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Published Quarterly for the Information of Subscribers

Spring 1997

FOUNDATION FOR SCIENCE AND TECHNOLOGY

FOUNDATION FOR SCIENCE AND TECHNOLOGY

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TECHNOLOGY, INNOVATION AND SOCIETY

THE JOURNAL OF THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

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Typesetting by <i>Light Touch Typesetting.</i> Electronic page assembly by <i>LPS</i> , London. 0171-231 1376				
Printed by Aztec Press, Cardiff. 01222-464614				

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ISSN 0951-2918

FOUNDATION NEWS SPECIAL Collaborative event with French: Foundation hosts "return match" in London

In the autumn of 1995 the Foundation took a group of some 30 members to Paris to hold an event jointly with the Paris Chamber of Commerce and Industry. On 28 November 1996 some 20 French attended a "return match" with the Chamber, The Royal Society allowing the Foundation to hold the event in their rooms, and the event was sponsored by GEC Alsthom.

The topic was "High value and high technology industries in the European Union - possible roles for France and the United Kingdom". The speakers were M. Alain Bensoussan, President of CNES, and Dr John Forrest, Deputy Chairman, Trans-communications Limited. After lunch M. Hubert Flahault, President of the Paris Chamber, spoke. The event was under the chairmanship of the Lord Butterworth, and there was, of course, a stimulating discussion. There was a good cross section of French including, for example, Dr J Bordé, Deputy Director for Strategy, CNRS, M. Jean-Jaques Dordain from the European Space Agency, M. J L Funk Brentano, Délégue à la Communication du CADAS, Mme Jöelle Garriaud-Maylam, Conseil Supérieur des Français de l'Etranger, who helped so much with the 1995 event, M. Bruno Magne, Managing Director, France Telecom UK, M. Bernard Michaux from elf, Professeur Michel Ronis, Ministère des Affaires Etrangeres and M. Richard Zisswiller from the Paris Chamber and also other French guests. Professeur Henri Gibert, Science Counsellor at the French Embassy in London, did much to advise and assist generally. The papers of the three speakers will appear in the next issue of the Journal.

"High value and high technology industries in the European Union - possible roles for France and the United Kingdom"

The fire in the Channel Tunnel prevented the French coming by that route which would have been the reverse to that taken by the British team the year before. To make matters worse, Air France chose to strike for two days, and so there were inevitably a few last-minute cancellations. However, attendance was good and many stayed for the reception given by the French Ambassador in his residence in the evening.

A small party remained for the visit to the Thames Water London Ring Main on the following morning, and there is a separate report of that in this issue.

By the end of the visits there were wishes from the French that there should be a further event in France in 1997.



▲ Lord Butterworth CBE DL calls the meeting to order, introducing Monsieur Hubert Flahault, President of the Paris Chamber of Commerce and Industry, sitting on his right. On his left are Monsieur Bensoussan and Baroness Hooper.

FOUNDATION NEWS SPECIAL



▲ Monsieur Flahault, President of the Paris chamber of Industry and Commerce, addresses members and guests at the lunch following the meeting held in the rooms of the Royal Society at which the Foundation welcomed many from France.





FOUNDATION NEWS SPECIAL



▲ Dr David Grant (right), Research Director of GEC, and Mr Buck of European Gas Turbines Ltd at the joint meeting of the Foundation and the Paris Chamber of Commerce and Industry. GEC-Alsthom generously sponsored the event.

Foundation Medal



On 28 January 1997 Oscar Roith CB FEng was presented with the Foundation Medal immediately before the lecture and dinner discussion under the title of 'University Research. How Should Limited Funds be Deployed?' In presenting the medal, Lord Butterworth said:

"Mr Roith was my Deputy Chairman, and also the Lord Lloyd of Kilgerran's before me. I gather his association with the Foundation started in 1982 when he was Chief Engineer and Scientist at the Department of Trade and Industry. He played an important role in the Foundation's first major event. Then later during his time as Deputy Chairman he helped enormously to guide and develop the Foundation. He was a great stalwart to me and my predecessor and, through his membership of the Foundation, he remains a friend and great ally."

FOUNDATION NEWS SPECIAL

Thames Water Sponsors Visit to London Ring Main during French Visit

A visit to the London Ring Main at the New River Head site by a small party of French and British ended the joint event in London with the Paris Chamber of Commerce and Industry. Welcomed by John Sexton, Director Environment and Science, who is well known to many other members of the Foundation, there were briefings on the purpose, construction and use of the London Ring Main and sufficient information as a basis for informed and indepth questions and discussion. A visit to the plant, facilities and display followed before the final question session chaired by The Rt Hon the Lord Jenkin of Roding, a Vice President of the Foundation.



New Associate Members

ADWEST Group plc Contact: Mr Denis E Filer CBE TD FEng, Chairman

University of Glasgow *Contact*: Professor Sir Graham Davies FEng FRSE, Principal & Vice Chancellor

Coutts & Co *Contact*: Mr Douglas C Carr, Client Manager, Technical Sector

SAP (UK) Limited *Contact:* Mr Martin Blomley, Director

University of Ulster *Contact*: Professor P G McKenna, Dean, Faculty of Science **European Public Policy Advisers** *Contact*: Jeanie Matthew, Director

British Safety Council *Contact*: Sir Neville Purvis KCB, Director General

University of Keele *Contact*: Professor G D Williams, Dean of Science

SHARED SPONSORSHIP SCHEME

The Foundation is grateful to those who have so far joined the Shared Sponsorship Scheme for 1997 (others would be most welcome). The Scheme is extremely valuable to the Foundation since it adds flexibility to the preparation of its programme. BP International Limited Comino Foundation Esso UK plc Glaxo Wellcome plc ICI ✓ Members of the party of French and British who visited the Thames London Water Ring Main being briefed by John Batchelor just above the Ring Main at the New River Head site in Islington.

Possible future Foundation meeting with Belgians in Brussels

In the Autumn of 1996 Dr Richard Haas CBE, a Vice President of the Foundation, arranged for Lord Butterworth and the Director to meet his Imperial and Royal Highness the Archduke Lorenz von Habsburg in Brussels with a view to arranging an event there jointly with an organisation in Belgium. In early February Dr Haas and the Director were introduced to Count Yves du Monceau who is President of the 'Association Belgo-Britannique' and a member of the Upper House in Belgium. It is intended that a small meeting of interested parties should take place between the Foundation and the Association in Brussels later in the year.

THE GERMAN SCENE

As reported in the last issue, a prestigious event was held in Berlin on 31 October 1996. It was organized jointly by the Foundation with the London-based German–British Chamber of Industry and Commerce, the Confederation of German Industry (BDI) and the Economic Initiative for Germany (WIR). Frau C. Yzer, Parliamentary Secretary of State in the German Federal Ministry for Education, Science, Research and Technology was the principal guest at dinner in the Kempinski Hotel, Bristol, under the Chairmanship of Herr J.C. Gehrels, Chairman of the German–British Chamber of Industry and Commerce in London, and also Chief Executive of Siemens plc, Bracknell.

Cornelia Yzer MdB*

Introduction

The world has changed dramatically within a few years. Where would this be felt more clearly than in Berlin –the city once separated by a wall and barbed wire? In the wake of political upheavals, the world economy, too, is undergoing a process of restructuring. The once established circle of industrial nations is no longer a closed group.

The end of the Cold War made a market economy possible in the Central and Eastern European countries. Poland, the Czech Republic, Hungary and also Russia and other former Soviet Republics offer new markets, but at the same time they are also new competitors. In addition, countries in the Asian-Pacific region have in the past decades developed with a dynamism which makes it the world's strongest growth region today.

Globalization is therefore the order of the day for all who wish to keep up in international competition.

Whenever Germans and Britons talk about the phenomenon of globalization and the new challenges to be met by industry everywhere, they do so against the background of their very different economic histories.

British economists, like Ricardo Mill and others, were the first to explain why free trade increases welfare for all participants. These ideas bore new fruit only a few years ago with the conclusion of the Uruguay Round.

As the heart of the British Empire and later of the Commonwealth, Great Britain made free trade the maxim of its economic policy at a very early point in time. Even in the first phases of the first and second industrial revolutions, British industry's international capital links reached a high level.

Up until today, British companies are the largest European group among the 100 biggest multinational companies. Also, Great Britain has in the past years used its chances actively and pursued a very successful policy to attract international investors.

German industry, at the heart of the European continent, has developed differently. Later than Great Britain, Germany became an extremely successful industrialized and foreign trade country. Also, with regard to their current international presence, German enterprises tend to be latecomers. But the current dynamism of German enterprises is remarkable.

It may well be that, also due to their different historical backgrounds, globalization has, for many German people, become the dominant symbol of anxiety in regarding the future. These fears have probably also been intensified by the fact that no widely read paper has, in the last few months, refrained from presenting dramatic comments on the global economy.

A considerable contribution to this unfortunate development has also been made by the political opposition in Germany,

* Parliamentary State Secretary in the German Federal Ministry of Education, Science, Research & Technology Summary: Frau Yzer discussed the implications of globalization — industry's answer to the gradual coalescence of world markets into one internal global market — with special reference to Germany. She also emphasized the need to establish effective policies on innovation and pan-European research. Stating that economic relations between Germany and Britain were closer than they had ever been, she called for continued active collaboration between the two countries, together with France.

which, until this day, has not found an answer to globalization. It either denies the very existence of this development or calls for new international rules to meet competition.

In Germany, therefore, we must make it clearer than ever: globalization is not synonymous with horror visions but a chance and a challenge for an export-dependent country like Germany.

