

Intellectual property in the public sector research base / [Office of Science and Technology].

Contributors

Great Britain. Office of Science and Technology.
Great Britain. Office of Public Service and Science.

Publication/Creation

London : H.M.S.O., [1992], ©1992.

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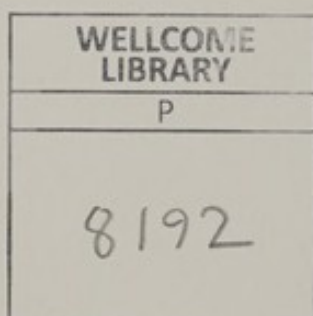
OFFICE OF SCIENCE AND TECHNOLOGY

*Intellectual Property
in the
Public Sector Research Base*



September 1992

HMSO



The front cover photograph shows two African daisies (pyrethrum). The discovery at the AFRC Institute of Arable Crops Research (Rothamstead Experimental Station) of synthetic analogues (pyrethroids) of natural insecticides from pyrethrum has provided highly active agricultural insecticides that are non-persistent and of low mammalian toxicity. The current annual sales value of synthetic pyrethroids is about £780 million of which over 50% are based on Rothamstead-discovered compounds.

The photograph was taken by Dr Michael Elliott, CBE, FRS, leader of the team which discovered pyrethroid insecticides.



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INTELLECTUAL PROPERTY IN THE PUBLIC SECTOR RESEARCH BASE

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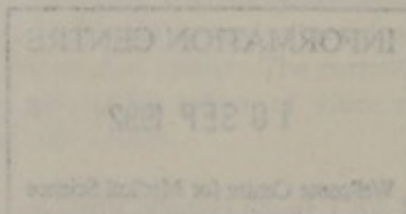
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First Published 1992

ISBN 0 11 430071 2

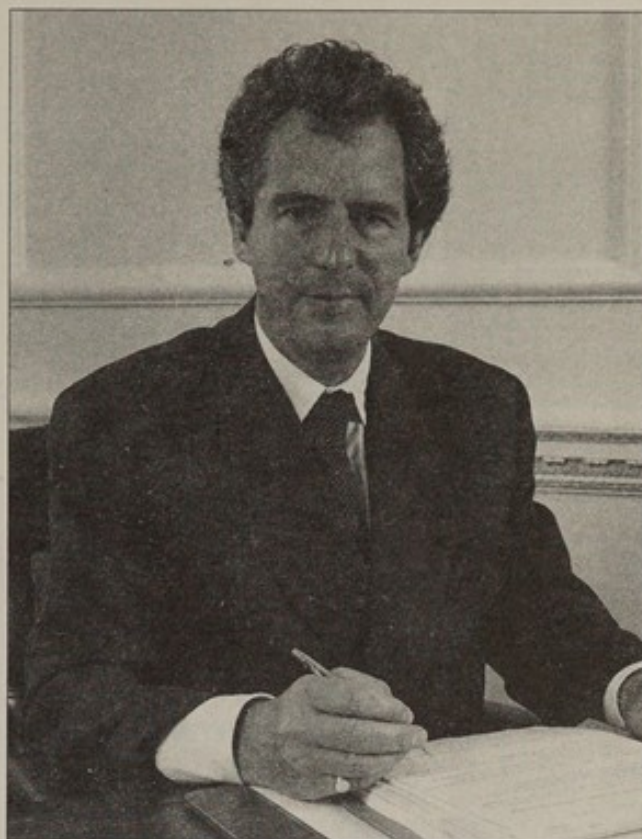
INTELLECTUAL PROPERTY IN THE PUBLIC SECTOR RESEARCH BASE



Preface

by

Chancellor of the Duchy of Lancaster
Rt Hon William Waldegrave



The UK has a strong record of scientific and technological innovation from basic research of which it is rightly proud. Basic and strategic research is funded largely by Government and is carried out in universities, Research Council institutes and Government laboratories throughout the UK. In 1992/93 the Government plans to spend £5.59 billion on research and development.

One of the most important ways in which we benefit from this substantial investment is through the commercial exploitation of our scientific discoveries. In practice this almost invariably involves protection of the intellectual property through patents, copyright or other means. To get the most from our scientific discoveries we must make the best use of the intellectual property system.

The Office of Science and Technology staff, following extensive consultations with academia, the public sector and industry, has produced this report of how public sector research laboratories exploit their intellectual property commercially. I hope it will encourage the widest possible dissemination of best practice and promote a deeper discussion of how we realize the commercial potential of our research.

It is nine years since a Cabinet Office paper was published on intellectual property rights and innovation. That paper did much to raise awareness of the issues involved. I hope this study will provide a further constructive contribution to the debate.

William Waldegrave

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EXECUTIVE SUMMARY

Introduction

1. In 1983 the Cabinet Office published a Green Paper on the subject of "Intellectual Property Rights and Innovation" (the Nicholson Report) which considered possible improvements to the intellectual property (IP) machinery and measures to encourage UK industry to make more use of it. This paper takes this theme forward by looking at a different issue – the effectiveness of the measures taken by public sector research organisations, such as universities, polytechnics, Research Council institutes and Government research establishments, to ensure that the commercial potential of new ideas emerging from research is fully appreciated and exploited.

2. Since the Nicholson report was published, the climate in which publicly funded research organisations are operating has changed in several important respects. British Technology Group's automatic right of first refusal to all intellectual property rights (IPR) has been withdrawn and BTG has recently become a private sector company; customer contractor principles and an internal market have been introduced into Government sponsorship of R&D; and most of the Government research establishments are executive Agencies.

3. At the same time the significance of science and technology in innovation has encouraged scientists and engineers to pay more attention to the application of their scientific knowledge. It is therefore timely to examine the effectiveness of current arrangements for the management of IP in the public sector research base in order to highlight possible improvements and to encourage wider adoption of best practice. The aim of this paper is to raise awareness of best practice and to stimulate discussion of measures to improve the UK's performance in this area.

The current situation

4. Compared with large industrial companies, publicly funded research organisations face a number of inherent disadvantages in attempting to exploit the commercial potential of their inventions. Since basic research can be far removed from immediate commercial application, it is often extremely difficult to identify the commercial potential of new discoveries before the details are published in the open literature. Professional and commercial judgement is required not only in deciding whether to file a patent, but also in selecting the most appropriate point in the development of the technology at which to do so; and in choosing the countries in which to seek patent protection. Professional and commercial expertise is also vital in marketing an invention and in licensing it to companies which might exploit it.

5. The management arrangements in non-industrial research laboratories make it more difficult to control the release of information than in their industrial counterparts. The costs of protecting and defending IPR are not negligible and the commercial expertise is not always available within the organisation. Added to this is the, generally false, perception that the proprietary nature of intellectual property protection may restrict academic traditions of open exchange of research information, and that research carried out using public funds should be

freely available to benefit society as a whole. However, the patent system was established to encourage the development and dissemination of new technologies. Inventors must disclose rather than conceal the details of their invention. New ideas emerging from the science base are rarely in a form for society to use without further development. Unrestricted rights to exploit the invention could discourage necessary investment with the result that society might derive no benefit from it.

6. There are encouraging indications that most research organisations appreciate the value of intellectual property and are taking some steps to protect and exploit it. Since the withdrawal of the BTG monopoly in 1985, universities have been encouraged to develop alternative arrangements for IPR exploitation and technology transfer subject to the approval of the Exploitation Scrutiny Group, set up jointly by the Research Councils at the request of the former Department of Education and Science. Each university has set up an Industrial Liaison Office (ILO) and Directors of Industrial Liaison have met regularly to exchange information and disseminate best practice. The excellent performance of some universities has demonstrated that it is both practicable and profitable for non-industrial publicly-funded research organisations to exploit innovations arising from basic research, provided the exploitation route is straightforward.

7. Arrangements for IPR exploitation in Research Council institutes vary according to the size of the institute and the function it performs. Councils have to find an appropriate balance between central and local responsibility. Local control may be preferable in identifying intellectual property which should be protected but exploitation might best be handled centrally where resources are greater. The Medical Research Council (MRC), and more recently the Agricultural and Food Research Council (AFRC), have been particularly active in exploiting their intellectual property. Each has a good patent record from which it earns a significant sum in royalties. The Natural Environment Research Council (NERC) has taken an imaginative and helpful approach to the marketing of data – its principal output.

8. Companies such as Agricultural Genetics Company Ltd and British Technology Group continue to form a valuable bridge between the research base and industry to finance the *development* of new ideas and to provide expert patent/market know-how. The MRC Collaborative Centre fulfils a similar role in the development of research inventions.

9. As funders of research with contractors, Government Departments also vary in their approach to IPR protection. Some, such as the Department of Trade and Industry (DTI) and the Department of Transport (DoT), have a general policy of vesting IPR ownership with the research contractor but will, in exceptional circumstances, retain ownership in the Department. Others, such as the Ministry of Agriculture Fisheries and Food (MAFF) and the Department of Health (DH), have believed that Departmental objectives are best served by the Department retaining ownership of all IPR and licensing commercial developers where appropriate. The remainder vest IPR ownership with industrial but not with non-industrial contractors. Copyright of all Government material rests with the Crown and is administered by the Controller, HMSO. Ministers have been given delegated authority by HMSO to issue licences for Crown copyright generated by their Department but not ownership of that copyright.

10. Fifteen Government Research Establishments (GREs) are now research Agencies. Increased independence and competition should stimulate a more positive approach to technology transfer activities but it will be important that the

framework documents under which Agencies operate provide adequate incentives.

11. Although there are a number of outstanding successes, much could still be done to improve the overall standard of IPR and technology transfer activities in all publicly funded research organisations. Universities are improving though some need to give more priority to the activities of the ILO. There is also scope for improvement in the polytechnic sector despite their closer focus on applied and industrial research. Research Council institutes and Government Research Agencies could do more to promote an ethos of commercial exploitation of their research.

Best practice

12. Virtually all of the recommendations of the 1989 report "University Intellectual Property: Its Management and Commercial Exploitation", by the University Directors of Industrial Liaison (UDIL), which set out key aspects of best practice in those Higher Education Institutes (HEIs) which had been successful in managing and exploiting IPR, can be applied more widely to all research organisations. Details are included in Box 3.1 of this paper.

13. In summary, effective IPR management requires a strong commitment throughout all levels of the organisation, with a clearly stated policy which is communicated to all staff. The commercial side of research contracts including the exploitation of IPR should be handled by a professionally staffed central office which is accessible to all research staff on demand. An appropriate system of incentives and rewards can enhance staff participation.

Factors inhibiting IPR exploitation

14. In order that all research organisations can emulate the performance of the best in taking commercial advantage of research innovations a number of specific points have to be addressed.

- (a) IPR exploitation and technology transfer require significant initial investment before they can become self financing.
- (b) Research organisations are not giving sufficient emphasis to acquiring marketing and licensing expertise.
- (c) The time constraints imposed by the practice of filing patent applications cheaply and then looking for licensees to bear the major patenting costs which arise 12 months after the initial filing date may lead to poor decisions on licensing and subsequent development; professional advice and access to development funds can be extremely important.
- (d) The costs of protection, and defence, of high earning patents can be high and might be beyond the means of even large public sector research organisations unless undertaken in partnership with a commercial company, or unless insurance against litigation costs is obtained.
- (e) It is unrealistic for all research organisations, irrespective of size, to believe that they can manage their own IPR. Small research organisations will usually need to seek alternative approaches.

General education

15. There is a need for education on intellectual property matters at all levels. Key decision-makers in Government Departments, HEIs and research organisations are often not fully aware of the advantages to be gained from informed use of the IP protection machinery and patent databases. The excellent educational work and video material prepared by

the Marketing Division of the Patent Office has demonstrated what can be done to instruct the non-expert in the basic essentials. Full use should be made of this and other sources of information.

16. The intellectual property system is not sufficiently understood by scientists, in private or public sector organisations. Professional bodies and others in the intellectual property field might consider whether it would be practicable to set up a help line (telephone, FAX or computer network), additional to existing advice services, to provide rapid practical advice to the inventor on how to proceed with protection of an innovation.

17. The introduction of some elements of the patenting of inventions into the National Curriculum Technology Order for 14–16 year olds is an important step forward. More emphasis needs to be given to providing students of science and technology in higher and further education with an introduction to the intellectual property system.

Specific measures for research organisations

18. Each publicly funded research organisation should consider preparing a policy statement on IPR – an intellectual property exploitation plan – to be made available to all scientific staff and to prospective research sponsors. This plan should address: measures to identify, protect and exploit intellectual property; policy on ownership; staff training and appraisal criteria; incentives to commercialise; and revenue sharing agreements with the inventor.

19. Measures to strengthen industrial liaison activities should place particular emphasis on access to licensing and marketing expertise.

20. Small research organisations should consider cooperation, joining a larger organisation, or engaging a technology transfer company to manage IPR on their behalf.

21. The rapid dissemination of best practice in IPR management should be encouraged, possibly through an extension of the role of UDIL, to bring together exploitation staff from all sectors of publicly funded research.

Changing the scientific culture

22. Research Councils should consider whether the criteria used to assess research proposals give adequate weight to the innovative application of existing knowledge compared with the more traditional academic focus on new basic knowledge. The rewards and incentives offered to scientific staff might take greater account of success in exploiting intellectual property; and research training given to students could give it greater emphasis.

Ownership of IPR in sponsored research

23. The ownership of IPR in sponsored and/or collaborative research involving HEIs is an area of considerable debate. Industrial sponsors believe that they should have ownership of the IPR because they are better placed to exploit it. HEIs argue that IPR is one of their principal assets and that fragmented ownership among many sponsors could impede exploitation.

