

A Selection from German Periodicals

Sixth Year

The German Tribune

Hamburg, December 16, 1967

THE TECHNOLOGICAL GAP BETWEEN THE UNITED STATES AND EUROPE

A DEFINITION OF THE PROBLEM

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There is scarcely an economic problem in the western world which has found so much echo as that of the so-called technological gap. It refers to the technological gap between Europe and the United States and means the differences revealed by a comparison of the countries in their ability to develop new technologies.

Aware that this question could cast a decisive shadow on relations between Europe and America, President Johnson in November 1966 asked Donald F. Hornig, his special adviser on science and technology, to form a special inter-ministerial committee for a quick review of this problem (Hornig Committee; *Beginning of a Technological Marshall Plan?* in *Science*, vol. 154, 9 December 1967; page 1307 f.). The Nato council has occupied itself with the problem (cf. the text of the communiqué on the ministerial meeting of the North Atlantic Council on 13 and 14 June 1967 in Luxembourg in: *Europa Archiv* 15/1967 page D 369 f.), the European communities have compiled an extensive memorandum about it (Memoran-

dum on the problems set by scientific and technological progress in the European community, Joint Document of the High Authority of the European Coal and Steel Community and the Commissions of the European Economic Community and the European Atomic Community, Brussels, 20 March 1967, EUR/C/1711/2/67d), and the Organisation for Economic Co-operation and Development (OECD) is conducting an exhaustive examination of the problem. The results are to be submitted to the third conference of science ministers in the spring of 1968 (OECD Press Release, Nr. A 66 59, 19 October 1966). The proposal of Italian Foreign Minister Adintore Fanfani to solve the problem by a "technological Marshall Plan" (Memorandum of the Council of the European Atomic Community, Brussels, 17 January 1967, R/1430/66 ATO 214, with Appendix I: Europe's technological backwardness and the utility of revitalising international cooperation, and Appendix II: Observations on the Italian document on technology submitted in September 1966. Cf. also Achille Albonetti, *The Technical Gap: Proposals and Documents*, in *Lo Spettatore Internazionale*, English Edition, vol. II, No. 2, March/April 1967, pages 139 f., and Fanfani Plan for Nato, in *The Financial Times*, 26 October 1966) hit the headlines just as much as British Prime Minister Harold Wilson's proposal to form a European technological community for the same reason (cf. Technology still on stage in *Chemical and Engineering News*, 22 November 1966, page 22 f.; also Harold Wilson's speech at the Lord Mayor's banquet on 14 November 1966 in *British Information* No. 588, 21 November 1966).

THE 'SHOCK' FOR THE EUROPEANS

Up until the outbreak of the Second World War the countries of Europe were in the scientific and economic condition to maintain their traditional lead over the United States in many spheres, and even to be competitive in those fields where the United States held the lead through better exploitation of the advantages arising from mass production. In those days Europe was undisputed leader in almost all world markets, its

export of capital was considerable, its accounts strongly on the credit side and it was the pacemaker in standard and organisation for the other continents in its scientific life.

This is a highly simplified picture which did not apply in the same degree to every European country, but it shows the premise to which the reader will have to cast back his mind in the course of the

article in order to understand the often emotionally based passion of some European reactions.

Europe's economy was able to recover in a relatively short time after the war, thanks solely to extensive aid programmes of which the biggest was America's Marshall Plan. The accumulated backlog demand led to unequalled expansion in all branches of industry, as can be seen from the rapid increase in gross products. This achievement, which gave all European countries a standard of living they had never known before, certainly deserves acknowledgment. It is therefore understandable that some Europeans, comparing their situation with that of the Americans, are visited by feelings such as American envoy to the European communities J. Robert Schaezel recently described: "After twenty years of reconstruction, extraordinary growth and social and economic progress it comes as a shock to many Europeans to realise that they are no nearer the United States than twenty years ago, simply because the United States has not been standing still in the same period" (address to the American and Common Market Club in Brussels on 15 February 1967 entitled *Technology, Europe and the United States*, published in *USA Documents*, Brussels, page 2).

Yet this shock did not come suddenly for the Europeans. The development which led up to it has deeper causes. The technological gap is shown most clearly by the increasing superiority of American products and techniques on European markets. The march of American products is kept up both by American exports to Europe, and American factories in Europe (direct investments) or licence agreements with European partners. The influx of American capital to Europe, which many European countries had encouraged in the fifties by opening their own advertising offices in the United States, has been regarded since about 1963 with highly mixed feelings.

Particularly disturbing to European observers is the fact that American firms economically active in Europe establish themselves mainly in the research-intensive branches of industry. The increasingly large payments being paid to the USA for licences are also registered with misgivings. Some countries, finally, are worried by the number of graduates emigrating to the United States.