Globalization

Globalization is industry's answer to the gradual coalescence of world markets into one global internal market. This development has been facilitated by the reduction of trade barriers, the large-scale convertibility of currencies, the increase in the mobility of people and capital, and the technological and organizational advances in the fields of communications and worldwide transport. If the output of a large factory for advanced industrial goods, such as semiconductors, can be packed into only a few trucks or Jumbo jets, and a day's production fits into a briefcase, then transport costs only play a minor role.

Globalization stands for product markets growing together across national borders, for ever stronger international production and trade links in the form of direct investments, and for strategic alliances as well as global sourcing.

Many impressive figures underline the dynamism of this process. Thus, the number of companies operating simultaneously in many countries has tripled within a period of 25 years. In 1995, 39,000 transnational companies had more than 270,000 branches in foreign countries and a volume of direct investments of 2.7 trillion dollars.

Strategic and transnational alliances between enterprises are also gaining increasing significance. Let me give you a topical example. Long before the opening of the telecommunications market in Germany on 1 January 1998, German suppliers entered strategic alliances with foreign companies: the Deutsche Telekom with France Telecom and Sprint; Mannesmann with AT&T; Vebacom/RWE with Cable & Wireless; VIAG with British Telecom and MCI.

Not only the German telecommunications industry, but the whole German industry is getting ready for globalization. This includes, among other things, shifting German research, development and production capacities to other countries.

In the manufacturing industry, the percentage of staff employed by German enterprises abroad has risen from 13.6% to 23.7% in only seven years. This was accompanied by a considerable shifting of R&D capacities. I am not criticising this, for being present in world markets demands more than international sales offices. And a German firm with production operations in a foreign country must not therefore give up sticks in Germany. On the contrary, a German firm's commitment in world markets may well strengthen the company at home.

Analytical studies have shown that companies expanding vigorously abroad also show more favourable staff developments at home than others do. Direct investments abroad tend to secure employment at home rather than reduce it.

However, what does give cause for concern is that the gap between foreign investments by German companies and investments by foreign companies in Germany is ever widening. Last year, the negative balance of direct investments increased to 34 billion Deutschmarks. Companies with branches throughout the world will mount an internal competition among locations before every forthcoming decision on investments. *Standort* policy is thus becoming ever more important in an age of globalization.

As regards international locational decisions, factors such as costs, regulation density, licensing procedures and the tax system no doubt play a central role. Germany has started doing its homework here. However, only about 15% of German foreign investments made in the last few years went to Central and Eastern Europe or Southeast Asia, that is to say, to regions with huge cost differentials; 65% went to Western Europe and 20% to the United States. This suggests that cost differentials are neither the only reason nor the decisive one for the internationalization of German industry. Considerations of market strategy and the problem of securing competence and a presence in newly emerging and fast growing markets are equally decisive.

The above goes to show that in an era of globalization, *Standort* policy, with its criteria of centring on competence and excellence, is important.

Policy on innovation

Innovation policy can contribute to this not only by encouraging individual technological breakthroughs but also by supporting innovative networks while optimizing a number of other locational factors. This includes an academic environment that is open and attractive to students from other countries, as well as deregulation and optimization of conditions when new markets are emerging based on new technologies.

Not all companies –and this applies especially to small and medium-sized companies –are in a position to develop and implement their own globalization strategies. For this reason, they must rely heavily on integration within regional and European networks. Consequently, Germany's declared aim is to establish "critical masses" and competence networks through projects carried out jointly by science and industry, which we call "Key projects".

It is an approach quite similar to the one Great Britain took with its Technology Foresight Programme. The purpose is to link ambitious tasks to specific applications and to bring together a broad range of players in science and industry. The best ideas will be placed in competition so that we can determine which of the proposed projects show the best potential for giving the desired impetus to innovation.

Projects supported by industrial companies, as well as appropriate projects supported by research institutes and universities, are included in this overall innovation orientation. Each year, my ministry provides some 4 billion DM for this purpose. This funding, along with the industry's support, provides considerable resources for effectively backing ground-breaking innovation.

An outstanding example is the ongoing BioRegio competition, which will identify and concentrate funding on the German regions that are strongest in biotechnology.

By any international standard, Germany's *network of research institutions* is outstanding. The Deutsche Forschungsgemeinschaft (DFG), the Max Planck Society, the Fraunhofer Society, the Helmholtz Society and the Blaue Liste

Science Association are all part of a differentiated, pluralistic and decentralized scientific network that is one of the world's most capable.

In the light of the growing role new technologies play in our international competitiveness, we must "dynamize" this high-powered German research infrastructure through interdisciplinary co-operation, topical focus and competition.

The structure and content of Germany's overall research system must be modernized through better work sharing; synergies must be used through intensification of co-operation between research establishments and their scientific and industrial partners, both at home and abroad.

Globalization is not reserved only for the "big players". There are good opportunities for small and medium-sized companies, because such companies are flexible and deliver promptly. SMEs in Germany account for 75% of all jobs and 80% of all apprenticeships, and they earn nearly half of the country's GDP.

One of our primary aims in this connection is to gradually downscale ongoing government financing of research establishments. This is to be accomplished through more achievement-based funding, awarded through competition between research establishments and researchers.

Globalization is not reserved only for the "big players". There are good opportunities for small and medium-sized companies, because such companies are flexible and deliver promptly. SMEs in Germany account for 75% of all jobs and 80% of all apprenticeships, and they earn nearly half of the country's GDP.

Newly founded German companies are still suffering from a lack of venture capital. The sort of venture capital market that is taken for granted in the US or Great Britain hardly exists in Germany. The form of financing that is still typically applied is outside-capital financing. This has consequences: entrepreneurs have difficulties in raising money because the traditional universal banking system is not ready to take the risks of technological innovations.

Banks in Germany must become able to assess the value of innovative ideas just as they appraise property and buildings. Government can help out here –for example, by providing investment capital for small technology-based companies. But the ultimate aim is a self-sustaining venture capital market –an aim for which we are now creating the necessary legal framework. We also support initiatives that aim to establish new stock markets to improve access to the capital market for innovative companies.

Germany is very much interested in attracting students from other countries. Decision makers in other countries who have been to Germany in the past as students are open- minded discussion partners who encourage co-operation also at the industrial level. But, in comparison with other countries, Germany has lost some of its attractiveness for foreign students. The language barrier is often given as a reason for the decline. Mark Twain claimed that only the dead had enough time to learn German!

We are taking action to improve this situation. We are planning to establish internationally oriented pilot courses –with English as the working language and with qualifications also recognized by other countries, such as bachelor's degrees.

Economic relations between Britain and Germany have never been as close as they are today. Germany is not only Britain's most important partner in foreign trade but also by far the greatest investor among continental European countries. In 1995 almost 21% of all German direct investments abroad were made in Great Britain.

EU research policy

It is our common goal to develop and strengthen science and research in Europe. The European Community's research policy must finally assume its role as catalyst for the European research community. EU research support – even though accounting for only 4% of the entire public expenditure on research and development in Europe –can have a considerable impact, for example, if funding is concentrated on certain priority areas.

The Economist recently pointed out that the names of the leading American high-tech firms that have emerged in the past few years in the information technology sector cover the entire alphabet – from Apple, Borland, Compaq, Dell, to Word Perfect, Xerox, Yahoo and Ziff-Davis. Companies such as Netscape and Genentech launched new technology developments even before their business ideas could be assigned to new industries. In Germany only a few leading high-tech firms emerged in the information technology sector. The most important ones can be listed under "s", namely Siemens, SAP and Software AG.

There are numerous causes for this. One little-mentioned reason was given in *The Economist:* No European firm has direct access to a domestic market of 250 million customers –customers who buy under uniform market conditions using a single currency. In America a single good product can finance many years of expansion of a new company. Europe, where modern science and technology once originated, is still largely governed by fragmentation of markets, national strategies and interests. We are making a joint effort to change this situation.

Much has been achieved jointly in Europe by a concentration of effort and by determination. An example of good practice is EUREKA, which has led to numerous successful industrial initiatives, one of them being JESSI. Thus Europe has every opportunity as regards the utilization of biotechnology and the design of the information society.

The European Union's Fifth Framework Programme on Research can play a major future role in this connection. Discussion about this programme has just started in Brussels. This is not the place to present in detail the German position concerning the Fifth Framework Programme, which, by the way, is very similar to the British one. But I wish to point out the importance of structural reform to increase the efficiency of European research funding.

Such reform must include concentration on priority research subjects with a European dimension. We should abandon the principle of a little support for everyone. We must have the courage to apply the principle of variable geometry. Under world market conditions research can be successful only if relevant strengths and interests are pooled. It is not expedient to have all member states participate in every research priority.

For example, we cannot go without an aeronautical funding priority. Europe was successful with the AIRBUS project. It can win the competition for the megaliner only if European capabilities are again pooled in this field. Research cannot assume the role of the structural funds. A balance must be struck across the entire Framework Programme.

On the whole, European research funding must become more flexible. Scientific and technological quality and prospects for application must be the major criteria to be applied in the selection of research projects.

Finally, European programmes will produce a genuine added value only if the limited European funds are focused on the development of cutting-edge technologies that are of strategic importance for industry and the service sector.

The European Union alone comprises about 350 million people and offers cultural diversity and an excellent infrastructure. Our aim must be to place greater emphasis on Europe's potential and its advantages in international competition. Only in this way can we attract, create and hold jobs. The large internal market of the US, and also that of Japan, indicate how this might be achieved.

Anglo-German economic relations

Economic relations between Britain and Germany have never been as close as they are today. Germany is not only Britain's most important partner in foreign trade but also by far the greatest investor among continental European countries. In 1995 almost 21% of all German direct investments abroad were made in Great Britain.

