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BIOTECHNOLOGY : THE COMMUNITY'S ROLE

"Background note"

"national initiatives for the support of biotechnology"

(Communication from the Commission to the Council)

NATIONAL INITIATIVES FOR THE SUPPORT OF BIOTECHNOLOGY

A comparative assessment of the United States, Japan, and the Member States of the European Community

SUMMARY

Based on published reports and statistics, this paper describes national efforts for the promotion of biotechnology ; with particular reference to public sector R & D expenditure. The multi-disciplinary nature of biotechnology and its many sectors of application give rise to major problems of definition and of international comparability. Figures given are therefore tentative, and wide ranges reflect definitions varying from very narrow, to those substantially overlapping agricultural and medical research. With these caveats, the following figures are deduced for publicly supported R & D in biotechnology and related areas, at approximately 1982/83 :

U.S. : at least $ 200 m. p.a. ; up to $ 550 m. p.a. on "broad basis" ;

Japan : at least $ 50 m. p.a. ;

E.E.C. : 146 m. Ecu on narrow basis, up to 355 m. Ecu on broad basis ($ 156 m. - $ 380 m. p.a.).

NATIONAL INITIATIVES FOR THE SUPPORT OF BIOTECHNOLOGY

(A comparative assessment of the United States, Japan and the Member States of the European Community)

The rise of interest in the significance of biotechnology was marked by a series of national reports, rising to a peak in 1981 when more than 10 were published (see list attached, page 5).

Many of these reports recommended the establishment of special agencies, ad hoc committees, interminisnterial groups etc., and the allocation or increase of funds for research and development activities in biotechnology. Through these administrative actions and the funding of "mobilisation programmes", significant additional research and related activity in biotechnology is now being implemented, throughout the countries of the European Community and in most other developed industrial countries.

This annex provides some statistics on the scale of these expenditures ; but in appraising the relative strengths of different countries in the field, the problem of defining biotechnology has to be borne in mind. Since different countries include different activities in their understanding of the term, objective comparisons are difficult. Fuller details are given in the document XII-37/83 "Plan by Objective : Biotechnology", one of the papers prepared in support of the Community's R & D Framework Programme (1983-87)*. This paper includes some more recently published and up-to-date figures ; but there remain major problems of interpretation. The resulting estimates of expenditure on biotechnology, or "biotechnology-relevant" R & D, are therefore given as indicative ranges.

1. MAJOR NON-COMMUNITY COUNTRIES

1.1. The United States of America

1.1.1. Federal Support

The main federal support for activities related to biotechnology is channelled through two sources : the National Science Foundation (NSF), which is the principal federal agency for the support of basic research across all fields of science, and the National

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* available, in English or French, from the Commission's Directorate-General XII, for Science, Research and Development.

Institutes of Health (NIH), which are responsible for basic research in medicine and health care, and are also responsible for the registration of federally funded research work on recombinant DNA. The U.S. Department of Agriculture is also funding basic research related to agriculture, including projects and techniques which may be described as biotechnology ; similarly the Department of Energy's studies of biomass-based energy sources involve basic biology and biotechnology.

In fiscal year 1980, the NIH supported 717 basic research projects involving recombinant DNA at a cost of $ 91.5 million. At the request of the OTA (see below), the NIH recently estimated what proportion of their budget ($ 3.74 bn. estimated outlays for fiscal year 1983 ; $ 3.44 bn FY 1982) might be classified as "biotechnology" : for FY 1982, approximately $ 380 m., versus $ 170 m. in 1980 ; plus $ 20 m. for equipment in the "biotechnology resources program". The $ 380 m. figure is "a maximum approximation... the total costs of the awards not limited to the subject of the search" ; ** the 1980 rDNA figure of $ 90 m. might be taken as a minimum.

"Biotechnology-relevant" research supported by the NSF in fiscal 1980 amounted to $ 66 m. according to Zaborsky ***.

** Special report, "R & D Spending on Biotechnology in the U.S.", from the Science, Technology and Energy Section of the Commission's Washington office.

*** Paper by Oscar Zaborsky, of U.S. National Science Foundation, at Eastbourne, April 1981 : Second European Congress of Biotechnology.

