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NEW INTERNATIONAL LIQUIDITY FIGURES

TUNNELLING: A PILOT EXPERIMENT IN TECHNOLOGY ASSESSMENT

MANAGEMENT OF RADIOACTIVE WASTE

EXPERIENCE WITH NEW FORMS OF WORK ORGANISATION

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INTERNATIONAL LIQUIDITY

Complete data have just become available on official reserves at the end of 1969. In this article Mr. Harry Travers, Head of the International Payments Division of OECD explains the changes in international liquidity in 1969 and recent years and the developments leading up to the decision to begin creating the new form of reserves, Special Drawing Rights, of which the first allocation was made on 1st January 1970.

The level of world reserves (1) hardly changed in 1969. This was in strong contrast with the previous four years 1965-1968 and the decade 1955-1964 when the annual increases averaged, respectively, $ 2 billion and $ 1½ billion.

The static overall position in 1969 reflected a $ 1 billion loss of reserves by OECD countries and a slightly larger gain by the rest of the world. For the *OECD countries*, a significant feature was the gain of $ 1¼ billion of gross reserves (2) by the United States and the United Kingdom, which had been losing gross reserves at an average rate of more than $ ½ billion a year in the previous 14 years. (The official liabilities of the two reserve currency countries also fell substantially.) Japan increased its reserves by about $ ¾ billion in 1969 following a gain of nearly $ 1 billion in 1968. The gains of these three OECD countries were more than offset by the losses, totalling $ 3¾ billion, of Germany ($ 2.8 billion), France ($ 0.4 billion), Italy ($ 0.3 billion) and Spain ($ 0.25 billion).

It is a welcome fact that the *less-developed countries* (3) were able to gain $ 1½ billion of reserves in 1969, having already increased their reserves by an average $ ½ billion a year in the previous four years. In the decade 1955-1964 their reserves had fallen slightly.

Total world reserves at the end of 1969 (4) consisted of :

	$ *billion*	
Countries' gold holdings	39.1	51 %
Countries' foreign exchange holdings	31.0	40 %
Countries' reserve positions in the IMF (5)	6.7	9 %
Total national reserves (6)	76.9	100 %
IMF's gold holdings	2.3	
BIS (7)	— 0.5	
European Fund	0.1	
TOTAL	78.8	

On 1st January 1970 $ 3.4 billion of Special Drawing Rights were added to those reserves, making a total of $ 82.2 billion. This addition reduced the percentage of gold in total reserves to 49%. It is worth noting that this percentage has fallen substantially in recent years; in 1965 it was 59%.

Is this amount of reserves adequate? Is it growing at a satisfactory rate, taking account of the decision to create $ 9½ billion of Special Drawing Rights in 1970-1972?

Adequacy of the Stock of Reserves

The answer to the first question, concerning the *stock* of reserves, depends on complex judgements about the way reserves are used and countries' attitudes to them. The sum of all countries' reserves has not a lot of importance in itself. What is important is that most individual countries should feel that their reserves are not uncomfortably small in relation to the size of their international transactions and to the deficit swings which they are likely to experience.

One indicator often used in judging the adequacy of the stock of reserves is its size in relation to imports.

(continued on page 4)

(1) *Gold, foreign exchange and reserve positions in the IMF.*
(2) *i.e. before deducting liabilities.*
(3) *Excluding the Middle East where special factors have influenced reserve movements.*
(4) *For details see Table* 1.
(5) *The amount which they can draw on the IMF immediately and unconditionally.*
(6) *IMF members and Switzerland. The USSR, Eastern Europe, Mainland China and North Korea are not included.*
(7) *Excess of spot gold liabilities over assets, equivalent to reserves on loan to countries.*

1. ANNUAL CHANGES IN TOTAL RESERVES IN 1955-69

(Total reserves means gold, foreign exchange (1) and IMF reserve positions)

Millions of U.S. dollars

	Average 1955-64	1965	1966	1967	1968	1969
United States	- 631	- 1,222	- 568	- 52	880	1,254
United Kingdom	- 72	689	95	- 404	- 273	105
Total Reserve Currency Countries	- 703	- 533	- 473	- 456	607	1,359
Belgium-Luxembourg	113	112	16	240	- 403	201
France	446	619	390	261	- 2,793	- 368
Germany	530	- 453	599	124	1,796	- 2,819
Italy	290	976	110	552	- 121	- 337
Netherlands	107	67	32	171	- 156	66
Total E.E.C. Countries	1,486	1,321	1,147	1,349	- 1,677	- 3,257
Canada	85	145	- 334	15	329	60
Japan	109	133	- 33	- 88	876	748
Sweden	41	7	55	- 186	- 26	- 119
Switzerland	128	124	80	231	377	63
Total Group of Ten	1,146	1,197	441	864	486	- 1,146
Austria	89	- 6	22	151	26	27
Denmark	50	- 59	11	- 63	- 85	- 3
Finland	16	- 94	- 101	- 4	170	5
Greece	13	- 30	22	13	36	- 5
Iceland	2	10	4	- 22	- 6	10
Ireland	8	- 36	84	- 55	106	146
Norway	24	89	51	150	25	10
Portugal	16	67	139	156	129	82
Spain	131	- 105	- 203	- 157	46	- 262
Turkey	- 6	- 3	- 10	- 12	4	122
Total other OECD Countries	343	- 167	19	155	451	132
TOTAL OECD COUNTRIES	1,489	1,035	461	1,019	937	- 1014
• *Other developed countries :*						
South Africa	29	- 104	230	- 53	693	- 74
Other *	74	- 366	64	- 136	135	- 47
• *Less developed countries :*						
Middle East	105	355	170	350	55	- 315
Other	- 175	885	595	510	1,085	1,600
Total rest of the world (national)	33	770	1,059	672	1,968	1,164
TOTAL WORLD (national) (2)*	1,522	1,805	1,520	1,690	2,905	150
• *Bank for International Settlements*	- 15	- 508	134	- 200	275	- 131
• *International Monetary Fund* (3)	45	3	470	30	- 394	22
• *European Fund*	- 10	21	- 13	- 9	- 12	22
TOTAL WORLD (national and international)	1,542	1,321	2,111	1,511	2,774	63

Source : International Financial Statistics (IMF), April 1970 and supplement to 1966-67 issues.

* *Includes some unpublished gold reserves not allocated to specified countries in '' International Financial Statistics ''.*

(1) *Beginning 1959, when most of the major currencies of the world became convertible, the data exclude known holdings of inconvertible currencies and of balances under payments agreements and the bilateral claims arising from the liquidation of the EPU.*

(2) *Excluding the USSR, Eastern Europe, Mainland China and North Korea.*

(3) *Gold paid to the I.M.F. in 1965 ($ 313 m.) in respect of 1966 in-*

2. RESERVES

United States
United Kingdom
Total Reserve Currency Countries
Belgium-Luxembourg
France
Germany
Italy
Netherlands
Total E.E.C. Countries
Canada
Japan
Sweden
Switzerland
Total Group of Ten
Austria
Denmark
Finland
Greece
Iceland
Ireland
Norway
Portugal
Spain
Turkey
Total other OECD Countries
TOTAL OECD COUNTRIES
• *Other developed countries :*
South Africa
*Other**
• *Less developed countries*
Middle East
Other
Total rest of the world (national)
TOTAL WORLD (national) (2)*
• *Bank for International Settlements*
• *International Monetary Fund* (4)
• *European Fund*
TOTAL WORLD (national and international)

HOLDINGS AT THE END OF 1969

Millions of U.S. dollars

Outstanding at 31st December, 1969				Special Drawing Rights allocated at 1 st Jan. 1970	TOTAL at 1st Jan. 1970
Gold	Foreign Exchange	Reserve Positions in I.M.F.	Total		
11,859	2,781	2,324	16,964	867	17,831
1,471	1,056	—	2,527	410	2,937
13,330	3,837	2,324	19,491	1,277	20,768
1,520	712	160	2,392	74	2,466
3,547	286	—	3,833	166	3,999
4,079	2,748	302	7,129	202	7,331
2,956	1,187	863	5,005	105	5,110
1,720	370	439	2,529	87	2,616
13,822	5,303	1,764	20,888	634	21,522
872	1,756	478	3,106	124	3,230
413	2,615	627	3,654	122	3,776
226	369	101	696	38	734
2,642	1,353	—	3,995	—	3,995
31,305	15,233	5,294	51,830	2,195	54,025
715	656	166	1,537	29	1,566
89	356	1	446	27	473
45	272	41	359	21	380
130	162	25	317	17	334
1	38	—	39	2	41
39	594	58	691	13	704
25	599	87	712	25	737
876	550	19	1,444	—	1,444
784	49	—	833	42	875
117	128	—	245	18	263
2,821	3,404	397	6,623	194	6,817
34,126	18,637	5,691	58,453	2,389	60,842
1,115	129	153	1,397	34	1,431
432	1,189	263	1,884	138	2,023
1,052	1,815	68	2,935	77	3,012
2,410	9,275	551	12,236	776	13,011
5,009	12,408	1,035	18,452	1,025	19,477
39,134	31,045	6,726	76,905	3,414	80,319
- 480	—	—	- 480	—	- 480
2,310	—	—	2,310	—	2,310
52	—	—	52	—	52
41,016	31,045	6,726	78,787	3,414	82,201

creases of quotas is recorded in 1965, not, as in I.M.F. statistics, in 1966.

(4) *Not including I.M.F. gold invested in the U.S, ($800 m.) or deposited in the U.S. ($ 210 m.) and U.K. ($ 38 m.), included in these countries' gold holdings.*

It is an unsatisfactory indicator because visible trade accounts for only part of all international transactions. But it is convenient because data are available, whereas data on the gross turnover for a large part of other international transactions, especially in the fields of financial and capital flows, are not available. For all countries taken together the ratio of reserves to annual imports has fallen steadily from 1954 to 1969, from 68 % to 30 % (See Table 3). Put another way, reserves were equivalent to 8 months' imports in 1955, but now represent only about 3½ months' imports. Excluding the United States, whose reserves ratio fell from 206 % in 1954 to 44 % in 1969, the other countries' ratio fell from 45 % to 28 % over the same period.

Taking only the less-developed countries it is interesting to note that their reserves ratio, which was nearly 50 % in 1954, had already fallen below 30 % as early as 1961 but has since then remained around that level, falling at times to 27 % but in the three years 1966-1968 returning to about 30 % and in 1969 even increasing to 32 %. While this trend concerns the average ratio and there are wide differences between individual countries' situations, it indicates that the less-developed countries, whose export earnings are subject to sharp falls and who have for this reason frequently to use their reserves to maintain the flow of essential imports, have in general resisted a further deterioration in the ratio of their reserves to imports since about 1961. Many of them have in fact made the building-up of their reserves an important policy objective.

It is probable that similar resistance to a further deterioration of the level of their reserves relative to international transactions has been increasing for the developed countries also. But for them a major factor, additional to the growth of trade, has been the very rapid growth of other types of international transactions.

There are indications that developed countries have been coming to feel existing reserve stocks too low in relation to foreign transactions, especially countries plagued by balance-of-payments deficits. Domestic policies aimed at improving balance-of-payments positions have been supplemented by direct action intended to limit external payments. For example, several major countries have imposed temporary restrictions on trade and tourist expenditure. Also, many countries have applied or intensified controls on outward capital flows.

A further indication of reserves shortage was the greatly increased recourse by developed countries to international financial credits, in the period 1965-1968, to meet deficits or protect reserves. This took two forms : increased drawings on the credit facilities of the IMF and the development of bilateral swap arrangements. In effect, countries made temporary additions to liquidity. Their importance is illustrated by the fact that in 1965-1968 reserves generated as a by-product of international credits more than accounted for the total increase in reserves.

This raises the question of the appropriate interrelationship between unconditional liquidity (reserves)

and conditional liquidity (credit facilities). It would be impractical and undesirable for all countries to have enough unconditional liquidity at their disposal to deal with all the swings in their balances of payments which are likely to occur. The growing interpenetration between domestic and international financial markets has made it possible and usual for private flows of capital to exceed what can be financed out of a country's reserves at times when there is a sharp change in confidence in, or speculative attitudes towards, a currency. Countries use their reserves as shock absorbers, while action to deal with the causes of the balance of payments deficit is taking effect. Credit facilities mitigate the reserve loss and can be particularly valuable when a country is theatened by speculation. Short-term credits, mainly from central banks of other countries, are much used in such circumstances. Medium-term credits, mainly from the IMF, are more appropriate to help finance adverse cyclical swings or losses which, even if sudden, seem likely to take some time to recoup. The need to seek international credit facilities at a fairly early stage, by encouraging international discussion of policies, promotes better co-ordination of national policies.