24. There is unlikely to be a single solution to resolve this conflict. This was also the conclusion of the Cooper Report (1989) which carried out a detailed examination of the arguments. It is important to preserve the principle that HEIs and sponsors should be free to negotiate without presumption all matters relating to ownership, licensing and exploitation of IPR arising out of a particular research agreement, as well as the distribution of licence/royalty income based on

respective input. In the longer term, as HEIs develop greater expertise in IPR management, they may have a stronger case for retaining ownership of IPR and for reflecting this in their negotiations with the research sponsors.

25. Greater consideration might be given to arrangements which maximise the exploitation of the research, particularly when public funds are involved; and to providing suitable incentives to the research community to encourage innovation and enterprise. For example, other Government Departments might wish to consider following the example set by DTI and DoT of vesting IPR ownership in non-industrial contractors and allowing them to retain their share of the revenue earned from licensing or from royalties, possibly as a contribution to seedcorn funds.

Conclusions

26. The value of the research carried out in the public sector could be enhanced significantly if more attention was paid to protecting and exploiting the intellectual property. Modest changes in current practice, combined with more education and training in intellectual property issues, could lead to major improvements in performance. Not only could the research organisations benefit from the additional revenue, the closer contact with the business community could also assist the transfer of technological know-how into industry and enhance industrial innovation.

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Importance of intellectual property

1.1 The generic term intellectual property (IP) is used to describe the output of all creative or innovative human activity which might be used for commercial purposes. The associated intellectual property rights (IPR) recognise ownership of the IP and provide legal protection against imitation.

1.2 Intellectual property protection is available for a wide range of outputs: written works, images, designs, software, data, plant varieties, industrial processes and inventions. It is a vitally important aspect of all commerce and trade. The value of worldwide trade in IPR has been estimated to amount to £10 billion per annum, corresponding (at a notional royalty of 5%) to products valued at £200 billion per annum and growing rapidly¹. (Annex A provides a description of the different forms of IP and the protection available.)

1.3 The intellectual property protection machinery exists to encourage innovation. Broadly speaking, in exchange for complete public disclosure of the intellectual property, the owner is granted a limited period of monopoly in the market place to recoup his investment and profit from it. At the end of that period others can use the innovation at no charge.

Scope of the report

1.4 An earlier Cabinet Office Green Paper² entitled "Intellectual Property and Innovation" considered possible improvements in the IP machinery to stimulate greater use of it by UK industry. This report is concerned not with private sector use of intellectual property protection but with its use in public sector research organisations – universities, polytechnics, Research Council Institutes and Government research Agencies.

1.5 The significance of science and technology in almost every aspect of modern life has focused attention on the contribution of public sector research laboratories across a wide range of areas such as industrial competitiveness, the quality of life, public health, environmental change and food production. There is greater pressure than ever before to maximise the benefits of scientific research to the nation and to society as a whole.

1.6 Against this background there is some evidence that the UK is not as active in protecting intellectual property as its principal industrial competitors. In the private sector the number of patents filed by UK inventors (as measured by share of US patent applications) has been declining steadily³. In addition, it is often claimed that the UK does not capitalise sufficiently on novel ideas emerging from its research base.

Objective

1.7 This report attempts to analyse the difficulties faced by public sector research organisations in trying to exploit commercially the output of research whose primary motivation was quite different; and to consider the effectiveness of the measures taken by different groups within the public sector to profit from their intellectual property. The aim is to identify and disseminate views on best

practice as a basis for discussion within the public sector research community. The report also suggests certain generic measures which might be adopted across the whole sector to improve the overall UK performance in this area.

1.8 There are many intellectual property issues which are not addressed in this report. Typically, they are the subject of international negotiation in which it is important that the interests of the UK are properly represented. Also, the situation within the UK is not static and needs to be kept under regular review. Accordingly, intellectual property matters are now receiving regular cross-Departmental consideration within government and it is intended that further discussion documents addressing other IPR matters will be issued when it is appropriate to do so.

**The management of
intellectual property:
general considerations***Identifying research ideas
with commercial potential**Protection of the intellectual
property*

2.1 Transferring an idea from a public sector research laboratory into a commercial product is a complex process which can entail a high degree of risk and uncertainty. Within that process it is possible to distinguish nine principal facets: (i) identifying research ideas with commercial potential; (ii) evaluating that potential; (iii) protecting the intellectual property; (iv) obtaining funding for the project; (v) developing the research to the point where there is a marketable product; (vi) marketing; (vii) licensing the IP to potential exploiters; (viii) transferring the technology; and (ix) monitoring infringement of patents etc by licensees and non-licensees; all of which can be grouped under three headings: **identification, protection and exploitation.**

2.2 The early identification of ideas with commercial potential is a critical yet extremely difficult part of the whole process – critical not only because it is the starting point without which no further action can be taken but also because, except at present in the USA, patents and registered designs cannot be obtained once the subject matter has entered the public domain. Although the scientist carrying out the work might be expected to recognise its commercial potential first, he or she is rarely close enough to the market to make an informed judgement. In basic research, where the work is often far removed from commercial application, the risk is more one of losing innovations through prior disclosure. Satisfactory mechanisms to identify and assess innovations from basic research with commercial potential need to be developed.

2.3 Annex A describes the protection routes available. Although patents are probably the most effective means of protecting inventions arising from the public sector research base, other forms of intellectual property such as registered design rights can be valuable. Copyright, which ensures that authors and artists benefit from their creative endeavours, also covers technical areas like computer software; and unregistered design rights in the UK, or utility models and petty patents in a number of other countries, protect functional designs.

2.4 The most appropriate choice depends on the nature of the intellectual property and the exploitation options open to the originator. Secrecy or confidentiality can be effective if the time to market is short and the innovation is likely to be rapidly superseded. This is rarely the case for ideas emerging out of research. Secrecy can also be effective in the case of a process invention provided the process cannot be discovered from the product.

2.5 Provided a genuine invention has been made, filing a patent offers a high degree of protection, in exchange for full public disclosure of the innovation. However, substantial costs can be incurred if protection is sought in all the major countries in which products could be manufactured or sold. This can be worthwhile for major inventions, such as in the field of pharmaceuticals, where the returns can be tens or hundreds of millions of pounds. Generally, costs in the region of £50,000 over a period of 5 years would not be uncommon.

2.6 The profile of patent costs in the UK starts at a low level (£285, see Annex A) and rises through the life of the patent as revenue is expected to flow in. The high costs of overseas filing can be delayed by up to 30 months if the Patent Cooperation Treaty route is chosen, by which time the degree of risk might be better understood. For many inventions filing a patent in the UK and a few other key countries can be sufficient to secure worthwhile protection; and patent protection for the UK market on its own (including professional fees) can be obtained for as little as £1500 for five years protection.

2.7 Much larger costs can be incurred in defending the patent although the vast majority of patents are respected by industry once they have been granted. Insurance against the costs of defending a patent can be obtained at reasonable cost. Also, the setting up of the new Patents County Court as recommended by the Oulton Report⁴ (1989, see Annex B), was a deliberate attempt to simplify the legal procedures and reduce the cost of patent litigation. This has been in operation for only about a year and a half. It is too early to assess its effectiveness, but early signs are encouraging.

2.8 Judgement is required therefore in decisions on whether, when and where to file a patent on a new invention, and a clear view needs to be taken on its commercial potential. Professional patent agents can help in this process; their expertise can be invaluable in drafting patent specifications and the associated claims which are crucial to the strength of the patent.

2.9 Copyright protects original literary works, published scientific papers, diagrams and photographs. Its protection does not, however, extend to ideas, only to the form in which they are expressed. Copyright arises naturally in authorship, costs nothing and lasts for 50 years after the death of the author. Heavy costs may still be incurred in defending it.

Exploitation of the innovation

2.10 New ideas, once protected, can be either developed into products by the originator, or made available to companies through sale or licensing of the IPR. Innovations emerging from large company research laboratories are usually developed by the company itself. In some cases small companies and particularly non-industrial research laboratories may seek to sell or license the technology to others.

2.11 The effective transfer of new ideas from research to product and from one organisation to another is a universal problem. For those organisations with no immediate manufacturing outlet, often carrying out research of a more fundamental than applied nature, there is no easy solution. *But, it is the exploitation of the IPR which has the potential for generating revenue. Successful management of IPR needs to address and overcome these difficulties.*

2.12 Effective marketing and licensing play an important role. All investment decisions require a detailed assessment of the risks and opportunities. Potential purchasers or licensees of the technology look for a quantitative market analysis of the impact of the innovation including the market share likely to be achieved. The innovator, or his agent, will usually need to carry out a preliminary market survey to target specific companies with known interests in particular market sectors and to present a convincing business case.

2.13 The licensing of technology is a complex area. The licensor might prefer to grant as many non-exclusive licences as possible but most licensees seek exclusive licences to reduce competition so as to be able to recover the heavy costs of development and initial marketing. In practice, compromises which offer limited exclusivity in terms of timescale, market sector or geographical area are often negotiated. Details of royalty payments (either in cash terms or as a percentage of

selling price) and revenue sharing have to be agreed in advance. Clearly, the terms and conditions of the licence have to be tightly drawn to encourage the maximum exploitation of the innovation while protecting the rights in law of both parties.

Industrial Laboratories

2.14 Although this paper is concerned with IPR in the public sector the scale of the problem can usefully be illustrated by making a brief comparison with practice in industry. There are also important parallels which might be drawn between publicly funded research organisations and small and medium sized companies.

Practice in Large Companies

2.15 Large companies whose success is built on high technology products or highly innovative services make extensive and effective use of the intellectual property machinery. Most of these companies carry out applied research in their own laboratories to meet specific commercial objectives. Constant monitoring of progress against objectives is used to assess commercial potential and the need for IP protection when appropriate. In-house patent experts with specialist knowledge of different market sectors and geographical areas advise on patenting strategy and draw up patent specifications including carefully constructed claims.

2.16 A patent grants a market monopoly for 20 years from the initial filing date. But many ideas emerging from research require extensive development work before they can be converted into useful products to which the patents should relate. The development time and regulatory approval processes (in some industries) can mean that a long period elapses before this stage is reached. Although there are risks of inadvertent premature disclosure, it can sometimes make commercial sense to keep a discovery confidential while continuing to develop it for the market and then to take patents out at a later stage. Alternatively, it is possible to follow up an early patent covering the initial work with later patents protecting development though it is usually wise to patent early to preempt the competition. The optimum time to file a patent depends on a detailed appraisal of the commercial risks involved, the nature of the invention, and its likely developments. Market studies are normally carried out before research and development is taken to an advanced stage.

2.17 In a similar way, company policy on licensing technology takes into account market knowledge and perceived commercial advantage. Companies generally employ teams of specialists to draw up and monitor licensing agreements. Only in exceptional cases are employees entitled to compensation from their employer for patented inventions.

Small Companies

2.18 While it is difficult to generalise about a heterogeneous group like SMEs (Small and Medium Sized Enterprises), the Trade Marks Patents and Designs Federation, an industry body coordinating views on intellectual property matters, believes that SMEs under-use the patent system. We know of no specific study to test this. By contrast, in Germany, SMEs contribute more than 50% of all patent applications, many in the form of utility models or petty patents not available in the UK. The German Employee Inventor's law also permits an employee to patent an invention himself if the employer declines to do so within a given time.

2.19 The most commonly cited reason for under-use of the patent system in the UK is cost. SMEs are said to be reluctant to commit large sums to file patent applications in a large number of countries and are understandably wary of protracted and costly legal disputes over patent infringement. However, these perceptions are not necessarily borne out in practice and there are now ways in which costs can be reduced.

2.20 Several other factors may be involved. For example, small companies may not have such ready access to resident experts although they can nevertheless use the intellectual property system to good effect by bringing in expert advice from professionals in private practice. Patent protection may also be regarded as of relatively low value to a small company occupying a market niche and staying ahead of the competition through incremental and continuous innovation. If the window of opportunity for a new technology is short, being first to market may be more important than preventing others from copying. However, it is likely that one of the principal reasons why SMEs make less use of the IPR system than expected is that managers remain insufficiently aware of its utility.

Non-Industrial Laboratories

2.21 The principal non-industrial research organisations in the UK are the Research Councils' institutes and laboratories, the HEIs (universities, polytechnics and colleges) and government research establishments (GREs) including Next Steps Agencies. Figure 2.1 lists the numbers of laboratories within each category and the total research funds which each category receives.

2.22 The Research Councils, government Departments and research charities are also the principal funders of research, along with private industry and the European Commission. Figure 2.2 lists the funds provided by research sponsors to *external* research organisations, (ie other than those the sponsor owns).

2.23 Each group is considered separately below but they share a number of common features in attempting to manage and exploit their IPR.

Figure 2.1

Amount spent on R&D in public sector research organisations in 1989/90, the latest year for which figures are available. An indication is also given of the number of separate institutions involved within each group but the individual institutions differ very greatly in size and some are dispersed across many discrete sites.

	Numbers	Funds
Universities	47	£1608m
Polytechnics	39	£ 70m†
Research Council Institutes/Units*	81	£ 474m
Government Establishments**	25	£1188m

† PCFC estimate

* 55 of these are MRC units

** Many establishments occupy several sites

Sources: *Annual Review of Government R&D, 1991, CVCP*

Figure 2.2

Amount spent by different sponsors of R&D in laboratories other than those owned by the sponsoring body itself. The data are for the year 1989/90 and were obtained from the Annual Review of Government R&D, 1991.

