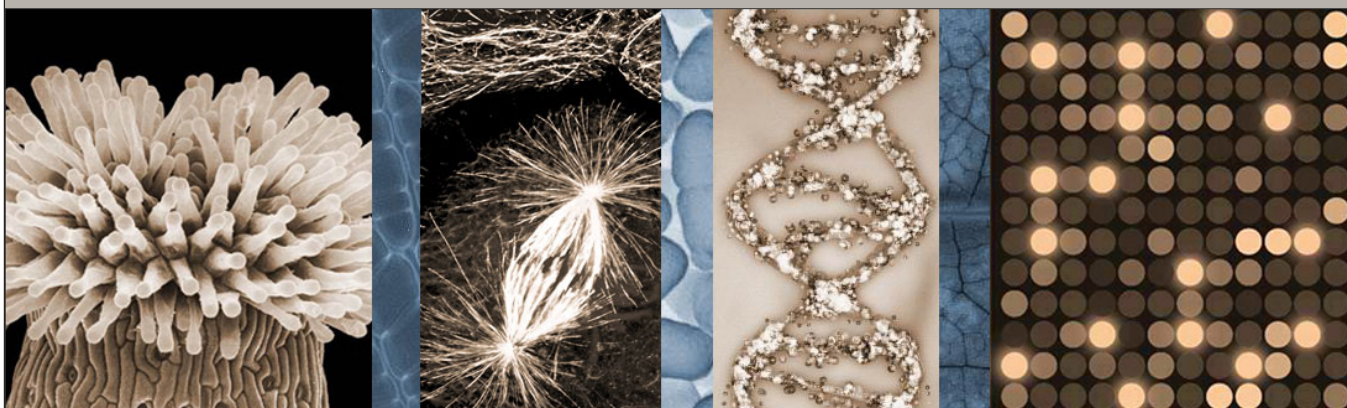


Science-Matrix

Genomics in the United Kingdom

December 2002



Overview of Research in Genomics in the United Kingdom and Prospects for Scientific Cooperation with Canada

Prepared for
Genome Canada

Science-Metrix

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Executive Summary

This report on genome research in the United Kingdom uses public information sources available on the Internet, such as the Medline database, and data from the Science Citation Index and the United States Patent and Trademark Office.

The first section presents an overview of genomic research programmes. Research in genomics in the UK is firmly supported by the British government's Foresight programme, the Office of Science and Technology (OST) and its related Research Councils. The Research Councils manage a budget of £110 M for the "Post Genome Challenge", which is one of the UK cross councils programmes.

Section II analyses the strengths of the UK and Canada in genomics and examines the most promising areas for genome research. There is strong potential for mutually beneficial collaboration in areas such as: Ecology; Marine Biology and Hydrobiology; Biomedical Engineering; Genetics & Heredity; Nutrition and Dietetics; Virology; Arthritis and Rheumatology; Fertility; Obstetrics and Gynaecology; Respiratory Medicine; and Veterinary Medicine.

Drawing from the Medline database, Section 3 examines the distribution of papers in genomics by sector, institution, city, and researcher. The core centre of excellence is London due to the University of London and its numerous colleges, institutes and associated hospitals. Cambridge and Oxford are also inevitable as in many other scientific fields. Other locations that stand out in genomics include Scotland (Edinburgh and Glasgow) and Wales (University of Wales).

The views presented in this report are those of Science-Metrix and do not necessarily reflect the opinion of Genome Canada.

I. An Overview of Genomics in the United Kingdom

Great Britain, the dominant industrial power of the 19th century, played a leading role in advancing literature and science. Its Empire once stretched over one-fourth of the earth's surface. However, during the two World Wars, the United Kingdom's (UK) strength dwindled. The second half of the 20th century witnessed the dismantling of the British Empire, and the UK reformed itself into a modern and wealthy European state. As one of five permanent members of the UN Security Council, and a founding member of NATO and of the Commonwealth, the UK pursues a global approach to foreign policy; it currently is weighing the degree of its integration with continental Europe. Despite its affiliation with the European Union, the UK chose to remain outside of the European Monetary Union for the time being (CIA. 2001. *The World Factbook 2001*).

Table 1 presents some basic socio-economic statistics for the United Kingdom and for Canada. It shows that although the UK is 40 times smaller than Canada, its population is nearly twice as large. The UK's gross domestic product per inhabitant is slightly smaller than that of Canada.

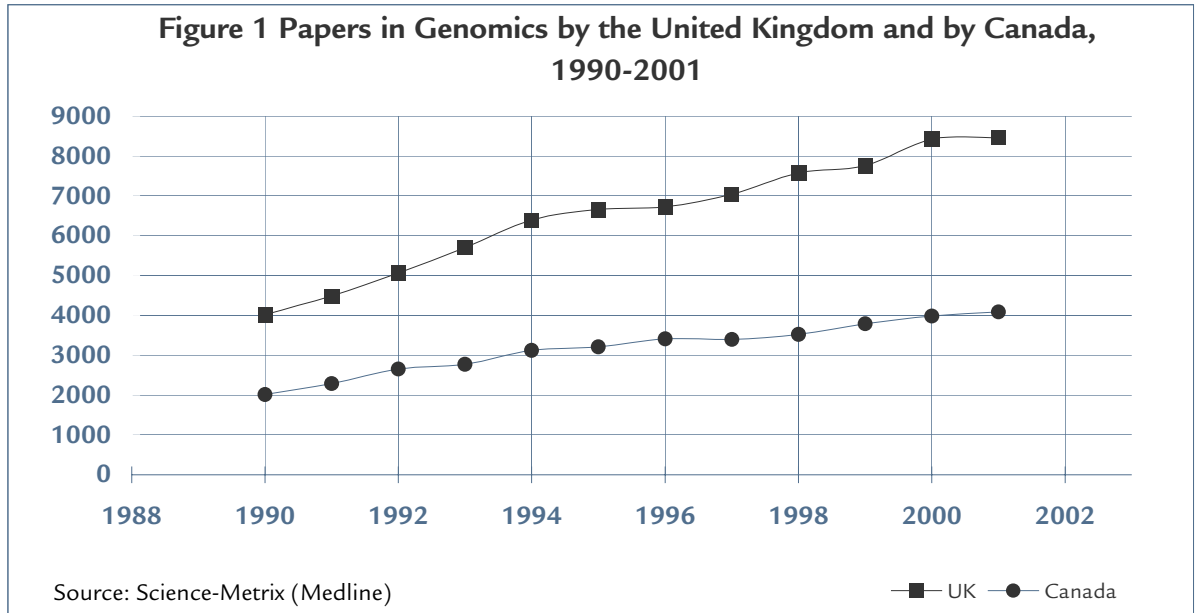
Table 1 Basic Socio-Economic Statistics

	United Kingdom	Canada
Area (sq km)	244,820	9,976,140
Population (July 2001 est.)	59,647,790	31,592,805
Labour force (2000)	29,200,000 (49% of pop.)	16,100,000 (51%)
GDP*	US \$1,306 billion	US \$775 billion
GDP per capita*	US \$22,800	US \$24,800
Government type	Constitutional monarchy	Parliamentary democracy

* Purchasing power parity – 2000 est.

Source: CIA. 2001. *The World Factbook 2001*.

From 1990 to 2001, the United Kingdom published over 78,000 papers in genomics that were indexed by Medline (measured by first author of paper and UK affiliation). No other European country compares to this output. France, for instance, published less than 60,000 papers during the same time period. The UK's leading position in Europe is likely to be maintained in the future due to a healthy 7.1% average annual growth. Figure 1 reveals that the output of papers in genomics grew slightly more rapidly in the UK than it did in Canada throughout the 1990s (7.1% growth rate vs. 6.7% respectively).



National Research Programmes in Genomics

Research in genomics in the UK is firmly supported by the British government's Foresight programme, the Office of Science and Technology (OST) and its related Research Councils. Foresight aims to inform and influence the decisions of research funding authorities, whether business, government, or charity and the research councils. The programme oversees developments in genomics, proteomics and bioinformatics. These fields are among the OST's scientific priorities. The development of bioinformatics is also a clear area of interest for the research councils.

Launched on 1 May 2002, Research Councils UK (RCUK) is a venture involving the UK's seven Research Councils working together scientifically, strategically and operationally, alongside the OST. The science budget for 2001-02 to 2003-04 has awarded resources (£110M) for the Post Genome Challenge, one of the RCUK's Cross Councils Programmes, which is dedicated to the general field of genomics. The share of resources is divided in the following manner among the five councils:

- Medical Research Council (MRC) £53M (48%)
- Biotechnology and Biological Science Research Council (BBSRC) £33M (30%)
- Engineering and Physical Science Research Council (EPSRC) £13M (12%)
- Natural Environment Research Council (NERC) £6M (5.5%)
- Economic and Social Research Council (ESRC) £5M (4.5%)

The councils support the following research areas: functional genomics, model organisms, structural analysis, population-based studies, public engagement in science and risk, "post-genomic" technologies and training of researchers.

In particular, the MRC's research good for the years ahead is to maintain the UK's position at the forefront of "post-genome" research, and to support research in the following areas: molecules and cells, genetics and health, infections and immunity, public health and health services, organs and cancer, neuroscience and mental health and nutrition and environment. Within these fields, priority for new investments will be directed, in part, towards establishing the infrastructure to underpin "post-genome" work. MRC's support falls under two main headings: 1) Genetic Information and Biological Function; and 2) Translational Research on Major Clinical Problems. MRC funded research is performed in 40 research centres, institutes, laboratories and/or units through the UK.