The Need for Long-term Growth of Reserves

Apart from the adequacy of the current stock of reserves in relation to changing conditions, there is a separate factor to take into account when deciding on the amount of deliberate and permanent reserve creation. This is the need for the overall amount of reserves *to grow in the long run*. Practically all countries either consciously aim to achieve a long-term growth in their reserves or conduct their economic policies in a way that implies such growth. Most seem to feel the need for rising reserves linked with, though not necessarily in any fixed proportion to, the growth of their economies and of their international transactions. Even when they are satisfied with the current level of their reserves they tend, for safety's sake, to aim for reserve gains rather than losses. No country aims at or accepts a long-term decline in its reserves. Were the total stock of reserves not to rise over time, countries which succeeded in gaining reserves would necessarily oblige others to lose an equal amount. Such a situation would lead to self-defeating competition, and the difficulties of deficit countries attempting to correct their positions would be aggravated by the resistance of other countries to the fall in reserves which would necessarily result from that correction.

One way of judging this need for long-term growth of reserves is to look at the trend in the past. It is useful to distinguish the decade 1955-1964 from the five-year period beginning 1965, because about the end of 1964 there was a radical change in the forms and sources of reserve growth (Table 1).

Previously the major sources were net additions to monetary gold holdings and increases in US dollar holdings, the latter corresponding to an increase in the official liabilities of the United States. During the decade 1955-1964 total reserves creation averaged about $ 1½ billion a year. For countries outside the United States it was about $ 2 billion a year, as the United States' loss of gross reserves averaged $ ½ billion a year.

In this period monetary gold holdings increased by $ 0.6 billion a year. This was particularly relevant to the need for a long-term growth of reserves, because it represented reserve gains without a corresponding national loss of reserves and without an increase in the liabilities of other countries.

The increase of $ 0.7 billion a year in official foreign exchange holdings, mainly US dollars, in 1955-1964 did not involve a corresponding loss of *gross* reserves either, but its counterpart was an increase in the official liabilities of the reserve currency countries, i.e. a weakening of their *net* reserve position. There are therefore limits to the amount of reserve creation from this source. About 1961 the United States total liquid dollar liabilities began to exceed its gold holdings. About 1964 the rising level of US liabilities to official foreign holders reached the falling level of US gold reserves.

In the next four years, 1965-1968, national monetary gold holdings fell by nearly $ 2 billion, mainly in connec-

3. RATIO OF RESERVES TO ANNUAL VALUE OF IMPORTS

Percentages

	Increase in Imports		*Increase in Reserves*		*Ratio of Reserves to Imports*			
					at end of period			*at 1st Jan. 1970 (i.e. after incl. $ 3.4 b. of SDR)*
	in 10 years 1955-64	*in 5 years 1965-69*	*in 10 years 1955-64*	*in 5 years 1965-69*	*1954*	*1964*	*1969*	
ALL COUNTRIES	102	58	29	11	68	43	30	32
All Countries less United States	105	53	71	15	45	37	28	29
United States	82	90	— 27	2	206	82	44	46
Developed Countries	119	64	37	5	75	47	30	31
Developed Countries less U.S.	128	59	111	6	43	40	27	28
Less Developed Countries	57	35	5	51	49	28	32	34

tion with the heavy sales by the gold pool to private purchasers through the London gold market, prior to the decision in March 1968 to cease these sales. And in this period the official liabilities of the United States did not increase greatly. Total reserves increased by about $ 7 billion. Thus, the creation of reserves other than gold during these four years amounted to nearly $ 9 billion. It is not possible to arrive at a precise breakdown of the various sources of this reserve creation, which is the net result of many influences. However, there was one dominating feature: the reserves created as a by-product of balance-of-payments assistance accounted for practically all the total net creation of reserves during this period. As a result mainly of the large drawings by the United Kingdom on its credit tranches in the IMF, some $ 2¼ billion of reserve positions in the Fund were created. On the basis of such information as has been published about swap drawings between central banks, one can estimate that the drawings outstanding increased from about $ 1 billion at the end of 1964 to something over $ 6 billion at the end of 1968, an increase of more than $ 5 billion.

Special Drawing Rights

Thus, when the monetary authorities — first the Group of Ten and then the Executive Board of the IMF — were considering in the summer of 1969 what amount of SDRs should be activated in the period ahead, they faced a situation with the following main characteristics :

(i) Many countries were beginning to feel their stock of reserves had fallen too low, while no country felt its stock too high.

(ii) The traditional sources of reserve growth, additions to monetary gold and increases in official liabilities of reserve currency countries, could no longer be relied upon.

(iii) Practically the whole of the reserve creation during recent years had been associated with balance of payments assistance, and therefore would be destroyed as and when the assistance was repaid.

(iv) It was very difficult to make forecasts about the rate of reserve creation from sources other than Special Drawing Rights. Much depended on developments about which it was impossible to make firm predictions — notably the prospect for the United States' balance of payments (deficits could increase its official liabilities and therefore the foreign exchange reserves of other countries) and the success of the United Kingdom and France in obtaining surpluses enabling them to repay the balance of payments assistance they had received in recent years.

One of the concerns expressed at the time was the risk that a creation of new unconditional liquidity might weaken the determination of major deficit countries to restore better balance of payments positions. It was therefore one of the conditions of the first activation of SDRs that general agreement should be reached that the process of adjustment would not be compromised.

Accordingly, when the Group of Ten discussed the amount and timing of SDR creation in the summer of 1969 they took account of the conclusions reached in Working Party No. 3 of the Economic Policy Committee of OECD about the prospects for the achievement of a better pattern of payments balances and how these might be affected by shortage or availability of international reserves. The general consensus was that there should be no objection on this score to an early allocation of Special Drawing Rights. It was felt that, for example, disinflationary policies of the United States and the determination of the United Kingdom and France to recover balance of payments strength would not be weakened.

In arriving at a decision on the amount of Special Drawing Rights to be created, it was necessary to reach a difficult compromise between conflicting considerations. On the one hand, reserve growth had recently been unsatisfactory both in rate and in form. There was therefore a case for beginning to supplement it by the deliberate creation of the new form of reserves. On the other hand, the deliberate creation of permanent reserves had to be related to the long-term reserve needs of the world economy and, though one could make a judgement as to what would be a reasonable rate of growth of all forms of reserves, it was very difficult to forecast what would be the contribution from traditional sources and, by deduction, what amount of SDRs would be needed in the long run.

As regards the overall rate of growth to be aimed at, extrapolations of experience in the previous 15 years pointed to the need for annual increases ranging from about $ 3 to $ 6 billion (or 4 to 7 %) a year in the next five years; most calculations were in the narrower range of $ 4 to $ 5 billion (or 5 to 6 %) per year. For example, it was estimated that reserves would have to be created at about this rate if a further fall in the ratio of reserves to imports was to be avoided.

If, on the basis of these calculations, one assumed that the desirable rate of growth of reserves from all sources was of the order of $ 4 to $ 5 billion a year, one had then to take a view as to how much of this would be supplied out of traditional sources, in order to arrive at the amount of SDR creation which would be needed. The compromise decided upon was to provide for the creation of SDRs at the rate of just over $ 3 billion a year (1) for a period of three years only, rather than the five-year period envisaged in the SDR scheme. This left open the possibility of an adjustment of the rate of SDR creation after three years if the overall rate of reserve growth was then felt to be too fast or too slow in relation to long-term needs.

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(1) *The decision was to create* $ 3½ *billion of SDRs on* 1*st January* 1970 *and* $ 3 *billion each year on* 1*st January* 1971 *and* 1972.

INNOVATION IN GERMAN UNIVERSITIES

The needs of the increasing numbers of German youth qualifying for higher education have resulted in the foundation of new universities planned on modern lines and the introduction of innovative intellectual and structural concepts in the case of older establishments.

As part of its programme to investigate the progress made in a number of Member countries with respect to available facilities for higher education, the OECD's Scientific Affairs Directorate invited two consultants, Eberhard Bonning and Karl Roeloff, to make case-studies of two recently founded German universities and a technical university where the programme of studies has been extended to include non-technological disciplines. Other case studies have been or are being prepared under the auspices of OECD on new universities and on non-university post-secondary institutions in the United Kingdom, on global reforms of higher education in France, Sweden and Yugoslavia and on post-secondary colleges in Canada.

The following article, which is based on the consultants' report, discusses the factors and circumstances which led to the creation of the new institutions, and the development of innovative features.

The Need for Reform

Two main motives underlay plans for the creation of new universities in Germany since about 1950 : the desire to bring about reforms and the need to meet the pressure of increasing student numbers — the qualitative and quantitative approaches. These two aspects have led to the programme of structural change and expansion in existing universities; but it is realised that more satisfactory results can be obtained by new foundations for higher education.

Demands for reform began to appear almost as soon as the universities re-opened after 1945, and shortly afterwards were discussed in the West German Conference of University Rectors as well as among the Education Ministers of the various Länder.

The initial tendency was for a return to what may be called conservative reform — a return to the highly successful period of the 1920's, a time of outstanding scientific achievement, the origin of student associations which shared the responsibility for university affairs, and the existence of such disciplines as political science, sociology and psycho-analysis.

By the mid-fifties the situation had somewhat changed with the return of economic prosperity and the influx of the pre-war baby-boom. Expansion of existing facilities and an increased staff — both meaning a struggle for greater allocations in the Länder budgets — became the main concern. Qualitative aspects were involved : better guidance and control; increase of medium cadre staff for tutoring, supervision and exercises.

As the analysis of the current situation and future prospects became more sophisticated, the numerical problem became even more serious; at the same time it was obvious that simple expansion of the existing pattern would be insufficient as well as uneconomical. Qualitative reform, too, became more and more urgent. The development of certain fields of study and research, notably in the natural sciences, called for a type of work and for facilities to which the traditional structure of the university was not suited. There was, and to some extent still is, the danger that these important research disciplines should be transferred outside the university. There was also the question of the " brain drain " to the United States.

These were problems of national importance, and the Science Council (Wissenschaftsrat - WR) was set up jointly by the Bund and Länder in 1957. Though it had no executive powers, the WR proved to be the essential body for guiding, initiating and assessing university expansion and reform on a national scale; as such, it has influenced the universities under review in this article.

The WR is composed of two committees :

- the Administrative Committee, which consists of six senior civil servants delegated by the Federal Government, plus one from each Land — usually the Minister of Education;
- the Science Committee, which consists of 16 scientists (mostly university professors) appointed by the Federal Government on the recommendation of national science organisations, and six leading figures from public life (including representatives of industry) appointed on joint recommendations of the Federal and Länder Governments.

Terms of reference include the development of an overall plan for the promotion of science, the co-ordination of Bund and Länder plans, and the establishment of points of special importance and priority rating; the drawing-up of an annual priority programme; and recommendations for the allocation of the funds provided in Bund and Länder budgets for the promotion of science.

A series of publications issued by the WR reflects its main concerns in chronological order :

- University expansion and development.
- The structure of new universities.
- Planning and preparation of construction projects at new universities.
- Entrance qualifications and student numbers.
- Structure of academic staff.
- A new organisation of university study programmes.
- Recommendations on university expansion and development until 1970.

These recommendations and suggestions have by no means been realised in full, but they have become the main guidelines for university development and reform policy. The fate of the reform recommendations, however, depends on their reception in university organisations, and perhaps even more so on their reception by the individual professors. Their success or failure varies with the subject and the university; it seems fair to say that one of the main reforms has so far been completely adopted by the universities of the Federal Republic as a body, and a certain impatience on the subject may sometimes be detected in comments of outside observers and reform-minded university people.

By its terms of reference, composition and actual functioning, the WR is, up to now, the most important agency for planning and advice in science policy, university policy in particular. It is not, however, the only important body in this field.

Other Agencies and Plans for Reform

The West German Rectors' Conference (WRK), whose members are the rectors of all universities (at present 36). Reform issues have played a prominent part in the deliberations of this body, including the abolition of course fees, the status of academic staff and student co-responsibility in university self-administration. It has, however, neither achieved systematic university reform nor developed a comprehensive concept for it.

In the Länder with several universities, the rectors form the Land Conference of University Rectors; they have in some cases recently played an important role as partners of the Land Ministers of Education in the preparation of " university laws " and other matters in Länder policy.

Länder Ministers meet in the Permanent Conference of the Länder Ministers of Education and Cultural Affairs (KMK). Among various committees, there is one on schools and another on universities. But in accordance with the constitutionally guaranteed principle of autonomy of each Land, KMK decisions must be unanimous, and this has proved a handicap in settling controversial issues. WRK and KMK have set up a joint committee to study examinations and curriculum requirements. An essential aim, in addition to national co-ordination, is to increase efficiency by a more rational organisation of studies and thus to reduce the average study duration.

In 1965 the Bund and Länder jointly set up the German Education Council (BR). Though its main field of responsibility lies in primary and secondary rather than in university education, it is expressly intended that a joint co-ordinating Committee should be set up of BR and WR members with the object of presenting comprehensive, co-ordinated proposals on the reform of secondary education and the university. The BR is expected to make recommendations for somewhat drastic changes concerning the university entrance qualification.