These include major industrial investments such as the purchase of the British motor vehicle manufacturer Rover by BMW but also the construction of a big semiconductor factory by Siemens, which we would, of course, have preferred to be built in Germany. More than 1,500 German companies are operating in Britain, where they have directly created about 100,000 jobs; another 120,000 jobs were created in the supplier industries

Vice versa, British enterprises were the most important foreign investors in Germany last year. We appreciate in particular that British firms have made major efforts in the new German Länder. They have co-operated in 188 privatization cases and helped secure 17,000 jobs. An outstanding example is BMW– Rolls Royce in Dahlewitz, the sole manufacturer of entire aircraft engines in Germany.

Great Britain has promised additional investments to the tune of about 2.2 billion DM, thus taking third place after the US and France as regards foreign investment in the new German Länder.

The approximately 900 British firms accounting for more than 136,000 jobs in Germany, and the German companies operating in Britain, are a visible sign of the increasingly close relations between both economies.

The German-British Chamber of Industry and Commerce does exemplary work in this field. I wish to take this opportunity to express my heartfelt thanks to the Chamber and its members in Britain and Germany for their valuable contribution to German-British relations.

As regards European matters, however, Germany and Britain seem to be at opposite ends of the range of opinions held in Europe. Germany advocates greater integration, increasing delegation of power to the supranational level, creation of a monetary and political union, more rights for the European Parliament, integration of the Western European Union into the EU, and it supports the principle of subsidiarity –a word that is causing confusion, as numerous German-British talks have revealed.

Policy-makers in Britain, however, envisage Europe as a partnership of nations. Britain, it seems, is not willing to cede more sovereign rights and accept greater integration.

On the conclusion of the Conservative Party convention in Bournemouth, Prime Minister Major said that Britain would, of course, have to be part of Europe, but with the aim of helping to design it, not to be designed.

However, Britons and Germans agree on numerous important European issues: together we advocate the early opening of the European Union towards Eastern Europe, close links between Europe and America, more deregulation as well as institutional reform. Together we oppose European protectionism in trade policy and the approach to make employment policy a subject of the EU.

Expansion of the European Union (and of NATO) means that new players will enter the ground. Most of them are smaller countries, but there are also some medium-sized countries such as Poland, Czechoslovakia and Hungary. Europe will become larger, more heterogeneous and more difficult to steer. The big countries in the European Union will therefore have greater responsibility in the future. These countries are in the first place Great Britain and France, and also Germany. So far, Germany and France have played the leading roles, unfortunately without Great Britain, but with support from Belgium, Luxembourg, the Netherlands and some others.

Allow me to refer to Winston Churchill, who, cautioning that he would say something unexpected, stated that the first step towards re-uniting the European family must be partnership between France and Germany. Only in this way, he said, could France regain moral leadership of Europe. According to Churchill, resuscitation of Europe would not be possible without an intellectually great France and an intellectually great Germany.

Very true, we would like to reply even today. However, we would have to add an idea that obviously did not occur to Churchill at the time: namely, that Europe also needs an intellectually great Great Britain.

In a completely different international political environment, Europe needs a stronger team of leaders. If Britain would be prepared to abandon the position it currently holds and to cooperate at the heart of Europe, the German-French partnership could be extended and become a European troika, and Churchill's vision of a kind of United States of Europe could become a reality.

And as regards the question of the British partners in the Monetary Union, I trust that the City of London will settle the question.



▲ Sir Hermann Bondi (centre), a member of the Foundation, talking to Dr Jill Jager and Dr Nebojsa Nakicenovic during the Foundation's event on the subject: "Engineers, Natural Scientists and Social Scientists Working Together".

MORE NEWS in pictures

WHENCE THE SKILLED TECHNICIAN?

On 23 April 1996 the Foundation held a lecture and dinner discussion under the title "Whence the Skilled Technician?" The Lord Butterworth CBE DL was in the chair and the evening was sponsored by the Engineering Council and the Engineering Training Authority. The speakers were Mr John Spensley, operations manager, Graseby's plc, Mr Victor Lucas, senior inspector (Engineering), FEFC and Dr R.G. Evans, principal, Stockport College of Further Education and Higher Education.

Mr Victor Lewis*

Introduction

"Increasingly employers will require technicians with an enhanced engineering knowledge. There will be an increased emphasis on technical generic skills such as IT, social skills such as customer relations and team working, and in project management including continuous improvement and innovation"

This quote from the Engineering Council's document *Competence and Commitment* on the structure of the engineering profession summarizes the role that the further education sector has to play in providing the workforce that will enable industry to meet the UK's manufacturing needs and compete in the international market place. The Institute of Employment Research has stated that 1.9 million people, or 7.8 per cent of the UK workforce, are employed in engineering related activities. Technological change, and pressure to reduce labour costs, are expected to result in an overall decrease of around 8 per cent in this figure by the year 2001. However, within this overall decline, employment in technician and higher grades is expected to grow at a rate of about 2 per cent a year during this period.

The state of engineering education

How well is the FE sector measuring up to meet this task? In an attempt to seek an answer the inspectorate of the Further Education Funding Council recently completed an extensive national survey into the state of engineering education and training in FE colleges. Over half the 347 colleges offering engineering courses were inspected and interested stakeholders, including the Engineering Employers Federation, the Engineering Council, qualification awarding bodies and trade associations, were consulted with regard to trying to find out what industry expects from the FE sector. [Copies of the report of the survey can be obtained from the FEFC in Coventry.]

Since 1989 enrolments have declined by about 12 per cent. However, there have been some encouraging changes of late. In 1994-95 the number of enrolments was about 289,000, an 11.7 per cent increase on the previous year but, when set against the projected increase required to make courses viable, recruitment this year has begun to fall behind. With the pressures on engineering departments to increase the overall number of students, in order to maintain the level of funding, many colleges have had to lower their sights in terms of entry qualifications. As a consequence a greatly increasing majority of students are working to achieve craft or foundation qualifications, and the number on technician courses, that is those leading to NVQ3 in engineering competencies (including the modern apprenticeships), BTEC National Diploma and Certificate and

* Senior inspector (Engineering), FEFC

Summary: Mr Lewis concluded that although there were difficulties in recruiting sufficient numbers of the more able students, and success rates were low, the many technician students that succeeded went a long way towards satisfying the Engineering Council's expectations. There was scope, he suggested, for colleges to do more to help themselves and for industry to help colleges meet industry's requirements. Stating that there was need for the UK to regenerate its industrial base (which implied the requirement for the supply of highly qualified craft and technical people) Dr Evans said there was still no long-term strategic framework for education and training in the country. The need for an urgent review was underlined by projections that employment in occupations related to science and technology would grow at a faster rate than other employment over the period 1991-2000. He put forward his own suggestions.

advanced GNVQ engineering (the vocational 'A' levels), has declined by about 22 per cent. Many engineering colleges plan to increase their overall numbers of students on engineering courses by extending the full-time provision for school leavers with limited qualifications. These low-level foundation programmes provide important new pathways to more advanced studies, but they are not going to halt the downward trend in numbers on technician courses.

There is some good news. One of the outcomes of last year's survey showed that about a quarter of the colleges achieved a growth in enrolments of more than 20 per cent in the last three years. These colleges were distinguished by a number of common features, including:

- active links and special initiatives with schools. For example, second-year, full-time students at one college assisted school teachers with science and technology classes, and schools near another college benefited from the use of a well-resourced drop-in centre which helped them to cover aspects of national curriculum technology.
- strong links with local training agencies.
- close involvement with industrial partners to develop courses.

In spite of such positive initiatives to improve recruitment there are still only 8 per cent of students on engineering courses who are female. The generally perceived unattractiveness or uncertain future of a career in engineering has an even greater influence on the recruitment of women. The inspectorate has seen little advertising or marketing of the areas of engineering that perhaps could be more attractive to women. For example, there are opportunities to join the invasion of engineers into medicine where engineering technicians are in demand in hospitals and in the development of medical equipment. There are also other increasingly complex areas where technician qualifications are now required.

Course development

How then is the curriculum for technician education and training changing to meet these tasks? There are many examples of good collaborative course developments with industry and Training and Enterprise Councils leading to national qualifications. The schemes are particularly effective where GNVQ engineering, with its theoretical content, is offered as part of a modern apprenticeship and provides a focus and direction for the GNVQ. Engineering courses often have a formal requirement from the awarding bodies to develop skills in written and oral communications, and in information technology. Where courses are well organized these requirements are integrated with the course and not taught as separate skills. Some colleges and awarding bodies require other personal skills to be developed such as initiative, leadership and the ability to work in groups. Engineering departments are increasingly providing courses for technicians specifically related to management. There are few other opportunities for the continued professional training of experienced technicians. This raises the question of how the country can become and remain competitive as the knowledge and competence of the skilled workforce needs to be kept up to date. With the rapid developments in technology and engineering techniques the shelf life of knowledge and skills acquired on courses is only valid for a few years.