Also of interest is the Biotechnology and Biological Science Research Council, which foresees the potential for the rapid application of advances in the fields of molecular biology and genomics. The BBSRC's objectives are as follows:

- Support the development of research centres in functional genomics;
- Support the development of research centres in structural biology;
- Support advances in bioinformatics and large computing problems in post genomics, proteomics and structural genomics;
- Establish new and upgrade existing laboratories and facilities in its institutes.

EPSRC contributes to the development of genomics by encouraging the physical science community to perform research on new techniques and methods towards a predictive understanding of biological systems. NERC's priority within the Post Genome Challenge is to fulfill the need to link molecular and structural biology with ecology and evolutionary biology in programmes to interpret the genome as the molecular basis of adaptation. Finally, ESRC's role is to develop the research capacity for the social sciences in genomics, working particularly in the area of health, risks, and governance.

Also worth mentioning is the LINK¹ programme in Applied Genomics which is jointly funded by the Department of Trade and Industry (DTI), the MRC and the BBSRC. Its overall objective is to encourage research between industry and academia in the use of genome sequences and genetic data to identify new functions in biological systems that can be applied to the healthcare industries. The projects are coordinated under the umbrella of the Post Genome Challenge Cross Councils Programme. At the launch of the programme in July 2000, the total Government funding available was £15m, to be matched by £15m from industry. By the end of 2002, approximately two thirds of the available government funds were committed, with the total commitment to individual projects by government and industry being over £20m.

¹ The LINK scheme is the UK government's principal mechanism for promoting partnership in pre-competitive research between industry and the research base. It aims to stimulate innovation, wealth creation and improve the quality of life.

Finally, a significant initiative is the Consortium for Post-Genome Science, established in 2001 and funded by three research councils, the MRC, the BBSRC and the EPSRC. It is designed to accelerate developments in post-genome science and technology for the benefit of scientists, clinicians and companies particularly those operating in the North West of England.

Genome Research in Universities

While research on genomics is being performed around the country, the University of London, with its 30 and more constituent colleges and/or institutes appears, not surprisingly, to be the most active hub of research in the field in the UK. The universities of Cambridge and Oxford also represent significant loci of research.

As part of the University of London, the University College of London hosts two MRC funded organizations. The MRC Laboratory for Molecular Cell Biology and Cell Biology Unit (LMCB) performs research on the molecular mechanisms underlying cell biology. The MRC Centre Development for Medical Molecular Virology at the Department of Molecular Pathology & Clinical Biochemistry is working on viral pathogenesis and virally-mediated gene therapy, with groups studying retroviruses and herpes viruses. The Department of Biochemistry & Molecular Biology and the Department of Biology are active in genomics and proteomics. Finally, the Advanced Centre for Biochemical Engineering of the Department of Biochemical Engineering conducts studies on materials for human protein, gene, cell and tissue therapy and on biocatalytic processes enhanced by directed evolution and metabolic engineering. At King's College, the MRC Centre for Developmental Neurobiology is conducting research on the axon guidance in the *Drosophila* central nervous system in addition to offering DNA sequencing facilities. At the Imperial College of Science, Technology and Medicine, the BBSRC Centre for Structural Biology (CSB) is an important hub for interdisciplinary research on structural biology comprising research groups from the Department of Biological Sciences, the Department of Chemistry and the Faculty of Medicine. Birkbeck College hosts a department of crystallography.

The University of Cambridge hosts four MRC funded organizations. The MRC Centre for Protein Engineering, in close link with the Department of Chemistry and the Laboratory of Molecular Biology, performs research on protein folding, stability and activity and on the engineering of antibodies. The Department of Biochemistry hosts an impressive number of facilities including the Protein and Nucleic Acid Chemistry (PNAC) facility, the Cambridge Centre for Proteomics, a DNA sequencing facility, a crystallography and biocomputing group, and the Cambridge Centre for Molecular Recognition. The Department of Genetics' interests embrace all aspects of genetics from molecular to population biology. The Department of Zoology conducts research on genomics such as the caste determination system in Polistine wasps and other genomics and proteomics related subjects.

At Oxford University, the Department of Biochemistry is very active, being home to the Functional Genetics Unit of the Department of Human Anatomy and Genetics which has a research programme on bioinformatics and comparative genomics. A BBSRC centre, the Oxford Centre for Molecular Sciences works on protein folding, protein structure and protein-molecule interactions. The Laboratory of Molecular Biophysics also performs works on proteomics.

The UK universities with the highest visibility on the Internet in genomics are presented in Annex IA.

Genome Research in the Health and Hospital Sector

The health sector in the UK falls under the responsibility of the National Health Service (NHS), managed by the UK government's Department of Health. At the regional level, the authority of the NHS is vested in hospital trusts, each composed of a varying number of institutions offering a complete range of services to the population and often conducting research in affiliation with local universities. As mentioned before, the Medical Research Council (MRC) is also a player in the sector: it has a number of research initiatives that take the form of specialized institutes, centres or units dedicated to specific biomedical subjects and funds research within hospitals and medical schools.

Cancer Research UK² is the most important umbrella organization in genomics and related fields in the UK health sector. Cancer Research UK Institute for Cancer Studies³ in Birmingham has a broad portfolio of research in cancer genetics, signal transduction, viral oncology and immunology, cancer gene and immunotherapy and cancer clinical trials. The Wellcome/Cancer Research UK Institute of Cancer and Developmental Biology⁴ in Cambridge hosts several research groups with a wide range of interests related to genomics as well as proteomics. At the London Research Institute⁵, the Clare Hall Laboratory conducts research on DNA replication, damage and repair.

The Oxford Radcliffe Hospitals NHS Trust⁶ is another major research organization in the field of genomics. Research is one of the Trust's three key strategic activities alongside clinical services and teaching. Most of its research activities are performed in collaboration with the Division of Medical Sciences at Oxford University and the School of Health Care at Oxford Brookes University.

² <http://www.cancerresearchuk.org/>

³ <http://www.cancer.bham.ac.uk/DCS/>

⁴ <http://www.welc.cam.ac.uk>

⁵ <http://www.cancerresearchuk.org/science/lifch/index.html>

⁶ <http://www.oxfordradcliffe.nhs.uk/>

One of MRC's major research centres, the Clinical Sciences Centre⁷ (CSC), located at the Faculty of Medicine of the Imperial College of Science, Technology and Medicine (Hammersmith Hospital Campus, London), hosts an impressive number of research groups and facilities in the fields of genomics, proteomics and bioinformatics. The Genomics Core Laboratory⁸ (GCL) provides DNA sequence analysis instrumentation for CSC. The Genetics and Genomics Research Institute performs research in mammalian genomics, pathogen genomes, and interdisciplinary approaches to functional genomics, proteomics and related subjects. Part of the Post Genome Consortium⁹, the Centre for Integrated Genomic Medical Research¹⁰ (CIGMR, opened in July 2002) offers a comprehensive facility for the analysis of complex diseases by combining epidemiological, statistical and genetic approaches.

Health sector institutions with the highest visibility on the Internet in genomics are presented in Annex IB.

Genome Research in Governmental and Non-Governmental Organizations

A relatively small part of UK's research on genomics is performed in governmental and non-governmental organizations, often under the authority of the research councils which also act as fund providers alongside numerous charities.

Although not a non-governmental organization *stricto sensu*, the Wellcome Trust¹¹ and its Genome Campus, near Cambridge, is core to UK's contribution to the Human Genome Mapping Project (HGMP). Its constituents are the Sanger Institute, one of the world's leading sites of genome sequencing and analysis, the European Bioinformatics Institute, providing researchers throughout the world with instant electronic access to an up-to-date and comprehensive collection of DNA sequences and other biological information, and the HGMP Resource Centre, providing databases, and other biological resources and computing services for the UK research community.

The Institute for Animal Health (IAH) is the largest research institute in the UK dedicated to the health of farm animals. Administered from Compton, it conducts research at three sites: the Compton Laboratory, the Pirbright Laboratory and the Neuropathogenesis Unit in Edinburgh. The divisions of the Institute are: molecular biology, immunology and pathology, epidemiology and environmental microbiology.

⁷ <http://www.csc.mrc.ac.uk/>

⁸ <http://www.csc.mrc.ac.uk/researchfacilities/genomicscorelaboratory/genomicscorelaboratoryactivities.html>

⁹ <http://www.postgenomeconsortium.com/index.html>.

¹⁰ <http://www.postgenomeconsortium.com/cigmr/index.html>

¹¹ The Wellcome Trust is an independent research-funding charity, established under the will of Sir Henry Wellcome in 1936. It is funded from a private endowment and managed with concerns for long-term stability and growth.

The Edward Jenner Institute for Vaccine Research in Compton possesses several research groups dedicated to work on immunology and bioinformatics.

A list of governmental and non-governmental organizations that have the greatest visibility on the Internet relative to genomics is presented in Annex IC.