The basic idea seems to be that the last years of the Gymnasium (secondary school) should be changed from

Innovation in Three Universities

Three institutions were selected to illustrate the direction and progress of innovation in higher education in the Federal Republic of Germany. Of these, two are new foundations :

- *the University of the Ruhr at Bochum, Land Nordrhein - Westfalen and,*
- *the University of Konstanz, Land Baden - Würtemberg; while the third,*
- *the Technical University of Rhineland - Westfalia at Aachen, Land Nordrhein - Westfalen, is an established technical university to which philosophical and medical faculties have recently been grafted.*

The development of all three has been conditioned by a number of disparate factors. In the case of the Ruhr University which accepted its first students in the autumn of 1965, present planning is for the accommodation of 18,000 students with about 250 full professors. The University has therefore been in operation long enough for an evaluation to be made of the original concept in the light of practical experience.

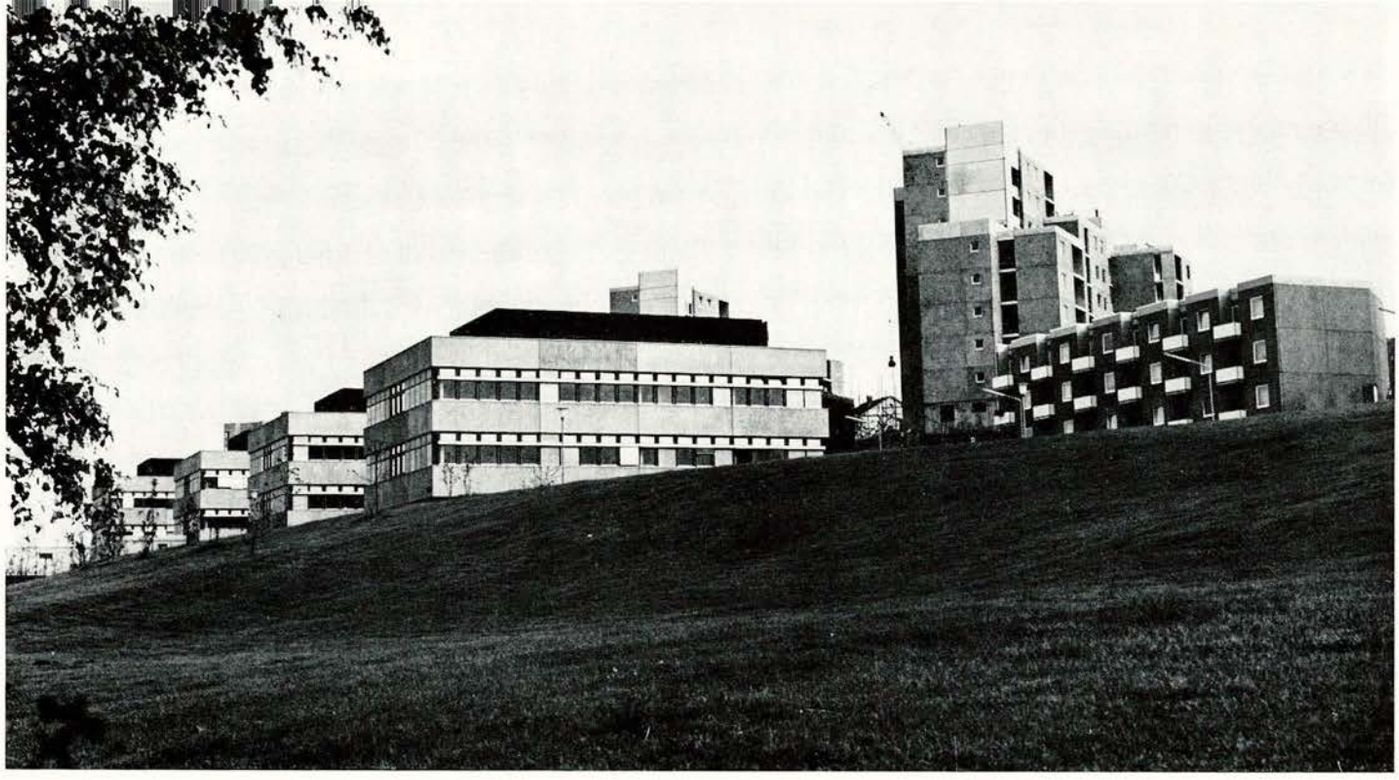
The essential characteristics of the Ruhr University include the fact that it follows tradition in comprising all academic disciplines normally represented at a university with the addition of engineering and technology. The academic disciplines are not grouped in the traditional form of large faculties, but in smaller departments and — a novelty in Germany — the University is of the campus type.

Entrance requirements, academic programmes and degrees will be in line with those of other universities; it is hoped to bring about a closer inter-relationship between the various disciplines and between staff and students, however, by means of a number of special features in the organisation of the administrative structure and the academic life.

Konstanz University is designed to operate on a smaller scale : 3,000 students and 106 professors. It differs in other ways from the Ruhr University, and is indeed more radically innovative by comparison with the traditional German university. Outstanding features include a limited number of disciplines and students; appointment of a permanent Rector instead of election of one of the professors as Rector with one-year tenure; and new institutional and organisational methods designed to ensure unity of teaching and research as well as inter-disciplinary projects.

The Aachen " Technical University " is one of the older universities of high repute which has, as in the case of other technical universities, gradually expanded to cover not only the areas of pure science and the humanities, but also a school of medicine. Though some of the traditional academic disciplines (e.g. Law, Theology) are not fully represented, this recent development may be considered, for Aachen itself, as representing a conscious policy to develop the non-technical sector of the programme. For the Technical Universities as a group, it represents a conscious policy to overcome the traditional barrier between technological disciplines and " university proper " disciplines. For university policy as a whole, it indicates a general tendency towards the integration of technology proper on the one hand, and on the other a deviation from the traditional concept that every university should cover all fields of scholastic endeavour.

In 1938 the German Reich comprised 42 institutions of university rank with a total of 55,900 students; the number for 1980 is expected to be over 500,000.



The University of Konstanz, Land Baden-Würtemberg.

a " one-way street " (via " Abitur " - the university entrance qualification) into a " traffic roundabout " with numerous radial roads to take into account the sharp increase in student numbers in secondary schools.

The WR's primary concern is to safeguard the university's function in research and highest quality professional training; it should therefore be allowed to restrict admission and to select the best according to its own criteria. The political authorities also realise and accept the need for saving the university from being crushed by the " student avalanche " but at the same time feel obliged to continue their policy of mobilising ability reserves, securing equality of chances and making sure that everyone reaches the level of qualification that corresponds to his ability and interest. With the plans for a range of institutions open to every qualified student in Gymnasium or any other school at the end of the twelfth school year, it is hoped that the demand for higher education can be satisfied, and that at the same time the universities can be relieved. It is intended that :

- shorter, 3-year academic courses are not to be offered at the universities, but only at the new institutions promoted into the higher education sector;
- qualification for admission to these new institutions will be obtained a year earlier than the " Arbitur ";
- admission to these new institutions will be open to pupils from all branches of secondary education.

In general terms, this means a decisive step towards a horizontally structured educational system. A number of other plans for dealing with these problems have been put forward, notably that prepared by an advisory council set up by Baden-Würtemberg under the chairmanship of Professor Ralph Dahrendorf, a Konstanz sociologist, and at present Secretary of State in the Ministry of Foreign Affairs, which proposed a complete reform project; this plan met with nation-wide attention, but criticism was levelled at certain of its suggestions, including the separation of long-course and short-course study programmes, and fear that the change in rank and entrance requirements for institutions of the promoted type would lead to a demand that they should be paid, staffed and equipped like the traditional universities.

In all three of the cases under study in the report, the basic decisions to found a new university or faculty, as well as the principles of structure, were strongly influenced by the WR recommendations on expansion and structural reform of universities. It was certain that expansion of existing universities alone would not suffice; on the other hand the possible solution of limiting admission to the university was unacceptable for reasons of educational policy principles, the campaign for the democratisation of the educational system just beginning to show results in an increase in Gymnasium attendance leading to the university entrance qualification, and the estimated further social needs for highly qualified personnel.

The WR therefore recommended the establishment of three new universities, one technical university, and several medical academies (corresponding to the medical faculty of a university).

The basic ideas for the three institutions under investigation in the report on which this article is based were formed about the same time and under the influence of the same facts and ideas that shaped the WR recommendations. As the WR itself came to put greater stress on organisational changes (limitation of subjects and development of " strong points "; inter-disciplinary contacts; abolition of the " separate institute for every established chair " principle and the hierarchical structure within the staff) and suggested their implementation at new universities, some of the ideas were used in the foundation plans of Rühr, Konstanz and Aachen institutions.

Innovation: Aspects and Evaluation

The motives for innovation in German universities, as described in the OECD Consultants' report, have been outlined in preceding paragraphs. Some account must now be given of other aspects of development in German higher education. These aspects include innovation in :

- administrative and staff structure;
- university studies;
- university research.

Innovation in Administrative and Staff Structure

The most important example of ***university self administration*** is provided by Konstanz, where the traditional temporary rector is replaced by a permanent one; and executive responsibilities traditionally resting with the Land Ministry or the individual faculties have been turned over to the "little senate". Rector and little senate together form an exceptionally strong executive, with the large senate serving as a kind of university parliament. Though there have been no important changes at the head of the other two institutions, both Aachen and Bochum have taken important measures with regard to the structure and role of the faculties as units of university self-government.

As for the *legal status of academic staff* (civil servants), conditions in Germany do not permit important innovations by an individual university; Konstanz is the only university so far to have transferred authority from the individual chair-holding professor to a senate committee.

A greater share in university self-government is the *demand of the student body*, and most universities are working out plans to meet this demand. At Konstanz the radical demands are far from being met; but by comparison with the usual pattern, representation of the study body in the various organs of university self-government is much stronger.

A most important innovation is the delegation of traditional *state responsibilities* to the university, which receives a large part of its funds in lump sum payments and decides on the allocation itself.

The only definite plan that can be cited is that of *freeing the assistants from their dependence* on one individual professor. Aside from this issue, the main need within the university seems to be for greater coherence, i.e. for *strengthening the head of self-administration* against the individual faculties and chair-holders.

Innovation in University Research

The main national problems in this sector are partly related to defining and implementing a comprehensive national science policy, and partly to adapting the structure of the individual university to the needs of modern scientific research. The most important aspects of these general issues are :

- to co-ordinate university and non-university research;
- to replace the idea of "each university equally strong in all fields" by that of a planned pattern of "centres of excellence";
- to replace the individual institute as a basic unit for research by larger and more efficient units;
- to replace the hierarchical structure of university staff and the monocratic position of the individual institute director by organisational forms which permit modern research methods and efficient use of facilities;
- to co-ordinate administrative and academic responsibility for research financing.

Both Bochum and Aachen have given top priority to the need for *changing the structure* of the university *in the interests of research*. The same principle has led to more radical consequences at Konstanz, which from the beginning was conceived as a university limited in the range of subjects and student numbers, with strong emphasis on research and on biology as a "centre of excellence".

Where *staff for research* is concerned, the general need is that of team-work and full participation of all qualified research personnel. Again, Konstanz seems to have gone furthest in this respect, while the main feature at Bochum is that of collegiate institute administration, with "medium cadre" scientists eligible for the position of acting director.

The *availability of research funds* has often depended on the individual professor's bargaining position with the Ministry of Education. Except for the consequences of the changes in organisation of research units and staff, Bochum and the medical faculty at Aachen do not represent important innovations though they may eventually be responsible for the allocation of regular budget funds to the various disciplines; Konstanz is already practising this, and though its research commission maintains university control of the research carried out in all individual units.

To sum up, the *need for university research* to form larger units and to specialise and concentrate in certain fields of research within a national pattern has been generally accepted; so have, in principle, the plans of the national organisations to meet it.

Recent Progress in University Education

The step from discussion to policy action in higher education has already been taken, but the expectation of a break-through to systematic, coherent and thorough reform has so far proved premature. Higher education has, on the other hand, remained one of the main issues of international policy and a focal point of public interest.

Konstanz, Bochum and Aachen have not really invented the innovative features discussed above, but rather were the first to put into practice what, at the time, could be distilled from the general discussion as to the main points of agreement among reform advocates, be they within the universities, the WR or the general public. In view of the present dilemma in university reform, there is a growing demand that a national solution should be reached.

The debate concerning far-reaching reforms of higher education in Germany is now entering a crucial phase. Many of the innovations introduced at Aachen, Konstanz and Bochum universities were the foreunners of the recent developments and, implicitly, testing grounds for some of the ideas which will probably determine the new patterns of German higher education. The expected changes might be much more profound than those launched in the three universities.

Another new institution, the University of Bielefeld, goes considerably further in its innovative features than Konstanz and radical transformations of the overall structure of post-secondary education including universities, teacher training, technical and vocational colleges are now envisaged both at the Länder and at the federal levels. But reforms introduced at the three universities analysed in the new OECD report, and indeed the creation of these universities, represented one of the first important phases in the process of mutation to which German higher education will be subject in the near future, and which it is undergoing already.

A Pilot Experiment in Technology Assessment

OECD Advisory Conference on Tunnelling

If technology is to be channelled into socially desirable directions, what is needed is not only a monitoring and alert system to safeguard society against its potentially undesirable consequences, but also — perhaps more importantly — a positive strategy to use technology creatively as a tool of social and environmental betterment. Both perspectives have found a tangible expression in the unifying concept of "technology assessment".