	£ millions
Government: Civil	865
Defence	1222
Industry	481
Research Councils	411
Research Charities	177
Overseas	1138

Source: *Annual Review of Government R&D, 1991*

- First, all non-industrial research organisations carry out research the primary purpose of which is other than commercial gain. *Although the research has broad objectives, it can be difficult to predict its course in advance and opportunities for commercial exploitation may be relatively rare, although often significant when they do occur.*
- Second, there is often a conflict in the minds of many researchers between the academic tradition of open publication and exchange of scientific data and know-how, and the perceived confidentiality required of commercial exploitation. Although publication of the research need not be delayed for long there are other benefits in making a careful and considered judgement on the timing of a patent application. Except at present in the USA, publication must wait until the application is filed. As long as scientific publications are more important to scientific reputations and rewards than commercial exploitation of research, scientists will tend to favour the former.
- Third, non-industrial research laboratories share with small companies the problem of meeting the costs of protecting intellectual property and of gaining access to the necessary expertise to identify, assess, market, license and defend it.
- Fourth, there may be areas, such as the recent case of partial sequences of cDNA related to the human genome, where it is considered to be inappropriate for a publicly funded research organisation to seek patent protection. However, any action taken nationally needs to take due account of parallel decisions in other countries.

Research Council laboratories

2.24 Four of the five Research Councils (the Agriculture and Food Research Council (AFRC), the Medical Research Council (MRC), the Natural Environment Research Council (NERC), and the Science and Engineering Research Council (SERC)) between them carry out research in 81 institutes and laboratories which vary in size from about 20 staff at one extreme to several hundred scientists at the other. Each Council has set up a small central unit to develop IPR policy and to act as a principal point of contact with major customers. Larger laboratories have their own technology transfer arrangements but few are professionally staffed. There is no uniformity of practice between Councils, partly because laboratories differ in size, distribution and function, and only recently have Councils begun to hold joint meetings of industrial liaison staff. The Economic and Social Research Council (ESRC) has no permanent institutes but has an interest in copyright in respect of data sets.

2.25 The MRC has been particularly active in patenting and exploiting the IPR generated from its research. Patent income in 1989/90 was £0.9 million. With over 50 individual laboratories, many of them based on small research teams in HEIs or hospitals, the MRC has opted for a highly centralised system of IPR management. They have appointed a new Director, Industrial Collaboration and Licensing, who has many years' experience in the pharmaceutical industry, and plan to recruit more staff to assist in the identification of commercially exploitable IP at an earlier stage.

2.26 MRC has also set up a Collaborative Centre with over 50 staff, funded entirely by collaborating companies, engaged in developing the MRC's intellectual property, which is typically in the form of an enabling technology, into products for different market sectors. Companies are granted non-exclusive licences on the enabling technology but are expected to bear the full costs of any patents arising from the development of particular products. The MRC negotiates a revenue sharing agreement on the final product. Only if the basic technology has large earning capacity in its own right would the MRC consider retaining full ownership of the IPR. If any patent action is necessary, the costs are borne by the

MRC Commercial Fund which receives its income from a share in the licence revenue.

2.27 The AFRC has a small central Commercial Policy Unit which issues guidelines on IPR but delegates responsibility for exploitation to the institutes. Each institute has appointed commercial officers whose responsibilities include managing IP. As an incentive institutes may retain income of up to 10% of their total cash allocation per annum. In certain pre-defined technical areas the AFRC's intellectual property rights are normally assigned to BTG, as it has had an outstanding record of success in exploiting past AFRC inventions in these areas. But the main exploitation route is by direct assignment or licensing with industry. In a specific area of plant biotechnology, the AFRC has a special technology transfer arrangement with the Agricultural Genetics Company, which was established with venture capital funds some 9 years ago (Box 2.1), and which has since placed £1M per annum for contract research with the AFRC. From April 1990 all IPR arising from the significant programme of research commissioned by the Ministry of Agriculture, Fisheries and Food (MAFF) is owned by the Ministry on revenue sharing terms. The IPR terms are considered on a case by case basis but, as the customers are paying the full economic cost, IPR is normally assigned to them with a revenue sharing agreement.

BOX 2.1

THE AGRICULTURAL GENETICS COMPANY LTD

The Agricultural Genetics Company Limited (AGC) was set up in 1983 as a joint AFRC/BTG initiative with venture capital support to exploit AFRC-sponsored research in defined areas of plant biology.

Initially the company had an exclusive first option to commercialise the results of AFRC research in this area. This exclusivity was necessary in view of the long lead time required to develop products coupled with the need for the company to establish its market position. With the passage of time this need has declined and the exclusive aspect of the agreement has been progressively reduced. The current agreement provides a framework on a non-exclusive basis for co-operation which combines AFRC basic research with AGC's funding for more applied work to the mutual benefit of both parties.

The company works closely with the staff at institutes to assess the commercial potential of emerging technologies and then takes appropriate action to exploit them. The assessment includes thorough quantitative market analyses carried out on a worldwide basis to target potential customers and to promote the technology.

This places AGC in a unique position to act as an interface between the academics developing new technologies and the industrialists seeking to exploit them.

If IPR are offered to AGC, the company usually assumes all responsibility for filing patent applications, provides further development funds as necessary to bring the technology to a patentable stage and arranges licences to exploiting firms. In exchange for accepting the considerable risks involved in developing the technology for the market place, IPR may be assigned to them, although this is decided on a case by case basis. Experience has shown that in this field it can be as long as ten years from the date of filing the patent before any revenue flows back from product sales.

Because of the small scale of the company, the narrow technology base and risks inherent in all technology transfer activities, AGC stabilises and augments its income through other activities. In particular, it acts as manager for contract research, placed within institutes and universities, for other larger companies.

AGC's strength is that it can act as an essential bridge between scientific discovery and industrial exploitation in a narrow technological area where it can combine its scientific and business expertise. It is a good example of what can be done if suitable, patient start-up capital is available.

2.28 In the NERC a small central Marketing Group and Commercial Contracts Section works closely with marketing staff in NERC institutes, actively supporting proposals to safeguard and exploit IPR. One imaginative and highly effective tactic has been the use of MBA students to carry out short market surveys and then to work with staff at the institutes to generate a business plan for exploitation. The use of such students who are suitably qualified and highly motivated is well suited to the needs of the NERC. At the same time institute staff are also being trained to enable them to carry out some of these tasks themselves in the longer term. A major component of the NERC's intellectual property is in the form of data, which are subject to copyright protection rather than patents. Increasingly, the NERC is also seeking to exploit, mainly through licensing, the IP related to instrumentation, computer software, and techniques and know-how developed from basic research.

2.29 The transition from the previous culture in which data and techniques were passed freely between institutes and to other non-NERC establishments, which are now also taking a more commercial outlook, has led to a number of disputes on ownership and revenue sharing concerning IPR generated at one institute but now a vital part of the business of another.

2.30 The principal SERC "institutes", the Rutherford Appleton Laboratory and the Daresbury Laboratory, serve largely as centres for major facilities requiring expensive instrumentation. Both have set up liaison units to try to attract commercial customers and to encourage technology transfer, particularly of novel instrumentation and techniques. The revenue generated by the intellectual property from these activities has been disappointing so far, although there are prospects for improvement.

Research Council Grants to HEIs

2.31 In 1985 the Government removed the monopoly right of BTG to all exploitable technology arising from government funded research. The Research Councils then agreed in principle to vest all IPR from Standard Grants (ie those fully funded by the Research Councils after Peer Review) with the HEIs, subject to approval from a cross-Council Exploitation Scrutiny Group. Box 2.2 lists the requirements the HEI must satisfy to be granted authorisation. Each authorised HEI was asked to provide an annual list of patents filed and a financial balance sheet.

2.32 Out of a total of 117 HEIs, provisional authorisation has been granted to 65 (as at February 1992), with a further 7 under consideration. Of these, 29 have been granted indefinite authorisation. Twenty-two institutions have elected to remain with BTG, 6 are still considering their position, 23 have been asked to provide more information to the Scrutiny Group and 7 have made no response.

2.33 One exception to the general rule on transfer of IPR to the HEIs on Research Council grants occurs in the MRC AIDS Directed Programme. Grants to HEIs stipulate joint ownership of IPR arising from the research and provide for the MRC to take the lead in commercial exploitation. Revenue would be shared with the HEI in the event of royalty income from this IPR. The reason for the exception is to avoid fragmentation of IP arising from a Directed Programme.

Higher Educational Institutions (HEIs)

2.34 Most HEIs have set up the equivalent of an Industrial Liaison Office (different titles are used) to act as the principal interface between the HEI and the business community. They are generally responsible for negotiating IPR conditions in contracts with external research sponsors. The size and vigour of the ILOs varies considerably from one HEI to another although the quality and business experience of the ILO management has improved noticeably since the

BOX 2.2

EXPLOITATION SCRUTINY GROUP

GUIDELINES FOR ARRANGEMENTS FOR EXPLOITATION

The ESG requested each HEI to set out their arrangements dealing with the following ten points.

- identification of discoveries and know-how that may be exploitable;
- assessment of potential for exploitation;
- protection of intellectual property; relationship to publication;
- securing exploitation; sources of finance (including development work), marketing, negotiation etc;
- respective roles of the researcher and the institution; safeguards, and reversion of rights; incentives for the researcher;
- royalty sharing; a balance is needed between the incentive and the reward for the researcher, and due return to the institution on the public monies involved;
- providing, or buying expertise;
- annual reporting;
- consequences for terms and conditions of employment, including the waiver of rights of ownership under the Patent Act 1977;
- accountability: making the guidance and arrangements known to staff and students, and more widely; monitoring the working and effectiveness of the institutions's arrangements.

The performance of each HEI was to be monitored over a three year period from initial authorisation, taking into account criteria of effectiveness including: the number of patent applications and the number of those taken up for exploitation; the extra income earned; and the sales of products or processes arising from the invention both by UK and overseas companies.

On the basis of that assessment a decision would be made on whether to continue the authorisation period for an individual institution to exercise its own arrangements for exploitation of Research Council funded inventions or whether to require changes before authorisation could continue.

ending of the BTG monopoly. Those with the highest profile have the strong personal backing of the Vice-Chancellor or Principal and his (or her) endorsement of a clear strategy backed up with the necessary resource to carry it through. Box 2.3 gives details of the very different approaches adopted by two successful universities: Imperial College and the University of Strathclyde.

2.35 Strong support from the HEI management is important. The position of the ILO within the HEI management structure and the status of its Director in the academic hierarchy can be critical to its success or failure. With the prospect of a financial return so uncertain, many HEIs feel unable to divert resources to meet the significant up-front costs of IPR protection and exploitation in the face of other competing pressures.

2.36 The creation of UDIL, an informal organisation of University Directors of Industrial Liaison which meets twice a year, has done much to exchange ideas and disseminate best practice. The Committee of Vice Chancellors and Principals (CVCP) has also been active in suggesting guidelines and encouraging higher standards. They have issued a guidance note to universities which offers useful advice on the handling of IPR in contract negotiations.

2.37 Despite the more applied nature of the research in polytechnics and their greater contact with industry, their industrial liaison activity has some way to go

to catch up with that of the average university. The polytechnics and colleges have traditionally had a much smaller research base (as figure 2.1 shows), concentrated mainly in applied research. As a consequence they have less well developed industrial liaison activities. Stronger links have been established recently between UDIL and the Association of Industrial Liaison Officers (AILO) which represents the polytechnics and colleges sector.

2.38 The general approach of HEIs is to commit as little of their own financial resources as necessary to file an initial patent application then to use the following 12 month period to identify potential licensees who will assume the burden of subsequent patent costs in developing the invention further. There is a risk that this may lead to over-hasty and ill-considered judgements on long term exploit-

BOX 2.3

EXAMPLES OF UNIVERSITIES SUCCESSFUL IN EXPLOITING IPR

Imperial College of Science, Technology and Medicine and the University of Strathclyde are two technology oriented universities which have developed successful but very different solutions to the problem of exploiting their research base.

IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE

Imperial College has chosen to create a separate company to manage technology transfer which works closely with the Industrial Liaison Office, an integral part of the College, handling all research grants and contracts. Imperial Exploitation Ltd (IMPEL) was set up in 1987 as a joint venture between 3i plc, a leading venture capital organisation, and its subsidiary 3i Research Exploitation Ltd (3i REL), which has expertise in the assessment, protection, licensing and marketing of IPR. The College holds a 51% stake, 3i plc holds 44% and 3i REL the remaining 5%. IMPEL's primary function is outward technology transfer from the College although until March 1990 it also ran a Consultancy Service and the hiring out of College facilities, then spun off into a separate company.

The agreement with the College is non-exclusive; the College is free to approach other exploitation companies if it wishes. IMPEL has a permanent staff of six with a Chief Executive who is also Pro Rector (Research Contracts) responsible for the Industrial Liaison Office to the Rector, Sir Eric Ash, who takes a keen personal interest in research contract and technology transfer matters.

Income from research grants and contracts amounted to £43.0 million in 1990/91, some 32% of turnover. £19.1 million came from the Research Councils and £10.8 million from UK industry and government departments. By comparison, the operating costs of IMPEL were only about £200,000 in 1990/91. IMPEL's income derives from: a 30% share of royalties it negotiates; 10% commission charged on contracts/consultancies arising directly from outward technology transfer activity; and direct payment from the College to carry out a systematic continuous technology audit. For the latter, each academic is visited in turn for discussions on the potential commercial promise of his or her research. IMPEL can arrange funds for developing ideas before licensing and to assist in assessing the viability of start-up companies.

So far some 80 topics have been identified as definite licensing prospects of which 27 are already producing revenue and a further 9 are likely to begin doing so in the coming year. Although it is expected to take a few further years before significant revenue from licenses is generated, income passed to Imperial College by IMPEL from royalties and licence issue fees in 1990/91 was over £320,000, up from £150,000 in 1989/90. It is likely to exceed £500,000 in 1991/92. IMPEL's financial results for the year to March 1991 show a pre-tax profit of £49,120 on a turnover of £235,228.