Genome Research in the Private Sector

Like many European countries, British private genomic research is concentrated in health science. Most of the companies that are present on the Internet assert they are performing research in gene therapy, pharmaceutical research, bioinformatics and gene sequencing and identification tools. There is also a notable portion of companies that are working in the fields of agro-science, food production and cosmetics.

In addition to multinational enterprises with headquarters in the UK (e.g. GlaxoSmithKline, Waters Corporation, Oswell etc.), a very large number of multinational corporations have a subsidiary in UK (Syngenta, Novartis, Roche, Quiagen, Promega, Sigma-Aldrich, etc.). A noticeable number of them are the European headquarters of large American corporations. The synergy created by the presence of British, European and American corporations makes the UK one of the most important players in private genomic research. Moreover, due to its multiple governmental programs that are financing genomic research and due to government-sponsored private organizations that promote the transfer of knowledge and technology from publicly funded research laboratories to private firms (i.e. Medical Research Council Technology), a large number of small start-ups and university spin-offs are present on the Internet. Most of them are located close to the university where they originated and some of them appear to be highly successful (BioRobotics, Oxford Biomedica, etc.).

The address of firms located in the UK that perform research in genomics can be found in Annex II.

* * *

The dominant position of the UK in the European genomic area is clearly reflected on the Internet. Similar to Canada, although with a much larger number of intervening parties, the UK has invested in a national effort in the field of genomics. This has had great impact in genomic-related research areas and created many vibrant research communities in universities, hospitals and private companies, as shown in the previous section. The different research communities are also well connected with one another, given that government-sponsored organizations help to create bridges between them. UK is one of the most interesting countries in the field of genomic research in part because it has been able to instil a balance between publicly and privately funded research.

II. Strengths of the United Kingdom and Canada in Genomics

This section compares Canadian and UK scientific output and the level of protection of their intellectual property. The analysis uses data from the Science Citation Index (SCI) and the United States Patent and Trademark Office (USPTO). The aim is to identify fields where Canada and the UK can cooperate in a mutually beneficial manner.

Global Position in Genomic Science and Technology

Table 2 highlight the fact that, in most scientometric indicators, UK's genomic science has more potency than that of Canada. UK ranks 3th globally, just behind the United States and Switzerland, whereas Canada ranks 6th. In terms of number of papers, UK holds the 3th rank, but drops to 5th place when the number of papers is weighed by number of inhabitants. In both these indicators, Canada ranks 6th. The United Kingdom specializes more in genomics than Canada (Index of specialization), but Canadian genomic science tend to have a greater expected impact (Relative impact factor).

**Table 2 Rank of Leading Countries in Genomics
by Publication of Scientific Papers, 1990-1998**

Rank	Number of papers	Papers per inhabitant	Index of specialization	Relative impact factor	Global rank
1	U.S.A.	Switzerland	U.S.A.	U.S.A.	U.S.A.
2	Japan	Sweden	Switzerland	Switzerland	Switzerland
3	UK	Netherlands	France	Canada	UK
4	Germany	U.S.A.	Sweden	Netherlands	Netherlands
5	France	UK	Japan	UK	France
6	Canada	Canada	Netherlands	France	Canada
7	Italy	Australia	UK	Germany	Sweden
8	Netherlands	France	Australia	Sweden	Japan
9	Australia	Germany	Canada	Australia	Germany
10	Sweden	Japan	Germany	Spain	Australia
11	Switzerland	Italy	Italy	Italy	Italy
12	Spain	Spain	Spain	Japan	Spain
13	USSR/Russia	USSR/Russia	USSR/Russia	USSR/Russia	USSR/Russia

Source: Science Citation Index and United Nations Statistics Division

Statistics on patenting activity in the US provide a different portrait than that of publications (Table 3). First, Canada ranks second globally, whereas the UK occupies tenth place. Although ranks vary between indicators, Canada always occupies a better position than the UK, being at least two ranks ahead. Canada ranks 4th and UK 10th in terms of patents per inhabitant. Canada is also more specialized than the UK and grew faster.

Table 3 Ranking of Leading Countries in Genomics by Patenting Activities in the USA, 1990-1999

Rank	Number of patents in USA	USA patents per inhabitant	Index of specialization	Growth	Global rank
1	USA	USA	Australia	Switzerland	USA
2	Japan	Netherlands	Netherlands	Australia	Canada
3	Germany	Switzerland	Canada	Canada	Australia
4	France	Canada	USA	France	Netherlands
5	Canada	Sweden	USSR/Russia	USA	France
6	Netherlands	Japan	UK	Germany	Switzerland
7	UK	Australia	Spain	Sweden	Germany
8	Australia	France	France	Netherlands	Sweden
9	Switzerland	Germany	Sweden	UK	Japan
10	Sweden	UK	Germany	Italy	UK
11	Italy	Italy	Switzerland	Japan	Spain
12	Spain	Spain	Italy	Spain	Italy
13	USSR/Russia	USSR/Russia	Japan	USSR/Russia	USSR/Russia

Source: United States Trademark and Patent Office and United Nations Statistics Division

Positioning Canada and the United Kingdom for Cooperation

Table 4 shows that in both core fields of genomic research (Biomedical Research and Clinical Medicine), UK ranks second, outranking Canada by a few ranks (5th and 7th rank respectively). There is also a good potential for collaboration in Biology since Canada ranks first and the UK 3rd. On the other hand, scientific performance in Chemistry is not a strong area for either country; thus it may not be the most promising field for collaboration.

Table 4 Global Rank of Leading Countries in Genomics by Scientific Field, 1990-1998

Rank	Biology	Biomedical Research	Chemistry	Clinical Medicine
1	Canada	USA	Switzerland	USA
2	Australia	UK	USA	UK
3	UK	Switzerland	Sweden	Netherlands
4	USA	France	Germany	Sweden
5	Japan	Canada	France	Switzerland
6	Netherlands	Germany	Japan	Japan
7	Germany	Netherlands	Canada	Canada
8	France	USSR/Russia	UK	Italy
9	Spain	Australia	USSR/Russia	France
10	Switzerland	Sweden	Spain	Australia
11	Sweden	Japan	Netherlands	Germany
12	Italy	Spain	Australia	Spain
13	USSR/Russia	Italy	Italy	USSR/Russia
Papers (%)	21,343 (6%)	205,864 (58%)	7,240 (2%)	117,948 (33%)

Source: Science Citation Index and United Nations Statistics Division

In some specialities, the excellent performance of both Canada and the UK sets the ground in favour of mutually profitable collaboration (Table 5). In the field of Biology for instance, where the UK and Canada are leaders, collaboration could be prioritized in Ecology, Marine Biology and Hydrobiology. Within biomedical research, the sub-fields of Biomedical Engineering, Genetics & Heredity, Nutrition and Dietetics, and Virology show a great potential. On the other hand, only one specialty in the field of Chemistry seems to indicate that fruitful collaboration arrangements could be made, that is Applied Chemistry.

UK scores first in many Clinical Medicine specialties. Some of these specialties show great collaboration potential, especially when Canada is also in a good position. They are Arthritis and Rheumatology, Fertility, Obstetrics and Gynaecology, Respiratory Medicine and Veterinary Medicine. Some collaboration opportunities can also be found in Computers and Materials Science, and in Clinical Psychology.

* * *

The analysis presented here is an aggregate evaluation of the performance of two countries. The fact that the scientific fields listed present opportunities for *planned* collaborative research does not mean that mutually beneficial collaboration could not be performed at an individual level between leading researchers.

**Table 5 Global Rank of Leading Countries in Genomics
by Field and Sub-Field, 1990-1998**

Field	1	2	3	4	5
Biology	Canada	Australia	UK	USA	Japan
Botany	Australia	UK	Netherlands	Germany	Canada
Dairy & Animal Science	Canada	Netherlands	USA	Australia	UK
Ecology	USA	Australia	UK	Canada	Sweden
Entomology	Australia	Canada	USA	France	UK
Marine Biology & Hydrobio.	Canada	Australia	UK	USA	Sweden
Misc. Biology	UK	USA	Spain	Italy	Canada
Biomedical Research	USA	UK	Switzerland	France	Canada
Anatomy & Morphology	Canada	Netherlands	USA	Australia	UK
Biomedical Engineering	Switzerland	UK	Japan	Canada	Germany
General Biomedical Research	USA	UK	Switzerland	France	Canada
Genetics & Heredity	UK	Netherlands	Canada	USA	Australia
Misc. Biomedical Research	UK	Switzerland	USA	Canada	Spain
Nutrition & Dietetic	USA	Canada	Australia	UK	Spain
Physiology	USA	Switzerland	UK	Germany	Canada
Virology	USA	UK	Germany	Canada	Netherlands
Chemistry					
Applied Chemistry	Germany	UK	USA	Canada	Japan
Clinical Medicine					
Addictive Diseases	USA	Canada	Australia	Japan	UK
Arthritis & Rheumatology	UK	Canada	Netherlands	USA	Japan
Fertility	USA	Canada	Netherlands	UK	Australia
General & Internal Medicine	UK	USA	Sweden	Canada	Netherlands
Neurology & Neurosurgery	USA	Switzerland	Canada	Sweden	UK
Obstetrics & Gynecology	UK	USA	Canada	Germany	Netherlands
Orthopedics	USA	Sweden	Canada	Japan	UK
Pharmacology	USA	UK	Switzerland	Sweden	Canada
Psychiatry	UK	USA	Sweden	Canada	Australia
Radiology & Nuclear Medicine	USA	Netherlands	UK	Germany	Canada
Respiratory System	UK	Canada	Switzerland	Japan	France
Veterinary Medicine	Australia	UK	Switzerland	Canada	USA
Engineering and Technology	USA	Germany	Canada	Japan	UK
Computers	USA	UK	Canada	Germany	Italy
Materials Science	Japan	UK	Canada	USA	Germany
Mathematics	UK	USA	France	Canada	Germany
Applied Mathematics	USA	UK	Netherlands	Canada	Italy
Probability & Statistics	UK	USA	Australia	Canada	France
Psychology	Canada	USA	UK	Switzerland	Australia
Behav. Sci. & Complementary Psycho.	Canada	USA	Switzerland	UK	Germany
Clinical Psychology	Canada	UK			
Developmental & Child Psycho.	USA	Sweden	Canada	UK	
Miscellaneous Psychology	UK	USA	Netherlands	Canada	Australia