The idea of technology assessment was first given currency three years ago by a committee of the United States Congress under the chairmanship of Congressman Daddario. Since then it has become the subject of increasing interest and scrutiny, recently culminating in the publication of two in-depth studies (1). Broadly conceived, technology assessment represents an effort to examine systematically and to evaluate the consequences of technological development in order to foster a more constructive evolution of technology. The concept embraces the exploration of how environmental quality might be affected, beneficially or adversely, by technological change; the development of methodologies and mechanisms to monitor, measure and forecast the probable impacts on society of specific technologies and to assess in cost-benefit terms the social and environmental consequences that might flow from their widespread application; and the formulation of more precise requirements for technical development in relation to broad national objectives and major social needs.

An OECD Advisory Conference on Tunnelling to be held in Washington D.C. in June of this year probably represents the first attempt at international level to put into practice a new concept — technology assessment. This pilot experiment is described in the following article by C. Kenneth Orski of OECD's Scientific Directorate.

It was against the background of the rising interest in the concept of technology assessment that plans within OECD for the Advisory Conference on Tunnelling were made (2).

Underlying the proposed conference has been the premise that the technology of tunnelling offers great potential for alleviating a wide range of proclems related to urbanisation. With the accelerated growth of urban areas two major challenges have been added to the social agenda of many OECD nations : the first challenge is to contain urban sprawl and to relieve congestion so as to preserve cities as healthy, economically viable centres of commerce, management, information and culture; the other challenge is to preserve decent living conditions for those who reside in urban areas.

Both challenges can be partly met by a more intensive utilisation of the urban subsurface. By placing a larger proportion of facilities and services underground, cities can benefit from the advantages of high concentration while suffering less from its negative consequences. For example, they can promote, if they so choose, high density living and still retain adequate open spaces for plazas, parks and playgrounds. Their residents can continue to enjoy the comfort and flexibility of the automobile while being exposed less to its undesirable by-products such as congestion, disruption, pollution, noise and the risk of accidents.

Gradual, evolutionary improvements in the technology of underground construction, however, such as have occurred to date — will not be enough for the task at hand. If cities are really to have an option to utilise intensively the sub-surface environment, a radical change in the scope of thinking about the performance of tunnelling technology is needed.

To be sure, the use of the underground is no longer limited today, as in the past, to utility conduits for water, sewage, gas and electricity and to railrapid transit. A growing number of cities have begun to put the underground to novel uses : shopping arcades, parking garages, street cars, sewage treatment plants and waste water storage reservoirs are a few examples. But such efforts as have occurred have been sporadic and — with the notable exception of Montreal and Munich — uncoordinated. Few attempts have been made to exploit

(1) *"Technology : Process of Assessment and Choice", Report of National Academy of Sciences, Washington, D.C. (July 1969); "A Study of Technology Assessment", Report of the National Academy of Engineering, Washington, D.C. (July 1969).*

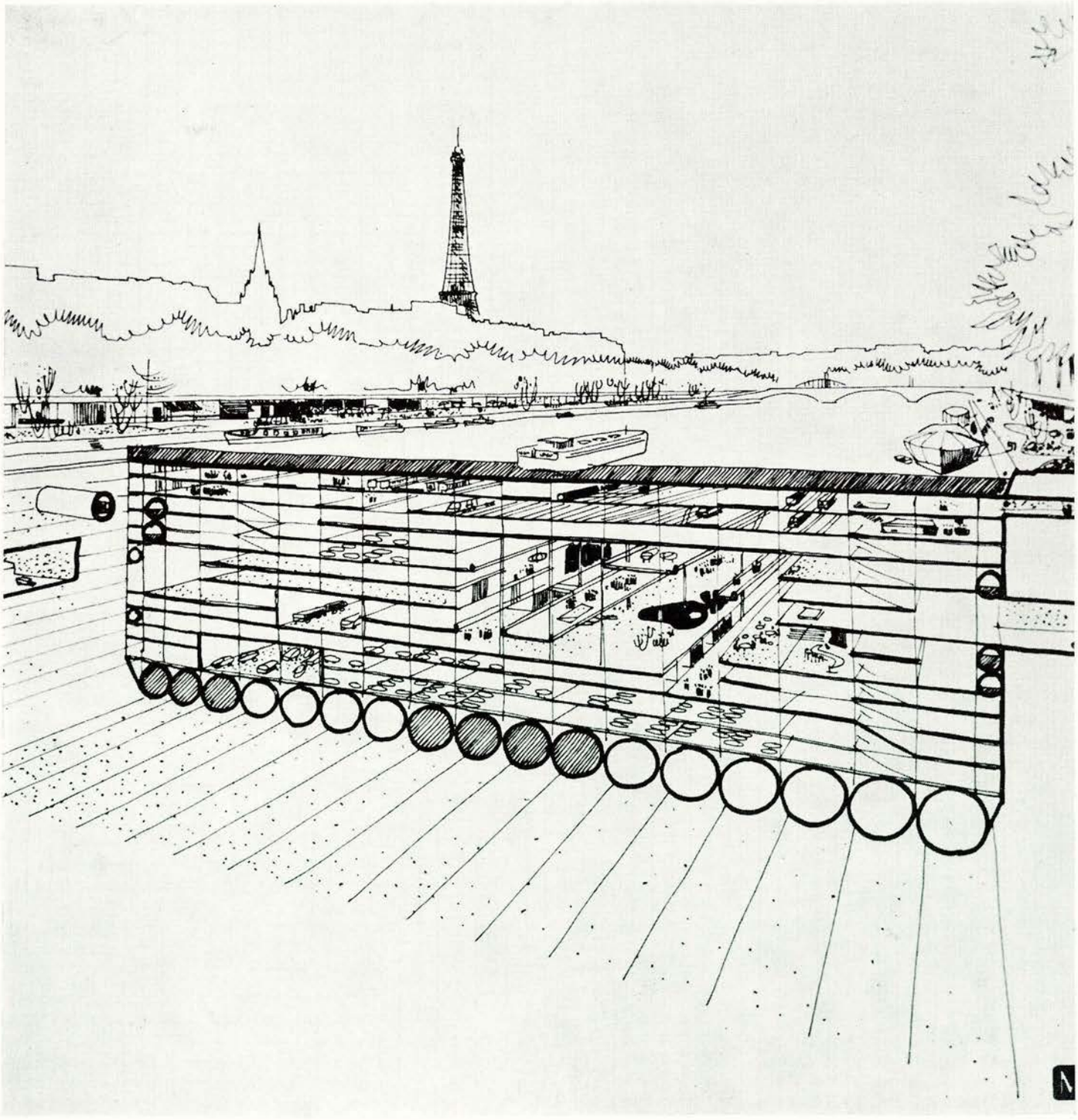
(2) *This conference is part of the programme of OECD's Consultative Group on Transportation Research.*

the metropolitan subsurface to its full potential and no concerted effort has been devoted to developing the technology necessary to relax the constraints that presently inhibit such intensive exploitation.

Present constraints

First on the list of constraints is *cost* of underground construction. Despite the rising price of land in metropolitan areas, the unit cost of underground facilities is still four to five times higher than the cost of comparable surface facilities. The current practice of evaluating proposed investments in terms of market costs only, without taking into account either the social costs of surface facilities or the social benefits of underground facilities, tends to make this gap wider than it actually is. For example, a potential reduction in traffic accidents or the savings in human costs incident to relocation of people which would result from the construction of an underground in lieu of a surface road, are indirect but very real benefits to the community. So are the less quantifiable advantages of reduced air pollution, less conflict between

Architect Paul Maymont's design for an extension of Paris underneath the Seine.



pedestrians and vehicular traffic, or an aesthetically more pleasing environment. Yet none of these benefits are accounted for in a conventional benefit/cost analysis.

A second constraint is *time*. To those planning public works facilities — transportation systems, for example — the element of time is critical. The longer the construction period, the longer investment capital is tied up unproductively in unfinished facilities. Because of the present disparity in construction time between subsurface and surface facilities, the choice is often made in favour of the latter.

What steps can be taken to stimulate the development of improved technology and operating practices? What would be the social and environmental consequences of improved tunnelling technology and its implications for public policy?

Early in the planning for the Conference it was realised that a concerted effort would be needed to arrive at reliable and meaningful conclusions to these questions. The mechanism adopted by OECD took the form of an international inquiry involving a wide spectrum of the professions related to tunnelling in OECD countries — national and local agencies responsible for public works, consulting architect-engineer firms, contractors, equipment manufacturers, research institutes, laboratories and universities. The inquiry was conducted with the help of a detailed questionnaire which sought answers to three categories of information :

- Present-day inadequacies and needed improvements in the technology of tunnelling.
- Research and development related to tunnelling.
- Past and projected demand for tunnelling.

The questionnaire, prepared with the help of experts in various OECD countries, was distributed in April 1969. During the following eight months the locus of activity shifted to the participating countries where specially designated national representatives (or inter-agency task forces) took charge of distributing the questionnaire to qualified organisations, of collecting and analysing the individual replies, and preparing " country replies ". The resulting nineteen national replies, based on a total of more than 1,500 individual answers constitute one of the most ambitious and far-reaching surveys of its kind ever undertaken.

The data contained in these surveys will provide the basis for four major analyses, to be presented at the Conference.

Present-day inadequacies and needed improvements in the technologies of :

- Hard Rock Tunnelling
- Soft Ground Tunnelling
- Cut-and-Cover Construction
- Immersed Tunnel Construction.

The four reports are being prepared by rapporteurs from the United States, France, Germany and the Netherlands, respectively. Two additional reports — to be prepared by the Secretariat — will deal with the status of research and development and with past and projected demand for tunnelling (1960-69, 1970-71).

The primary objective of the Conference, of course, is that of providing *policy guidance* to governments. The six analytical reports are thus primarily a means to an end. The end product of the Conference will be a set of explicit recommendations identifying the technical strategies and possible changes in private and public incentives which might help to accelerate the development and application of improved tunnelling technology.

The Advisory Conference on Tunnelling probably represents the first attempt to carry out a technology assessment on an international scale. It can be viewed as a *positive assessment* in that its aim is to stimulate a lagging technology rather than to confine or restrict the development of an emerging technology. It is *directive assessment* in that its main purpose is to influence the rate and direction of technological change rather than just predict its most likely natural evolution. It is an assessment which focuses on the factors which *facilitate* the development and diffusion of a technology as well as on those that *constrain* its widespread use. Lastly, it is an *international assessment*, drawing on the combined knowledge and expertise of many countries in order to arrive at sounder, more balanced judgement about technological policy.

A related factor that influences planning decisions against underground construction is *surface disruption* associated with tunnelling. Although disruption is inevitable whatever type of construction is undertaken, the process of excavation and spoil disposal, as well as the long period of time required for completion of an underground structure, compound the problem of disruption and militate against underground development.

Still another set of factors that have impeded a more intensive use of the subsurface has had to do with the *nature of the excavation industry* — the planners, designers and contractors, and the manufacturers and suppliers of excavating equipment. By and large, the industry has been highly fragmented; it seldom commands detailed interest in or knowledge of the whole underground construction process. This has militated against development of an integrated attack to improve the entire process, and has reduced the ability to innovate in equipment and operating techniques.

Lastly, there are the *social acceptance* constraints — the sometimes deeply-held reservations of the public against underground working and travelling — which no sensitive planner can totally ignore.

The net result of all these constraints has been to limit severely the exploitation of the urban subsurface. Today, facilities are placed underground only when there is practically no alternative. When a choice is available, economic considerations alone will often suffice to swing the decision in favour of a surface facility.

Offsetting considerations

However, in view of the growing public concern about the environment, and the necessity to conserve urban land, to preserve open spaces, to relieve congestion and to improve the quality of urban living, strong public pressure is likely to develop in favour of placing more urban facilities underground, even if this can be done only at an increased economic cost.

In the light of these circumstances it is appropriate to ask : how can this latent demand for subsurface facilities be realised? How much could presently existing constraints on tunnelling be relaxed through better technology? What are the most serious deficiencies in the present state of the art and what research is needed to fill the gaps?

Organisation for Economic Co-operation and Development

OECD AT EXPO 70

OSAKA, Japan, March 15 - September 13

A Special Feature of

THE OECD OBSERVER


Netherlands
Portugal
Spain


経済力

At the invitation of the Japanese Government, OECD and 3 other international organisations, 77 national governments, 10 local and regional governments and 33 business enterprises are joining together to further the idea of "Progress and Harmony for Mankind", the theme of this year's World's Exposition. OECD's approach to this goal is to encourage international co-operation to enhance the standard of living and quality of life in both developed and developing countries.