LIMITED ATTEMPT TO DEFINE CAUSES AND EXTENT

Only some aspects of the problem of the technological gap have been touched on when these questions have been dealt with by European countries, but even so, the initial symptoms were recorded. The discussion first came out into the open when a report commissioned by the Organisation for Economic Cooperation and Development on research and development efforts in western Europe, North America and the Soviet Union was published in December 1965 (C. Freeman and A. Young, *The Research and Development Effort in Western Europe, North America and the Soviet Union*, Paris/OECD 1965). The authors stress that the study is largely based on estimated figures since it is impossible to find exact comparative statistics. Nonetheless, its results were discussed without reserve and created great controversy (cf. Diether Stolze: *Wie lange kann Europa schlafen?* in *Die Zeit* of 24 December 1965 and K. Rudzinski: *Wachsende Disparität in der Forschung* in *Frankfurter Allgemeine Zeitung* on 29 December 1965). Much attention was paid to the comparison of the numbers of research workers and the sums spent on research.

● In 1962 the United States spent 17,500 million dollars on research and development while western Europe, with roughly the same population (Great Britain, France, the Netherlands, Belgium and the Federal Republic together) spent only 4,360 million dollars.

● About 435,000 scientists and engineers were employed in research and development in the United States in the same year, compared with only 147,000 in the five above-mentioned countries of western Europe.

Even if these figures are approximate due to the difficulties in compiling them, they give an idea of the difference in scope between American and European research and development.

Interpretations differ greatly in attempted definitions of American industry's technological lead over Europe and the reasons for it. Former American trade secretary John Connor sees the cause of the technological gap in "industrial disparities" (cf. *The Technology Gap* in *Time*, 13 January 1967, page 30). To American Defence Secretary Robert S. McNamara it is less of a technological than a management and educational gap: "Europe is weak in general education, it is weak

Week, 8 April 1967, page 185). American envoy to the European communities Schaezel regards it as a question of the whole complex of growth and change in a modern industrial society. Edwin Moline, attaché for economic affairs at the American embassy in the Federal Republic, has expressed similar ideas (cf. Edwin Moline: *Das Problem der "technologischen Lücke" zwischen den Vereinigten Staaten und Europa*. Ausmass, Ursachen und Lösungsmöglichkeiten, *Europa-Archiv* 12/1967, page 427 ff.).

The European viewpoint, on the other hand, is that the technological gap derives primarily from a distorted competitive position which one-sidedly favours American industry rather than European. Federal Scientific Affairs Minister Gerhard Stoltenberg is of the opinion that research commissions awarded to American firms from the defence budget particularly distort the competitive position (US-Forschungssystem verzerrt den Wettbewerb in *Die Welt*, 4 February 1966). Other supporters of European interests go even further. Former French Prime Minister René Pleven warned of the danger that Europe could become the USA's 51st state if European governments did not share fully in the progress of technology. Others speak of America's technological colonisation of Europe, or of Europe as a technologically underdeveloped continent (cf. Hermann Bohlé: *Wird Europa kolonisiert?* in *Die Zeit*, 20 October 1966, page 38; *Le sous-développement européen* in *Atomes*, February 1967, page 75; and *Technological Colonisation*, an unpublished manuscript by B. R. Williams, September 1966). The above-mentioned memorandum of the European communities traces the technological gap back to inadequacies of market stimuli, of industrial and non-industrial research and innovation.

A comparison of the two camps' opinions on the same problem shows that the Americans lay emphasis on the differences in management and education while Europeans put the stress more on the differences in technology.

The first of the many misunderstandings about the technological gap is presumably a linguistic one. The term "technology" in the American sense is more comprehensive than the German "Technologie" (cf. the article of assistant director Ivan L. Bennett Jr. of the scientific and technical office of the White House: *L'écart entre les Etats-Unis et l'Europe Occidentale est un fait réel qu'il importe avant tout de définir*, in *Le Monde Diplomatique*, February 1967, page 5). The attempts in many places to measure the

that the greater part of American research is devoted to the military sector and to "big science," space travel, nuclear research etc., and thus does not directly influence the competitive ability of their industry. The proportion of American industrial research does in fact amount to only one quarter of the United States total expenditure on research and development, while in European countries it comes to at least a half (exceptions: Great Britain—about 45 per cent, and France—about 30 per cent).

However, even if the huge American research and development outlay brought direct returns in the civil sector only to the economically so significant fields as the aircraft and electronics industries, the entire American economy nonetheless profits to a large degree from one by-product. The defence and programme schooled a whole generation of managers and technicians to think in terms of the connections between systems and to make the best possible use of technological innovations. It is no coincidence that Americans are always praising the quality of European basic research, on the results of which applied research and development in the USA frequently develops products ready for marketing.

A further rough basis for defining the technological gap is a comparison of research capacity in terms of people. Not only the number of scientists, engineers and technicians involved in research and development should be compared here, but the general educational level of all people employed in science and technology should be taken into account. Considerable differences in the length and standard of education and training already exist not only between Europe and the United States but also between individual European countries. In this connection attention must also be paid to the way of thinking of American researchers at university and in industry. It is much more consciously focused on the market than in Europe.