The success rates of technician students on what are generally perceived to be very demanding courses is variable. The proportion of students who started the course and achieved the qualification within the normal two years ranged from an appalling 5 per cent for students on one full-time course to a good 90 per cent on others with an average of about 50 per cent. The part-time students mainly sponsored by employers fared only slightly better. These figures show that there is a significant wastage rate in technical training which the country can ill-afford. Mathematics is the subject most commonly failed by students on technician courses. Many students enter these courses with an insufficient grounding in arithmetic, algebra and trigonometry as they have often studied on GCSE courses in which these topics are not adequately covered. In contrast to these disappointing figures some college engineering departments consistently achieve good results across all courses. Colleges that have good pass rates are often those which recruit

Mathematics is the subject most commonly failed by students on technician courses. Many students enter these courses with an insufficient grounding in arithmetic, algebra and trigonometry as they have often studied on GCSE courses in which these topics are not adequately covered. successfully and are often distinguished by common features such as:

- a wide range of courses at each level which allows students to choose a course that is most suited to their abilities and aspirations.
- a close involvement of the parents and employers of 16 to 18 year olds.
- effective teaching and student support of high quality which monitors their progress and gives sound career advice.
- well-organized, integrated work experience arrangements for full-time students.
- appropriate accommodation and equipment often purloined from industry.

Inspections have shown that pressures on funding have meant that the engineering equipment in most colleges is out of date and requires considerable maintenance support to keep it operational. In the main it is sufficient to support the formal training for students to achieve the basic technician qualifications. But much equipment is now unrepresentative of that found in industry and this

- dissuades many of the better potential students from
- enrolling on engineering courses (often discouraged by their parents).
- prevents some of the new NVQs being offered by colleges.
- prevents new skills and new technology being demonstrated.
- discourages employers from sponsoring part-time courses.

Thankfully this situation is not always the case and there are a few examples where colleges have energetically pursued industrial support and established centres of excellence. But nationally there are only about 20 colleges who have benefited significantly from such initiatives. There is a great opportunity for industry to do more for its local colleges in this way and help themselves to take advantage of their training facilities at the same time. The Private Finance Initiative may provide an additional means of achieving industrial involvement.

From what information there is available it would seem that of those who successfully complete the technicians courses 60% are either returning to or seeking employment, and 40% move on to higher education courses. The main reason for some of the better students progressing to HE is because many of the more attractive jobs, that a few years ago would have been available to them on completion of their technician course, are now filled by the large number of graduates in the market place.

In summary, although there are difficulties in recruiting sufficient numbers of the more able students, and success rates are low, the many technician students that succeed generally go a long way towards satisfying the expectation of the Engineering Council's statement in *Competence and Commitment*. There is scope for colleges to do more to help themselves and for industry to help colleges meet industry's requirements. The initiative from the Engineering Employers Federation to encourage senior staff in industry to become governors of colleges is therefore very welcome.

Dr R.G. Evans*

Introduction

"The prizes will not go to the countries with the largest populations. Those with the best systems of education will win."..

"But if we are to make full use of what we are learning, we

* Principal, Stockport College of Further and Higher Education

shall need many more scientists, engineers and technicians. I am determined that this shortage shall be made good"

So said Anthony Eden on 18 January 1956. This statement joined many similar ones before and since about the concerns for the education and training of scientists, engineers and technicians. Couple these statements with innumerable reports and national commissions over the past 150 years which have focused on the problems associated with the education and training of craftspeople and technicians, particularly in the areas of science, technology and engineering, then one would have hoped to see evidence of improvement. In spite of all these laudable activities, the situation has not improved.

There is a long-standing deep and fundamental cultural hostility towards vocationalism and vocational awards in this country, particularly in England. The academic approach has always been given preference over the vocational. Intellectual skills were always more respected than the practical ones. Until recently, the education system favoured the academic curriculum and the institutions themselves continually participated in the so-called 'academic drift'. This historical cultural hostility has now to be linked with the more recent development following the wholesale destruction over the past two decades of the engineering and manufacturing base of this country. People now have an even more jaundiced view of these subjects, and most certainly possible employment opportunities in areas that have witnessed massive downsizing in key manufacturing companies. The people made redundant, particularly if they are parents, are very unlikely to encourage their children to be educated or trained to enter these areas of employment.

One of the major factors re-shaping future work is the concern for the environment which puts science, in particular the biological and life sciences, centre stage. Employment opportunities for highly qualified/skilled people in professional, associate professional and technical occupations will increase.

Need to regenerate the industrial base

It is essential that this country does regenerate its manufacturing base. The future economic well-being depends critically on a balance of manufacturing and service-based activities. A sobering fact reinforces this need: "This country will have to increase service industries by ten per cent to compensate for every one per cent reduction in the manufacturing base". However, it must be said that the manufacturing processes will be very different than in the past. The global economy will require us to develop and produce products and services that the rest of the world will wish to purchase. These products and services will need to possess significant value-addedness and this is where the quality of the workforce, particularly at craft and technician level is so important.

For every professional scientist or engineer there needs to be a supporting team of highly qualified craft and technical people to help research, develop, manufacture, sell and then maintain the products and services that we sell. Real opportunities do exist for this country to re-establish a manufacturing base. Numerous national and international reports have attempted to predict the future nature of employment. For example, the Institute for Employment Research (IER) have produced projections of occupational employment that include two occupational groups relevant to science and engineering. The latest projections over a period 1991 to 2000 are shown in the Table.

Table: Projections of occupational employment: 1991 to 2000

Occupational Group	1991 (1000s)	2000 (1000s)	% increase 1991-2000
Science and Engineering Professionals	642	797	24.1
Science and Engineering Associate Professionals	569	677	18.6
Whole Economy	25,382	25,939	2.2

Source: IER

The framework for training

Thus the IER expect that employment in occupations related to science and engineering will grow at a faster rate between 1991 and 2000 than employment in the whole economy. It is therefore essential that the curriculum offers pre- and post-16 aligns with these changes. One of the major factors re-shaping future work is the concern for the environment which puts science, in particular the biological and life sciences, centre stage. Employment opportunities for highly qualified/skilled people in professional, associate professional and technical occupations will increase. There will be a greater demand for:

- technological skills, as new environmentally friendly technologies become more widespread;
- knowledge-based skills as new environmental regulations are put into place;
- entrepreneurial skills, as the need to achieve cost-effective increases in the face of these new regulations.
- Therefore the favoured occupations will be:
- scientists, engineers and technologists and their associates (i.e. technical and other business support staff);
- specialists in reclamation/waste conservation and management;
- multi-skilled technicians/craftspeople;
- supervisory staff

If this country is serious about upgrading its skill levels, it must be able to 'access the reserves' of welleducated/trained people whose 'foundation learning' will be started and often completed long before any accurate prediction can be made about the precise nature of their roles in the economy.

Unfortunately, the current political and financial climate does not help institutions committed to the education and training of craftspeople and technicians. There is still no long-term strategic framework for education and training in this country. Couple this with the operation of an open market and the increasing level of deregulation of the post-16 education and training system which will not, in the long term, have any major benefits or tackle some of these deep-seated problems.

It is interesting to note that many of our international competitors, who have more effective education/training systems, operate very highly regulated systems and these are coupled to long-term strategic planning frameworks for creating flexible, responsive and highly qualified individuals. In addition, these are congruent with economic and political policies that are so necessary to maintain a national and global competitive advantage. This country seems to be moving in the opposite direction to most of our competitors, particularly those that constitute the so-called Pacific basin economies. In his presidential address to The Royal Academy of Engineering, William Barlow commented on this country's obsession with short termism by saying " ... encourage people to think long-term instead of concentrating with myopic gaze on next year's problem".

There needs to be an initial phase which produces a strategic reserve of highly qualified people through 'foundation learning'. In building up that 'strategic reserve', there is an essential need to increase the stock and flow of highly qualified craftspeople and technicians (in some respects even more important than increasing the graduate population).

Funding

The current funding regimes operated in the Further Education sector most certainly disadvantage institutions that wish to continue and enhance technical education and training. The funding regime is not sufficiently sensitive or highly differentiated enough to recognize the additional costs of developing and delivering this provision. The delivery of vocational qualifications, whether they be occupationally specific or general require additional monies to cope with the teaching and learning methodologies that have to be introduced. There also needs to be a more realistic allocation for capital and equipment. It is also important to recognize within the funding methodology that fewer students enrol for science- and technology-related provision. The current funding regime is largely driven by student numbers.

One essential feature for the future is to develop stronger partnerships between colleges and employers, and this will require financial incentives to employers. Employers need to be encouraged to invest in life-long learning in order to develop a flexible and responsive workforce. The ever accelerating base of knowledge understanding and skills requires continuous professional development for all members of the workforce. Increasingly, many companies are configuring their workforces into teams and this will require a fundamental review of how the members of the team are educated and trained and kept up to date. It will also place greater importance on the role of small and medium enterprises.

At present, many employers, particularly in manufacturing and engineering, are struggling to deal with the recession and the consequences of increasing global competition. They need help from the government. Whether this be by way of 'tax incentives for employers', a 'modem training levy' or a compulsory system of individual learning, accounts will need to be carefully considered.

Finally, on funding, the students themselves need support. Increasingly, they are finding it difficult to return to learning, particularly in the initial stages, because of changes in terms of grant and benefit support. The introduction of universal learning credits may assist to encourage people both young and adult to return to study.

A possible solution

So, what is the possible solution in education and training of craftspeople and technicians for the future? Because of the ever accelerating change in knowledge, understanding and skill, it must now be accepted that the rate of change is far greater than the traditional response rate of education and training systems. There therefore needs to be a fundamental review of how this country operates its education and training systems. If this country is serious about upgrading its skill levels, it must be able to 'access the reserves' of well- educated/trained people whose 'foundation learning' will be started and often completed long before any accurate prediction can be made about the precise nature of their roles in the economy.

Therefore, there needs to be an initial phase which produces a strategic reserve of highly qualified people through 'foundation learning'. In building up that 'strategic reserve', there is an essential need to increase the stock and flow of highly qualified craftspeople and technicians (in some respects even more important than increasing the graduate population).