Imperial College has taken a firm stance on the related issue of payment of proper overheads on research contracts and on ownership of intellectual property, in some cases declining contracts because the terms were not acceptable. Some sectors of industry have accused the College of trying to drive too hard a bargain and have threatened to withdraw all research support.

THE UNIVERSITY OF STRATHCLYDE

The University of Strathclyde has opted to retain all intellectual property and technology transfer activities within the university. In the words of the previous Vice-Chancellor, Sir Graham Hills, "The positioning of a university's research portfolio into areas of evident promise is part of the strategic planning of that university's future." A Deputy Principal (Research) has been appointed as an academic champion, reporting directly to the Vice-Chancellor.

The university's Research and Development Services Office reports directly to the Vice-Chancellor and the Deputy Principal (Research). It consists of six full time staff including separate officers for intellectual property, marketing and EC liaison along with other expertise in contract negotiation and licensing. All research grants and contracts are signed by the Director of the Office but in other respects use of the Office by academic staff is voluntary. It is a service available to the academic staff if they need it.

The Vice-Chancellor, Deputy Principal and the Director of R&D Services (the equivalent of the ILO) meet fortnightly as a Research Review Group. The policy of the university is centred around the creation of multi-disciplinary research centres bringing together expertise from different departments. Suitable topics are first suggested bottom-up from the research staff and are then selected by the Research Review Group after market research to identify technology needs which can be matched to university strengths. The intention is that these centres should be organisationally flexible to allow a dynamic evolution of ideas, skills and personnel as technology needs change.

Successful centres are expected to evolve into self-sufficient research institutes under more professional management which recover the full cost of the research from customer contracts. A small trading unit attached to the institute handles customer interaction. Eventually, separate companies will be spun off if viable, with the university retaining a stake. A total of 15 centres have already been created and a further 20 are under active consideration.

The university has also involved its Department of Technology and Business Studies in creating a Research Centre for the Management and Assessment of Technology Change. This is studying technology transfer mechanisms and comparing the effectiveness of different marketing approaches used by the university.

The Vice-Chancellor has a strong personal involvement in the development of university research policy. Sir Graham Hills championed the concept of the technology transfer highway consisting of research centre – research institute – spin-off company as a form of continuous extended interface with industry, looking increasingly commercial in outlook at the industrial end but allowing the free bi-directional flow of scientific personnel and information along it. He viewed the real benefits to the university of exploiting research as more complex than profit and loss on research alone. If managed well a positive feedback loop could be established involving enhanced reputation, high quality research staff and students, a better research base and more research funding.

The University's new Vice-chancellor, Professor J P Arbuthnott is no less committed to the University's programme of research and to the development of its research policy, which are essential for the future of the university and its distinctive role with industry.

ability. Many inventions coming out of basic research need further development before their potential for exploitation becomes clear. Valuable ideas may be sold off too cheaply or be dropped altogether because their true potential has not been appreciated on the right timescale. Access to good market information is critical. Companies like BTG or 3i could have an important role to play in providing development funds to advance the technology before it is offered to potential licensees. If the invention is in the form of a widely exploitable enabling technology, the HEI may gain most by retaining ownership of the IP and bearing the full patent costs itself.

2.39 It may be that only the larger institutions are in a position to take these financial risks. Smaller organisations may not be able to afford either the initial outlay to maintain a critically sized ILO or the costs and responsibilities of exploiting IPR, and should not be encouraged to try. Unrealistic expectations may have been raised in smaller institutions by the Exploitation Scrutiny Group's authorisation of HEIs to manage their own IPR when they have neither the full range of professional expertise nor the financial resources to be successful. Nevertheless, smaller research organisations, like small businesses, can use the intellectual property system to good effect by bringing in expert advice from professionals in private practice. Moreover, it is not clear that sufficient attention has been paid to alternative options such as combining with larger neighbouring institutions, forming consortia, or negotiating an exploitation agreement with a commercial partner.

2.40 Some HEIs have made the ILO a separate profit centre with profit-related performance targets. While this has some benefits in imposing financial discipline on the activities of the ILO, and in making it more acceptable to the academic staff by keeping the overhead to a minimum, it may also have disadvantages. To be effective, the ILO needs strong links with academic research staff in the HEI and commercial links with the outside world. The majority of HEIs favour maintaining the ILO as an integral part of the institution to keep it responsive to the needs of the research staff. They take the view that to do otherwise might lead to greater selectivity in the choice of topics to be developed or divert the ILO away from its main function towards less risky activities which offer a more assured return.

2.41 Many HEIs have also set up a separate wholly-owned company to facilitate general technology transfer and downstream exploitation of IPR. If this company is managed separately from the ILO, there may be a risk that research staff can become confused as to whom they should approach if they have a potentially exploitable idea; and it may blur responsibilities for key steps of identification, assessment, protection, marketing and licensing the IPR.

2.42 Only a relatively small number of HEIs appear to have satisfactory mechanisms to exploit their own IPR. There is a wide spread in capability and commitment; and most HEIs could benefit from adopting best practice.

Government Departments

2.43 Research funded by government Departments is done largely for public good reasons. Departments have no specific remit to exploit it commercially. There is a belief that in many cases the proprietary nature of IPR protection conflicts with the Government's wish to make the results freely available to the general public or to regulatory authorities. Some Departments, (such as the Ministry of Agriculture, Fisheries and Food, the Ministry of Defence and the Department of Transport) issue general policy guidelines on IPR. Other Departments consider IPR questions as they arise in relation to particular programmes.

2.44 In response to an internal report on IP in 1987 (the Fisher Report⁵), MAFF set up an Intellectual Property Liaison Unit (IPLU) in March 1989 with a remit to ensure the effective transfer of technology arising from its R&D programme and to maximise the financial returns. Each MAFF laboratory has a nominated officer to identify IPR at source. The Ministry retains ownership of all IPR from research for which it is the sole funder, believing that it is better able to handle the protection, development, licensing and marketing of the IPR. It claims additional benefit in being able to assemble customer-specific portfolios of IPR from different research sources. Ownership of IPR is negotiable where MAFF is not the sole funder, eg in LINK or subscription-type international activities.

2.45 MAFF has made use of the Patent Office Marketing Division to provide seminars for staff, starting at Grade 2/Grade 3 level, to raise awareness of the importance of IPR. All final reports on research contracts are required to identify IP. The IPLU, in consultation with the R&D contractor, then makes a decision on whether or not it will seek protection and exploitation of any IP, within four weeks of receiving the final report. Consultants are used in exploiting, marketing and licensing MAFF technology.

2.46 The bulk of MoD's research is carried out by the Defence Research Agency (DRA) which was set up in April 1991. Both MoD and the DRA have central organisations, staffed from a common pool of specialists in Intellectual Property Rights (IPR) and licensing; each of the four main DRA research establishments has its own patents staff.

2.47 IPR arising from in-house research is protected to ensure the availability of technologies for use in defence procurement and is exploited commercially where possible; several hundred licences have been granted over the last decade. However, neither MOD nor the DRA has a separate mechanism for assessing technology in commercial as opposed to military terms, and virtually no use is made of independent marketing consultants. Both MoD and the DRA use in-house licensing specialists. MoD takes the view that full scale marketing at the invention stage would not be an appropriate use of its vote. The lack of success of Defence Technology Enterprises, launched in October 1985 to encourage greater spin-off from military technology into the civil sector, has re-emphasised the need for a clear departmental strategy to improve commercial exploitation.

2.48 For extramural R&D contracts placed in industry, MOD generally allows IPR ownership to be vested in the company, but retains free user rights for the Crown and negotiates a royalty on any non-MOD sales. A pragmatic approach is adopted based on ability to exploit and the desire not to split ownership of foreground and background IPR. The same principles lead MOD currently to retain IPR ownership for all HEI contracts, and are also applied to collaborative research programmes in which MOD is a partner.

2.49 The details of DTI policy on IPR are specific to the objectives of the particular scheme under which the research is funded. However, the Department does not seek to retain ownership of the IPR. For research related to policy, statutory or regulatory functions of the Department, ownership of all IP is vested in the contractor, whether private industry, public research organisation or HEI, subject only to the rights of any third parties concerned. If the contractor is a DTI research establishment or agency, ownership is held by the establishment on behalf of the Secretary of State for Trade and Industry and exploitation is handled either directly by the establishment or through BTG.

2.50 All contractors are expected to use their best efforts to exploit IP generated in the course of the work, with any royalties shared with the Department on terms which reflect respective financial contributions. Safeguards are provided against failure by the contractor to exploit the IP within a fixed period. The Department requests copies of all patent applications.

2.51 In collaborative research involving companies and HEIs, the traditional DTI position has been that IPR should belong to the industrial partner, with an appropriate return to the HEI in the event of commercialisation. This stance has been adopted because the industrial partner is regarded as better placed to seek due protection for the IP and to exploit it. However, DTI is aware of developing HEI capability and accepts that a more flexible approach may be required in the future.

2.52 The Department of Transport's approach to IPR balances the statutory obligations of the Department against the need to encourage the widest possible exploitation. Ownership is assigned to the contractor provided there is no danger of the contractor achieving a monopoly position with regard to future Departmental contracts and the Department will seek to negotiate a royalty agreement on sales where the potential returns justify the administrative costs. Revenue on sales is shared between the Department and the contractor. No distinction is made between industrial and academic contractors. Ownership of IPR is retained by the Department if the results are vital to the maintenance of competitive supply to the Department itself or to local authorities. Royalty bearing licences are given to firms seeking to exploit the IPR for commercial purposes.

2.53 The Technology Transfer Unit at the Transport Research Laboratory (TRL) already carries out exploitation of DoT research. With the move to customer-held budgets and the vesting of TRL as an Executive Agency from April 1992, the Department is considering proposals to vest IPR from intra-mural research placed with TRL with the "Chief Executive for and on behalf of the Secretary of State".

2.54 The Department of Health is currently considering how best to make the result of its, and NHS, research programmes widely available to improve the services for which they are responsible. The Health and Medicines Act 1988 gave the Secretary of State express powers to exploit intellectual property rights to make more income available for improving the health service, and these powers were delegated to authorities. The NHS and Community Care Act 1990 similarly empowered NHS Trusts. However the unique constitutional status of the NHS and the dispersed nature of its research activity poses particular problems for effective technology transfer.

2.55 AEA Technology is a major research, development and technology service organisation which was formerly part of the Department of Energy. Since the early 70's it has encouraged a close interaction between its Marketing, Sales and Patents Departments to establish an effective infrastructure for handling intellectual property matters, and has benefitted from past innovations both in promoting sponsorship of research and in direct licence income.

2.56 The approach to evaluating innovations and championing their exploitation has evolved with the organisation. A review system provides for assessment of new ideas by panels of experienced commercial, scientific and patents staff prior to initial filing of an informal UK patent application. A further more searching review is carried out eight months later to determine the extent of overseas cover required. Recent developments have shifted the responsibility for the final decision and the associated costs directly to the AEA business units. AEA Technology is beginning to take steps towards a more strategic look at how it might structure its research programme to take maximum advantage of the value and strength of its IPR.

Summary of current performance

2.57 The importance of IP is generally recognised. All the groups of organisations considered in this study have taken some steps to consider how they will manage and exploit it. However, practice and performance vary widely. Progress in some areas has been impressive.

2.58 In non-industrial laboratories, management of IPR is furthest advanced in the university sector. UDIL has played a valuable role in raising standards and disseminating best practice. By comparison, there is room for improvement in polytechnics, Research Council Institutes, GREs

and research agencies. Industrial liaison offices are often reactive and depend on scientists to bring forward ideas with commercial potential. The level of awareness of IP among scientists has improved dramatically over the last decade, but there is still a lack of understanding of the mechanics of patent protection and of its implications for publication.

2.59 The Exploitation Scrutiny Group has been effective within its remit and resources but questions about the effectiveness of measures adopted by some HEIs remain. There may be a critical size below which HEIs would benefit from seeking alternative arrangements, rather than manage their own IPR.

2.60 The dispersed nature of Research Council laboratories raises the question of balancing central against local responsibility. Local control may be preferable in identifying R&D work for protection but exploitation might best be handled centrally where resources are greater. Greater commitment from management and more positive staff attitudes are required if the record of the institutes in exploiting IPR is to be improved.

2.61 Companies such as the Agricultural Genetics Company Ltd (AGC) form a valuable bridge between the research base and a particular industrial sector to finance the *development* of new ideas and to provide expert patent/marketing know-how. BTG fulfils a similar role but covers a much broader range of technologies. It is unfortunate that there are not more companies taking on this kind of role.

2.62 As funders of research with contractors, Government Departments vary in their approach to IPR protection. Some, such as the DTI and DoT, have a general policy of vesting IPR ownership with the research contractor but will, in exceptional circumstances, retain ownership in the Department. Others, such as MAFF and DH, believe that Departmental objectives are best served by the Department retaining ownership of all IPR and licensing commercial developers where appropriate. The remainder vest IPR ownership with industrial contractors but not with non-industrial contractors.

2.63 Most Government Research Establishments are in the process of conversion to research Agencies. Increased independence and competition should stimulate a more positive approach to technology transfer activities but it will be important that the framework documents under which Agencies operate provide adequate incentives.

2.64 A future study of the use of IP by the private sector could include the need for greater awareness of the benefits of using the intellectual property protection procedures among managers of small and medium sized companies; and the case for additional training and improved incentives for scientists in all companies to make greater use of IP protection, as a means of encouraging innovation.

3.1 Encouraging progress has been made since the Nicholson Report in 1983. There is more general awareness that intellectual property rights are important; the Patent Office has become an Executive Agency and better able to take on the entrepreneurial role that was envisaged; the legal process of protecting and, particularly, defending IPR has been simplified; and most research providers and research funders have started to ensure that potentially valuable IP is not neglected.