Built alongside a large artificial lake, OECD's pavilion was designed by Lanfranco Bombelli Tiravanti of Barcelona and built by the Kajima Construction Co. of Tokyo. The Shoko Bijutsu Co. also of Tokyo, installed the interior. Modular in structure, the exhibit makes use of colour, photos, text and visual effects such as stroboscopic lights and magic mirrors to develop the ideas presented. In the main areas there are slide projections visually amplifying the themes, and in the centre of the exhibit area rises a free-standing model of a nuclear reactor provided by OECD's European Nuclear Energy Agency. Some of the main features of OECD's exhibit are shown on the following pages.

OECD Day, April 28th, commemorates the sixth anniversary of Japan's joining the Organisation. Ambassador Toru Haguiwara, Japanese Ambassador to France from 1961 to 1967, presided over the accession of Japan to OECD in 1964. He is now Commissioner General of the Japanese Government at Expo 70 and is to welcome OECD's Secretary General, Mr. Emile van Lennep, to the Exposition.

In connection with Expo 70 an essay contest was held by OECD with the co-sponsorship of the Japanese Branch of its Business and Advisory Committee (BIAC), the Japanese Ministry of Foreign Affairs and the Japan Economic Journal (Nihon Keizai Shimbum) for Japanese nationals of 18 to 35 years. The winning essays are those of Mr. Shoji and Mrs. Tomie Nakagawa, Mrs. Eiko Satsuma and Mr. Hiroto Nakayama writing respectively about Japan's Role in the Development of the World Economy, the Problems of the World Economy in the 1980's and Increasing Interdependence and International Economic Co-operation.

(Above) : *A fish-eye view of the main exhibit area of OECD's pavilion.*

The exhibit includes a display of OECD's most recent publications in English, French and Japanese and a projection room, in which two films — in Japanese and English — are shown at regular intervals. The first, entitled "Co-operation is our Business", is an explanation of OECD's aims and functions; the second, the prize-winning film, "Not Enough" points to the urgent need for public support of development assistance. This room is also being used for the lectures and discussion groups planned in connection with Expo 70.

(Extreme Left) : *The 9 OECD hostesses at the pavilion come from Japan and 4 other OECD Member countries — Austria, France, Ireland and the United Kingdom.*

(Left) : *James R. West, Director of Information and Commissioner General of OECD at Expo 70.*

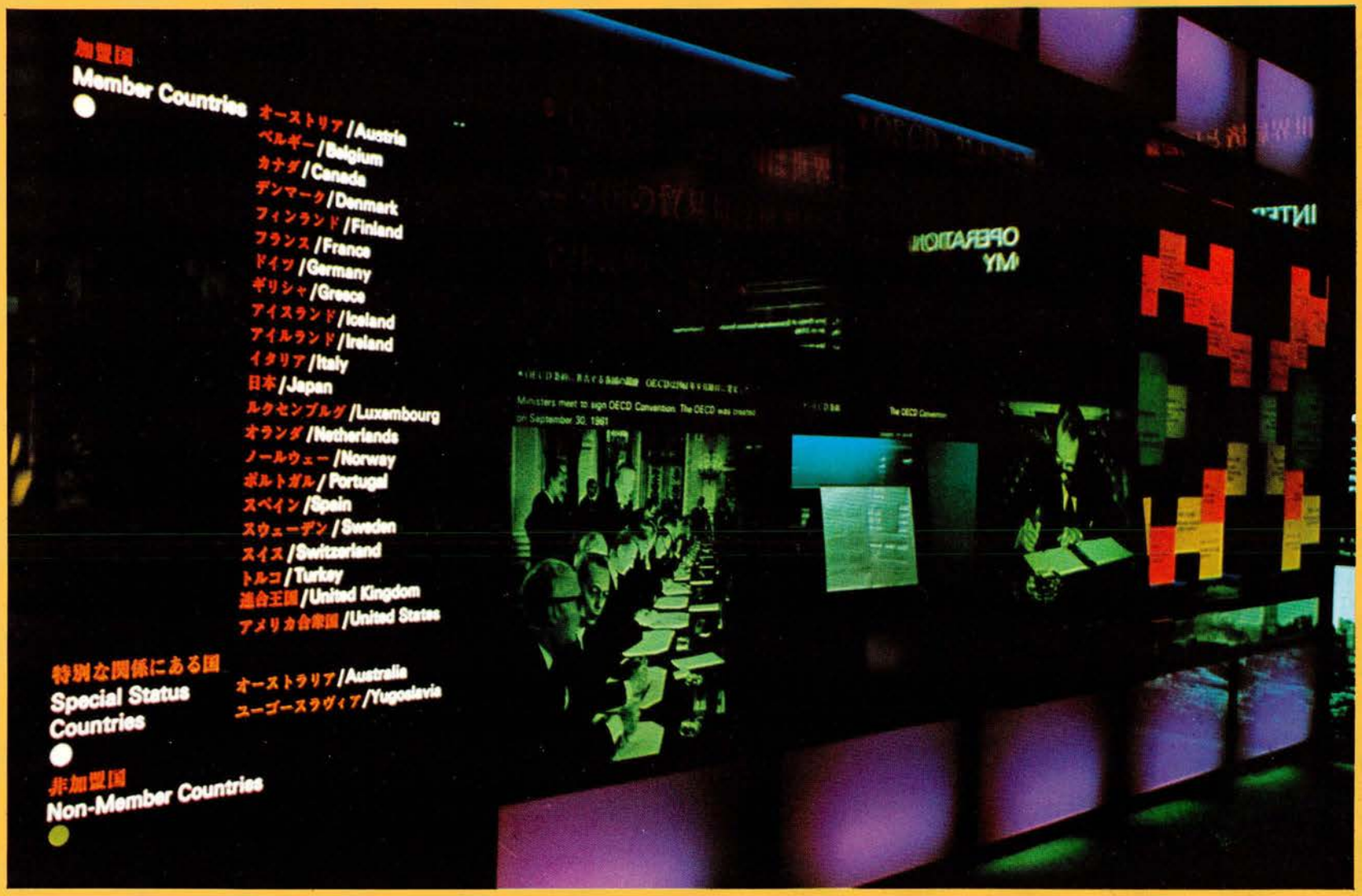
(Right) : *Projection room and library.*

OECD TODAY

The first exhibit area presents the basic facts about OECD and its objectives.

Progress and Harmony for Mankind

OECD's contribution is to encourage international economic co-operation.

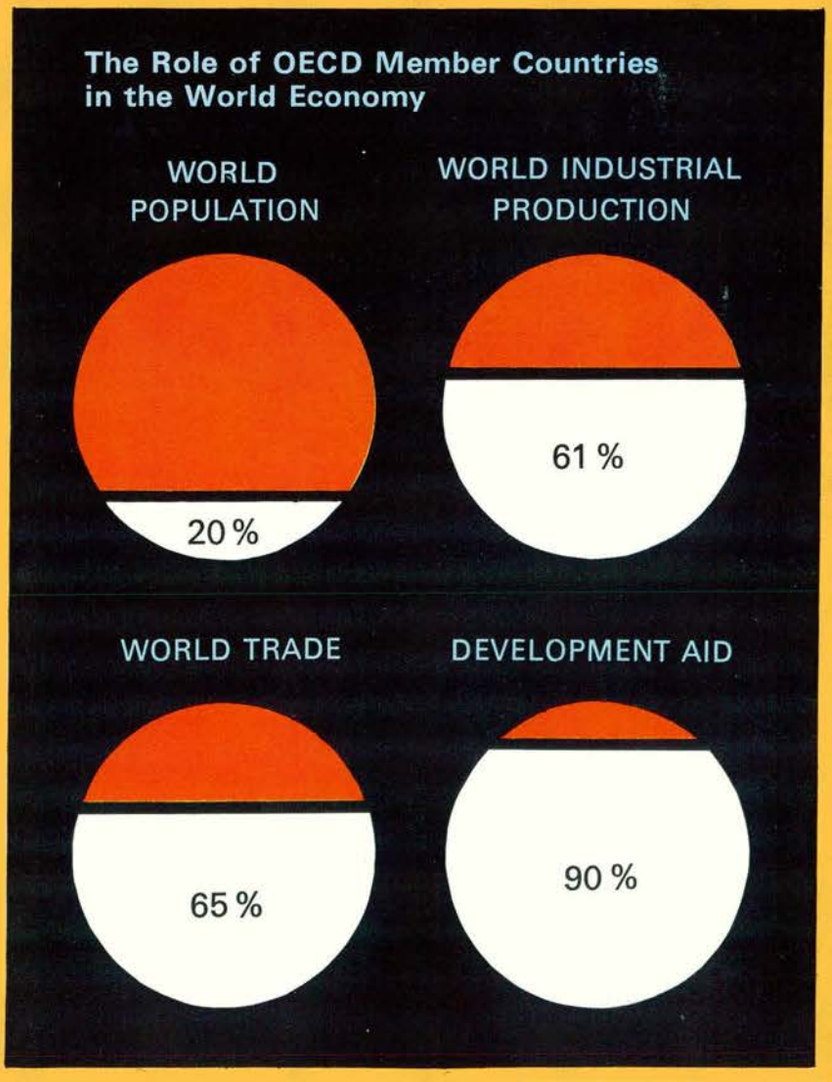


OECD aims :

- highest sustainable economic growth with financial stability and full employment in Member countries
- rising living standards
- expansion of world trade
- new approaches to the problems of modern society
- efficient co-operation with developing countries
- OECD represents 20 per cent of world's total population
- OECD countries produce 61 per cent of world's industrial goods
- OECD Members account for 65 per cent of world trade
- OECD countries contribute 90 per cent of all development assistance.

International Co-operation is indispensable to sustained economic expansion.

OECD provides a continuous forum for co-ordination of Member countries' economic policies.



INTERNATIONAL CO-OPERATION I

経済成長

economic growth

N A WORLD ECONOMY

After World War II Europe needed help in rebuilding its homes, factories and infrastructure.

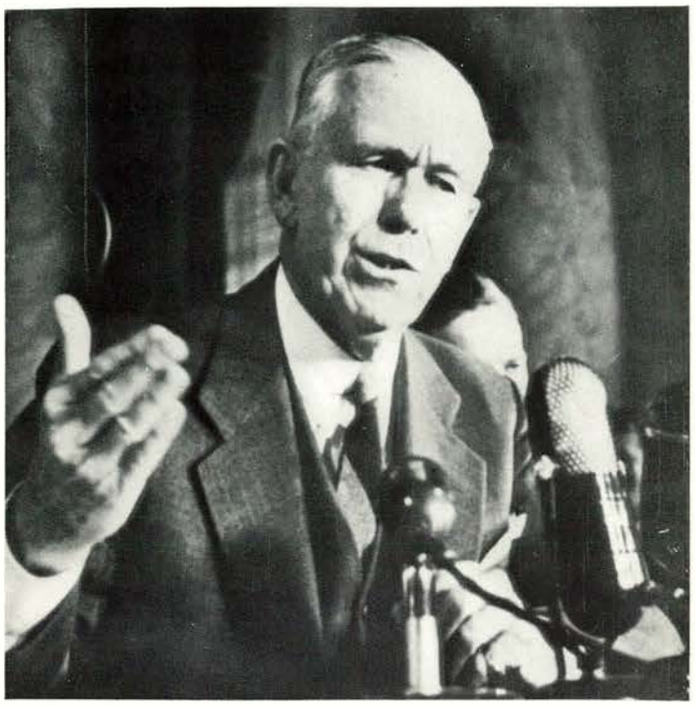
Assistance for European recovery was offered by the United States under the Marshall Plan on condition that European countries get together to allocate the funds by mutual agreement. In 1948 the Organisation for European Economic Co-operation was founded to undertake a co-operative recovery programme.

This task completed, the principle of economic co-operation was extended to deal with problems of further economic growth and development, and the United States and Canada joined the European OEEC countries to form OECD.

Japan became a Member in 1964 and Finland in 1969.