If schools and colleges are supported financially, they can develop this strategic reserve of people. There then follows the second part of this very important equation, namely the development of a culture of life-long learning. This will allow people to keep up to date with new markets and technologies and remain flexible and responsive. The craftspeople and technicians are centre stage on this approach as they will play an increasingly important part in the wealth generation of this country. What is not in question is that they will need to be highly qualified, possessing an up-to-date skills/knowledge /understanding base. In addition, their roles will need to be redefined to fully recognize their importance.

In the discussion, Tamsyn Imison, Headteacher, Hampstead School, commented on the key issues for schools.

Begin Pre-16 Post-16 is too late

The lack of skilled mathematicians and crafts people –few of my technology teachers have a skills-based background. (This is not required for the national curriculum.) Some of my best teachers have an industrial/business background and a few are still running small businesses.

The heavy subject content of the curriculum which reduces our ability to manoeuvre in support of the needs of the student.

Parity of esteem between vocational and academic courses – we are extremely good at processing more of ourselves –the academics, but not so good at setting young people off on more adventurous paths. This is a real pity when the vocational elements are so important.

The way forward

A far better use of work experience with linked teacher placements in key employment centres so that students have good job descriptions and make the maximum use of their experiences at the time and later in their studies.

The use of industrial and business mentors linked through video conferencing.

The development of IT to provide up-to-date skills as well as offering opportunities for sharing skills and expertise through video conferencing.

Talent spotting through industrial residencies where marketable skills are shown off in schools and students encouraged to show aptitude.

Links with Youth Award Scheme to encourage greater participation in community works.

Reduction in content of curriculum but not breadth while opening up more scope for assessment and accreditation.

All students having progression facilitated and given the opportunities to show initiative and be rewarded for it.

MORE NEWS in pictures



▲ Professor Henri Gibert (centre), the French Science Counsellor, attended the Foundation's event held in association with CBI Scotland and The Royal Society of Edinburgh on the topic: "Business and Universities Growing Together. What are the Issues?" With him ar e Professor Peter Jones from the University of Edinburgh (right) and Mr Cubie, Chairman of CBI Scotland (left). The event was sponsored by BIOSIS UK and Zeneca Group plc and held in the rooms of the Royal Society of Edinburgh.



▲ Mr Andrew Cubie poses an opinion and question at the meeting.

PARTNERSHIP IN TECHNOLOGY, USA-EUROPE

On 17 July 1996 a Foundation lecture and dinner discussion was held at the Royal Society on the subject "Partnership in Technology, USA-Europe" under the chairmanship of The Lord Butterworth CBE DL. The speakers were Mr Peter L Bloom, Partner, General Atlantic Partners, and The Rt Hon The Lord Trefgarne PC. The evening was sponsored by General Atlantic Partners and Techlantic Ltd.

Mr Peter Bloom*

Introduction

World class poker players have an immutable characteristic. They will "raise" the stakes or "fold" from the hand, because to "call", to simply match the opponents' bet, is to eventually lose.

This talk is about technology, not poker, but I think you'll see the parallel. We either raise the competitive stakes through a software partnership, or we are at risk of losing leadership of the most vital sector in today's, and tomorrow's, economy.

Although we Americans are shameless modernists, I would like to start my discussion of technological leverage in 1815 at the Battle of Waterloo with some true British ingenuity. Nathan Rothschild had agents on the battlefield with carrier pigeons. When it was apparent that the British would win the battle over Napoleon, Rothschild's carrier pigeons were dispatched to London with the news. I gather from my research that Nathan made some prudent investments in those few hours before the government received official notification.

This may have been an early example of wireless mobile communications, but more importantly it exemplifies the advantages gained from taking advantage of new opportunity before others recognize the potential. This is at the heart of tonight's discussion - battles for national success are being fought economically. The weapon is often technology and there is opportunity to be found through meaningful partnerships.

To make the case for a transatlantic software partnership, I'd like to first discuss some of the most profound changes that are occurring in our society because of software. To build a sustainable partnership, I believe there is much we can learn from the innovators of much of these changes. I will conclude with some suggestions that are intended to stimulate a discussion of how we can act together to forge a partnership.

Growth of software

From 1960-1990 computer hardware dominated worldwide spending on technology. The reason that companies like IBM and Digital Equipment Corporation thrived is that 80% of all technology spending was on hardware created by companies like these. However, we are now experiencing an economic transformation relative to software. It is estimated that by 2000, 80% of all spending on technology worldwide will be devoted to software. Bill Gates was one of the earliest identifiers, and beneficiaries, of this trend. Software has already become the most important asset on the balance sheet of most modern corporations. As a result we are seeing some dramatic changes in our society.

New paradigms, and results, of improved communication are perhaps the most obvious and most significant effect of the widespread adoption of software. In the United States there was Summary: Mr Bloom discussed the tremendous growth that occurred in the software market and its implications. There was, he believed, a strong case for a more active partnership to encourage the development and sponsorship of emerging software companies. Lord Trefgarne outlined the strong special relationship that existed between the USA and Britain over many years. Britain, he believed, should continue to maintain and exploit those links, including those with Japan and look to the thrusting Asian markets.

a double blind study initiated to test the effects of a new medication on sufferers of ALS, Lou Gehrig's disease. It was a double blind because neither the doctors nor the patients knew who was receiving a placebo and who was receiving the medication being tested. Not long after the study commenced, patients started coming back to the doctors asking to be taken off the placebo and put on the real medication. The doctors responded that they had no idea which was which. It turned out that the subjects of the study had gotten together via e-mail and deduced which pill was the placebo and which was real. It used to be that doctors knew everything, patients nothing. In this case, that relationship was inverted by software.

Effects of software

Software breaks down many of the barriers that used to constrain us to one location. If one envisages the London Stock Exchange prior to the deregulation of Big Bang in 1987, for dealers to transact business, they had to be physically present on this floor. What happened when these dealers were freed from this constraint? Computer terminal screens took over.

At General Atlantic we believe that this is the most valuable, or disruptive, effect of software, depending on your point of view. Disintermediation is the process of rendering an intermediary obsolete if they don't add value to an economic process. A century ago the transatlantic telegraph cable disintermediated the clipper ship from the transport of time critical communication between the US and the United Kingdom. For a more modern example, the seemingly ubiquitous automatic teller machine has essentially disintermediated bank tellers. Software

The single most influential factor to spur innovation in this area has been the availability of venture capital.

The availability of international venture capital in Europe and the United Kingdom has been limited until recently.

^{*} General Atlantic Partners

is accelerating this trend dramatically.

Projections have been made of the economic value that will be transferred away from travel agents, retail stores, computer salespeople and others who can now be bypassed when consumers and producers use technology to communicate with each other. This improvement in value, or dislocation, depending on your perspective, is expected to aggregate to several bil-

The strong upward trend of European and British companies to list on NASDAQ, the US exchange most attractive to emerging software companies, is a vital factor in the overall growth and vitality of the software industry because it provides a clear path to economic liquidity for all stakeholders.

lion dollars over the next five years. To pick one example from our own portfolio of software companies, you can electronically buy 5,000 shares of IBM stock from E*TRADE, an electronic broker situated in California, via your computer in your home in London. The total cost of the transaction is £10 - or you could go to a full service broker like Merrill Lynch who will do exactly the same thing for 100 times that amount (£1,500). The brokers in their offices at Merrill Lynch are being disintermediated by a few computers in California that offer better, faster and cheaper service. To identify this trend elsewhere, look for examples like insurance or banking where the product is not physical, but rather informational. These are ideal candidates for disintermediation through software.

I don't know about you, but I'm overwhelmed by the amount of information we can now get immediately thanks to software. It is radically changing our perspective and knowledge base. One example is provided by a well established agricultural firm in the north of England called J & H Bunn. A satellite map of a farm highlights where fertilizer is needed to maximize crop yields. The real stroke of genius, however, the instant access to information, is a satellite-based Global Positioning Receiver that instantly locates any position on Earth. J & H mounts one of these in their fertilizer spreaders so that they can deposit fertilizer exactly where the satellite image directs. As an aside, this software driven device may have been the technology most responsible for coalition victory in the Gulf War as it sits in the nose of every Cruise missile.

Each of these changes, the redefinition of communication, freedom from specific location, elimination of obsolete intermediaries and immediate access to vast amounts of information, is significant in its own right, but they all lead to the theme of this evening's discussion - software can enable new forms of transnational collaboration.

Transnational collaboration

Perhaps the most dramatic scientific endeavour of our time is the Human Genome Project, a transnational effort to identify every gene in the human body. The social and economic ramifications of this massive and extraordinarily complex multiyear project will be as profound as the introduction of the computer. The most striking characteristic of the Human Genome Project is that no one country has the resources or intellectual talent to accomplish the goal alone. Software is enabling researchers in all these countries to co-operatively complete the initial map of the more than 100,000 genes in our body. Sir Walter Bodmer, one of the founders of this Foundation, is one of the primary co-ordinators of this truly profound scientific effort. There is much of great import to be learned from him and his colleagues.

Building blocks for software innovation

In our work, General Atlantic has the unique opportunity to identify and assess those factors that stimulate the production of great software and the growth of great software companies. I believe we can learn much from these innovators to establish an effective partnership. The single most influential factor to spur innovation in this area has been the availability of venture capital.

The availability of international venture capital in Europe and the United Kingdom has been limited until recently. I'll return to this point later, but without a vibrant source of private equity capital it is clear to us that software innovation is stifled.

One clear indicator of the viability of an indigenous software industry is the focus that academic programmes bring to commercial software engineering skills. In Europe, there is a tradition of disdain for diluting the theoretical rigor of traditional university academics with a focus on commercial applications.