3.2 However, these positive signs have yet to result in a significant change in the use of the IPR machinery. There is no evidence of larger numbers of patent applications nor of increased licence or royalty revenue earnings. Use of the patent system is mostly by large companies, and not necessarily by those associated with high technology research based industrial sectors. There is scope for increased use of IPR machinery by SMEs and the cultural barriers to the principle of commercialisation of research seem to remain in most publicly funded non-industrial research laboratories.

Education

3.3 One of the common features evident in all sectors has been a limited awareness among researchers and many senior managers of the way the intellectual property system functions. The patent system with its origins in Letters Patent under the Royal Seal remains a mystery to all but a few. Perceptions of legal and technical complexity may have intimidated the non-expert.

3.4 It is important to de-mystify the intellectual property system and to make it more accessible. Its importance to all aspects of commercial life is such that elements of the application of inventions and control of patents are now taught to 14–16 year olds under the National Curriculum Technology Order. This promising start should now be developed in further and higher education.

3.5 Graduates emerging from higher and further education with science or engineering degrees tend to be unfamiliar with IP matters. A few universities offer IP courses but these tend to be for the specialist and unsuited to providing practical advice at a more general level.

3.6 There are many advantages to be gained from training scientists in the public and the private sector to appreciate the commercial potential of novel research and to communicate effectively with patent agents, licensing executives and marketing experts. Many profitable ideas may be lost because their commercial potential is not identified at an early stage or because, once identified, it is not exploited adequately through poor communication.

3.7 Well-informed management is equally essential to provide the right climate of encouragement, to take immediate decisions on innovative ideas which are brought forward and to make available the necessary resources for exploitation.

3.8 Key decision-makers in government, academia and all research organisations need to become more aware of how the patent and other IP protection machinery works. The excellent educational work and video material prepared by the Marketing Division of the Patent Office has demonstrated what can be done to instruct the non-expert in the basic essentials. Full use should be made of this and other educational material.

3.9 Professional bodies and others in the intellectual property field might consider whether it would be practicable to set up a help line (telephone, FAX or computer network), additional to existing advice services, to provide rapid practical advice to the inventor on how to proceed with the protection of an innovation.

An IPR Exploitation Plan

3.10 In the short term there is a need to improve exploitation of IPR in the non-industrial laboratories. A small number have amply demonstrated that it is both practicable and profitable to manage their own IP and that the fact of being in the public rather than the private sector does not represent a fundamental obstacle to effective exploitation. However, the majority of research organisations still need to take a number of steps to come closer to the standard of the best.

3.11 It is necessary to be realistic about the scale of the likely financial return and to bear in mind that:

- the primary purpose of the research is not financial gain;
- it is not the intention that the organisations should place commercial return above scientific value;
- there is unlikely to be a huge reservoir of undiscovered IP in research laboratories just waiting to be exploited;
- exploitable IP will appear relatively rarely in organisations carrying out more fundamental research;
- most of the IP is probably not in an immediately exploitable form; and
- apart from the occasional nugget, the earnings from any particular item of IP are likely to be small.

3.12 We should not therefore expect a major financial windfall from exploiting latent IPR in publicly funded research organisations, though the return should grow with time. The main benefits can come from second order factors such as a change in attitudes among research staff and laboratory management and ultimately in the public perception of scientific research as a worthwhile investment. In addition, the experience of laboratories which have been successful in exploiting IPR has highlighted the value to the organisation of freedom to use the revenue earned as seedcorn funds to stimulate new research activities.

3.13 Box 3.1 gives an aggregate of best practice. A major improvement in performance could be achieved if all research organisations adopted the practice of the best.

3.14 However, a number of difficulties still need to be addressed:

- (a) IPR exploitation and technology transfer activities require significant investment but compete for resources with mainstream research activities. Much of the investment is required up front and may take many years to pay for itself, let alone make a profit. Many industrial liaison and technology exploitation activities are under-resourced. The recently announced DTI "Support for Industrial Units" scheme which aims to strengthen – and in some cases establish – industrial units in HEIs should help.

- (b) there is a shortage of expertise within research organisations in licensing and marketing, which are critical areas for the generation of revenue. This has become more significant with the change in the relationship between research organisations and BTG.
- (c) filing patent applications quickly and cheaply to allow publication, followed by a search for licensees to bear the subsequent patent costs within the 12 month period can lead to poor decisions on licensing and subsequent development. The Patent Cooperation Treaty route can be a particularly

BOX 3.1

AGGREGATE OF BEST PRACTICE

The recommendations below seek to build on the experience of the most successful organisations and draw heavily on a report published by UDIL: "University intellectual property: its management and commercial exploitation", Int J Technology Management, 1989.

- Effective IPR management requires a strong commitment throughout all levels of the organisation. Ideally, IPR policy should be built into the overall objectives of the institution and should be clear to all staff.
- A central unit, similar to the Industrial Liaison Office in HEIs, is an effective means of channelling all commercial enquiries through a single point of contact. Research scientists should refer any commercial sponsor or customer to the ILO rather than enter into negotiations alone.
- A high standard of professionalism inspires confidence in commercial clients. The ILO should be headed by someone with extensive relevant business experience and have available expertise in finance, patenting, contracts, licensing and marketing.
- The policy of the organisation on ownership, licensing and revenue sharing should be clearly set out in model contracts prepared by the ILO. Negotiation of specific agreements should then be conducted by the ILO, guided technically by the scientific staff, to meet the needs of individual clients.
- Technology audits are beneficial in identifying broad areas of the organisation's research which may have more obvious commercial potential. In organisations which have a large spread of research fields selectivity is recommended. The audits are best carried out by management and scientific staff with help from the ILO and not left to the ILO alone.
- Most organisations will depend on the alertness and vision of individual scientists to bring specific ideas forward for evaluation. It is important that these scientists know they have immediate access to specialist expertise and that a decision on the commercial potential will be made rapidly (typically within a month).
- Market research is extremely important to inform exploitation decisions and optimise revenue return. Scientific staff and the ILO should work together in developing an exploitation and marketing strategy. The use of short term MBA students to conduct market surveys and develop business plans could be a particularly cost-effective marketing technique.
- It is probably counter-productive to make the ILO a profit centre, although its cost-effectiveness needs to be closely monitored. Many of its activities have to be assessed over a long time period rather than on the basis of in-year return alone. There are dangers of diversification away from the main function and of playing safe in the selection of exploitable technology if short term profit pressures are applied.
- Education and training provided to all staff from top management to laboratory technicians can increase awareness of the specialist help which is available and when it is appropriate to seek it out. The use of confidentiality agreements should be encouraged in discussion with any outside body to control the release of information before protection is secured.

BOX 3.1 *cont.*

- In staff appraisal, performance assessment and promotion reviews, research organisations might usefully place greater emphasis on patents filed and licence/royalty revenue earned rather than concentrate exclusively on numbers of papers published and standing in the academic community.
- Each organisation might review its system of rewarding scientists and scientific teams financially for innovative ideas which generate income.
- HEIs should consider a more interdisciplinary approach to IPR exploitation. The typical structure of individual departments based on scientific disciplines is not well suited to the solution of technological problems. Potential opportunities to exploit the diversity of HEI research might be lost if departments compete rather than cooperate at the interfaces.
- Exploitation of innovations with the potential to earn very large sums in royalty payments will probably be beyond the means of even the largest research organisations. IPR companies might be approached to manage the technology on behalf of the organisation, and perhaps provide development funds.
- Smaller institutions are less able to manage IPR themselves and should consider joining a larger partner.
- Start-up companies to exploit IPR should be set up by research organisations only if they have a sound business plan and secure financial support from non-HEI investors.
- In Research Councils with a large number of laboratory sites it is necessary to consider the correct balance between the economies of scale arising from a centralised approach and the desirability of local management involvement and commitment. Local responsibility with central guidance and specialist help is to be preferred.

attractive option for research organisations. The substantial costs of filing a full application in many countries can be delayed for up to 30 months. Access to development funds to strengthen the patent and to advance the technology before seeking a licensee could enhance the probability of its being accepted. This is well recognised by companies like BTG, 3i, AGC and others which invest large sums in research organisations for this purpose. The terms on which such assistance is offered have to be attractive to the inventor.

- (d) the costs of protection and defence of those rare patents with the potential to earn very large royalty revenue can be high and might be beyond the means of even the largest research organisation unless in partnership with a major IPR company. Patents which become the subject of litigation are, however, rare and it is possible to insure against the costs involved.
- (e) although large research organisations can clearly justify managing their own IPR, subject to the reservations given above, there is probably a critical size below which it may not be sensible to do so and where alternative approaches should be sought.

3.15 The following measures might be taken to address these problems in the short term:

- (a) Each publicly funded research organisation should consider preparing a policy statement on intellectual property and technology transfer – an intellectual property exploitation plan – addressing:
 - (i) policy on IPR ownership, patenting, licensing and exploitation;
 - (ii) the mechanisms it has put in place and the resources devoted to it;

- (iii) training of staff in handling IP issues;
 - (iv) terms and conditions of employment clarifying issues of ownership of IPR between employer and employee;
 - (v) the weight given to patents and licence/royalty revenue in staff appraisal, performance assessment and promotion reviews;
 - (vi) distribution of income from IPR exploitation;
 - (vii) technology audits;
 - (viii) provision of expertise in patenting, licensing and marketing; and
 - (ix) resources available to exploit major discoveries.
- (b) Strengthening of industrial liaison activities should place particular emphasis on access to licensing and marketing expertise.
 - (c) Small research organisations should consider forming groups, joining with a larger organisation, or engaging a technology transfer company to manage IPR on their behalf.
 - (d) The rapid dissemination of best practice in IPR management should be encouraged, possibly through an extension of the role of UDIL to bring together exploitation staff from all sectors of publicly funded research.
 - (e) There should be a study of the statistics of UK patent applications by type of organisation (large company, SME, HEI, Research Institute) as a first step in quantifying the utilisation of the patent system.
 - (f) Research organisations should promote contacts with local Chambers of Commerce to keep in touch with the business sector and to provide access to market information.

Changing the Scientific Culture

3.16 The purpose and practice of publicly funded research is in the process of change. The UK has a strong tradition of scientific enquiry and discovery. Most of the basic research into the fundamental processes of nature takes place in the public sector. While contributing to the world stock of knowledge, this research also informs Government decisions on policy, regulatory and statutory matters and trains research workers for the private sector. Publicly funded research can also make an important contribution towards industrial innovation and competitiveness, and to the quality of life, both now and in the future.

3.17 There have also been changes in international science. All developed and developing countries have appreciated the value of a scientifically trained workforce and indigenous technical skills; and open publication in the scientific literature, collaborative research programmes, conferences and exchanges ensure rapid dissemination of scientific discoveries. Economic benefits generally come not from having or owning the knowledge but from using it: that is, not from the science itself but from its technological applications. Scientists in any organisation, whether public or private, have an important role to play in filtering and interpreting this knowledge in order to apply it to their specific needs.

3.18 Research Council laboratories and government research agencies rightly place great emphasis on the academic quality of the research they undertake. However, this need not exclude consideration of the potential application of such work, which should be taken into account at all stages of the research. Much of their research is judged by academic standards of originality and novelty rather than by its direct application to real problems faced by society. Peer Review pressure tends to discourage the adoption and application of ideas already developed elsewhere.

3.19 HEIs play a key part in shaping the attitudes of science graduates towards their own role and the role of science in the community. HEIs should consider whether enough is being done to promote *innovative applications* of the existing knowledge base in addition to the more traditional academic focus on *extending* it. The new pilot scheme on post-graduates jointly based at HEIs and industrial research organisations launched by DTI and SERC might be one means of achieving this end. However, at present, very few graduate courses in science and engineering currently provide course material on the workings of the IP protection system.

3.20 Further consideration is needed as to:

- how scientific training in HEIs and Colleges of Further Education can ensure that science and engineering graduates acquire greater understanding of the intellectual property rights system; and
- how Research Council criteria to assess research proposals could give greater weight to innovative applications of existing knowledge.

The Issue

4.1 The ownership of IPR in sponsored and/or collaborative research is an area of considerable debate. Until recently intellectual property arising from work in HEIs commissioned by a single sponsor was assigned to the sponsor whether this was a government Department or private industry. In recent years HEIs have argued that this might not always be appropriate and could have disadvantages. Most sponsored or commissioned research in HEIs or in GREs, even in the most basic areas, has an applied aspect. The sponsor is generally best placed to exploit the IPR in his particular business sector but opportunities to exploit it more widely might be lost.