THE PROSPECTS FOR CLOSING THE GAP

American and European observers at present see no indications that the technological gap will close. On the contrary, the above-mentioned memorandum of the European communities talks of numerous signs

its business education," (text of News Release, Office of Assistant Secretary of Defence, Public Affairs, Washington, No. 154/67, 24 February 1967; cf. also What McNamara said, in *Science*, 4 March 1967, page 853). The American magazine *Business Week* believes the "technological gap has arisen because the Europeans are apparently incapable of learning from the example of American industrial progress" (*Business*

rather than a clarification of the problem. There is no objective yardstick applicable to this question. There is no room here to go into the fundamental difficulty of trying to solve a qualitative problem with quantitative methods. Thus the only thing that can be done towards an analysis of the technological gap, or rather what is held to be the technological gap, is to compile and assess important factors.

PROBLEMS RELATED TO THE DETERMINING FACTORS

Analysis of the determining factors which compose the technological gap is made doubly difficult by their dependence on a plethora of political, economic, sociological and psychological influences which can only imperfectly be assessed.

Of the numerous determinants relevant to the problem of the technological gap, the following are of fundamental importance: 1. extent and composition of research and development expenditure, 2. number of people employed in research and development, 3. type of training system, 4. size of market, 5. size of firms and, 6. situation of capital market.

Government measures in fields such as subsidy, tax, money and credit, patents, competition and foreign trade, which contribute to further understanding of the problem but which are treated differently in different countries, are only touched on here or have to be neglected completely (cf. S. Klett: *Wie wird technischer Fortschritt manipuliert?* in *Der Volkswirt*, 1 July 1966, page 1154). The same applies to differences arising from natural conditions, such as size, amount and structure of population, mineral resources, climate and so on, of the countries concerned.

It has become common practice in disputing the technological gap, since the OECD published the Freeman/Young study, to conclude from a country's research and development expenditure the extent of its technological progress, which then gives rise to the desired productivity increase in the economy as a whole. A study by the Ifo Institute for Economic Research in Munich recently showed how unreliable such a generalisation is by revealing that countries with comparatively the lowest expenditure on research had the highest improvements in their overall economics and vice versa (*Forschungsaufwand, technischer Fortschritt und Produktivitätsfortschritt im internationalen Vergleich*, Ifo-Schnelldienst No. 14,

7 April 1967. The USA, Great Britain, Belgium, the Netherlands, France and the Federal Republic were examined). Most statistical comparisons in research and development are based on estimates. An international comparison on the basis of at least approximate statistical techniques will only be possible when the OECD published the results of its "International Statistical Year for Research and Development" conducted in 1964.

There is an unresolved problem of which exchange parity to base such comparisons on—the official exchange rate or a special R & D rate pegged to costs (Elmar Freund in his study *Forschung—der dritte Faktor*, Mainz 1967, page 25, follows the Freeman/Young example in using a special exchange parity. He explains: "An exchange parity valid for the sphere of research naturally had to be based on a comparison of prices of typical products and services required in research. Scarcely any serviceable work has yet been done in this field. Occasional checks have nonetheless shown that purchasing power parity approximates more closely to actual conditions than the conversion of research and development expenditure according to official exchange rates"). If absolute expenditure on research and development is calculated at official exchange rates, the difference between the United States and Europe is alarming. In 1964, for example, the USA spent six times as much on research and development than all the EEC countries together. If Great Britain is included the American expenditure was only four times as great. But if the adapted research and development exchange rate is applied, which takes into account the generally lower costs in Europe, the gap becomes even narrower.

Another picture also emerges if consideration is given to the argument, heard mainly from Americans,

The technological gap in individual industrial sectors varies widely. Most of Europe's traditional industries are exposed to the pressure of increasing American competition, but this is not of a technological nature. If American businessmen are frequently more successful with the same investment of means, the reason is another and more effective combination of the factors of production. A gap of this kind could be closed by Europe with appropriate measures. It is less a question of European basic research, whose quality is recognised by Americans and on the results of which much American work is based. Much more to the point is to learn from the Americans' highly developed capacity for innovation. By innovation is meant the introduction of new or improved products or techniques in industry. There is therefore much in favour of referring to the technological gap between Europe and the USA as the "innovation gap."

The real technological gap would then be the whole complex of research results financed largely out of the American defence budget. These involve sums of such proportions that no industry is in a position to raise them by itself. It was Heraclitus who said that war was the father of all things. In the current discussion of the technological gap it is as well to be aware that whole branches of industry nowadays vital to a nation's ability to compete at international level owe their origin and furtherance largely to military considerations. This applies to Europe just as much as to the United States.

Two turning points are clearly perceptible in a review of the balance of power between the old and the new world over the last 25 years. One is the construction of the first American atom bomb. The other is the launching of the first Soviet sputnik, as a result of which the Americans stepped up their research effort to an unparalleled level. The results of this effort have led not only to the desired military effect. They have reinforced certain branches of civil American industry to such an extent that the rest of the western world has little or nothing to compare with them. Examples are the American computer industry, nuclear research, the aircraft industry, space travel or satellite probes.

However broadly or narrowly the term "technological gap" is conceived, the solution of the problem exceeds the powers of individual European states. Yet no one can foresee when the national prestige motive still largely current in research policy will give way to a mode of thought which will facilitate a European solution in this field.

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