KEY REPORTS IN BIOTECHNOLOGY

1974	W. Germany	DECHEMA, for BMFT : Biotechnologie
1976	Japan	MITSUI : Present and Future on Enzyme Technology
1976	U.K.	A.N.EMERY, for Science Research Council : Biochemical Engineering.
1977	Commission of the E.C.	DG XII : Possible Action of the European Communities for the optimal exploitation of the fundamentals of the new biology in applied research.
1978	Europe	DECHEMA organise first European Congress of Biotechnology, Interlaken, Switzerland ; European Federation of Biotechnology founded.
1979	France	F.GROS, F.JACOB, P.ROYER : Sciences de la vie et société pour le Président de la République.
1979	France	J. de ROSNAY : Biotechnologies et Bio-Industrie.
Jan. 80	W. Germany	BMFT Leistungsplan 04 : Biotechnologie
Mar. 80	U.K.	"SPINKS REPORT" Biotechnology : report of a joint Working Party (ACARD,ABRC, Royal Society).
May 80	Belgium	SPPS : Développements en matière de biotechnologies.
Sept.80	Canada	MILLER et al : Biotechnology in Canada.
Feb. 81	Canada	Report to Minister for Science and Technology : Biotechnology : a development plan for Canada.
Feb. 81	France	J.C. PELISSOLO : la Biotechnologie, demain ?
Mar. 81	U.K.	Govt.White Paper : Biotechnology (response to SPINKS).
Apr. 81	U.S.A.	O.ZABORSKY : Biotechnology at the National Science Foundation.
Apr. 81	U.S.A.	Office of Technology Assessment : Impacts of Applied Genetics : Micro-Organisms, Plants and Animals.
May 81	Netherlands	STT : Biotechnology : a Dutch perspective.
May 81	Ireland	NBST : Biotechnology Trends.
Sept.81	U.S.A.	Office of Technology Assessment : Project Proposal for a Comparative Assessment of Biotechnology.
Sept.81	Spain	La ingenieria genetica en la biotechnologia (Centro para el Desarrollo technologico Industrial, Ministerio de Industria y Energia).
Oct. 81	Japan	Report : Heading toward new Research and Development, by the Study Association for the Foundation of a Long-Term Plan for the Development of Industrial Technology.
Nov. 81	UNIDO	The Establishment of an International Centre for Genetic Engineering and Biotechnology (ICGEB) report of a group of experts (proposal).
Nov. 81	Australia	Biotechnology R&D : the application of DNA techniques in research and opportunities for biotechnology in Australia (Commonwealth Scientific and Industrial Research Organization).
Dec. 81	U.S.S.R.	Speech by Academician OVCHINNIKOV at the Annual General Meeting of the Soviet Academy of Sciences.
Apr. 82	Netherlands	Programmacommissie Biotechnologie : Innovatieprogramma Biotechnologie (Chairman : Prof. R.A. SCHILPEROORT).
Sept.82	OECD	International Trends & Perspectives in Biotechnology : A State of the Art Report by A.T.BULL, G. HOLT and M.D. LILLY.
Dec. 82	France	Programme Mobilisateur of the Mission Biotechnologie.
Dec. 82	Italy	ENI group : le Prospettive dell'Ingegneria Genetica.
Jan. 83	C.E.C.	FAST report, recommending Community Strategy for Eur. Biotechnology.
Summer 1983	Ireland	NBST : Major national policy document on biotechnology.
Autumn 1983	U.S.A.	OTA : Comparative Assessment of the Commer. dev. of Biotechnology.

The Office of Technology Assessment study "Impacts of Applied Genetics : Micro-organisms, Plants and Animals" (1981) gives details of federal support for projects on plant molecular genetics and other biological topics of agricultural significance. Their figures include some NSF programmes in plant research ; the other main channel is the U.S. Department of Agriculture (USDA). USDA's Competitive Grants Programme (1982: $ 16.5 m.) supports new research directions in plant biology. But as with the NIH budget, the biotechnology-relevant research is overshadowed by the total budget of the Agricultural Research Service ($ 458 m. proposed for fiscal 1984).

The ARS budget itself forms only part of the Dept. of Agriculture's total R & D spending ($ 830 m. estimated outlays in FY 1983), and including state programmes the total is over $ 1.5 bn. a year.