Source: Science Citation Index and United Nations Statistics Division

Leadership Structure of the United Kingdom in Genomics Research

This section examines the distribution of papers in genomics by sector, institution, city and researcher. The Medline database is used here since more than 91% of papers in genomics are published in journals classified in the fields of biomedical research and clinical medicine. From 1990 to 2001, the UK published around 78,000 papers in genomics that were indexed by Medline (measured by first author of paper and UK affiliation).

Distribution of Papers in Genomics by Sector

In the United Kingdom, researchers affiliated with universities are present in 70% of papers in genomics (Figure 2). The proportion of papers by university researchers is higher in the UK than in Denmark, the Netherlands and Switzerland. Authors from the health sector also play an important role in the development of research in genomics since 34% of papers are authored by researchers affiliated with a health centre, a medical clinic or a hospital (including university hospitals)¹². Governmental organizations authored a little more than 4% of papers, while private enterprises authored about 3%. Other institutions have authored less than 1% of papers and authors from unknown institutions 3%.

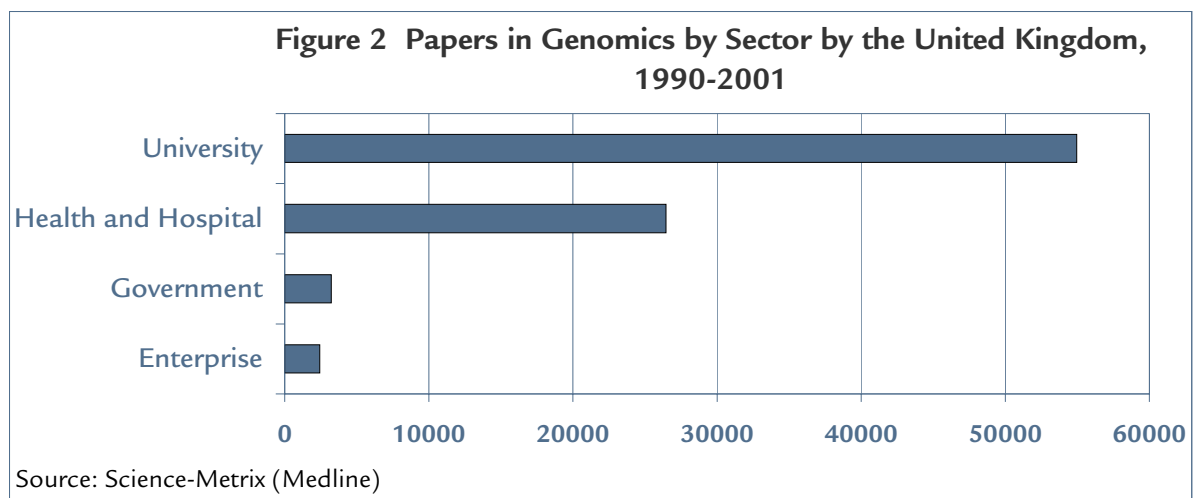


Figure 3 clearly shows that the production of papers by universities is led by the University of London with 20% of the output by universities¹³. Cambridge is next in importance followed by Oxford with respectively 14% and 8% of the UK output. The fourth and fifth universities are Scottish (U. of Edinburgh and U. of Glasgow) and the sixth is Welsh (U. of Wales).

¹² The fact that the total figure is above 100% is due to the fact that several researchers have more than one affiliation, that is, they are affiliated with a health institution and a university.

¹³ See <http://www.lon.ac.uk/colleges.htm> for a list of colleges and institutes constituting the University of London.

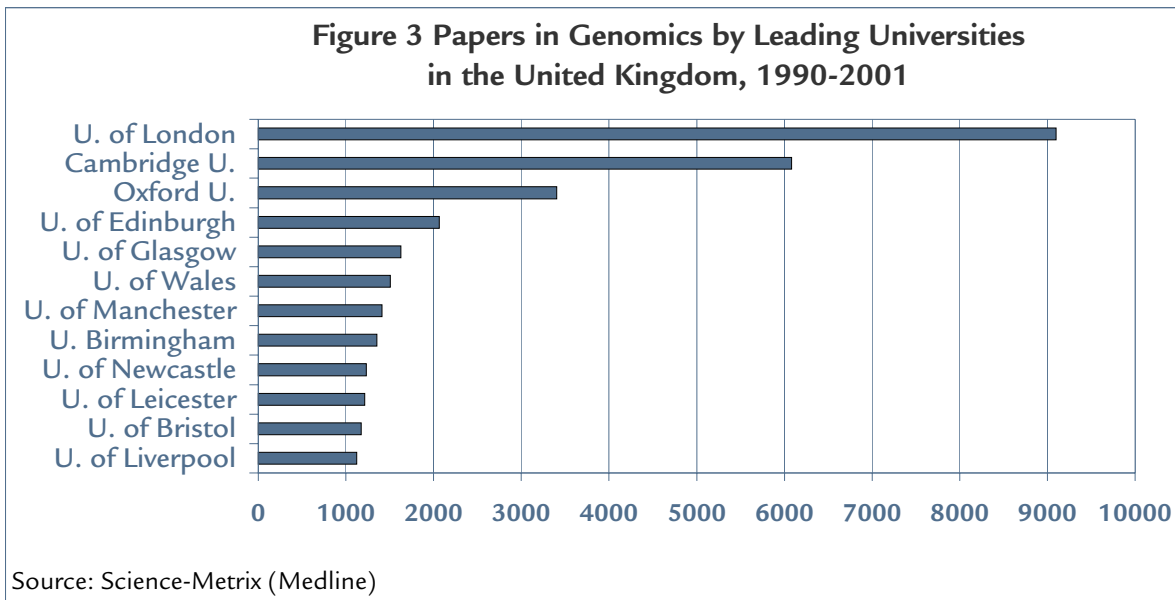
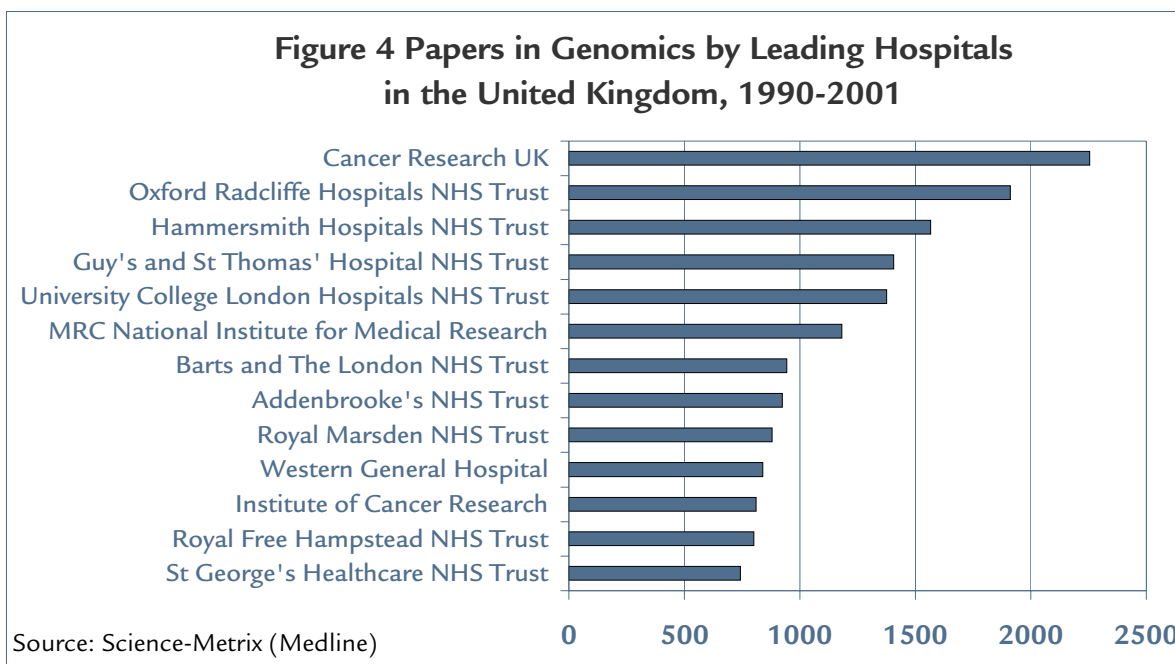


Figure 4 lists the most active institutions in the health and hospital sector. These data reflect the reform of the UK health system where several health institutions were merged in NHS trusts (see Part I). Of the leading 13 health sector institutions in genomics, 9 are NHS trustees.