This is not true in India. The growth of software exported from India in the last five years is staggering and it is projected to hit \$1 Bln by 1997. The obvious and most important explanation of this phenomenon is the low cost of skilled software labour. More subtly, however, the reason it really started to accelerate in 1989 is that the Indian government spurred the creation of university programmes designed exclusively to train software engineers that could create commercially viable software. The results of this policy and educational focus are just starting to be felt on the world stage.

Given their visibility and economic importance, one might assume that China and other Asian powers would turn out to be hotbeds for the creation of great software. It turns out that this is not the case and that is certainly due in part to the lack of protection for the intellectual property that is the only asset a software programmer creates. 75% of all software in China is pirated. The protections for software authors are stronger in the United States and Great Britain than anywhere else in the world. Ironically, some of the best software created for the Japanese video game industry comes from small software factories in the south of England.

Government support

Economic and policy support for young software companies is nowhere more in evidence than in Israel, where the government has decided to spend its "peace dividend" on creating a dominant centre for the creation and distribution of technology.

As I came to learn more about this Foundation, I was impressed with the Lloyd of Kilgerran Prize. Prizes are a tangible way of rewarding leaders that should not be restricted by national boundaries. I think that a prize directed to recognize leadership in the area of creating and promoting software would have the effect of raising this effort to a more visible level. "In every revolution there are two groups - those that make the revolution and those that profit from it". The revolution is being made in the software factories of Silicon Valley, Cambridge, Bangalore and Tel Aviv. With the right kind of partnership, we can be well positioned to profit from it.

The government provides significant tax benefits, grants and other support for new technology companies. The most active benefit of this initiative has been the conscious attraction of international venture capital. As a percentage of GNP, Israel ranks second behind the US in the availability of venture capital. This is because the government has created partnerships with firms like ours to minimize our risk in funding new software ventures. The Israeli government has formed similar partnerships throughout North America, Europe and Asia. This is a proven model worth emulating.

Supportive equity capital market

If venture capital is the factor that sparks investment in software, then the availability of an exit path for investors, founders and employees is what sustains it.

The strong upward trend of European and British companies to list on NASDAQ, the US exchange most attractive to emerging software companies, is a vital factor in the overall growth and vitality of the software industry because it provides a clear path to economic liquidity for all stakeholders.

The absence of comparable markets in Europe and Britain, although some are poised to emerge, has been an anchor on the growth of indigenous software markets. We have learned that it is difficult for a company to even get listed in these markets without a dividend-paying structure. This is a cultural issue that needs to evolve and with that I offer these suggestions to help forge a software partnership between our two countries. Let me preface it by saying that none would be easy to implement and are intended to stimulate a discussion that can lead to positive action.

USA/UK partnership

During the Cold War the greatest concentration of scientific capability in the United States was found in our National Laboratories like Los Alamos, the home of the atom bomb.

The Rt Hon The Lord Trefgarne PC*

Introduction

We have just heard from Dr Peter Bloom of the growing importance of transatlantic software partnerships. I would like in my own remarks to view the subject of technology partnerships in a rather wider context and to draw upon my experience as a Minister at the Foreign Office, the Ministry of Defence and the DTI.

My prime thesis will be that there is an inextricable link between international politics, trade and technology transfer and my main theme is to try and explore how each of these factors is interrelated. I shall underline the special place that

* Chairman, The Engineering Training Authority

There is now an active local effort under way to commercialize the activities of this domestic brain trust. I understand from my discussions with Ian Taylor, the British Minister of Science and Technology, that the same initiative is taking place here. I propose that much would be gained from an active partnership in this area, promoted by our two governments, that could create a truly unique transformation of these national assets for the development of world class software.

I also believe that India is a model for academic software programs that both of our countries can benefit from. To test this thesis, I propose a joint international software engineering programme tailored to prepare students for leadership in the global software market, much like the Fulbright, Rhodes and Marshall Scholarships that have done so much to promote cultural understanding and create government and business leaders. Lord Trefgarne is far more expert than I in this area and I will defer to him for more exploration of this idea.

There is certainly some sponsorship by British companies in research conducted at US universities and vice versa, but very little in software. I believe that much would be gained from a specific effort by our universities to sponsor such cross-border research and, more imperatively, to fund young start-up companies based on the commercialization of university research in this area.

As I came to learn more about this Foundation, I was impressed with the Lloyd of Kilgerran Prize. Prizes are a tangible way of rewarding leaders that should not be restricted by national boundaries. I think that a prize directed to recognize leadership in the area of creating and promoting software would have the effect of raising this effort to a more visible level.

The last and certainly most controversial idea is to reform investment and tax policies that discourage the creation and growth of vibrant software enterprises. Nothing could be harder to accomplish or more important. The reformulated tax policies promoted by the government of Israel were initially deleterious, but the pay-off has made up for that many times over and provided an ongoing and recognized stimulus to growth. Challenges like this can certainly be daunting in the revolutionary environment I described earlier. With that in mind, I must conclude with another historical perspective from a time of great revolutionary change.

Even though he was the runner-up to Lord Wellington, Napoleon was a leader of uncanny prescience. A long time before fax machines, software and the Internet, he said "In every revolution there are two groups - those that make the revolution and those that profit from it". The revolution is being made in the software factories of Silicon Valley, Cambridge, Bangalore and Tel Aviv. With the right kind of partnership, we can be well positioned to profit from it.

Britain holds in linking the two sides of the North Atlantic.

Our relationship with the USA

Our special relationship with the United States goes way back into the 19th century but has been particularly apparent since the Second World War. There are some obvious reasons for this.

The first is the natural affinity which is derived from a common language, a common heritage and a broadly similar culture.

The second is the convergence of our two countries' economic interests. Primarily, this convergence centres around trade. More importantly, the maintenance of the free market system of world trade has long been mutually beneficial to both



▲ Mr Peter Bloom (right), General Atlantic Partners, expressing views during the discussion at the evening, which was chaired by the Lord Butterworth CBE DL (centre). A further talk was given by The Rt Hon. The Lord Trefgarne PC, Chairman of the Engineering Training Authority (left).

If we map the progress of the 'special relationship' we can see the effect that it has had on the partnerships in technology between us. Broadly speaking, at times of particular closeness between the USA and Great Britain the sharing of information and technological research has undoubtedly increased.

countries. Both America and Britain are open economies with wide-ranging and diverse patterns of trade. By contrast, the protectionism of more totalitarian, centralised economies has represented a threat to their combined success and something we could oppose together with absolute conviction and determination.

Thirdly, a convergence of economic interest inevitably led to a convergence of security interests as we both feared the expansion of the Soviet Union and led the establishment of a mutually deterrent alliance. Such a realist view of foreign affairs united the two countries.

The special relationship

But by examining the history of the special relationship we can also begin to understand the role it has played in promoting partnerships in technology between Britain and America.

In the post-war history of the USA and Britain, the low point of the relationship was undoubtedly the summer of 1946. The MacMahon Act of that year effectively ended collaboration with Britain in atomic research and development. This was a major blow to a Britain which was struggling to establish a role in the new post-war world order. The possession of nuclear weapons was inextricably linked with the notion of a 'Great Power' and without access to the latest American nuclear technology Britain's post-war ambition would be seriously hampered.

Yet from this low point, Anglo-American relations very soon recovered. By the autumn of 1946 the 'American Loan' was already coming to the rescue of the struggling British economy; in September America acknowledged that its Forces would not be speedily evacuated from Europe; by March of the next year (1947) the 'Truman Doctrine' was proclaimed and by June the 'Marshall Plan' was announced. The Marshall Plan was a key moment in the history of the partnership between America and Europe. That massive programme of economic reconstruction revitalised Western European capitalism and committed the United States into the future well-being of Europe against all comers.

The Americans' involvement in the rebuilding of Europe was not, of course, brought about by purely altruistic consideration.

America agreed to supply the newly developed Skybolt missile system to Britain. This was to be capable of delivering nuclear warheads to Soviet Block targets; more importantly, it would be under the complete control of Britain's armed forces. The USA needed the help of Britain in the far corners of the world where Communism threatened countries not under the American sphere of influence. The former British Empire still had an outpost in most areas of the world and the USA needed to tap into this to stave off Soviet advances. Further to this was the need to maintain a European market for American goods. America had built its success on the free market; for that success to continue it needed to not only ensure the Soviet threat was resisted but also maintain the economies with which it could trade.

The costs of American involvement in the defence of Europe and the maintenance of the so-called "special relationship" required an active commitment from Britain. Examples of this are Britain's involvement in the Korean War, our expensive rearmament programme between 1951 and 1954 and our decision to station 55,000 troops in Germany in 1954.

If we map the progress of the 'special relationship' we can see the effect that it has had on the partnerships in technology between us. Broadly speaking, at times of particular closeness between the USA and Great Britain the sharing of information

Whatever you may think of Ronald Reagan or, for that matter, of Lady Thatcher, their common commitment to the rejuvenation of free enterprise ensured an increasing degree of Anglo-American collaboration and the 'special relationship' was lifted to new heights. and technological research has undoubtedly increased.

But the political breach between London and Washington over Suez was certainly serious. We British were deeply wounded by the diplomatic humiliation we had suffered at the hands of Eisenhower and especially John Foster Dulles, which represented a measurable damage to Britain's position in the world. But the communist threat was still apparent and this, if nothing else, forced the repair of the relationship. The process began with the Macmillan-Eisenhower meeting in Bermuda in March 1957, following which sixty Thor missiles were stationed in East Anglia, thus signalling Washington's willingness to heal the wounds left by Suez and putting the Anglo-American partnership back at the heart of the defence of Europe.