The biotechnology element was estimated as $ 40 m. out of $ 426 m. in FY 1982, and the proportion is rising. In addition, federal ($ 15 m.), state ($ 15 m.) and private ($ 5 m.) funding supports the State Agricultural Experimental Stations'* work in biotechnology research.

The structure and control of U.S. agricultural research are the subject of intense current debate**. A factor in this debate is the relevance of the new biotechnology to agriculture, which has been emphasised by long-term studies, particularly

(i) "The Impending Revolution in World Agriculture", Futures Group (1982), and

(ii) "An Assessment of the Global Potential of Genetic Engineering in the agri-business Sector, Chicago Group (1981).

The latter points out that the market for agricultural products is "close to ten times the size of the market for all pharmaceutical health care products in the U.S. alone", and consequently predicts that the market for new genetically engineered products in agriculture could ultimately outstrip the medical market by tens of billions of dollars.

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* "Emerging biotechnologies in agriculture : issues and policies". Progress report November 1982, Division of Agriculture Committee on Biotechnology, National Association of State Universities and Land-Grant Colleges.

** "Science for Agriculture", report of a workshop (June 1982) on critical issues in American agriculture research, jointly sponsored by the Rockefeller Foundation and the Office of Science and Technology Policy ; pub. by Rockefeller Foundation, October 1982.

Combining the figures mentioned suggests U.S. federal expenditure of at least $ 200 m. p.a. in areas directly relevant to biotechnology ; but of equal or greater relevance to the country's strategic capability, are the much larger sums referred to in health and agricultural research. In both these fields, reasonable judgements seem to indicate that some 10 % may be viewed as "biotechnology-relevant" ; hence one can build up the following estimate on this broader basis :

NIH :	10 % of $ 3.7 bn/NIH estimate =	380
	Biotechnology resource Program	20
NSF :	(1980, careful estimate)	66
USDA :	10 % of ARS $ 426 m. (1982) =	40
	+ biotechnology elements of State Agricultural Experiment Stations (50 % federal, 50 % State)	30
+ Dept. of Energy and other agencies		10-20
		550

The U.S. Government is examining its strategy in the field of biotechnology. The Office of Technology Assessment is responsible and by means of a 2 year study (1981-83 ; to appear in autumn '83) will consider issues of Government policy, funding and regulatory requirements in this field, university/industry relationships and relevant features of the educational system, industry characteristics and patent law. The study will be comparative and extend therefore to Japan, West Germany, Great Britain, Canada, France, Switzerland and the USSR.

1.1.2. The role of industry

It is clear that biotechnology research and development is being substantially funded in the U.S. Industrial funding is probably several times that of federal expenditure (narrow definition), which is concentrated at the fundamental end of the research spectrum. Venture capital activity on the other hand is aiming for payback (either revenue, or capital gain) in the short and medium term, particularly in the bio-medical and pharmaceutical fields ; but larger companies (particularly the major oil, chemical and pharmaceutical groups) are investing in longer term potential, with the expectation that research breakthroughs during the next ten years will lead to commercial products in the years beyond.

1.2. Japan

1.2.1. National Support for Biotechnology R & D

Government support for biotechnology dates from the beginning of the 1970s. The Science and Technology Agency initiated the new government biotechnology programmes by establishing a Committee for the Promotion of the Life Sciences in 1973. Rogers * describes how "Since then, the scale of Government support for biotechnology R & D has steadily increased. Support in 1981 for Life Science in general is estimated at a minimum of Yen 50,000 million ($ 210 m.), ** and if one considers only the more restricted areas which are currently referred to as biotechnology the support was of the order of Yen 5,600 million in 1981 (i.e. approximately $ 24 million). Government financial support has received fresh impetus in the last year with the announcement of the Ministry of International Trade and Industry's (MITI) biotechnology national projects. These new projects are the Biomass Development Project concerned with alcohol production (7 years from 1980-total budget Yen 12,300 million : $ 52 m.) and the next Generation Industries national project which has three biotechnology themes (10 years from 1981 - total budget in the biotechnology sector is in excess of Yen 30,000 million : $ 127 m.)".

Adding the above three elements : $ 24 m, plus $ 52 m/7 = $ 7 m. p.a., plus $ 127/10 = $ 13 m. p.a., gives an estimate of $ 44 m. p.a. ; but in the absence of details of the $ 24 m. figure quoted, this is probably a significant under-estimate, omitting in particular any reference to the funding through the Ministries of Agriculture, Health and Education, all of which give some support for Biotechnology research, and the "coordination funds" from the Council for Science and Technology.