The leading health sector institute is Cancer Research UK and it is noteworthy that the Institute of Cancer Research is also in the list of top ranking institutes (ranking 11). The most active NHS trusts are the Oxford Radcliffe Hospitals, the Hammersmith Hospitals in London, and Guy's and St Thomas's Hospital, also located in London.



Private firms in the UK account for about 3% of the scientific output in genomics. This figure compares to most of the European countries except for Switzerland and Denmark. Table 6 reveals that only eight of the 17 leading firms have headquarters in the UK. GlaxoSmithKline, which has headquarters in the UK, ranks first with close to one thousand papers in genomics (40% of the UK private-firms papers). Syngenta, a Swiss-based firm, ranks second with 14% of the private-firm output, while Merck, a US-based firm, ranks third with 6% of papers by private firms.

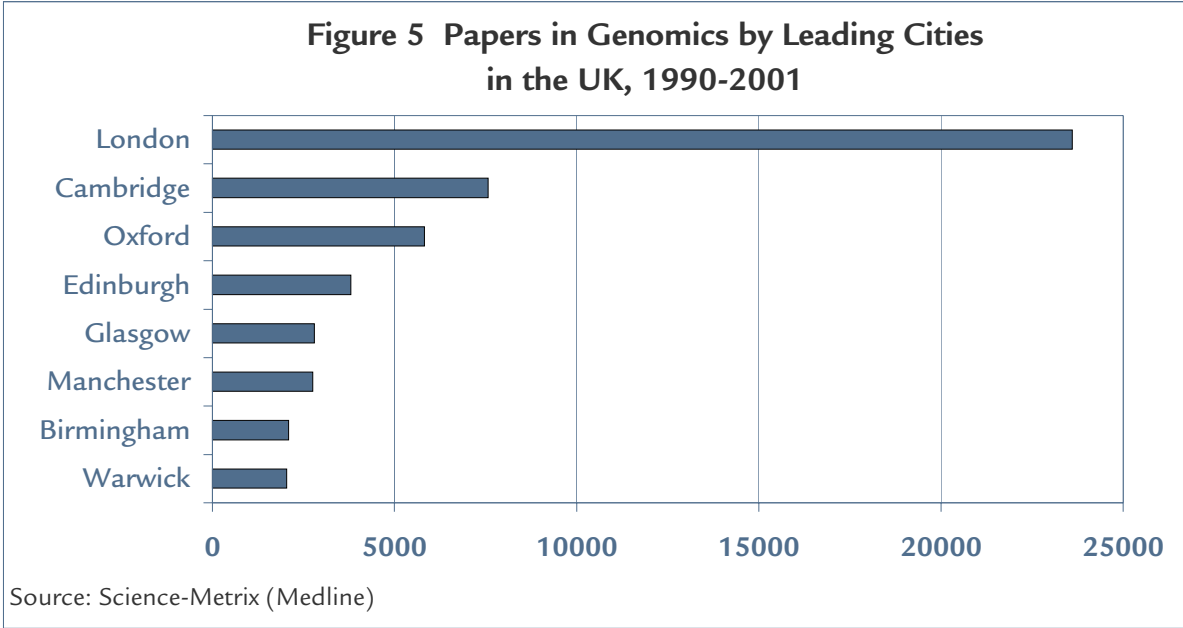
**Table 6 Ranking of Leading Enterprises in Genomics in the United Kingdom.
Number of Papers by City, 1990-1999**

Rank	Enterprise	Headquarters Location	Harlow	Macclesfield	Beckenham	Stevenage	Hertfordshire	London	Cambridge	Alderley Park	Carshalton	Oxford	Welwyn	Slough	Greenford	Nottingham	Bedford	Warwick	Others	Total
1	GlaxoSmithKline	UK (Brentford)	216		251	188	106			119			39		74				78	977
2	Syngenta	Switzerland (Basel)		280															65	345
3	Merck	USA (Whitehouse Station, NJ)	142																	142
4	ReNeuron Ltd	UK (Guildford)						98												98
5	BIBRA International Ltd	UK (Carshalton)									95									95
6	Celltech Group plc	UK (Slough)												77						77
7	Roche Products Ltd	Switzerland (Basel)					22						50							53
8	Bruker Spectrospin Ltd	Unknown (subsidiary: Coventry)																50		50
9	Unilever	UK (London)															50			50
10	British Biotech PLC	UK (Oxford)										46								46
11	Amersham International plc	Sweden (Uppsala)																	45	45
12	Aventis	France (Strasbourg)														23			10	33
13	Pfizer	USA (New York)																	33	33
14	Oxford GlycoSciencesLtd	UK (Abingdon)										31							27	31
15	Novartis Pharma AG	Switzerland (Basel)							29											29
16	Eli Lilly and Company	USA (Indianapolis, Ind)																	25	25
17	Medical Res. Council Tech.	UK (London)						25												25
	Others			5			9	13	103		1	15				32			216	393
Total			358	285	251	188	137	136	132	119	96	92	89	77	74	55	50	50	499	2445

Source: Science-Metrix (Medline)

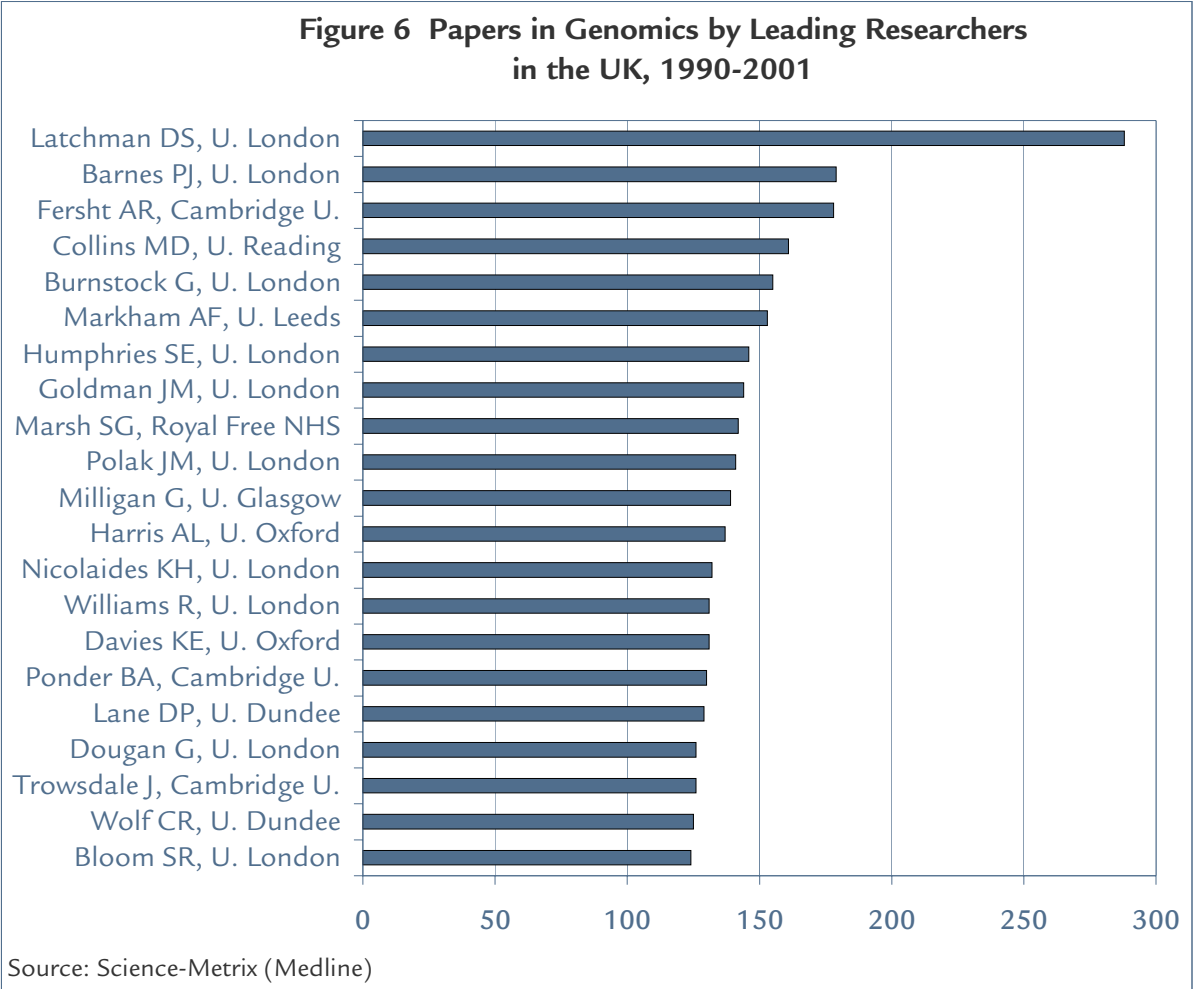
Position of United Kingdom's Cities in Genomic Science

By and large, the rank of leading cities is determined by the rank of the leading universities. With 30% of the output, London is by far the UK city with the largest number of papers in genomics (Figure 5). It is followed by Cambridge (10% of the output), Oxford (7%) and Edinburgh (5%).