4.2 The views of industrial sponsors may be summarised as follows:

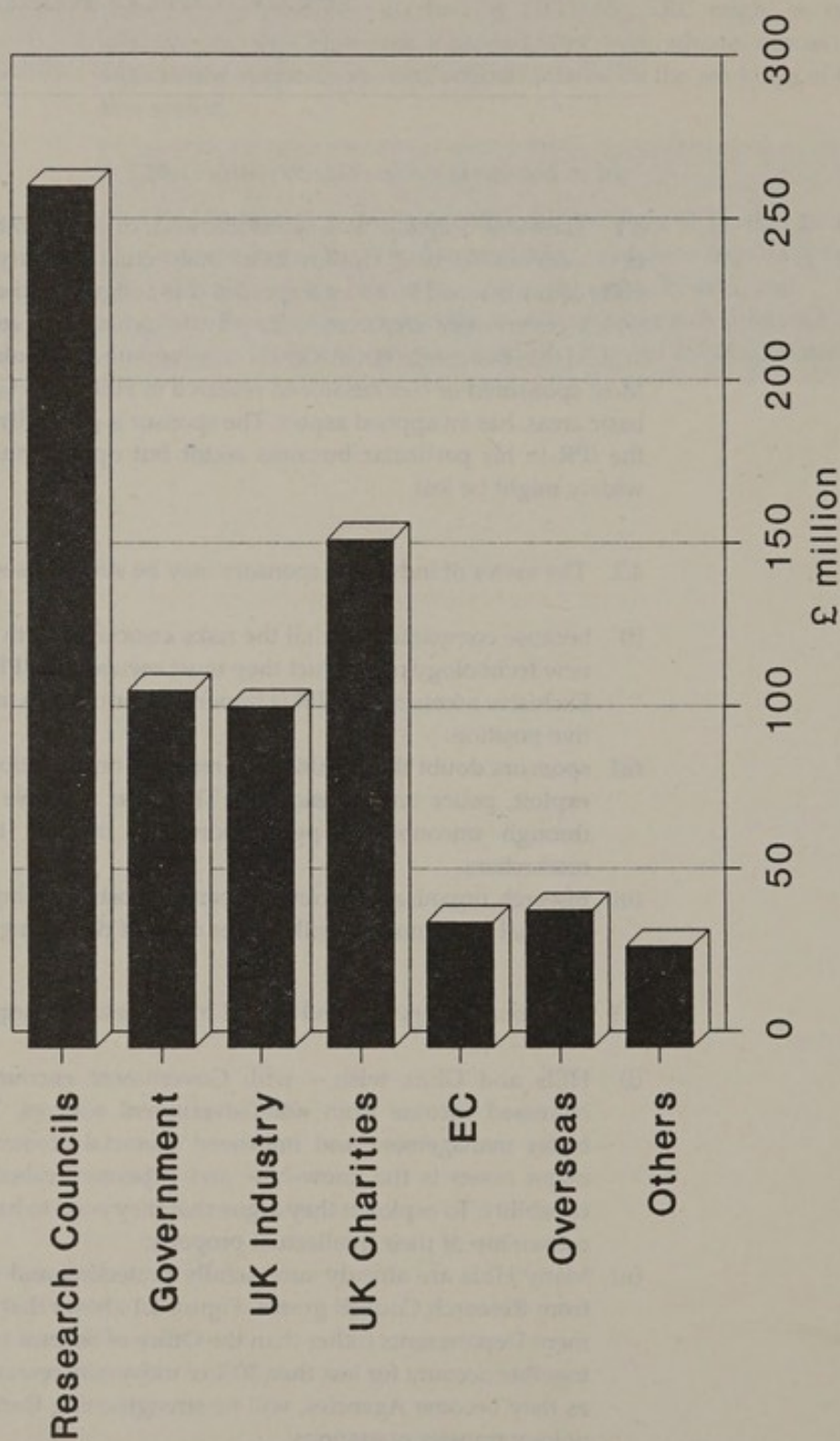
- (i) because companies bear all the risks associated with the development of a new technology or product they must own all the IPR on which it is based. Exclusive access to the IPR is important for them to maintain their competitive position.
- (ii) sponsors doubt the capability of research organisations to identify, protect, exploit, police and defend IPR. They fear valuable know-how may leak through uncontrolled publication and through the mobility of HEI researchers.
- (iii) research organisations cannot bear the costs of filing patents on an international scale, nor the still greater costs of defending against infringement.

4.3 The counter-argument advanced by the research organisations is:

- (i) HEIs and GREs wish – with Government encouragement – to attract increased income from non-Government sources. They are introducing better management and improved financial accountability. One of their major assets is the know-how and expertise embodied in their research capability. To exploit it they argue that they need to have a stronger claim on ownership of their intellectual property.
- (ii) Many HEIs are already successfully protecting and exploiting IPR arising from Research Council grants. Figure 4.1 shows that industry and government Departments (other than the Office of Science and Technology (OST)) together account for less than 30% of university research income. The GREs, as they become Agencies, will be strengthening their marketing and technology transfer operations.
- (iii) As research organisations broaden their funding base, the impact of current practice would be to fragment ownership of IPR across many different funding bodies. This may impede exploitation rather than encourage it. A more effective solution might be to vest ownership in the research organisation which could then negotiate appropriate licences and revenue sharing agreements with each funding body. In addition, the research organisations would be able to grant licences to other potential exploiters in different

Figure 4.1

UNIVERSITY RESEARCH INCOME



Data supplied by CVCP (1989/90, provisional)

Figure 4.1

Total external research income to UK universities for the year 1989/90, showing the contribution from different sources. The figure does not include the research component of the block grant the universities receive from the Universities Funding Council (£860 million for 89/90).

market sectors without compromising the position of their earlier sponsors. This could generate income for the research organisation and tap a larger market.

4.4 There is unlikely to be a single solution to resolve this conflict. *The parties should be free to negotiate an acceptable agreement.* Box 4.1 summarises the main factors to be considered in the negotiating process. It is important to recognise that ownership of IPR is not the primary issue on either side. Industry is concerned mainly with control over how the IP is used. Ownership provides absolute control. Research organisations are concerned mainly with maximising revenue return and see IPR ownership as the only way of securing a better deal with potential licensees. In many cases government Departments and other non-commercial sponsors have less need to own IPR, provided they have adequate user rights and a share in royalties. The implications of the EC Directive on the public procurement of R&D services will also have to be considered.

4.5 The issues range wider than the UK context. Significant research in the UK is now sponsored by foreign-owned companies, which often offer large scale investment and which place fewer conditions on IPR ownership arising from the research they fund but are prepared to license any exploitable technology which emerges. They also pay full overheads.

4.6 Additionally, an increasing number of UK research organisations take part in EC collaborative programmes. The EC model contract vests ownership of foreground IPR (ie the IPR generated as part of the particular programme) with the organisation which generates it. The collaborating companies receive a free non-exclusive licence to exploit the foreground IPR and have access to essential background IPR (owned by a partner before the programme started) on fair and reasonable terms. A royalty is payable to the non-industrial partners for use of the foreground IPR. Royalties on any sales are shared by prior agreement. UK non-industrial research organisations, which see the European model contract as meeting most of their needs, point out that many UK companies have been willing to sign up to the EC rules but have resisted their adoption in UK collaborative programmes.

Ownership options

4.7 The issues were considered in 1989 by a committee chaired by the then Comptroller-General of Patents, Designs and Trade Marks, Philip Cooper CB. Their report⁷, entitled "Intellectual Property Rights in Collaborative R&D Ventures with Higher Educational Institutes" referred specifically to sponsored research at HEIs but the conclusions, summarised in Box 4.2, can be applied to all research organisations. Although the Cooper Report provides an excellent statement of the issues involved, the debate continues. On balance, the Cooper committee favoured ownership of IPR remaining with the HEI in principle, but concluded that this should be conditional on its ability to manage the IPR effectively. This left open the question of the criteria against which the ability of the HEIs to manage their own IPR could be judged and how this ability might be improved.

4.8 It is important to preserve the principle that HEIs and sponsors should be free to negotiate without presumption all matters relating to ownership, licensing and exploitation of IPR as well as the distribution of licence/royalty income based on their respective contributions – which may be financial, material and intellectual – to the research programme. It is for the parties themselves to agree terms which provide adequate protection to companies to cover development risks while at the same time giving research organisations a fair financial return and appropriate publication and research use rights.

BOX 4.1

KEY QUESTIONS TO BE CONSIDERED IN NEGOTIATING IPR OWNERSHIP

- Are both parties equally capable of managing IPR. This includes the technical and legal expertise to file effective patents, the financial resources to file internationally if necessary, the marketing and licensing expertise to exploit it effectively and the machinery and resources to defend against infringement.
- Does the industrial sponsor have confidence in the research body to maintain confidentiality and to manage the IPR in a way that will protect the company's commercial position.
- What are the likely costs and timescales for development. How much of a risk is the company taking and over what period. Different market sectors display different characteristics in this regard. This is related to a subsidiary question of how much exclusivity in the technology does the company need.
- What know-how or background IPR is each party bringing to the project. It is advisable not to fragment the IPR if it can be prevented.
- Are there many likely funders for the same general area of research. This is most likely to be the case for technologies which are at the enabling stage with potential for application in a number of different markets. The more general the technology the greater the disadvantage to the research institution of handing exclusive exploitation rights to a single funding body.
- To what extent is the IP generated likely to be in the form of patentable material and to what extent is it simply know-how on a particular process. If patentable, protection can easily be arranged. Know-how can be protected only through confidentiality and is more difficult to police, particularly in a research organisation with a transient and mobile workforce.
- What restrictions will be placed on the use of the IPR at the end of the research programme.

BOX 4.2

MAIN CONCLUSIONS OF COOPER REPORT

"INTELLECTUAL PROPERTY RIGHTS IN COLLABORATIVE R&D VENTURES WITH HIGHER EDUCATION INSTITUTES"

- No single solution could be identified which would suit all circumstances
- Joint ownership of IP should be avoided
- There were advantages and disadvantages wherever ownership was vested but most of the disadvantages could be addressed through a proper agreement on licensing and user rights
- On balance, the Committee appeared to favour ownership remaining with HEI but recognised that industry had valid concerns on confidentiality and the HEIs' ability to protect and defend the IPR
- The decision on ownership should be based on ability to manage IPR effectively and on balance of background IPR contributed by the two parties
- If ownership was vested in the company the agreement should provide for a satisfactory return to the HEI, including user rights for further research, and protection against non-exploitation by the company
- If ownership was vested in the HEI, the industrial partner should have exploitation rights, in return for royalties, with appropriate safeguards.

4.9 In the longer term, if HEIs developed greater expertise in IPR management, one would expect them to have a stronger case for retaining ownership of IPR and for this to be reflected in their negotiations with the sponsors of commercial research. However, the structure of incentives and rewards could provide greater encouragement to HEIs and other publicly funded research organisations to improve their record of research exploitation and commercialisation.

4.10 For example, it would seem reasonable that negotiations on IPR ownership and user rights should take account of the way in which research is funded and whether the commissioning body was meeting the full costs of the research, including properly attributed overhead costs, or the research was being subsidised out of other funds. If publicly funded research organisations were to retain a share of the revenue earned from the commercialisation of their IPR, whether by a commercial partner or through their own efforts, this could be a powerful incentive for them to devote greater attention to the exploitation of intellectual property. Sponsors should also recognise that restrictions on publication of research results, although often necessary for commercial, security, or other reasons, strike at the heart of the academic ethos and could have implications for the charitable status of HEIs.

4.11 The possibility that exploitation may be inhibited by fragmented ownership of IPR when several sponsors separately fund research within the same research organisation should be taken into account in drawing up agreements on IPR. Often it might be in the interests of all concerned for IPR ownership to be vested in the research organisation with each sponsor negotiating a licence to use it for its own commercial purposes.

4.12 The Government's objectives in providing financial support for collaborative research programmes involving industry, HEIs and GREs are to promote links between the research base and industry and to encourage the widest possible exploitation of the technology. The treatment of IPR should strike an acceptable balance between the wish of participating companies for some degree of exclusivity to protect their commercial position and the interest of other industrial sectors in technology transfer. There should also be protection against non-exploitation by industrial partners.

4.13 IPR was one of the issues addressed in the recent review of the LINK programme conducted by Segal Quince Wicksteed Ltd. In its response⁸ the Government have accepted that the guidelines issued to potential participants should not state any Government preference on IPR ownership but should encourage free negotiation between partners.

Government supported collaborative research programmes

Conclusions

4.14 The above analysis suggests that there should be no prescriptive rules on the ownership of IPR in collaborative or sponsored research involving publicly funded research organisations. The details of specific agreements between partners on ownership, user rights and royalty payments should reflect the particular circumstances.

4.15 In addition to the needs of private sector sponsors to underpin their investment in subsequent development and the needs of research organisations to pursue their research interests, including dissemination through publication without undue restriction, greater emphasis might be placed on arrangements to maximise the exploitation of the research and to create incentives to the research community to encourage innovation and enterprise.

4.16 In particular, there may be cases where government Departments could allow research contractors to own the IPR while preserving their own interests through appropriate arrangements for dissemination and exploitation rights. The examples of the Departments of Trade and Industry and of Transport (paragraphs 2.49 to 2.53) could be possible models for this type of approach. Further consideration is needed as to whether publicly funded research organisations should retain their share of the revenue earned from licensing or from royalties, as a possible contribution to seedcorn funds.

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ORGANISATIONS CONSULTED

Companies

GEC
Thorn EMI
ICI
BP
Unilever
Fisons
Agriculture Genetics Company Ltd
Rolls Royce
Ford
Lucas
IMI
Glaxo Holdings

Higher Education Institutes

U. Strathclyde
U. Cambridge
Imperial College
U. Newcastle
South Bank Polytechnic
U. Leeds
U. Edinburgh
U. Surrey
U. Sheffield
U. Dundee

Research Councils

SERC
NERC
AFRC
MRC

Government Departments

MAFF
DTI
MOD
DOE
OST
DoT
DEn
DH

Others

The Patent Office
British Technology Group
Trade Marks Patents and Designs Federation
University Directors of Industrial Liaison
Association of Industrial Liaison Officers
Association of British Pharmaceutical Industries
AEA Technology
Interdepartmental Group on Intellectual Property

Intellectual property and its protection

A-1 Intellectual property can be found in many different forms: inventions, written works, software, images, trade marks, designs or plant varieties. The rights to which the originator is entitled have been developed to meet the needs of the particular sector of the marketplace to which each form applies. Ownership of IPR generally provides only a right to stop others doing something, it does not give the owner a positive right to do something he could not otherwise do. The scope of these negative rights depends on whether or not official registration is required. If it is, the law confers a limited monopoly on the owner which means that no-one is entitled to exploit the subject matter of the rights, not even someone who develops the same invention or design independently of the registered owner of the rights. When, as with copyright, registration is not required the only protection is against copying. If someone develops the same thing independently he is free to exploit it.