A more recent report *** quotes 7,471 Y for government expenditure on biotechnology R & D in 1982, and 7,906 m. Y ($ 33.2 m.) budgetted for 1983, apparently including all ministries and agencies ; if this omits the national projects cited, the total must be well over $ 50 m. p.a. for 1983.

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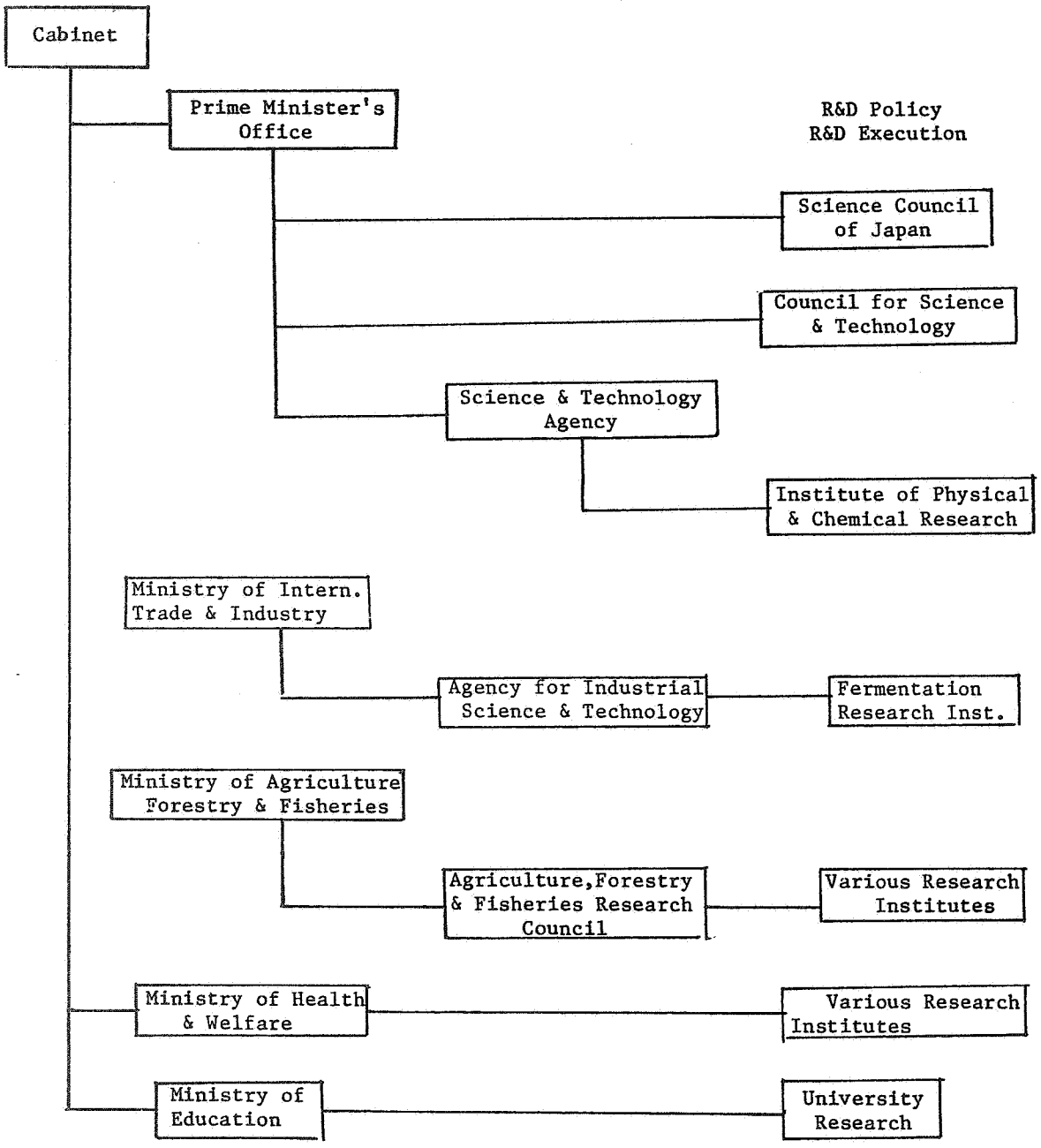
* Rogers, M.D. "The Role of the Japanese Government in Biotechnology Research and Development", Chemistry and Industry, 7 Aug. 1982.