Similar realist political thinking initiated the next partnership in technology. With the launch of Sputnik in October 1957, there was no telling what the Russians might be capable of achieving in the field of technology. This Soviet victory in the space race could have lead to new means of delivery for nuclear warheads. Such a threat suggested that America and Britain should pool their scientific knowledge in order to meet this unexpected new challenge. The outcome in July 1958 was the repeal of the infamous 1946 MacMahon act and the signing of the Agreement for the Co-operation on the Uses of Atomic Energy for Mutual Defence Purposes, thus effectively restoring the nuclear-sharing status of the pre-MacMahon years. Having maintained our own programme of nuclear research since 1946, Britain did have something to offer, but the greater political importance of the agreement was that it showed a very high degree of trust between the two countries.

In June 1960 America agreed to supply the newly developed Skybolt missile system to Britain. This was to be capable of delivering nuclear warheads to Soviet Block targets; more importantly, it would be under the complete control of Britain's armed forces. This was clear evidence that the special relationship had been restored. Unfortunately, in November 1962 it was announced that Skybolt, this great symbol of Anglo-



▲ The Lord Finsburg MBE (left) with Dr Richard Haas, a Vice-President of the Foundation, at the meeting.

American relations, didn't work. Happily, this setback was soon swept away by the next partnership in defence and technology reached by Macmillan and Kennedy in Nassau in December 1962. The USA agreed to supply Britain with the Polaris submarine-launched missile system. This agreement enabled the UK to maintain its independent nuclear deterrent without having to incur the enormous costs of a full research and development programme.

This significant agreement followed the Cuban missile crisis of October that year. The fact that America was willing to share the latest nuclear weapon technology and to consult Britain at the time of the most serious international crisis since 1945, showed the strength of the relationship between the two governments at this point and the amazing closeness of Macmillan and Kennedy.

But, sadly, a decay in the 'special relationship' and subsequent decline of any technological partnerships occurred over Vietnam. Whereas previously Truman had consulted Attlee over Korea and Kennedy had consulted Macmillan over Cuba, Lyndon Johnson's response to a meeting with Wilson was to reply "I won't tell you how to run Malaysia and you don't tell us how to run Vietnam". The fact that we did not commit a force, however small, to Vietnam angered the Americans. Two years previously, Washington had generously handed Britain the latest nuclear technology at a knock-down price and now, it was said, Britain refused even minimal assistance in South-East Asia.

British reluctance in Vietnam was compounded by the decision to withdraw from east of Suez after the defence review of 1966. Britain suddenly became less useful as an ally to fight Communism in the far corners of the world, as it concentrated on Western Europe. As far as America was concerned, this was seen as a serious abdication of responsibility. The US now saw themselves as standing alone east of Suez in the defence of freedom, and this certainly weakened the special relationship.

This decline began to be reversed in the late 70s and early 80s, powerfully supported by Lord Carrington who maintained that the primary objective of British foreign policy was the maintenance of our long-term security and this could only be achieved by the strengthening of our ties with America. In January 1980 Britain announced its intention to allow 160 American-owned Cruise missiles to be deployed in the UK. In July, agreement was reached on the purchase of the Trident missiles from the US. This would replace the Polaris system and maintain an independent British deterrent well into the 21st century.

An important moment of our relationship with the USA was undoubtedly the election of Reagan in November 1980. The mutual interests of the two nations were now underpinned by a common view of the world as seen from Downing Street and the White House. Whatever you may think of Ronald Reagan or, for that matter, of Lady Thatcher, their common commitment to the rejuvenation of free enterprise ensured an increas-

"I found myself dealing with an administration which saw Germany as its main European partner in leadership, which encouraged the integration of Europe without seeming to understand fully what it meant and which sometimes seemed to underestimate the need for a strong nuclear defence. In January 1980 Britain announced its intention to allow 160 Americanowned Cruise missiles to be deployed in the UK. In July, agreement was reached on the purchase of the Trident missiles from the US. This would replace the Polaris system and maintain an independent British deterrent well into the 21st century.

ing degree of Anglo-American collaboration and the 'special relationship' was lifted to new heights. As a result, we were able to acquire Trident II on very favourable terms and, as you know, HMS Vanguard is now the first of four subs. in service with this system.

Later on, Britain supported the American decision to press ahead with research into new defensive technologies which led to the so-called Strategic Defences Initiative. In 1985, Michael Heseltine was even able to sign an agreement which enabled British companies to secure up to \$1.5b worth of work for the Star Wars programme, as it came to be known.

With the retirement of Ronald Reagan in 1988, Mrs Thatcher found herself dealing with George Bush. Of his new administration she said the following in her autobiography

"I found myself dealing with an administration which saw Germany as its main European partner in leadership, which encouraged the integration of Europe without seeming to understand fully what it meant and which sometimes seemed to underestimate the need for a strong nuclear defence. I felt I could not always rely as before on American co-operation."

These fears did not, however, last long. The protectionism of an integrated Europe with Germany at its heart, which America had originally encouraged, suddenly started to arouse fears in the US that jobs and trade might be lost. Secondly, Saddam Hussein's aggression showed Britain to be a willing partner in the fight against tyranny. Britain had the skilled armed forces and the political resolve to fight alongside America and prove itself the real partner in leadership.

The present position

It is quite easy to see that the political history of the 'special relationship' has a direct bearing on the volume and extent of any 'partnership of technology' that takes place between the two countries. When the relationship is going well, there is a feeling of mutual trust and an indisputable increase in technological partnerships. The three periods of exceptional closeness (directly after the Second World War, the interim between Suez and Vietnam and the Thatcher-Reagan years) all see height-ened activity in technological links between us.

There is some evidence that the relationship between the US and Britain has cooled since the end of the Gulf War and the election of Bill Clinton. The world has changed out of all recognition. There is now only one super-power: the USA. The free trade system, so often defended by the US and Britain, is not threatened by a Communist Russia. The basics of a market economy are operating there as well as in many other previously "command" economies. The US and Britain are no longer forced together to defend their common values.

Today the EU and North America are each others' largest trading partners, and account between them for half the world's trade.

I ought also to mention that there is a technology transfer scheme as part of the European Co-operation Network. Its aim is to pool resources between regions to enable transfer from producers to users.

A very significant development in the relationship between the US and Europe is the new transatlantic EU/USA action plan which was signed at the last EU-USA summit last December. This wide-ranging document touches on many areas of contact between America and Europe, but there are three of specific importance.

First, there is the recognition that each is the other's largest trading and investment partner and that the economic prosperity of the two are, therefore, inextricably interlinked. There is also a commitment to create a New Transatlantic Market place by progressively reducing or eliminating barriers that hinder the flow of goods, services and capital.

Secondly, in a section entitled 'Building Bridges Across the Atlantic', there is a recognition that a transatlantic relationship can only be truly secure if future generations understand its importance as well as their parents and grandparents did. A vibrant transatlantic community would be maintained and deepened by promotion of, and I quote, "...commercial, social, cultural, scientific, and educational ties that bind us".

Science and technology co-operation

Part of that 'Bridge Across the Atlantic' is a commitment to broaden science and technology co-operation. There is a commitment to negotiate a new, comprehensive agreement by 1997 and to conclude an Agreement on Intelligent Manufacturing Systems, mainly in the fields of advanced technologies and robotics.

In addition, there is a proposal to collaborate in many other areas of technology; examples of specific projects include:

- Intermodal transport and fast shipment techniques
- Intelligent transport systems
- The study and forecasting of travel behaviour
- Development of a Malaria vaccine and the study of environmental health and the effects of radiation.

Finally, the plan includes a commitment to encourage "people to people" links so that grassroots support for the transatlantic relationship is strengthened and there is an enriched flow of ideas for the solution of common problems. Part of this approach, which is of relevance to me as Chairman of the Engineering Training Authority, is the Agreement on Co-operation in Higher Education and Vocational Training.

Time may judge whether such promising rhetoric produces the fruits of a serious, 'special' relationship, but there is no doubting the intentions on both sides of the Atlantic.

There is, of course, considerable transfer of technology across Europe itself. As a member of the EU, Britain is part of the

The legacy of the 'special relationship' and the attractiveness of our economy lead to the lion's share of US and Japanese investment flowing into Britain as opposed to other EU states. Britain must maintain and exploit these links, particularly those with Asia. Fourth Framework Research and Technical Development Programme, which has a budget of 12 billion EC, no less, over the four year period of its life. This Programme is very much a top-down programme with research at a European, not national, level.

In contrast, other European schemes like EUREKA are bottom-up schemes which seek to improve European competitiveness by encouraging and facilitating collaborative near-market research and development. One of the UK's largest fresh food companies, Geest plc, wanted to expand into the prepared chilled and frozen vegetable products. The EUREKA project Microfreeze aimed to pioneer and exploit techniques for doing just that. Geest collaborated with partners from Hungary and the UK in order to develop the new techniques necessary. Successful consumer trials have demonstrated that the new techniques give better results than conventional commercial freezing, and it is hoped that this will now become a commercial success. Over 650 UK organizations have already received support with EUREKA projects, and this has yielded partners in twenty-three member countries. The UK itself took over the chair of EUREKA last month.

I ought also to mention that there is a technology transfer scheme as part of the European Co-operation Network. Its aim is to pool resources between regions to enable transfer from producers to users.

Today, the relationship is not as close as it once was. As the EU grows and strengthens, the USA increasingly looks towards it in order to make technological and trade partnerships. The Madrid agreement and the subsequent work on technological links are clear examples of this.