(Below) : *Ministers meet to sign OECD Convention.*

(Below, right) : *Ambassador Haguiwara signing Memorandum of Understanding for the Government of Japan.*



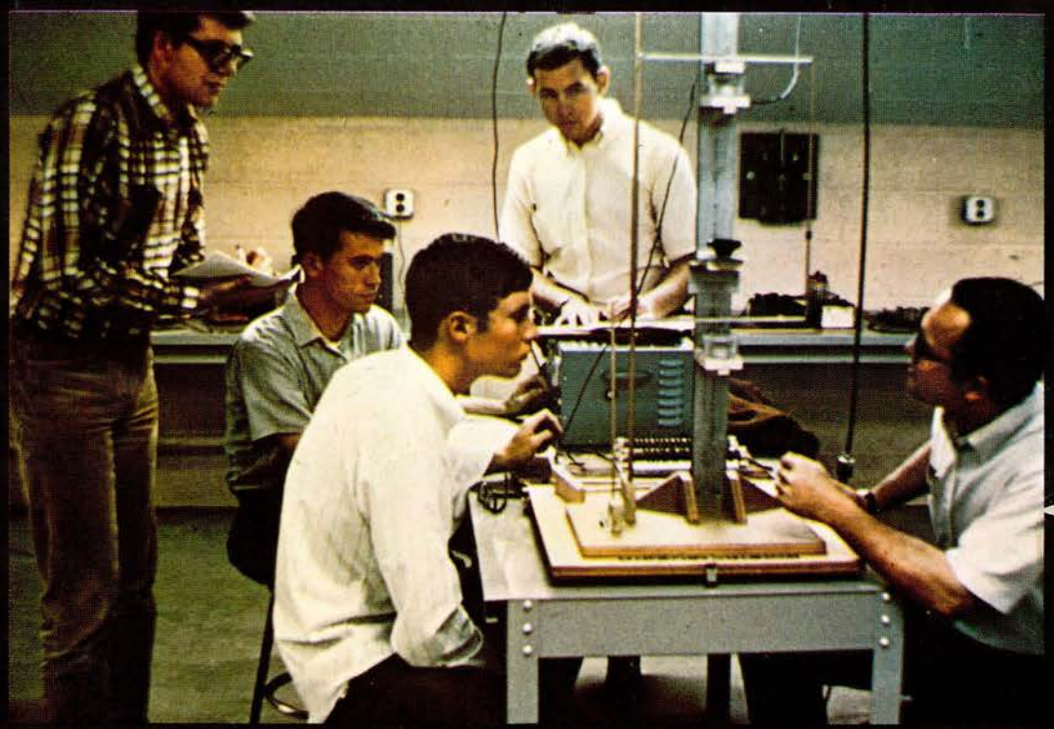
One of the first tasks of OECD was to set a target for economic growth in the 1960's — an increase of 50 per cent in the Gross National Product. This target has been reached. During the past ten years the average GNP of Member countries has increased by about 55 per cent. Japan, which was not a Member of OECD when the original target was formulated, shows a bigger percentage increase than any other country.

During the 70's the growth of the labour force in some countries will slow down, but if productivity continues to expand at the same rate as in the past 10 years, GNP may rise by about 65 per cent between 1970 and 1980.

Full Employment

OECD encourages Member countries to :

- *retrain* workers
- help the *handicapped*
- reduce *seasonal* unemployment
- create new jobs in *distressed* areas
- help people find their way to *better* jobs.



But OECD Countries have Faced Recurrent Problems :

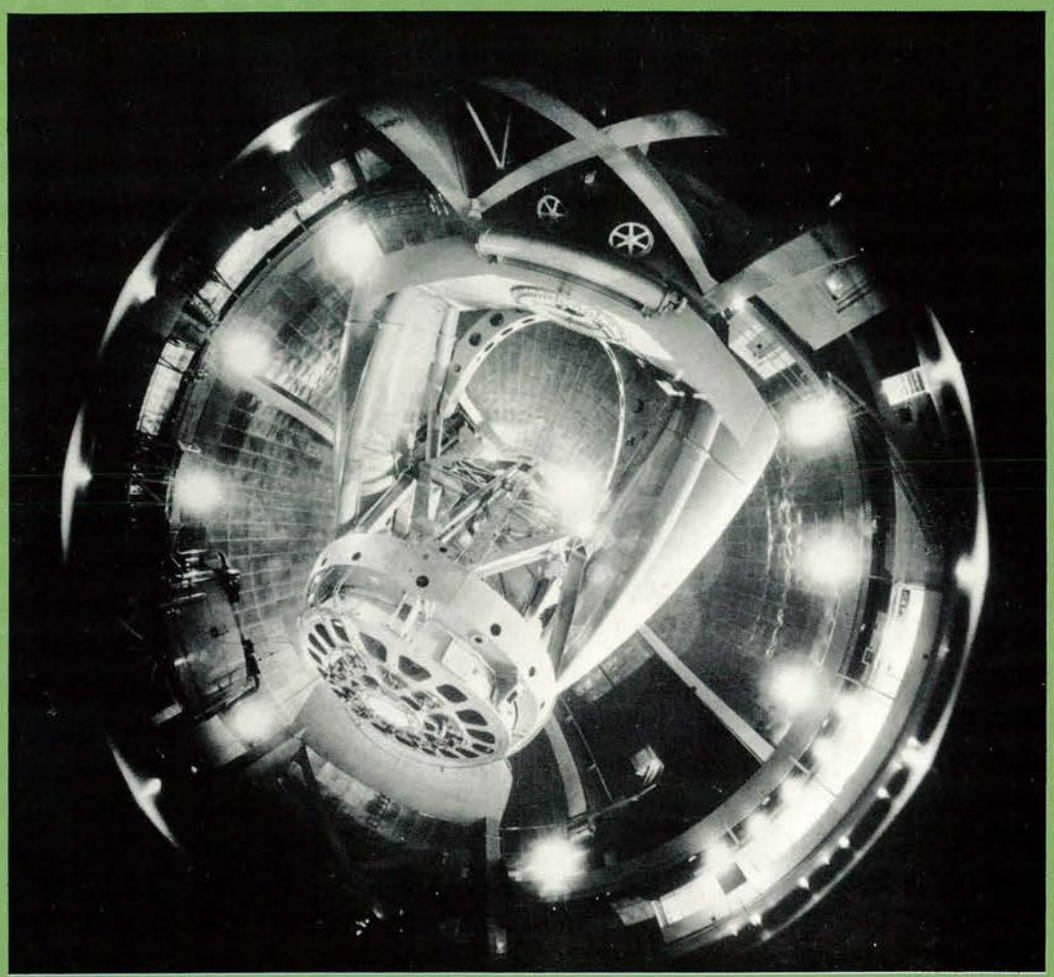
- rising prices
- balance of payments difficulties.

Member countries try to solve these problems in ways which will not harm their neighbours :

- increased use of fiscal policy • more flexible monetary policy • incomes policies • an active manpower policy.

(Below) : *The main conference room in OECD's new building at Paris headquarters.*

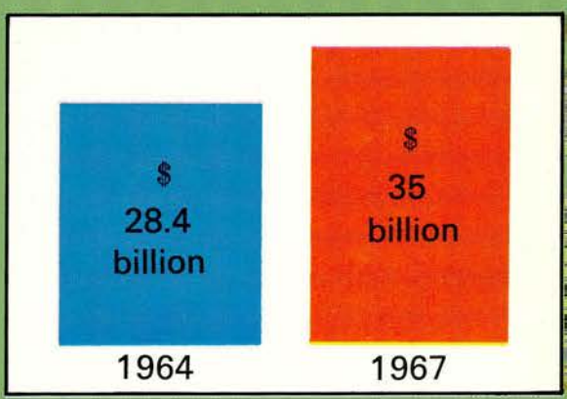
SCIENCE AND TECHNOLOGY



New technologies have contributed much to economic growth...

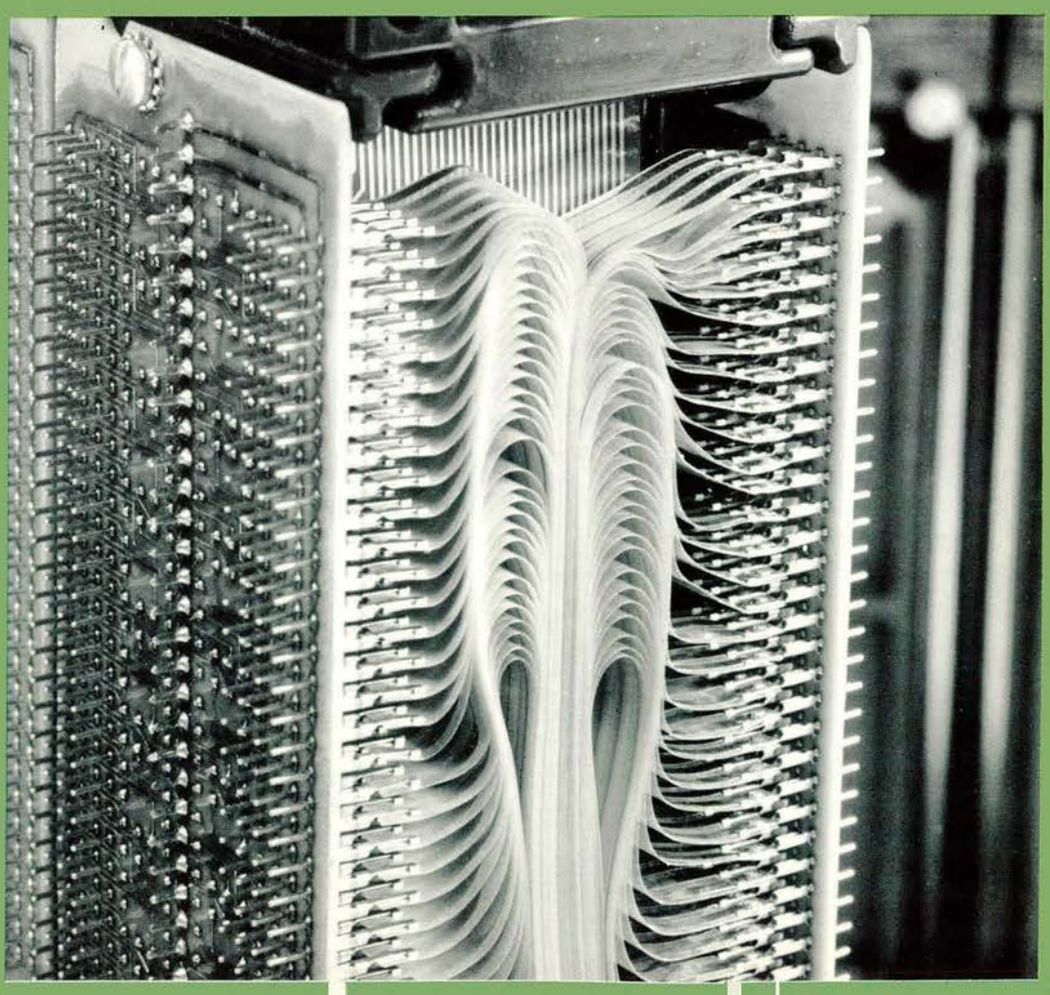
... and man's daily life.

- In 1964 OECD countries spent $28.4 billion on scientific research and development.
- By 1967 the outlay for the year had increased to $35 billion.



... this research provided the basis for new technologies.

- OECD sponsors Ministerial Meetings on science.
- OECD reviews the science policies of Member countries.
- OECD examines the role of science in overall economic policy.
- OECD studies ways to liberalise the transfer of technological know-how among Member countries. But one of OECD's major interests today is the impact of new technologies on man himself.



PROBLEMS OF A MODERN SOCIE

While nations moved from scarcity to abundance, progress also brought unwelcome changes :

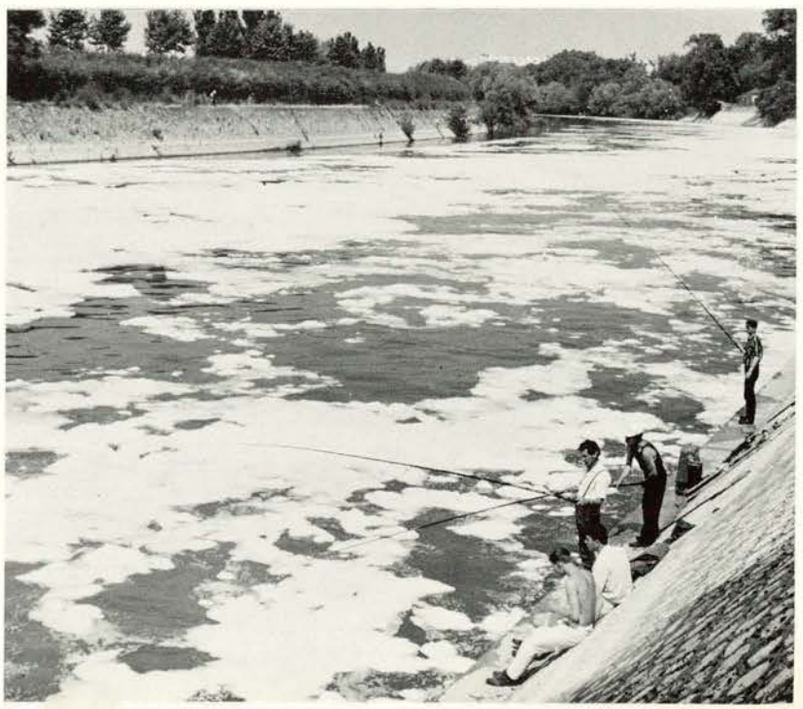
- congestion in man's urban environment
- pollution of air and water supplies.

These affect man's social and economic welfare.

*

Big City Congestion - Within 50 years 80 per cent of the people in OECD countries will live in cities.

This means a huge investment in new houses, hospitals, water supplies, waste disposal. And in roads for private and public transport. This means advance planning — now. Some countries spend as much



TY

as 15 per cent of their Gross National Product on transportation... But... costs are rising... and revenues declining.

Thus more people are using automobiles for transport.

Result : Noise... Pollution... Accidents... Waste of land... Problems in urban living.