** Y 236 /$, April '83.

*** McGraw Hill "Biotechnology Newswatch", 21 March 1983 : "Japan's R & D biobudget jumps 5.8 %".

Diagram 1 The Main Organisations Involved in Japanese Government Support for Biotechnology



Source : Rogers, op. cit.

A detailed qualitative description of government support for biotechnology R&D is given in the JETRO report * ; the following summary is based on both reports, the figures being from Rogers.

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* Japan External Trade Organization (JETRO) : The Japan Industrial and Technological Bulletin, Special Issue 14, 1982 : Research on Biotechnology in Japan.

1. The Council for Science and Technology (CST), chaired by the Prime Minister and including the President of the Science Council of Japan (the top scientific body), establishes general science policy and passes recommendations to the various ministries for executive action. It is responsible for overall coordination, and in biotechnology JETRO mentions seven biotechnology-related research themes being promoted in 1982 from CST's "Special Coordination Funds" : no figures available.

2. The Science and Technology Agency (STA) has two roles :

   a) policy and inter-ministry coordination
   b) its own R & D programmes, including biotechnology.

   It has to overcome inter-ministerial rivalries, and Rogers considers it "fairly effective in the field of biotechnology, not least because STA was involved from the beginning with its own programmes and because it has taken a central role in the setting of rDNA regulations". It attempts to establish national science and technology strategy and to help coordinate departmental efforts.

   The STA Life Sciences Programme is directed by the Committee for the Promotion of Life Science, the 15 projects managed and controlled through the (nominally) independent Institute of Physical and Chemical Research ("RIKEN"). Expenditure on the projects was Y 640 m. in 1981 ($ 2.7 m.). The essential distinction between the STA biotechnology projects and those of MITI (see below) is that the former concentrate on basic medical aspects and longer-term advanced bioreactors, whereas those of MITI are mainly concerned with fine chemicals, alternative routes to petrochemicals, enzyme technology, and general applications of biotechnology to the chemical industry.

   A feature of interest at RIKEN is its role in coordinating national policy for culture collections, and the establishment of a Life Science Information department to develop "NISLO" : National Information System for Laboratory Organisms. (cf. the Community's Task Force for Biotechnology Information, under the Committee for Information and Documentation in Science and Technology).

3. The Ministry of International Trade and Industry (MITI) inaugurated a major national programme on 1st October 1981, "The Next Generation Industrial Foundation Technology Development System". Of this 10-year, Y 104 bn. programme, some Y 30 bn ($ 127m) is for biotechnology. MITI has since (June '82) established a "Bioindustry Office" designed to draft "comprehensive measures for smoothly cultivating the new industrial field known as the bioindustry", and "plans and measures to promote domestic biotechnology research and international cooperation in the development of the industry, while projecting the industry's future vision".
The programme of research is being implemented partly through the ministry's own institutes - particularly the Fermentation Research Institute - and partly through the private sector in a grouping of 14 firms (predominantly chemical majors) known as the "Research Association for Biotechnology" or "Biotechnology Forum".
MITI has also launched the Biomass Development Project already referred to, establishing (May 1980) within its Basic Industries Bureau a "Biomass Policy Office" to establish the feasibility of Biomass utilisation in Japan and the most promising lines for development. Projects are being executed through the 22 member companies of the "Biomass Research Association (petroleum, chemical and fermentation)" (Rogers) or "Research Association for Petroleum Alternatives Development (RAPAD)" (JETRO).

4. The Ministry of Agriculture, Forestry and Fisheries is conducting research through its institutes, including rDNA work, "with the aim of developing innovative technologies conducing to the stabilization of food supplies and sophistication of agriculture" (JETRO). The JETRO report describes three themes : green energy, biomass conversion (particularly waste utilisation), and genetics. Rogers gives figures for the second of these : Y 300 m. ($ 1.3 m.) in 1982. Noteworthy is the fact that over 30 % of Japanese government R & D is spent on Agriculture (1979)*.