The economic aspects

But Britain would be unwise to disregard the inward investment in jobs, research and technology that can be gained from outside the EU. Because of its excellent past links with the US, the UK receives 40% of US investment into Europe; that is over double its nearest competitor, Germany. The importance of such statistics cannot be ignored and plays an important part in the prosperity of our country.

It is also important to point out that similar statistics arise with investment by Japan into Europe. Again, we see the UK receiving nearly double the investment of its nearest competitor, The Netherlands.

What can we conclude from this evidence? Britain cannot afford to put all its eggs in one basket and concentrate, at the expense of others, on any one country or area. We have an attractive economy with low inflation and a competitive workforce that make us a sensible choice to overseas investment. The fact that we can create partnerships of a substantial nature with three different areas of the world adds to our appeal. While Europe is now our home market, our special relationship with America attracts their interest, and now we are attracting interest from Japan likewise.

The importance of the Asian economies to Britain is rapidly growing. The growth in trade, both exports and imports, to the countries of Hong Kong, Malaysia, Singapore, South Korea, Taiwan and Thailand has steadily risen to account for about 6% of UK exports and 7% of UK imports. This is a growing market and one that Britain must continue to exploit. The importance of Asia in the future development of world trade is absolutely paramount.

Asia, or more particularly South East Asia, forms the third corner of the trade triangle. She accounts for 30% of world GDP; by early next century it will contain sixteen of the world's twenty-five biggest cities and is the fastest growing region on Earth. The Asia Pacific economies will grow by an average of 7% per annum from 1996-2000. Both the US and the EU have been fostering links in that area and will surely be the fastest growing market of the future.

Asia is particularly important to the USA. American trade across the Pacific is now 50% higher than across the Atlantic and last year Asian markets accounted for 60% of US merchandise exports and 66% of US imports. At current growth rates Asia, excluding Japan, will be the biggest export market for the US by 2018, pumping \$248 billion annually into the American economy. Growth in the Asian tigers does not appear to show any sign of faltering. Hong Kong and Singapore continue to grow, whilst Malaysia, Thailand and Indonesia will maintain their high growth. South East Asia on the whole is expected to expand its GDP by 8.2% this year.

Asia is the EU's largest regional trading partner. The EU does more trade with Asia (including Japan) than North America. However, inter-EU trade still outweighs such volumes by nearly three times. But the truth is that the EU has not been so vigorous in pursuing its links with the up-and-coming markets of Asia. Plans are afoot to change this and ASEM (the Asia-Europe Meeting) held earlier this year was intended to start to solve that.

An Inaugural ASEM was held in Bangkok on the 1st and 2nd of March this year and attended by the Heads of State from ten Asia nations and fifteen European nations. There were general commitments made to foster political dialogues and reinforce economic co-operation. Of particular interest to those of you here today was the promise to intensify science and technology flows between Asia and Europe, especially in the priority driving sectors of agriculture, communication technology, energy, environmental technology and transport.

Conclusions

Britain's special relationship with America has had a variable history since the Second World War, during which the high points have been followed by periods of technological partnership.

Today, the relationship is not as close as it once was. As the EU grows and strengthens, the USA increasingly looks towards it in order to make technological and trade partnerships. The Madrid agreement and the subsequent work on technological links are clear examples of this.

Britain's partnerships in technology broadly follow its pattern of trade. The many schemes set up by the EU also help to promote a large number of technology partnerships in and around Europe. The legacy of the 'special relationship' and the attractiveness of our economy lead to the lion's share of US and Japanese investment flowing into Britain as opposed to other EU states. Britain must maintain and exploit these links, particularly those with Asia.

Asia is undoubtedly the market of the future. Europe is attempting to catch the US and strengthen its links with the region. There is a huge wealth of technology, resources and spending power that is there to be captured. Let us hope that the battle for Asia and its markets remains on a friendly level and the triangle of trade remains complete. If so, we can all combine and share our knowledge and partner each other in all fields of technology. I hope that you will join me in saluting that end.

PROFILES OF COUNCIL MEMBERS

Dr Geoffrey Robinson FEng

Dr Geoffrey Robinson is Director of Technology at IBM UK and Member of the Foundation's Council since last year. The Foundation was first helped by Dr Robinson in the mid 80s when he participated in a large seminar for learned societies at the London International Press Centre where he gave a somewhat philosophical lecture on information technology. David Hall recalls wondering where his fascinating introductory few minutes would possibly lead, but it very soon became clear that he was typically weaving in new ways of looking at IT and its effects on society, and learned societies in particular. It illustrated so well Geoff's refreshing and broad-minded approach to the new technological and social revolution, then in its early days.

Dr Robinson joined IBM at the Hursley Development Laboratory in 1969 after gaining a first class honours degree in Mathematics and a PhD in Quantum Mechanics from Nottingham University. He contributed to the development of major programming projects including languages, compilers, transaction systems, distributed systems and workstations. In 1982 he was appointed manager of the IBM UK Scientific Centre, subsequently becoming Technical Director of IBM UK with additional responsibility for Advanced Manufacturing and Academic Research projects. It was in this period that Geoff developed his approach to the management of research: "Provide an inspiring vision, get the best people, ensure they are constantly challenged - and make the coffee, so they can get on with the work!" Geoff rejoined Hursley in 1986 as Director of Software Development, becoming Laboratory Director in 1988 with worldwide business responsibility for major hardware and software products.

Steve Baker, Assistant to Geoff Robinson at Hursley at that time, describes him as "The most impressive all-rounder I've met" and recalls his "regular 8am Monday morning meetings with his senior staff - not the most popular move. To Geoff, this was the natural thing to do - because by Sunday evening he would be bursting with ideas that he wanted to discuss! In fact, one of the most uncomfortable jobs I had was to call all of his senior team to get them in for a 9am SUNDAY meeting because he couldn't wait until Monday!"

In 1992 he was appointed Chief Adviser on Science and Technology at the Department of Trade and Industry. He was responsible for advising government ministers on a wide range of policy matters including academic and industrial research, space, energy, information technology and intellectual property. He played an influential role in the development of the government's White Paper on Science, Engineering and Technology: 'Realising our Potential'. Geoff resumed his position as Director of the Hursley Laboratory in 1994. He was also appointed Chairman of Transarc Corporation, an IBM US subsidiary company, and Vice President of the IBM Networking Software Division. He had worldwide responsibility for IBM's transaction processing systems business.

Pete Peterson, Development Systems Manager at Hursley, describes Geoff Robinson as "Always full of radical ideas, a great visionary". As his Staff Assistant while Dr Robinson was the Hursley Laboratory Director, Mr Peterson recalls "He was effectively holding down 3 full time jobs at the same time. How he managed it is a mystery, but his work rate was prodigious and the e-mail messages from him time-stamped 4.00 am might give a clue!"

Dr Robinson retired from his full-time IBM career in 1996,

The Foundation has benefited greatly from Geoff's broad and interesting view on many subjects, his encouragement of the involvement of young people and, above all, in the world of information technology together with the social sciences.

but is retained in an advisory capacity on strategic matters including Network Centric Computing, the Internet and related issues.

He now gives much of his time to serving on many public advisory bodies, including: as a non-executive Director of the Ordnance Survey, the supervisory boards of the Radiocommunications Agency and the Health & Safety Laboratory, the Particle Physics and Astronomy Research Council, the Central Laboratory of the Research Councils and the Innovative Manufacturing Initiative Management Committee. He is also Chairman of the Economic and Social Research Council's Innovation and Virtual Society Research Programmes.

Professor Ronald Amann, Chief Executive of the Economic and Social Research Council, describes Geoff as "A most engaging character from whose advice and support ESRC has benefited greatly". A man with "Considerable energy and imagination" which he illustrates with the following anecdote. "As current Chairman of our major research programme on innovative management, Geoff was selected to go on a two-day retreat to concentrate on some of the long-term issues of UK science policy. The opening of his presentation was typical of the man - he went to each Chief Executive in turn and presented them with a £1 coin, which he had calculated was his own annual personal tax contribution to each of the Research Councils, and invited us to suggest how he was receiving value for money! From that point the discussion really took off". Professor Amann writes "Members of Council will always be able to rely on Geoff to think the unthinkable". Dr Paul Williams CBE, Chairman and Chief Executive, CLRC, also highlights his "astonishing ability to ask the unaskable" and goes on to describe him as "One of the most energetic people that I have ever met, he has an insatiable appetite and enthusiasm for science and technology".

Geoff has also played an active role in the British Computer Society, being President in 1995/1996. There he forged a new alliance with the Institution of Electrical Engineers, demonstrating one of his other passions: "breaking down the institutional, discipline and other barriers which, as a nation, we seem so good at creating".

Geoff produced a series of questions for this article which he then answered objectively, neatly illustrating his daughter Catherine's tribute "Dad has the ability to distance himself from a situation and look at it from an objective point of view this of course means that he can always give an unbiased and sound opinion on the many trials and tribulations of life though as he will tell you, I will usually respond at the time that he just doesn't understand (only to admit some days or months later that he was right all the time!)" Marking Geoff out of 10, his daughter writes "Overall, he scores 10/10 as a father but 0/10 as a dedicated shopper!"

He lists the accomplishments that have given him most satisfaction as "Establishing the IBM Scientific Centre as an open centre for very leading edge academic/industry partnership research - years before Faraday Centres were thought of" and he gives his motivation as "Encountering new situations, identifying their idiocies and changing them!"

The Foundation has benefited greatly from Geoff's broad and interesting view on many subjects, his encouragement of the involvement of young people and, above all, in the world of information technology together with the social sciences. Indeed, he is helping enormously to carry forward from the late Sir Alastair Pilkington the Foundation's torch of encouraging the social sciences to work together with the other sciences and engineers.



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