Patents

A-2 Patents are intended to cover new processes and products which are of practical commercial utility. They are granted for inventions in most fields, although there are certain areas where patents cannot be obtained, eg for mathematical rules and schemes, and methods of surgery, therapy or diagnosis. The basic idea of the patent system is that in exchange for publishing details of the invention and how to make it work, the inventor obtains from the state a limited monopoly over his invention for a period of 20 years. At the end of this period the invention is available for the public to use freely.

A-3 A patent must satisfy conditions of novelty embodied in a series of claims made by the inventor which define the area of monopoly he is seeking. Patents are not intended to protect ideas as such, only the resulting products or processes which are practically useful. The patent must also describe how the idea could be put into practice. If a competitor's product falls within the scope of any of the claims then it may represent an infringement of the patent. Even after the issue of a granted patent duly examined by the Patent Office, it is still open to third parties to challenge its validity in the courts.

A-4 A patent application is first subjected by the Patent Office to a preliminary examination to ensure that formalities are complied with and a search to identify the documents which will be relevant to a consideration of novelty and inventive step. The applicant may then, if he wishes, amend the claims. The application is published as originally filed together with any amended claims and the applicant has to decide within 6 months of publication whether he wishes to proceed with the application. If so, the Office carries out a substantive examination as to novelty, inventive step and the other legal requirements. The patent is granted as soon as possible after the application is in order – which it must be within 4 years 6 months of the first filing.

A-5 To allow time to consider in which foreign countries to seek protection and prepare the necessary application, the Paris Convention (1883) permits the applicant to make a single first filing in one country and then to file corresponding foreign applications within one year with the same priority date as the original.

At this stage it is possible to put additional material into the patent application, but any added subject matter cannot take the original priority date. This effectively allows a 12 month period in which the inventor can judge whether it is worth proceeding with the application. This period can be considerably extended by the use of the PCT system referred to in the following paragraph.

A-6 To avoid duplication in patent search in different countries, and to a lesser extent, examination, the Patent Cooperation Treaty (PCT) enables the inventor to file one application in his home Patent Office designating any of 50 countries in which he is interested in acquiring protection. The Patent Office then examines the case for formal defects and arranges to have a single search carried out by an internationally recognised searching body. The applicant can decide, after learning the result of the search and, optionally, a preliminary examination as to patentability, whether to pursue. If he decides to proceed, the report is passed on to each of the national Patent Offices designated for individual examination leading to grant of a patent. The Patent Cooperation Treaty route can be particularly attractive for public sector research organisations and for SMEs. The initial cost is modest and decisions to proceed with the application can be extended from the normal 12 months to as much as 30 months after the filing date. In 1990 there were a total of 19,000 filings under this scheme, corresponding to 400,000 national applications. Not all nations have joined the PCT system.

A-7 Under the European Patent Convention (EPC), the European Patent Office was set up in Munich. A single application is filed designating the countries in which protection is sought and a single search of the relevant state of the art is carried out. A report, which is published, is sent to the applicant to enable him to assess the prospect of obtaining grant of a patent. If the applicant decides to proceed the EPO carries out the substantive examination for novelty, inventive step and industrial application and, if satisfied, grants a set of national patents in the countries concerned.

A-8 In the UK, filing a patent through the UK Patent Office can cost as little as £25. This establishes a priority date and provides twelve months in which to formulate claims and decide whether to make some form of international filing. No search will be carried out. For this a further sum of £130 is payable within twelve months and another £130 is required for substantive examination, making a total of £285. This provides protection for 4 years after which annual renewal fees are payable, starting at £110 and increasing over the remainder of the patent term. It is not obligatory to have a professional Patent Agent draw up the patent specification but it is recommended. The additional cost is approximately £1000.

A-9 In spite of recent moves to harmonise national patent law in the major industrialised nations, considerable variations remain. The structure of costs for the various stages leading to grant of a patent can show particular variability, especially if translation is required. For example, filing in the European Patent Office is considerably more expensive than in the UK. It costs around £3000 for protection in 6 countries. One major company has indicated that the total cost of filing a patent in 12 European countries is around £12,000 over the first five years. In Japan, it is £3,600; in the US, £2,700. Over the whole life of the patent the total cost, including renewal fees, is £75,000.

A-10 A patent may be taken out in the name of the inventor or his employer. Where the invention is made in the course of an employee's normal occupation or could reasonably be construed as such, the invention is owned by the employer. The employee is legally entitled to a personal reward from his employer if the patent proves to be of outstanding benefit.

Copyright

A-11 Copyright affords protection from plagiarism of the fine arts and literary and musical works. However in the UK protection also covers many works which have a fairly functional purpose such as circuit diagrams and operating instructions. Literary copyright has also been used to cover computer software. Copyright covers not only exact reproduction but also copying in which a substantial part of the copyright work has been taken even though there may be substantial differences.

A-12 Copyright protection is granted for a period ending 50 years after the death of the author. There is no need to register copyright in a work; it arises as soon as the work is created. Subject to agreement otherwise, copyright is generally held by the individual who created the copyright work, unless such creation is part of his job in which case it will be held by his employer. A person commissioning a work does not automatically own copyright in it.

A-13 Responsibility for the administration of all Crown copyright material rests with the Controller of HMSO. In those cases where the copyright element is incidental to other IPR, in an invention for example, Departments have delegated authority to deal with the IPR in its entirety. When the copyright element is an integral or key part of the IPR, as in computer software for example, the general policy has been to allow the copyright to be held by the developer and for the Crown to seek a share of revenue generated by any subsequent commercialisation. Crown copyright lasts for 50 years beyond the date of any commercial publication up to a maximum of 125 years.

Unregistered Design Right

A-14 This protects the design of any aspect of the shape or configuration of an article with exceptions relating to those aspects of the design intended to match or fit with other articles or to the surface decoration of the article. It is a hybrid which bridges copyright and registered designs, though with a limited life. The right expires 10 years after first marketing or 15 years after creation of the design whichever is the earlier. Ownership is the same as for copyright with the one important difference that a person commissioning a design will own rights in it.

Registered Designs

A-15 These protect the aesthetic appearance of novel designs. Registered designs are similar to patents in that the designer permits his design to be published in return for securing limited monopoly rights. The protection lasts for 25 years. Ownership has now been brought into line with that for unregistered design rights (Copyright Designs and Patents Act, 1988).

Plant Variety Rights (Plant Breeders Rights)

A-16 To overcome the difficulties for a new plant variety of satisfying the normal conditions of patentability, plant breeders are able to protect their commercial interests through plant variety rights (PVR). This allows rights of limited monopoly to the breeder of a new variety to control the sale of seed. The PVR system is governed by the *Union internationale pour la Protection des Obtentions Vegetales* (UPOV) last revised in 1991, to which 18 countries, principally the USA, Japan and most countries of Western Europe, are bound.

A-17 The rights cover only the particular variety which has been registered and do not cover any derived variety. Other breeders are free to use the protected variety as a source for the creation of further varieties. Unlike a patent the creator need not describe how the new variety was obtained and, although a deposit of a sample of the propagating material is required, this is not made publicly available.

A-18 A potential variety for which PVR is sought must be examined officially in field trials and in some cases through chemical analysis in order that it meets the requirements of "distinctness, uniformity and stability". Trials can take 2 or 3

years. At present, official trials in the European Community are conducted on a national basis, but draft legislation from the EC may establish a European Plant Breeders' Rights Office able to grant European PVR as an alternative to national PVR.

Biotechnology

A-19 Biotechnology can be defined as the exploitation of biological materials and processes for industrial purposes, encompassing

- the use of micro-organisms (eg. bacteria, fungi, viruses)
- the use of sterile culture techniques to grow or modify plant or animal cells or tissues
- the production and use of antibodies which specifically recognise certain biological or chemical materials
- the use of recombinant DNA technology (genetic engineering) to modify plants, bacteria etc.

A-20 Living organisms differ fundamentally from other patentable inventions in three ways. First, they can reproduce or replicate. Once even the smallest sample of a new micro-organism is obtained it is necessary only to keep it in the right environment to have, for all practical purposes, an infinite supply. Second, it is subject to spontaneous modification and may also be stimulated to mutate in a controlled way. After many generations the change could be substantial. It is difficult to define the point at which a new micro-organism has evolved. Third, the organisms are usually too complex to describe precisely in the way that would be expected in a conventional patent. It is almost impossible to prove two organisms are the same in all respects.

A-21 Patent law in the UK and most other countries is such that it is very unlikely that patents for naturally occurring proteins, genes and other biological material would be valid; there has to be some human inventive activity. Usually the biological material will have been modified in some way but in certain cases the isolation of a pure sample of a material previously existing in nature can be regarded as sufficient human intervention for the grant of a patent. However, the assessment of patentability in this field is difficult and has yet to be fully considered by the courts. Processes involving microbiological materials and the products of such processes are patentable.

A-22 It is a fundamental tenet of UK patent law that the specification and claims of a patent application should be in the public domain. Since the complexity of biological material precludes an adequate description, reference can be made to a sample in a depository. The Budapest Treaty allows for a sample of the material to be deposited in an approved culture collection where it is maintained in good condition and can be made publicly available once the corresponding patent application has been published. Unlike a normal patent applicant, the depositor of a microorganism actually has to make material embodying or relating to the invention available as opposed to just a description. In recognition of this, the European and UK Patent Offices have introduced the option of having the deposited material available between publication and grant only to an independent expert.

A-23 Biotechnology research is unlikely to produce new varieties of crop plants but can provide the parental material from which new varieties will eventually be bred. New plants derived by biotechnological processes give rise to a conflict between the fundamentally different protection provisions of patent and plant variety rights. The latter are limited to the production and sale of the variety and the sale of seed for sowing. They specifically do not extend to the saving of seed from a current crop for sowing in a later season, nor to the production and sale of food products derived from the seed. Free use of the protected variety as source

material for new varieties is permitted unless commercial production requires repeated use of the original. The application for plant variety protection is determined essentially by reference to the living material itself. The practical impossibility of committing breeding methods to paper in such a way as to provide a reproducible process was the fundamental reason for judging the patent system as inappropriate in this area. Plant breeders obtain a return on the long term investment in breeding processes by the licensing of Plant Variety Rights. But no breed can be monopolised through absolute ownership of subsequent generations.

A-24 By contrast, patents for micro-organisms cover all sub-cultures of the defined micro-organism which retain its relevant characteristics and which do not in any significant respect constitute a different organism. In addition, all uses of the defined micro-organism fall within the scope of a patent. Any use of the micro-organism for a commercial purpose will be an infringement. If patent applications are granted for plants derived through genetic engineering, the extent to which subsequent generations are subject to patent restriction needs to be clarified. In the US the two systems co-exist – apparently successfully. In Europe, the position is not yet resolved.

Trade Marks

A-25 Trade Marks (including Service Marks) are symbols which are used on or in association with goods or services to denote to the consumer a particular source of origin or supply. They are an element of the greatest importance in the goodwill of a business. Registration of trade marks provides proprietors with a relatively simple means of combatting infringement, compared with the exacting process required to establish rights under common law.

A-26 The Trade Marks Registry examines applications to ensure that they are distinctive; that they are not deceptive; and that they do not infringe prior registered rights. All applications which are accepted are laid open to opposition by any interested party, before registration. Registration is initially for seven years, renewable thereafter for unlimited successive periods of fourteen years, at the application of the proprietor. It is planned to adopt common registration and renewal periods of ten years, and to overhaul the trade mark law more widely, as soon as the legislative timetable permits. This overhaul will take account of modern business developments and harmonisation provisions within the European Community. It will also be shaped by the approaching establishment of a unitary system of trade mark registration within the Community with which national registration systems will co-exist.

A-27 The current fee for the process up to registration and for the first seven years of registration is £185. The renewal fee is £275.

British Technology Group

B-1 The British Technology Group is an international technology transfer organisation with a world wide capacity to identify, develop, protect and exploit the product of researchers' creativity. It was formed in 1981 as a result of the merging of the two statutory corporations, NRDC and the NEB, but its history goes back to 1949. It employs 190 people in the UK and has been profitable for 25 years. Under the terms of the British Technology Act 1991 the business of the two corporations has now been vested in a new public limited company, British Technology Group plc. The objective of BTG plc remains the profitable exploitation of technology through its two main core activities:

Transfer of technology from public and private sources world-wide to manufacturing, marketing or service organisations under licence;

The provision of funding on commercial terms for companies undertaking innovative product development programmes.

Within the technology transfer activity is included the assessment of the commercial potential of ideas, patent protection and enforcement, provision of development funds, marketing and licensing and sharing the rewards of this activity with the source of invention.

B-2 Until 1985, BTG had a monopoly right of first refusal on all IPR arising out of public-funded research in HEIs, Research Council Institutes and GREs and indeed, as a public body itself, had an obligation to consider all ideas brought to its attention. Since the removal of the monopoly, BTG continues, in a competitive market, to handle IPR from many sectors of publicly funded research as one of a number of companies offering this service.

B-3 BTG actively seeks out inventions with commercial potential. Once an invention is accepted for exploitation BTG takes responsibility for patenting it at its own expense, funds further development if this is considered necessary to improve the prospects of successful international licensing, negotiates licence agreements, and sues infringers if necessary. Initial evaluation of the commercial potential of an idea is carried out by one of 47 executives in one of 4 Operating Divisions covering science, engineering, pharmaceuticals and electronics and IT. One of BTG's main strengths is this breadth of technical and business expertise.