5. The Ministry of Health and Welfare is engaged in research on biotechnology, including rDNA, "with the specific aim of applying related technologies to health preservation and medical treatments" (JETRO), through the National Institute of Health and other institutes. No details.

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* Economist, 6 Nov. 1982 : "International R & D spending.

6. The Ministry of Education supports fundamental research in the university research organisations, and extends "Science and Technology Research Subsidies" to projects advancing the progress of science and technology in Japan. No details.

1.2.2. Industrial activity

Japan is particularly strong in fermentation technology, for historical reasons going back a century (government revenues from the sake industry) ; public initiatives reinforced this pre-eminence in the post-war period. Gregory* claims that "By the 1970s, Japan's fermentation industry had a 10-year lead over others in the world.... In 1979, 7 of the 11 new antibiotics introduced across the world came from Japanese laboratories and in 1980 the Japanese industry ranked second only to the US in producing new drugs". The pharmaceutical firms are among the leaders in perfecting third-generation cephalosporins, in spite of R & D budgets small in comparison to those of the U.S. and European firms. (Takeda, the largest, $ 100 m. in 1981 ; cf. Hoechst $ 270 m. ; Merck $ 275 m. ; Eli Lilly $ 235 m. ; Hoffmann-La Roche, $ 400 m. ; Johnson & Johnson $ 161 m.).

But Pharmaceuticals may be less important than the food sector as leading edge in biotechnology (the reverse of the U.S. position). Japan's fermentation expertise originated in the food sector, and is reflected in dominance of world production of amino acids (which may be used as food additives for flavouring, or in order to improve the amino-acid profile of protein foods or feedstuffs). This is a $ 1.4 billion market worldwide. Ajinomoto, one of the major food companies, has developed (and is patenting) genetic engineering methods for amino acid production, which it claims will double existing yields. A major dairy firm, Showa Brand Milk Products is building a $ 20 m. biotechnology laboratory for completion in March 1983 and later expansion ; it started work on biotechnology research only in January 1981, concentrating on food, enzymes and fermentation. Future plans include pharmaceuticals.

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* New Scientist, 29 July 1982 : "Biotechnology-Japan's growth industry", by Gene Gregory, professor business studies at Sophia University, Tokyo.

Japanese firms (Kanegafuchi, Dianippon) originated the development work on hydrocarbon-based single-cell protein production, although consumer acceptance problems subsequently delayed development. The technology was subsequently licensed to European Producers such as Liquichima (Italy) and Roniprot (Rumania).

As part of the strategy of establishing independent technology Japanese pharmaceutical firms are seeking to buy their way into interferon production and the genetic engineering technology which provides one route into it. Green Cross has an agreement with Collaborative Genetics for research on a yeast based process for interferon, and another with Genex for research on albumin production.

In October 1981, it concluded an agreement with Biogen for marketing the latter's hepatitis B vaccine. Takeda, Japan's largest drug company has signed a contract with Hoffman-La Roche for joint research and production of interferon in Japan, using the latter's genetic engineering technology. Other companies mentioned as buying foreign genetic engineering technology are Kyowa Hakko (for interferon) and Mitsubishi. The most significant joint venture involving licensing agreements is Takeda's alliance with the American firm Abbott. Takeda-Abbott Products have manufacture and marketing rights for all new American drug patents obtained by Takeda, who also have joint ventures involving Bayer (West Germany) and Roussel Uclaf (France).

Gregory suggests that a conservative estimate of current output from industrial microbiology in Japan is Y 11-12 trillion ($50 bn.) in food, pharmaceuticals and refined metals, i.e. some 5 % of GNP ; but recent Japanese sources quote only Y 4tn for 1979, presumably using a narrower definition. MITI's Agency for Industrial Science and Technology forecasts a Japanese domestic market of Y 7 tn. by year 2000 ($ 30 bn.).

A detailed survey of research on biotechnology by Japanese corporations was conducted by MITI in August 1982, and the results are reported in full by JETRO (op.cit.). They show (see table below) rapidly rising industry research expenditure on biotechnology over the last three years : the 1982 total is Y 47.8 bn. ($ 203 m.).

Table 1.

