Development Establishment (RARDE)

(a) Road Transportable Bailey and Medium Girder Bridges. These bridges, developed for military use, have been widely used in a number of third world countries.

(b) Remote Control Tracked Vehicle. This was developed for use in Northern Ireland for investigations of suspicious articles etc. It has been adopted by a number of police forces throughout the world.

(c) High Current Transistors. These were originally developed by DCVD, for use on tanks. A firm now markets them, and one known application is in large medical equipment.

(d) Hydrogas Suspension. Developed for the Challenger tank, this is now being taken up by several companies.

(e) Mechanical Handling Devices. In military contexts remote control 'arms' have to do a wide variety of tasks, and hence require much flexibility. A patent application has been made in respect of a recent development, namely a 'Draw String Gripper', which has considerable licensing possibilities.

Admiralty Research Establishment (ARE)(Portsdown)

SPATE (Stress Pattern Analysis by Thermal Emission). This new method is now incorporated into an instrument for measuring stresses in structural components under dynamic load.

Directorate of Components, Valves and Devices (DCVD)

Semicustom Approach to Microcircuit Design. The concept of the Uncommitted Logic Array (ULA) was largely created and demonstrated through a MOD/VCD sponsored development project. Subsequently it has been evolved and extended in circuit complexity to form the basis of a major commercial business, eg in Sinclair and Nixdorf computers.