Leading United Kingdom Researchers in Genomic Science

Figure 6 reveals that about half the leading researchers are from the University of London. Only three are from Cambridge, and two each from Oxford and Dundee. The leader by far is Latchman with close to 290 papers in Medline, that is, 60% more than the closest contender. There is also a number of authors whose excellence in research is acknowledged by their presence in ISI's list of highly cited authors (Barnes, Fersht, Collins, Burnstock, Polak, Bloom) and of which two-thirds are from the University of London.



* * *

The greatest centre of scientific excellence in genomics in the UK is the University of London, followed – at a distance - by Cambridge and Oxford. The University sector plays a predominant role in UK research. Although the private sector is not extremely strong overall, the performance in genomics by GlaxoSmithKline is comparable to that of other leading firms in the pharmaceutical industry in other countries.

Annex IA – UK Universities Performing Research in Genomics

University	Department
John Innes Cent.	http://www.jic.bbsrc.ac.uk/
Institute of Food Research	http://www.ifr.bbsrc.ac.uk/
University of Birmingham	Functional Genomics Laboratories (School of Biosciences) http://www.genomics.bham.ac.uk/ School of Chemical Sciences http://www.chem.bham.ac.uk/
University of Bristol	Department of Agricultural Sciences http://www.iacr.bbsrc.ac.uk/lars/tlarshome.html
University of Cambridge	MRC Laboratory of Molecular Biology http://www2.mrc-lmb.cam.ac.uk/ MRC Biostatistics Unit http://www.mrc-bsu.cam.ac.uk/ MRC Centre for Protein Engineering (CPE has close links with the Department of chemistry and the Laboratory of Molecular Biology) http://www.mrc-cpe.cam.ac.uk/ Department of Biochemistry http://www.bio.cam.ac.uk/dept/biochem/ Department of Chemistry http://www.ch.cam.ac.uk/ Department of Genetics http://www.gen.cam.ac.uk/ Centre for Molecular Recognition (CCMR) http://www.ch.cam.ac.uk/CCMR/ Department of Zoology http://www.zoo.cam.ac.uk/ Physiological Laboratory (Department of Physiology) http://www.physiol.cam.ac.uk/ The Wellcome Trust and Cancer Research UK Institute of Cancer and Develop. Biology http://www.welc.cam.ac.uk/ MRC Cancer Cell Unit (The Hutchison/MRC Research Centre) http://www.hutchison-mrc.cam.ac.uk/
University of Cardiff	MRC Co-operative on Neuronal Plasticity, Learning and Memory: http://www.cf.ac.uk/plasticity/index.html
University of Dundee	MRC Protein Phosphorylation Unit http://www.dundee.ac.uk/lifesciences/mrcppu/
University of East Anglia	School of Chemical Sciences and Pharmacy http://www.uea.ac.uk/menu/acad_depts/che/
University of Edimburg	Centre for Inflammation Research http://www.med.ed.ac.uk/idg/inflamrs.htm MRC Human Genetics Unit (Part of the UK Mouse Sequencing Programme) http://www.hgu.mrc.ac.uk/ Institute for Stem Cell Research (formerly Centre for Genome Research) http://helios.bto.ed.ac.uk/cgr/
University of Glasgow	MRC Virology Unit (within the Division of Virology, Institute of Biomedical and Life Sciences) http://www.vir.gla.ac.uk/ Sir Henry Wellcome Functional Genomics Facility (SHWFGF) http://www.gla.ac.uk/departments/ibls/ASU/fgf/

University of Leicester	<p>Department of Biology http://www.le.ac.uk/biology/</p> <p>Department of Genetics http://www.le.ac.uk/ge/</p>
University of Leeds	<p>Astbury Centre http://www.astbury.leeds.ac.uk/</p>
University College London (UofL)	<p>MRC Laboratory for Molecular Cell Biology and Cell Biology Unit (LMCB) http://www.ucl.ac.uk/lmcb/</p> <p>MRC Centre Development for Medical Molecular Virology (Department of Molecular Pathology & Clinical Biochemistry, Windeyer Institute of Medical Sciences) http://www.mrc.ac.uk/index/about/about-research_centres/about-unit_details.htm?ID=92</p> <p>Department of Biochemistry and Molecular Biology http://www.biochem.ucl.ac.uk/</p> <p>Department of Biology http://www.ucl.ac.uk/biology/</p> <p>Advanced Centre for Biochemical Engineering (Department of Biochemical Engineering) http://www.biochemeng.ucl.ac.uk/</p>
Birkbeck College London (UofL)	<p>Department of Crystallography http://www.cryst.bbk.ac.uk/</p>
King's College London (UofL)	<p>MRC Social, Genetic and Developmental Psychiatry Research Centre: http://www.iop.kcl.ac.uk/main/ResRep/Centre.htm</p> <p>MRC Muscle and Cell Motility Unit (King's College London) http://www.kcl.ac.uk/depsta/biomedical/randall/mrcmcmu.html</p> <p>MRC Centre for Developmental Neurobiology: http://www.kcl.ac.uk/depsta/biomedical/mrcdevbiol/</p>
Imperial College of Science, Technology and Medicine (UofL)	<p>BBSRC Centre for Structural Biology (CSB) http://www.ic-csb.ic.ac.uk/</p> <p>Department of Biological Sciences http://www.bio.ic.ac.uk/</p> <p>Department of Chemistry http://www.ch.ic.ac.uk/</p>
University of Liverpool	<p>School of Biological Sciences http://www.liv.ac.uk/biolsci/</p>
University of Oxford	<p>MRC Biochemical and Clinical Magnetic Resonance Unit (Within the Department of Biochemistry) http://www.bioch.ox.ac.uk/mrs/</p> <p>MRC Immunochemistry Unit (Department of Biochemistry) http://www2.bioch.ox.ac.uk/immunoch/</p> <p>Department of Biochemistry http://www.bioch.ox.ac.uk/</p> <p>MRC Anatomical Neuropharmacology Unit http://mrcanu.pharm.ox.ac.uk/</p> <p>MRC Functional Genetics Unit (Department of Human Anatomy and Genetics): http://www.mrcfgu.ox.ac.uk/index.htm</p> <p>BBSRC Oxford Centre for Molecular Sciences http://www.ocms.ox.ac.uk/</p> <p>Laboratory of Molecular Biophysics http://biop.ox.ac.uk/www/top.html</p>
University of Manchester	<p>School of Biological Sciences http://www.biomed.man.ac.uk/</p>

University of Manchester Institute of Science and Technology	Department of Biomolecular Sciences http://www.bi.umist.ac.uk/
University of Newcastle	School of Cell and Molecular Biosciences http://www.ncl.ac.uk/camb/research/
University of Nottingham	National Centre for Macromolecular Hydrodynamics http://www.nottingham.ac.uk/ncmh/
University of Sheffield	Krebs Institute http://www.shef.ac.uk/misc/personal/mb1pja/kiss/kiss4.html
University of Sussex	MRC Genome Damage and Stability Centre http://www.biols.susx.ac.uk/gdsc/frameset Sussex Centre For Neuroscience http://www.biols.susx.ac.uk/SCNS/IRCinfo.html
University of Wales	Institute of Biological Sciences http://www.aber.ac.uk/biology/
University of York	Structural Biology Laboratory (Department Of Chemistry) http://www.ytbl.york.ac.uk/

Source: Science-Metrix (Internet)

Annex IB - UK Health Organizations in Genomics

Institution	Department/Organization
Addenbrooke's NHS Trust	Department of Medical Genetics (University of Cambridge) http://www.cimr.cam.ac.uk/index.html School of Clinical Medicine http://www.medschl.cam.ac.uk/
Barts and The London NHS Trust	Barts Cancer Centre Appeal http://www.bartscancercentre.org/ The Orchid Cancer Appeal http://www.orchid-cancer.org.uk/ Barts and The London School of Medicine and Dentistry http://www.mds.qmul.ac.uk/ Queen Mary University of London http://www.qmul.ac.uk/
Cancer Research UK	Cancer Medicine Research Unit (St-James's University Hospital, Leeds) http://science.cancerresearchuk.org/research/loc/leeds/26064/?version=1 London Research Institute http://www.cancerresearchuk.org/science/lifch/index.html The Cancer Research UK Beatson Laboratories (Glasgow) http://www.beatson.gla.ac.uk/ Cancer Research UK Institute for Cancer Studies (Birmingham) http://www.cancer.bham.ac.uk/DCS/ The Paterson Institute for Cancer Research (Manchester) http://www.paterson.man.ac.uk/ The Wellcome/Cancer Research UK Institute of Cancer and Developmental Biology http://www.welc.cam.ac.uk
Guy's and St Thomas' Hosp. NHS	Guy's, King's and St Thomas' Medical School http://www.kcl.ac.uk/depsta/medicine/index.html
Hammersmith Hospitals NHS Trust	The Clinical Sciences Centre (CSC, Faculty of Medicine of Imperial College) http://www.csc.mrc.ac.uk/ The MRC Prion Unit, Department of Neurogenetics (Imperial College of Science, Technology and Medicine, University of London) http://smwww1.med.ic.ac.uk/db/dbbm/tgunit.htm
National Institute for Medical Research	Genes & Development Divisions http://www.nimr.mrc.ac.uk/development.htm
Oxford Radcliffe Hospitals NHS Trust	The Division of Medical Sciences (Oxford University) http://www.medsci.ox.ac.uk/ The School of Health Care (Oxford Brookes University) http://www.brookes.ac.uk/schools/hcs/index.html
Royal Marsden NHS Trust	The Institute of Cancer Research (London) http://www.icr.ac.uk/
Royal Free Hampstead NHS	Royal Free and University College Medical School http://www.ucl.ac.uk/medicalschoo/
St George's Healthcare NHS	St George's Hospital Medical School (University of London) http://www.sghms.ac.uk/
U. College London Hospitals NHS Trust	The Institute of Child Health http://www.ich.ucl.ac.uk/ University College Medical School http://www.ucl.ac.uk/medicalschoo/