B-4 In addition BTG has one of the largest Patents Departments in the country enabling it to draw up forceful patent specifications and to build a stockade of patents around the major inventions to achieve maximum protection. The strength of the patents filed by BTG has been put to the test recently in winning major legal actions against Johnson and Johnson and against the Pentagon for infringement.

B-5 Where the intellectual property acquired by BTG is judged to be not yet in a position to be immediately licensable, BTG uses its own internally generated funds to develop it to the stage of being of commercial interest. In 1990 BTG spent

nearly £10m on the development of inventions, much of this in the originating research institutions.

B-6 Once licensing agreements are made, BTG retains 50% of the licence income and the institution and inventor share the other half. To simplify the arrangements for bringing matters rapidly to the attention of BTG and to ensure they are dealt with speedily, many research organisations have an umbrella agreement with BTG. This 'Technology Transfer Agreement' whilst not binding on either side, in effect means that BTG is that organisation's chosen route for exploitation.

B-7 The statistics of BTG's operation make impressive reading. For the year ending 31 March 1991, from a portfolio of 1708 inventions from public sources, 9070 patent applications had been filed with 485 licence agreements in force. 1991 licence income exceeded £30m of which nearly £8m was shared with sources. BTG's revenue grew by 28% over the three years 1989-91. Profit before tax reached a peak of £9.5m in 1990 but this fell to £6.5m in 1991 principally because of the cost of establishing the new BTG USA operation and also an increase in the proportion of revenue shared with inventors. From a total of 774 revenue earning inventions handled since 1949, ten have earned in excess of £1m including one, cephalosporin antibiotics, which has earned in excess of £100m. Among the top ten revenue earners are examples across several of the Operating Divisions.

B-8 BTG is now a large company and is already highly selective in the items it will accept. After privatisation it will become more so. Its major role therefore will be in handling those inventions which have the potential for a significant return, where the strength of its expertise can be brought to bear to ensure that these inventions are exploited to the full. BTG is unlikely to show interest in small scale exploitation projects from research organisations. There is therefore a clear separation of spheres of interest and maximum effectiveness: research organisations can handle smaller scale projects themselves but turn to companies like BTG to make the most of the big opportunities.

B-9 BTG has had many critics over the years but it has successfully seen off most of its rivals in a very difficult business. Its reputation today is high internationally both in academic and industrial circles.

Report of the Oulton Committee on Costs of Patent Litigation (1987)

C-1 A Working Group under the chairmanship of Sir Derek Oulton, the Permanent Secretary to the Lord Chancellor, was set up to consider in detail four possible models to simplify and shorten patent litigation procedures and in particular to reduce their cost. Membership of the group was drawn from DTI, the Association of British Chambers of Commerce, the Chartered Institute of Patent Agents, the Patent Bar Association, the Patent Solicitors Association and the Trade Marks, Patents and Designs Federation.

C-2 The problems of cost, delay and of the complexity of the legal process were identified in the Nicholson Report which recommended a right of re-examination of the patent in dispute by either party before the case was brought to court. The White Paper⁹ "Intellectual Property and Innovation" (1986, Cmnd 9712) accepted the guiding principle that intellectual property rights should be enforceable simply and with the minimum of expense but rejected the option put forward by Nicholson in favour of broader measures. The White Paper suggested that actions should be required to be brought in the first instance before the Comptroller General of the Patent Office who would be given the full powers presently available to the Court. It also suggested that proceedings before the Comptroller should be more inquisitorial and that automatic appeal from decisions of the Comptroller should be replaced by appeal by leave, either of the Court or of the Comptroller. The response to these proposals from the legal profession was mixed, with both strong support and strong opposition.

C-3 The Oulton Committee considered 4 options:

- (i) The White Paper proposals
- (ii) A Patent Office Court, presided over by a Judge
- (iii) A distinct new Court
- (iv) A Patents County Court

C-4 Although the White Paper proposals offered some advantages by introducing a pre-trial conference for clarification of the big issues likely to arise at the trial, it was not clear that the changes would offer opportunities for savings. At worst they could simply add a fourth tier of litigation. Also, because the hearing would be presided over by a member of the executive rather than by a Judge, there could be problems of jurisdiction if the action included aspects of commercial law other than patent infringement. These disadvantages of the White Paper proposals were felt to be unacceptable by the Oulton Committee.

C-5 A Patent Office Court, presided over by a Judge was seen as overcoming some of the limitations of the White Paper proposals while preserving many of the attractive features. However, there were concerns that it would fail to provide sufficient independence from the Patent Office.

C-6 The creation of a new court would run counter to current trends toward a more flexible use of resources. The volume of work it might have to deal with was uncertain and it might be seriously under-used. This was seen as the least attractive of the models.

C-7 The recommended option was an extension of the existing County Court system, a Patents County Court, although the recommendation was not unanimous. At the outset one London County Court would be designated the patents County Court with an aggregate jurisdiction to cover the whole of England and Wales. If justified by demand further courts would be designated in regional centres.

C-8 One full-time judge should be appointed along with two or three deputies who, when not occupied in the Patents County Court would be available to hear other civil matters. Powers should include determining claims for revocation of a patent, ordering injunctions and the issuing of writs of sequestration. Actions would be considered first by the Patents County Court subject to a financial limit of £100,000 awardable in damages. If a higher award was considered likely at the pre-trial review the matter would be passed to the full Patent Court. The plaintiff retains the right to have either court consider his claim if the likely level of damages is below the £100,000 limit.

C-9 The report of the Working Group concludes with the following "....patent litigation in England can, and must, be made cheaper than it is at present ... we see this being effected by the broadening of the rights of representation and audience. A major element of the present expense is the number of professionals involved and the number of hours worked by each: the aim must be for fewer people to be paid for fewer hours ... under our proposals it would in future be possible for one professional to conduct a case before the Patents County Court from the beginning to its conclusion."

C-10 A Patents County Court was set up under Judge Peter Ford at the Edmonton County Court at Wood Green in September 1990, adopting in its Rules nearly all the principles that the Oulton Committee sought to establish. To date the Court has accepted 47 cases of which 29 have been commenced. One case has been decided, following a one day trial.

Patent Office Marketing Division

D-1 In response to one of the recommendations of the Nicholson report in 1983, the Patent Office has set up a small Marketing Division of about 10 people with an annual budget of £800k to promote Patent Office services. Since the Patent Office has become an Executive Agency within DTI these funds come from overall Patent Office fee revenue and compete with other business priorities. Within its promotion of specific services offered by the Patent Office, the Marketing Division also produces a great deal of educational material targeted at potential users of the intellectual property system.

D-2 Examples of the education activities include:

- (a) *Road-show seminars* for businessmen. A total of 47 seminar presentations have been made around the country organised on a regional basis through local DTI offices and Chambers of Commerce. They are generally held in the evening, last around 2-3 hours and are free apart from the cost of a buffet meal. The style of presentation is light-hearted but business-like to appeal to managers in SMEs – the principle target. The seminars try to dispel misconceptions about cost and complexity and explain in plain english why IP protection matters. They are apparently well received by those who attend but a lack of resources has prevented follow-up measurement of the effect on SME usage of the patent system. Similar roadshow presentations have been made to some sections of MAFF, to a few universities and polytechnics and to the scientific staff of one large multinational company.
- (b) *One day courses*: a number of courses have been devised, tailored to the needs of industrial liaison officers in HEIs. Small groups are taken through the practical details of filing a patent and given hands-on experience of drawing up patent specifications and claims. Additional one day courses on licensing have also been prepared. The courses are again provided free of charge except for meal and beverage costs. The long-term aim is to develop modular courses on IPR which could be incorporated into all HEI science and engineering degree courses.
- (c) *Fact sheets*: an extensive range of plain english fact sheets covering different forms of intellectual property and how to use the protection available is produced and distributed free of charge on request. Last year alone 35,000 information packs were sent out, a total of 220,000 separate booklets. Short videos are also now available, priced between £30 and £200.
- (d) *School materials*: single page fact sheets have been prepared for use in schools with additional material available on request. Demand has been steady. A major proposal to collaborate with an educational publisher to produce a wider range of material for schools was not proceeded with because the cost was considered excessive.

D-3 Further information on the activities of the Patent Office Marketing Division can be obtained from:

Marketing and Information Service
Hazlitt House
45 Southampton Buildings
London WC2A 1AR

Some international comparisons

E-1 No comprehensive study has been made of practice in management of IPR in other countries as part of this report. The following borrows heavily from the work done for the Cooper Report⁷. Since the research institutions in other countries fulfil different roles and the pattern of industry/university interaction is also different, simple comparisons with the UK are not possible. Nevertheless, there are a number of common features which bear on the situation in this country.

United States

E-2 In the US it is now common practice for the HEI to retain ownership of the IPR it generates in a sponsored research project, even if the work is done collaboratively with the sponsor. An industrial sponsor is normally expected to bear the costs of any patent applications that they wished to see pursued and would receive a limited duration option to acquire either a royalty-free non-exclusive licence or an exclusive royalty-bearing licence. Exclusive licences are often limited in terms of technical field or geographical area leaving the HEI free to licence other companies outside these areas. Safeguards are provided against non-exploitation.

E-3 If government funding is involved, the US government retains a royalty free licence to use any invention on its own behalf anywhere in the world. Another condition imposed by the government is that licence income from project results should be returned to the project.

Japan

E-4 Most sponsored research in national universities is carried out collaboratively with the sponsor. It is common practice for patents to be jointly owned by the HEI and the industrial partner. The company has a priority right of exploitation for a set period of not more than 7 years, but a third party is entitled to a licence if there has been no exploitation after 2 years. Royalty income is usually split roughly equally between the HEI and the industrial partner.

Germany

E-5 Germany does not have a wide variety of collaborative ventures. The most common model involves joint research with multiple sponsors. In general, all participants, including the government, have a royalty free right to use and exploit any foreground generated in the project. In addition, all other firms have a right to a licence on payment of a royalty and publication of the results is compulsory.

E-6 The Fraunhofer Institute for Systems Technology and Innovation Research has developed a new patent information system which is especially geared to the needs of small and medium sized enterprises – this despite an estimate from the Federal Ministry for Research and Technology that more than half of all patent applications already come from the SME sector. The development was financed by the Ministry of Economics. The new service is being offered by the 12 branch offices of the German Patent Office throughout Germany.

France

E-7 Most French government-funded research is done by state research organisations whose laboratories are commonly located in universities.

E-8 There has been concern in France over the apparent reluctance of French industry to protect its innovations through patents. This was one factor leading to a recent reform of French patent law to entitle employee inventors to a financial reward from their employers, who own the invention.

E-9 The French Patent Office part supported a comparative study showing a strong correlation between patent filings and commercial trade balance for six major industrialised nations in different sectors of activity.

**European multinational
programmes**

E-10 The European Commission has issued a model contract for participants in its collaborative research programmes under the Framework Programme (ESPRIT, BRITE, CUBE etc). Each contractor (HEI or company) owns the foreground IP it generates and has the right to use another contractor's foreground for further research and development. Industrial contractors have a non-exclusive right to exploit such foreground – on a royalty free basis unless the foreground was generated by an HEI. In case of non-exploitation, licences must be made available on reasonable terms to any Community applicant with a legitimate interest.

E-11 Under the terms of research contracts placed by the European Space Agency, ownership of IPR generally remains with a contractor (HEI or company), subject to ESA and member states retaining the right to free use in member states within the space field and the payment of a royalty to ESA if exploited outside participating states or for any non-space applications. The contractor then gets a free non-exclusive licence.

1. The first part of the paper is devoted to a general discussion of the problem of the origin of life. It is shown that the problem is not only a scientific one, but also a philosophical one. The author discusses the various theories of the origin of life, and shows that the most plausible one is the theory of spontaneous generation.

2. The second part of the paper is devoted to a detailed discussion of the theory of spontaneous generation. It is shown that this theory is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor.

3. The third part of the paper is devoted to a discussion of the evidence in favor of the theory of spontaneous generation. It is shown that the evidence is of two kinds: (a) the evidence of the fossil record, and (b) the evidence of the present-day world. The author shows that the fossil record is in complete agreement with the theory of spontaneous generation, and that the present-day world is also in complete agreement with the theory.

4. The fourth part of the paper is devoted to a discussion of the objections to the theory of spontaneous generation. It is shown that the objections are of two kinds: (a) the objection that life is too complex to have arisen spontaneously, and (b) the objection that the fossil record is not in agreement with the theory. The author shows that these objections are unfounded, and that the theory of spontaneous generation is the only one that can account for the facts of the fossil record and the present-day world.

5. The fifth part of the paper is devoted to a discussion of the implications of the theory of spontaneous generation. It is shown that the theory has important implications for the study of the origin of life, and for the study of the evolution of life. The author shows that the theory is the only one that can account for the facts of the fossil record and the present-day world.

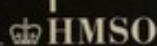
6. The sixth part of the paper is devoted to a discussion of the history of the theory of spontaneous generation. It is shown that the theory has been proposed by many different people, and that it has been accepted by many different people. The author shows that the theory is the only one that can account for the facts of the fossil record and the present-day world.

7. The seventh part of the paper is devoted to a discussion of the future of the theory of spontaneous generation. It is shown that the theory is still a subject of active research, and that it is likely to be accepted in the future. The author shows that the theory is the only one that can account for the facts of the fossil record and the present-day world.

8. The eighth part of the paper is devoted to a discussion of the conclusions of the paper. It is shown that the theory of spontaneous generation is the only one that can account for the facts of the fossil record and the present-day world. The author shows that the theory is the only one that can account for the facts of the fossil record and the present-day world.

9. The ninth part of the paper is devoted to a discussion of the bibliography. It is shown that the bibliography is a list of the books and articles that have been consulted in the preparation of the paper. The author shows that the bibliography is a list of the books and articles that have been consulted in the preparation of the paper.





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