Total Research Expenditures and Biotechnology Research Expenditures

Unit Y 1 million

Fiscal Year	Medical Drug		Chemical		Textile, Paper & Pulp	
	Total research expendit.	Biotechnology research expenditures	Total research expendit.	Biotechnology research expenditures	Total research expendit.	Biotechnology research expenditures
1980	77,417	4,831	161,562	13,616	50,898	4,131
1981	80,993(4.6)	5,711(18.2)	176,394(9.2)	15,912(16.9)	56,570(11.1)	5,090(23.2)
1982	90,063(11.2)	6,860(20.1)	193,046(10.7)	19,113(20.1)	61,212(8.2)	6,123(20.3)

Fiscal Year	Food		Others		All Industries (Total)	
	Total research expendit.	Biotechnology research expenditures	Total research expendit.	Biotechnology research expenditures	Total research expendit.	Biotechnology research expenditures
1980	27,734	6,979	308,351	3,502	625,962	33,059
1981	32,668(17.8)	9,318(33.5)	346,737(12.4)	3,873(10.6)	693,362(10.8)	39,904(20.7)
1982	38,352(17.4)	11,920(27.9)	390,795(12.7)	3,807	773,468(11.6)	47,823(19.8)

Note : 1. These figures represent tabulation of replies from 112 firms. (medical drug 12, chemical 47, textile, paper & Pulp 9, food 22 and other industries 22).

2. Figures in ( ) show increases over the preceeding fiscal year.

2. R & D RESPONSES : MEMBER STATES OF THE EUROPEAN COMMUNITY

The following sections give fuller details of activities and R & D policies relating to Biotechnology, in the Member States of the Community. Although inevitably brief and uneven, being summarised from heterogenous source materials, these descriptions indicate the common perceptions and needs, and hence provide a background for the discussion of European Community activities and policy for R & D in biotechnology.

A final section, 2.10, summarises the statistical picture with estimates of total expenditure on R & D in biotechnology and related areas.

2.1. Federal Republic of Germany

Germany has for many years had outstanding industrial strength in all major areas of biotechnology. Initiatives by DECHEMA (Deutsche Gesellschaft für Chemisches Apparatewesen) led to a major report in 1974 on the significance of biotechnology, and a revised version was subsequently commissioned by the Bundes Ministerium für Forschung und Technologie (BMFT)*.

BMFT has summarised in "Leistungsplan 04" a clear picture of federal expenditure on R & D in biotechnology : Figure 1 is based on the plan as at January 1980, showing the breakdown of the planned expenditure of DM 53 m. on project expenditures. To this should be added some DM 17 m. for support of biotechnology at the Gesellschaft für Biotechnologische Forschung and other institutions. Planned project expenditures for 1983 : DM 63m. (increase : 14.5 %). Figure 2 shows the historic growth.

The BMFT also makes extensive use of collaborative agreements in research with many other countries, including Japan, Sweden, and Canada as well as with EC partners.

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* Biotechnologie : Studie über Forschung und Entwicklung : Möglichkeiten, Aufgaben und Schwerpunkte der Forderung, DECHEMA, 1976.

The major strengths of German biotechnology lie in its large chemical and pharmaceutical companies : BASF, Bayer, Boehringer Mannheim, Boehringer Ingelheim, Degussa (amino acids), Hoechst, Merck, Schering. There is close collaboration with educational institutions, and with the industrially-oriented activities on the GBF and DECHEMA.

Hoechst is the largest of the chemical/pharmaceutical companies, and attracted considerable comment when in 1981 it signed a 10-year, $ 67 m. research agreement with Massachusetts General Hospital for work on molecular biology and genetics. This should be seen in the context of the company's total pharmaceuticals R & D budget of some $ 270 m. p.a. With BMFT support, Hoechst has developed a single-cell protein now being tested for human nutrition (production scale 2000 t. p.a.).

Chemical Engineering (12 July 1982) quotes an estimate that "West German firms will boost their biotechnology R & D outlays from the current (estimated) $ 90 million/year to nearly $ 200 million by 1985".

There is additional expenditure on biotechnology through local government, often in collaboration with industry. The Baden-Württemberg regional government has, for example, approved DM 30 m. for the construction of a new molecular genetics institute at Heidelberg, which will be supported also by the BMFT (DM 13 m. over 3 years) and by BASF (DM 4 m. over 5 years). A similar project in Berlin is being jointly financed (DM 40 m. each over 10 years) by Schering AG and the city.