Source: Science-Metrix (Internet)

Annex IC: Governmental and Non-Governmental Organizations Performing Research in Genomics

Organization	Research group
Babraham Institute (BI)	Developmental Genetics Programme http://www.babraham.ac.uk/research/developmental_genetics/index.htm Molecular Immunology Programme http://www.babraham.ac.uk/research/molecular_immunology/index.htm Neurobiology Programme http://www.babraham.ac.uk/research/neurobiology/index.htm
Centre for Protein and Membrane Structure and Dynamics (CPMSD)	http://www.srs.dl.ac.uk/VUV/CD/cpmsd.html
The Edward Jenner Institute for Vaccine Research*	Autoimmunity Group http://www.jenner.ac.uk/res-auto.htm Bioinformatics Group http://www.jenner.ac.uk/res-bio.htm CD45 Group http://www.jenner.ac.uk/res-cd45.htm
Hannah Research Institute (HRI)	http://www.hri.sari.ac.uk/
Horticulture Research Intern.	Crop Improvement and Biotechnology http://www2.hri.ac.uk/view_general.php?cat=rast&subcat=CIB&page=604&inner=EM
Institute for Animal Health (IAH)	http://www.iah.bbsrc.ac.uk/info/3WORG.HTM
The Institute of Grassland and Environmental Research (IGER)	Plant Breeding Programme http://www.iger.bbsrc.ac.uk/igerweb/plantbreeding/plant_groups.htm Cell Biology Department http://www.iger.bbsrc.ac.uk/igerweb/cellbiol/db_backed/display/view_group.asp Genetic Resources Unit http://www.igergru.bbsrc.ac.uk/
Institute of Arable Crops Research (IACR)	Assimilate Partitioning http://www.iacr.bbsrc.ac.uk/cpi/ap.htm Developmental Genetics http://www.iacr.bbsrc.ac.uk/cpi/dv.htm Plant Products http://www.iacr.bbsrc.ac.uk/cpi/pp.htm Signalling and Development http://www.iacr.bbsrc.ac.uk/cpi/sad.htm Stress Biology http://www.iacr.bbsrc.ac.uk/cpi/sb.htm Insect Molecular Biology http://www.iacr.bbsrc.ac.uk/bch/IMBGroup/IMBGroup.html Plant Pathogen Interactions http://www.iacr.bbsrc.ac.uk/ppi/ppiindex.htm Sugar-beet research http://www.iacr.bbsrc.ac.uk/broom/sbresearch.html Wheat Research http://www.iacr.bbsrc.ac.uk/cpi/wheat/wheatresearch.htm

Moredun Research Institute (MRI)	<p>Bacteriology http://www.mri.sari.ac.uk/bacteriology/</p> <p>Genomics http://www.mri.sari.ac.uk/Genomics/</p> <p>Immunology http://www.mri.sari.ac.uk/Immunology/</p> <p>Molecular Biology http://www.mri.sari.ac.uk/Molbio/</p> <p>Parasitology http://www.mri.sari.ac.uk/Parasitology/</p> <p>Pathology Theme http://www.mri.sari.ac.uk/Pathology/</p> <p>Virology http://www.mri.sari.ac.uk/Virology/</p>
MRC Dunn Human Nutrition Unit	http://www.mrc-dunn.cam.ac.uk/
Roslin Institute (RI)	<p>Genomics and Bioinformatics http://www.roslin.ac.uk/research/genomics.html</p> <p>Transgenics and biotechnology http://www.roslin.ac.uk/research/transgenics.html</p> <p>Animal breeding http://www.roslin.ac.uk/research/animal.html</p> <p>Animal welfare and behaviour http://www.roslin.ac.uk/research/welfare.html</p>
Rowett Research Institute:	<p>Appetite and Energy Balance http://www.rowett.ac.uk/divisions/appetite/appetite.html</p> <p>Cellular Integrity http://www.rowett.ac.uk/divisions/cellular/cell_integ.html</p> <p>Development, Growth and Function http://www.rowett.ac.uk/divisions/dev_bio/develop.html</p> <p>Gut Microbiology and Immunology http://www.rowett.ac.uk/divisions/Gut/gut.html</p>
The Sanger Institute	http://www.sanger.ac.uk/
Scottish Crops Research Institute	http://www.scri.sari.ac.uk/
The Wellcome Trust Genome Campus	http://www.wellcome.ac.uk/en/1/bioengen.html

Source: Science-Metrix (Internet)

Annex II Companies Active in the Fields of Genomics, Proteomics and Bioinformatics in the UK

This annex comprises enterprises that were active in genomics between 1990 and 2002 or that acquired firms active in genomics during those years.

Aber Genomic Computing Ltd
Unit 8F Science Park
Cefn Llan
Aberystwyth
SY23 3AH
United Kingdom
Tel: 44 1970 636 763
Fax: 44 1970 636 818
Email: mail@abergc.com
Internet: www.abergc.com

Affymetrix UK Ltd.
Voyager, Mercury Park,
Wycombe Lane, Wooburn Green
High Wycombe
HP10 0HH
United Kingdom
Tel: 44 1628 552 550
Fax: 44 1628 552 585
Email: saleseurope@affymetrix.com
Internet: www.affymetrix.com

Agilent Technologies UK Limited
Life Sciences & Chemical Analysis Group
Lakeside
Cheadle Royal Business Park
Stockport, Cheshire
SK8 3GR
United Kingdom
Tel: 44 161 492 7500
Fax: 44 161 492 7171
Email: cag_enquiry@agilent.com
Internet: www.chem.agilent.com

Amersham plc
Amersham Place
Little Chalfont
Buckinghamshire
HP7 9NA
United Kingdom
Tel: 44 1494 544 000
Fax: 44 1494 542 266
Internet: www.amersham.com

Aneda
The Logan Building
Roslin BioCentre
Roslin
Midlothian
EH25 9PS
United Kingdom
Tel: 44 1315 274 528
Email: enquiries@anedabio.com
Internet: www.anedabio.com

Apogent Discoveries
Lower Meadow Road,
Brooke Park,
Handforth, Wilmslow
Cheshire
SK9 3LP
United Kingdom
Tel: 44 161 486 2110
Fax: 44 161 488 4560
Email: matrix_europe@matrixtechcorp.com
Internet: www.apogentdiscoveries.com

The Automation Partnership
York Way
Royston
Hertfordshire
SG8 5WY
United Kingdom
Tel: 44 1763 227 200
Fax: 44 1763 227 201
Email: info@automationpartnership.com
Internet: www.autoprt.co.uk

Aventis Pharma Ltd
Aventis House
50 Kings Hill Avenue
West Malling
Kent
ME19 4AH
United Kingdom
Tel: 44 1732 584 000
Fax: 44 1732 584 080
Email: EnquiryUK@aventis.com
Internet: www.aventispharma.co.uk

aXia Therapeutics
c/o The Wolfson Institute for Biomedical Research
The Cruciform Building
University College London
Gower Street
London
WC1E 6BT
United Kingdom
Tel: 44 2076 796 693
Email: Tony.jones@ucl.ac.uk
Internet: www.axia-therapeutics.co.uk

Babraham Bioscience Technologies
Babraham Hall
Babraham
Cambridge
CB2 4AT
United Kingdom
Tel: 44 1223 496 205
Fax: 44 1223 496 020
Email: dj.hardman@babraham.co.uk
Internet: www.babraham.co.uk

Beckman Coulter (UK) Ltd.
Oakley Court, Kingsmead Business Park
London Road
High Wycombe
Buckinghamshire
HP11 1JU
England
Tel: 44 1494 441181
Fax: 44 1494 463843
Email: beckmancoulter_uk@beckman.com
Internet: www.beckman.com

Berthold Technologies (UK) Ltd.
The Priory
High Street
Redbourn, Hertfordshire
AL3 7LZ
United Kingdom
Tel: 44 1582 791 999
Fax: 44 1582 791 937
Email: James.Grand@BertholdTech.com
Internet: www.bertholdtech.com

BioRobotics Ltd.
Barton Road
Haslingfield
Cambridge
CB3 7LW
United Kingdom
Tel: 44 1223 873 500
Fax: 44 1223 873 589
Email: info@biorobotics.co.uk
Internet: www.biorobotics.co.uk

British Biotech plc
Watlington Road
Oxford
OX4 6LY
United Kingdom
Tel: 44 1865 748 747
Fax: 44 1865 781 047
Email: webadmin@britishbiotech.com
Internet: www.britbio.co.uk