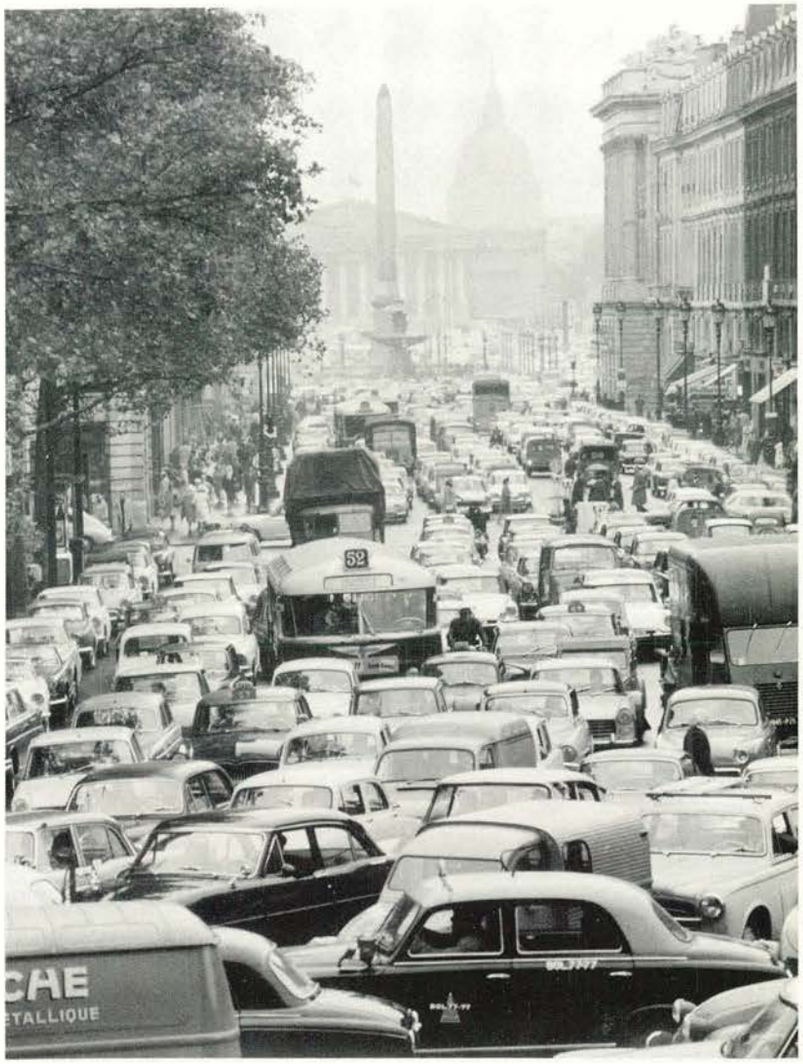
*

Air and Water Pollution - Can They Be Stopped ?

The main threat is to man's health — but its economic cost comes high as well.

Demand for water within the OECD area increases 5 per cent each year. The average person uses 36 gallons of water a day. It takes 200 tons of water to make one ton of steel. Yet supplies are limited and are being polluted.

Pollution knows no boundaries.



OECD is already tackling some of these problems through co-ordinated international research. In the 1970's more emphasis in all of OECD's work will be given to ensuring that economic growth is used to improve the quality of life.

(Left) : *A Japanese family enjoys a picnic.*
(Below) : *Crawley New Town in the United Kingdom.*

EDUCATION IN FERMENT

Man needs education for social progress and skills in a modern economy

The Problem of Quantity

• Demand for education has grown far beyond forecasts.

• Estimated increase in student enrolments in OECD countries :

The Problem of Quality

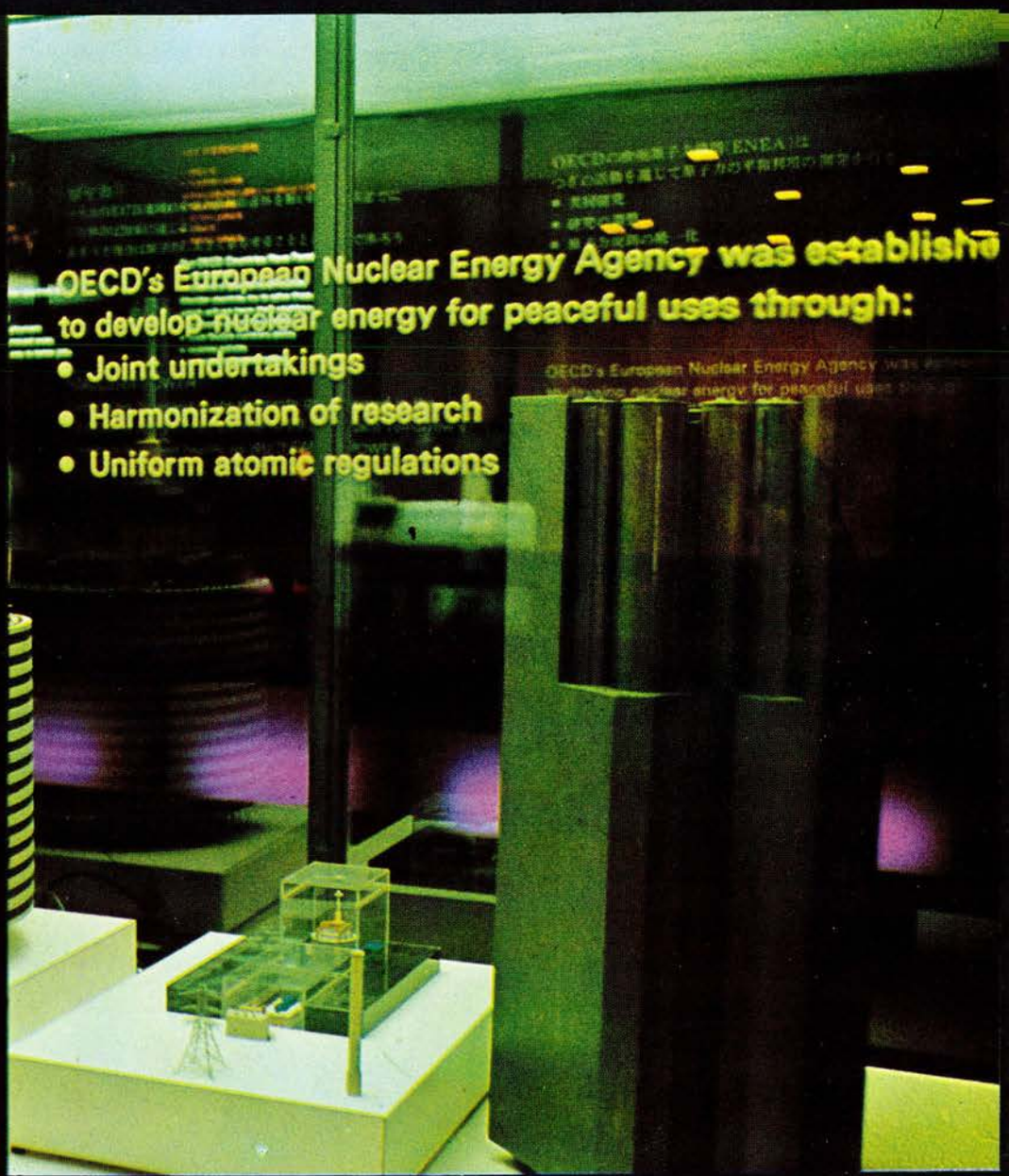
Today OECD is studying the new requirements of education :

- improved teaching methods
- curriculum reform
- better opportunities for disadvantaged groups
- new ideas on school structure, costs and management.

OECD helps the experts exchange views and pool experiences. Study workshops are held in conjunction with the OECD's Centre for Educational Research and Innovation (CERI).

NUCLEAR ENERGY

... contributes three per cent of the electricity generated in the OECD area... By 1980, this will be twenty per cent. Tomorrow's society will depend on nuclear power.



OECD's European Nuclear Energy Agency was set up to develop nuclear energy for peaceful uses through :

. . . Joint undertakings

. . . Harmonisation of research

. . . Uniform atomic regulations.

Included in the OECD exhibit at Expo 70 is a model of a Dragon-type high-temperature gas-cooled power reactor. This reactor represents a very successful case of international technological co-operation : twelve European countries have developed it together in a joint undertaking of OECD's European Nuclear Energy Agency, and it is one of the most advanced nuclear power reactors in the world. Over a period of 14 years some £40 million have been invested in the experiment which has now reached the application stage as several Member countries prepare to include Dragon-type reactors in their electric supply networks.

OECD AND THE DEVELOPING CO

Sixteen of the world's major aid-giving countries plus the Commission of the European Communities are Members of OECD's Development Assistance Committee (DAC).

Together they made available $111 billion to less-developed countries between 1957 and 1968.

*

DAC was created in 1961 to stimulate increased flows of aid to developing countries and make that assistance more effective.

DAC also :

- helps to improve terms of loans to developing countries
- surveys Member countries' aid programmes

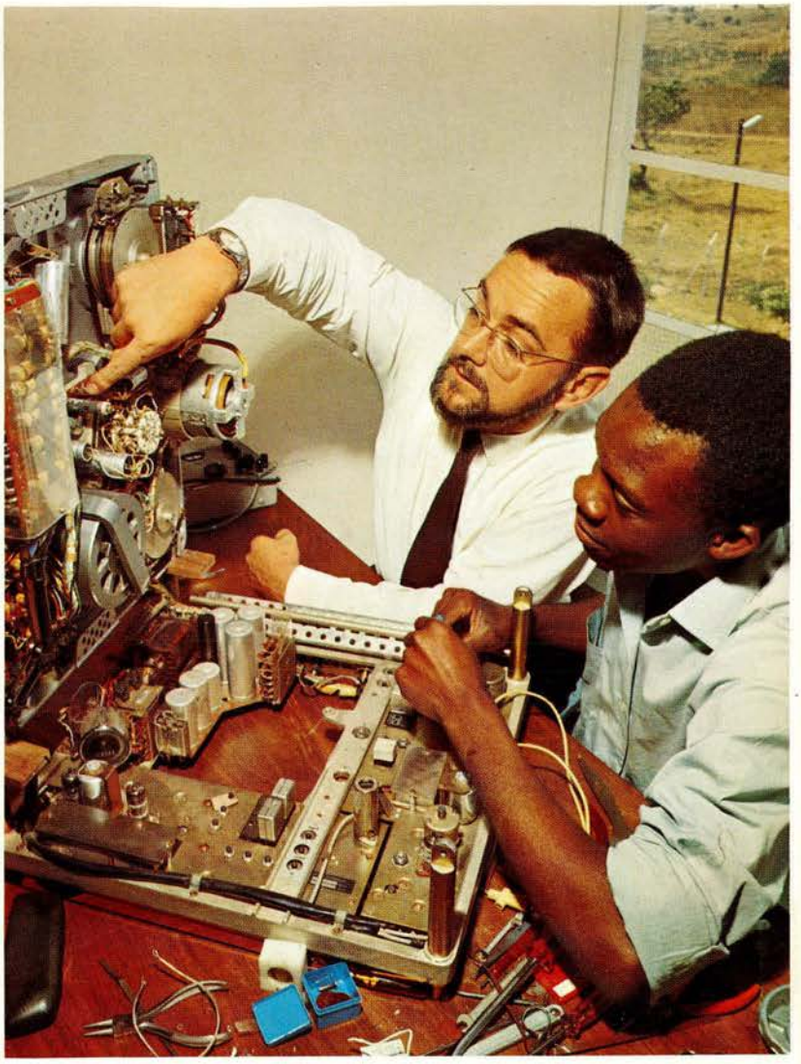
UNTRIES

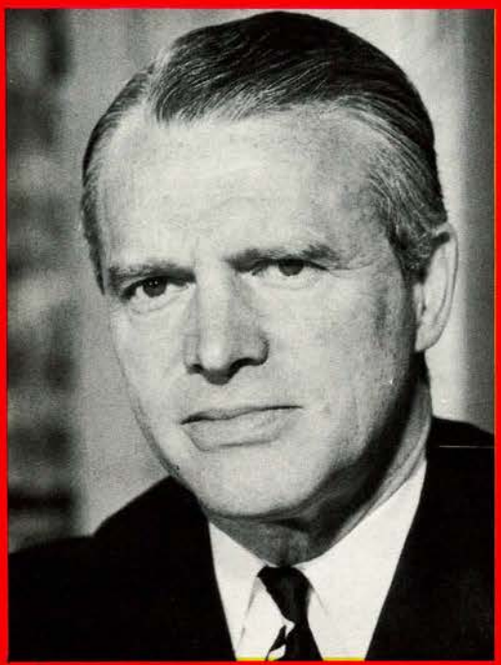
- publishes an Annual Review of Aid
- produces expert studies of the development process
- co-operates with the United Nations and its Second Development Decade.

The 61 major recipients of development assistance had an annual average growth rate of roughly 5 per cent during the 1960s.

This was about the same as that of the advanced countries, and it was higher than for any preceeding period.