Bruker BioSpin Limited
Banner Lane
Coventry
CV4 9GH
United Kingdom
Tel: 44 2476 855 200
Fax: 44 2476 465 317
E-mail: sales@bruker.co.uk
Internet: www.bruker.co.uk

Celltech Group plc
208 Bath Road
Slough
Berkshire
SL1 3WE
United Kingdom
Tel: 44 1753 534 655
Fax: 44 1753 536 632
Email: investorqueries@celltechgroup.com
Internet: www.celltechgroup.com

CSols plc
PO Box 13, The Heath
Runcorn, Cheshire
WA7 4QF
United Kingdom
Tel: 44 1928 513535
Fax: 44 1928 572145
Email: philg@csols.com
Internet: www.csols.com

InforMax Inc.
Europe Headquarters
The Magdalen Centre
Robert Robinson Ave.
The Oxford Science Park
Oxford
OX4 4GA
United Kingdom
Tel: 44 1865 784 580
Email: saleseurope@informaxinc.com
Internet: www.informaxinc.com

Genomic Solutions Ltd.
8 Blackstone Road
Huntingdon
Cambridgeshire
PE29 6EF
United Kingdom
Tel: 44 1480 426 700
Fax: 44 1480 426 767
Internet: www.genomicsolutions.com

Genetic Research Instrumentation Ltd
Gene House
Queenborough Lane
Rayne
Braintree
Essex
CM7 8TF
United Kingdom
Tel: 44 1376 332900
Fax: 44 1376 344724
Email: gri@gri.co.uk
Internet: www.gri.co.uk

Genetix Limited
Queensway
New Milton
Hampshire
BH25 5NN
United Kingdom
Tel: 44 1425 624 600
Fax: 44 1425 624 700
Email: info@genetix.com
Internet: www.genetix.co.uk

GlaxoSmithKline
Glaxo Wellcome UK Ltd.
Stockley Park West
Uxbridge
Middlesex
UB11 1BT
United Kingdom
Tel: 44 2089 909 000
Fax: 44 2089 904 321
Internet: uk.gsk.com

IBC Life Sciences
Mortimer House
37 - 41 Mortimer Street
London
W1T 3JH
United Kingdom
Tel: 44 1932 893 856
Fax: 44 1932 893 893
Email: cust.serv@informa.com
Internet: www.ibc-lifesci.com

Incyte Genomics Limited
Botanic House
100 Hills Road
Cambridge
CB2 1FF
United Kingdom
Tel: 44 1223 454 900
Fax: 44 1223 454 999
Email: help@incyte.com
Internet: www.incyte.com

Inpharmatica Ltd
60 Charlotte Street
London
W1T 2NU
United Kingdom
Tel: 44 2070 744 600
Fax: 44 2070 744 700
Email: info@inpharmatica.co.uk
Internet: www.inpharmatica.co.uk

Invitrogen Ltd
3 Fountain Drive
Inchinnan Business Park
Paisley
United Kingdom
Tel: 44 1418 146 100
Fax: 44 1418 146 260
Internet: www.invitrogen.com

Medical Research Council Technology
1-3 Burtonhole Lane
Mill Hill
London
NW7 1AD
Tel: 44 2089 063 811
Fax: 44 2089 061 395
Email: rob.lang@headoffice.mrc.ac.uk
Internet: www.mrcrctechology.org

Merck Sharp & Dohme Limited
Hertford Road
Hoddesdon
Hertfordshire
EN11 9BU
United Kingdom
Email: ho_hr@merck.com
Internet: www.msdl-uk.com

Mylnefield Research Services Ltd
Invergowrie
Dundee
DD2 5DA
Scotland
Tel: 44 1382 568 568
Fax: 44 1382 568 501
Email: nkerby@mrsd.com
Internet: www.mrsd.com

Nonlinear Dynamics
Tyne House
26 Side
Newcastle upon Tyne
NE1 3JA
United Kingdom
Tel: 44 1912 302 121
Fax: 44 1912 302 131
Email: info@nonlinear.com
Internet: www.nonlinear.com

Norwich Bio-Incubator
Norwich Research Park
Colney Lane
Norwich
NR4 7UH
United Kingdom
Tel: 44 1603 218 102
Fax: 44 1603 450 000
Email: rufuscharles@norbio.com
Internet: www.norbio.com

Novartis Pharmaceuticals UK Ltd
Frimley Business Park
Camberley
Surrey
GU16 7SR
United Kingdom
Tel: 44 1276 692 255
Fax: 44 1276 692 508
Internet: www.uk.novartis.com

Oxagen Limited
91 Milton Park
Abingdon
Oxfordshire
OX14 4RY
United Kingdom
Tel: 44 1235 443 300
Fax: 44 1235 443 301
Email: oxagen@oxagen.co.uk
Internet: www.oxagen.co.uk

Oxford BioMedica plc
Medawar Centre
Robert Robinson Avenue
The Oxford Science Park
Oxford
OX4 4GA
United Kingdom
Tel: 44 1865 783 000
Fax: 44 1865 783 001
Email: enquiries@oxfordbiomedica.co.uk
Internet: www.oxfordbiomedica.co.uk

Oxford GlycoSciences (UK) Ltd
The Forum
86 Milton Park
Abingdon, Oxon
OX14 4RY
United Kingdom
Tel: 44 1235 208 000
Fax: 44 1235 208 020
Email: Info@ogs.co.uk
Internet: www.ogs.com

Oswel Research Products Ltd.
Oligonucleotide synthesis Lab 5005
Medical and Biological Sciences Building
University of Southampton
Boldrewood,
Bassett Crescent East
Southampton
SO16 7PX
United Kingdom
Tel: 44 2380 592 984
Fax: 44 2380 592 982
Email: info.uk@oswel.com
Internet: www.oswel.com

Plant Bioscience Limited
Norwich Research Park
Colney Lane
Norwich
Norfolk
NR4 7UH
United Kingdom
Tel: 44 1603 456 500
Fax: 44 1603 456 552
Email: ajsc@plantbioscience.com
Internet: www.plantbioscience.com

Promega
Delta House
Chilworth Science Park
Southampton
SO16 7NS
United Kingdom
Tel: 0800 378994
Fax: 0800 181037
Email: ukcustserve@uk.promega.com
Internet: www.promega.com

Proteom Limited
Babraham Hall
Babraham
Cambridge
CB2 4AT
United Kingdom
Tel: 44 1223 496 180
Fax: 44 1223 496 181
Email: contact@proteom.com
Internet: www.proteom.com

Proteome Science
Coveham House
Downside Bridge Road
Cobham, Surrey
KT11 3EP
United Kingdom
Tel: 44 1932 865 065
Fax: 44 1932 868 696
Email: helpdesk@proteome.co.uk
Internet: www.proteome.co.uk

QIAGEN Ltd.
Boundary Court
Gatwick Road
Crawley
West Sussex
RH10 9AX
United Kingdom
Tel: 44 1293 422 999
Fax: 44 1293 422 922
Internet: www.qiagen.com

ReNeuron
10 Nugent Rd
Surrey Research Park
Guildford
Surrey
GU2 7AF
Tel: 44 1483 302 560
Fax: 44 1483 534 864
Email: info@reneuron.com
Internet: www.reneuron.com

Roche Products Ltd
40 Broadwater Road
Welwyn Garden City
Hertfordshire
AL7 3AY
Tel: 44 1707 366 000
Fax: 44 1707 338 297
Email: welwyn.corporate_affairs@roche.com
Internet: www.rocheuk.com

Sense Proteomic Ltd
Babraham Hall
Babraham
Cambridge, CB2 4AT
United Kingdom
Tel: 44 1223 492080
Fax: 44 1223 492081
Email: info@senseproteomic.com
Internet: www.senseproteomic.com

Sigma-Aldrich Company Ltd.
Dorset
England
Tel: 44 1202 733114
Fax: 44 1202 715460
Email: ukcustsv@eurnotes.sial.com
Internet: www.sigmaaldrich.com

Syngenta
European Regional Centre -- Regional Headquarters
Priestley Road
Surrey Research Park
Guildford
Surrey
GU2 7YH
United Kingdom
Tel: 44 1483 260 000
Fax: 44 1483 260 001
Email: customer.services@syngenta.com
Internet: www.syngenta.com

TNO BIBRA International Ltd
Woodmansterne Road
Carshalton
Surrey
SM5 4DS
United Kingdom
Tel: 44 2086 521 040
Fax: 44 2086 617 029
Email: help@tnobibra.co.uk
Internet: www.bibra.co.uk

TheRyTe Ltd.
The Duncan Building
Daulby Street
Liverpool
L69 3GA
United Kingdom
Tel: (+44) 151 706 4530
Fax: (+44) 151 706 5802
Email: info@theyrte.co.uk
Internet: www.theryte.co.uk

Unilever PLC
P O Box 68
London
EC4P 4BQ
United Kingdom
Tel: 44 20 78 225 252
Fax: 44 20 78 225 951
Internet: www.unilever.com

Waters Corporation
MS Technologies Centre
(Micromass UK Ltd.)
Atlas Park,
Simonsway,
Manchester,
M22 5PP
United Kingdom
Tel: 44 161 435 4100
Fax: 44 161 435 4444
Email: service@micromass.co.uk
Internet: www.micromass.co.uk

Whatman International Ltd
Whatman House
St Leonard's Road
20/20 Maidstone
Kent
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