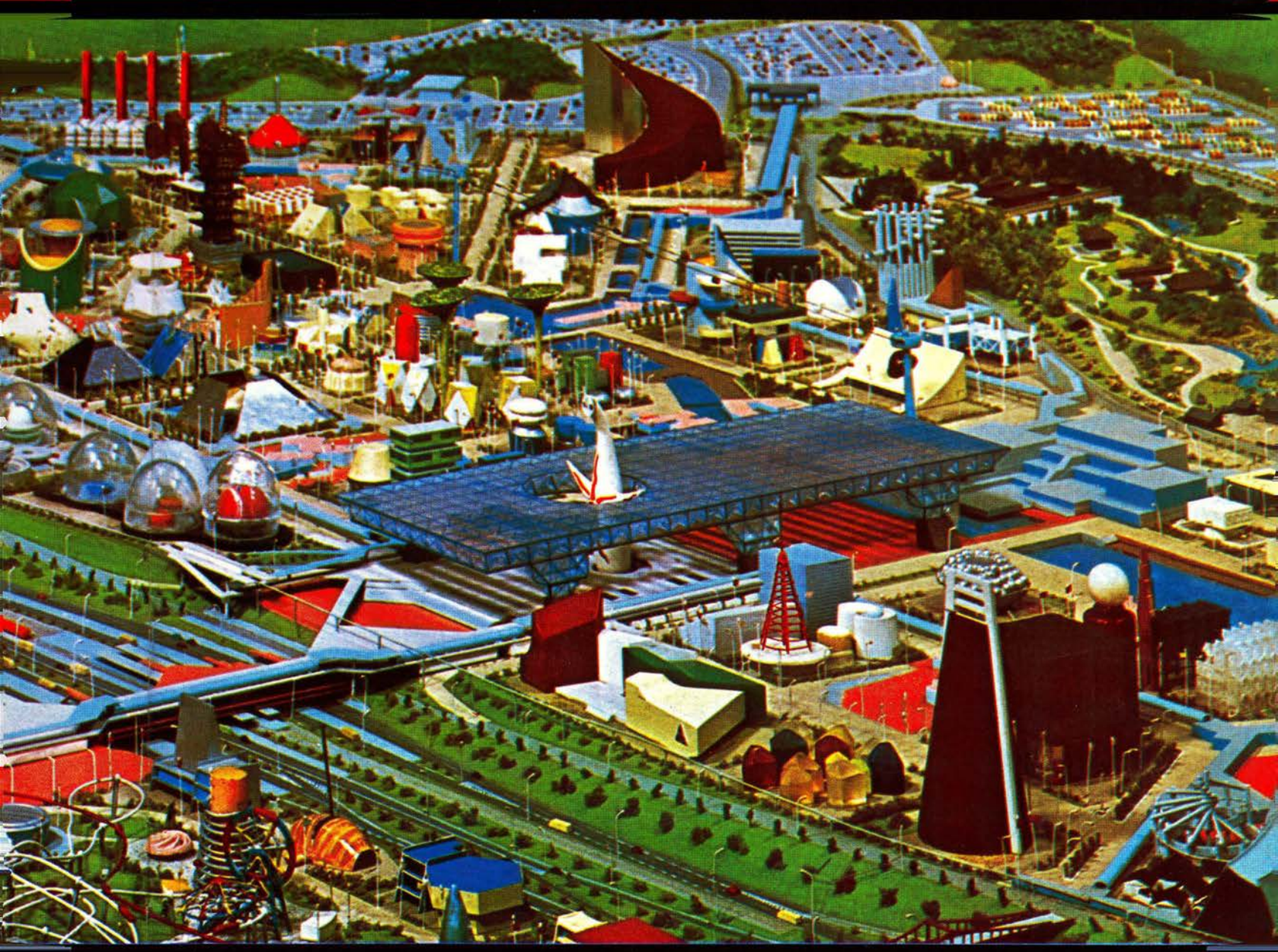
But in the developing countries rapid population growth absorbed about half the gains. Real per capita income increased by only 2 1/2 per cent a year.





The key word is CO-OPERATION. International Economic Co-operation is Necessary - OECD provides the instruments for it.

Emile van Lennep, Secretary-General



PHOTOS : Lanfranco Bombelli Tiravanti - Helga Romanoff (OECD) - Florita Botts (FAO) - Ken Gray (VISCOM) - Central Office of Information, London - Japan Broadcasting Corporation (NHK), Tokyo - Léo Jouan (OECD) - Dominique Berretti (OECD) - Jean Marie Michel (Rapho) - Emil Schulthess (Rapho) - Asahi Shimbun - F. Bibal (Unesco) - P. Almasy (Unesco) - IBM, Paris - USIS - EXPO 70.

RADIOACTIVE WASTE MANAGEMENT
principles determining disposal practices

By Ian Williams
Deputy Director General, European Nuclear Energy Agency (ENEA)

There is a growing tendency, particularly in newspapers, to talk of radioactive waste as though it is a single homogeneous commodity. In fact, the term covers a range of different materials to which very different considerations apply. All industrial processes give rise to waste products, but the problem is especially acute in the nuclear context because all wastes which may conceivably have become contaminated by radioactive materials must be treated as radioactive wastes. This means that virtually all materials in use in nuclear installations may, at one time or another, appear as radioactive wastes and the special factor of radioactivity means that considerably more sophisticated management techniques are necessary than are required in most other fields. Broadly speaking, the scale and range of radioactive waste disposal problems arising from the research and development stage has now stabilised, though this situation varies from country to country. What makes the subject of radioactive waste management of growing importance is the scale of the problems associated with the industrial stages of the nuclear fuel cycle, which will grow rapidly with the spread of nuclear power.

Before embarking on an assessment of particular radioactive waste problems, it is necessary to define the priority to be accorded to a number of general considerations. By " waste management " is meant handling, treatment and disposal; and the factors determining the approach to each of these aspects need to be clearly established.

The overriding consideration must always be the health and safety both of the staff called on to handle the wastes and of the general public. This requirement can be met by the rigorous application of standards derived from the recommendations of the International Commission on Radiological Protection — or ICRP. However, the circumstances will be rare when only one solution is possible to meet the required standards of health and safety. There will usually be a variety of possibilities, some better from the health and safety viewpoint than others, but all demonstrably within acceptable limits. The choice then becomes a matter of cost and convenience. There is no reason why these considerations should not be given prominence : what is important is that the relative priority of safety and costs should never become transposed.

Costs and convenience are factors having a particular bearing on the choice between alternative handling and treatment procedures. Perhaps the simplest example relates to combustible solid wastes. It is a simple matter of calculation to determine whether the volume reduction of perhaps 60 : 1 that can be achieved by incineration justifies, by reduced transport expenses, the costs of constructing and operating the specially designed incinerators required for processing radioactive wastes.

The second general principle of radioactive waste management must be responsibility to future generations. There is growing concern about the damage which modern industrial and other development is doing to man's environment and the extravagance

with which various sorts of nuisances and discomforts are being generated. The more obvious ones of air and water pollution have received plenty of publicity. It should be recognised that both of these are particular aspects of a wider question of general loss of amenity resulting from modern developments. In general, it is the current consequences which cause concern; but man's inability to accelerate the process of natural decay of radioactivity, which in some cases takes thousands of years, means that decisions on current radioactive waste management policies cannot be related only to the well-being of the present generation.

Two other general considerations must be emphasised. In most countries the problem of radioactive waste *disposal* has been controversial at one time or another and it has also provided material for lively international arguments. One of the regrettable consequences can be a tendency to adopt superficially more attractive procedures which are, in fact, less satisfactory by any objective standard. This can result, for example, from too strong a desire to avoid provoking vociferous protesters. Perhaps the second consideration follows from the first. The accumulated experience of dealing with radioactive wastes brings out clearly that the policy adopted in a particular situation must result from a complete evaluation of the circumstances of that particular situation. In other words, adopting a solution which is already being applied successfully elsewhere, though it may ease problems of public relations, will not necessarily be the best approach.

Evolution of Waste Management Systems

The fundamental question in any waste management system is whether all or part of the waste can be disposed of, and it is necessary first to define what is meant by " disposal ". Throughout this article the term is used in the sense that either all or part of the waste is dealt with in such a way that it is not the intention or would not be feasible subsequently to recover it. Consigning waste materials to the environment usually (but not always) therefore amounts to disposal in this sense. In certain cases, however, the risk of unintended recovery of the wastes may require continuing control of access to the disposal site.

Disposal may either have the object of using the environment (for example, the atmosphere or the ocean) to achieve dispersion and dilution; or alternatively it may have the opposite purpose of achieving virtual containment. An example of the latter might be disposal into geological strata in which the wastes are subsequently sealed off either by natural processes or by man's intervention.

It will be evident from this that practices involving consignment of waste to the environment in such a way that they may subsequently be recovered constitute storage rather than disposal. Storage is a legitimate practice when it may conceivably become worthwhile later to subject wastes to recovery processes (for example, when they contain materials for which a commercial demand may develop). Storage is also a reasonable device to take advantage of the natural rate of decay of radioactive materials so that their later disposal is greatly facilitated. On the other hand, storage becomes less reputable if it is used as a substitute for a considered disposal practice. In these circumstances, storage would mean bequeathing an unsolved problem to future generations.

Since the overriding consideration must be the health and safety both of the workers involved and of the general public, it is axiomatic that disposal of wastes into the environment must be governed by control levels with a substantial margin of safety. In fact, the determination of these levels is an extremely complex question involving the pooling of judgement by many professional disciplines. Moreover the diversity of characteristics of different radioisotopes, their behaviour in the environment and their potential effects on man mean that permissible discharges can vary considerably. The problem is therefore complicated when a mixture of isotopes is involved. Detailed analysis is often difficult, but usually sufficient is known to identify the most damaging of the constituents in a mixture and to derive the control procedure in relation to this constituent.

When *dispersal* in the environment is the desired immediate or ultimate objective, it is necessary to assess the relevance of two conflicting factors. On the one hand, the degree of dilution or dispersion which can be achieved (for example, by discharge of liquids into flowing water, or of gases into the atmosphere) may very quickly involve factors of several orders of magnitude. On the other hand, the environment may contain biological organisms with the capacity to take up discharged radioactivity and to re-concentrate it. This phenomenon is specific to the relationship between certain biological organisms and certain radioisotopes; and if these come together in the human food chain they may represent a very serious limiting factor on permissible discharge levels. In such cases, the eating habits of the most vulnerable group of the population concerned provide a factor in the chain of calculation.

Management of Gaseous Wastes

Turning now to the application of these considerations to particular types of radioactive waste, a brief mention should first be made of gaseous effluents which are associated with a variety of installations involving nuclear processes. The general principle must be that the plant involved must incorporate, at the design stage, devices such as filters to limit the discharge of gaseous effluents into the atmosphere to tolerable levels. The determination of these levels depends essentially on meteorological data, the nature of the terrain, and the extent to which the immediately surounding area is populated and used for agricultural purposes.

Routine monitoring of the environment (including sampling of soil, herbage and relevant agricultural products) should provide continuing assurance of the effectiveness of the control measures built into the plant. If the monitoring programme reveals unforeseen difficulties the remedy in an extreme case may have to be a slowdown or termination of operations

until modifications of the plant have been shown to be effective.

Management of Liquid and Solid Wastes: Some Common Factors

The problems of liquid and solid waste management are, of course, a great deal more complex. Although they differ in many respects, a number of considerations are common to both, notably those concerning which parts of the wastes may be discharged under properly controlled conditions into the environment.

This basic decision on the level of permissible discharges may be complicated by the consideration that, for example to allow for the factor of the natural decay of radioactivity, ultimate disposal may be postponed for an indefinite or predetermined period. The decision taken will also result from a choice between treatment methods in relation to potential disposal routes. A great variety of conclusions may be drawn but, to reduce this complexity to manageable proportions, an important starting point is the segregation of various types of waste as near as possible to their point of origin. The segregation practices adopted are essentially determined by the suitability of the various types of waste for further treatment or for immediate disposal and they necessarily involve assessing to an appropriate degree of accuracy the level of radioactivity contained in the wastes. Considerations of operational convenience and safety for handling and movement are also important.

Another important distinction to be made at an early stage in the establishment of a management system for liquid or solid wastes is between alpha (1) contaminated materials on the one hand and beta-gamma wastes on the other. Alpha active wastes require only secure containment for transport purposes whereas beta-gamma wastes must be transported in containers designed to provide adequate shielding from their penetrating radiations. Thus the cost penalty of transporting containers heavily weighted by shielding may limit the activity levels of beta-gamma wastes which may be disposed of at remote distances from their point of origin.

A second distinction between alpha and beta-gamma wastes is the extent to which advantage can be taken in their management of the phenomenon of natural decay. For example, for a typical make-up of mixed fission products of predominantly beta-gamma wastes, it has been found that only some 10 per cent of the original radioactivity is likely to remain after 25 years and only 1 per cent after 70 years. In the case of alpha active wastes, however, a principal constituent is often Plutonium for which the relevant nuclide has a half-life (2) of 24,000 years. Natural decay is not therefore usually useful in relation to alpha active wastes.

So far this article has been concerned with the factors governing the choice of waste management system. The particular problems of liquid and solid waste management respectively can most conveniently be illustrated by a few examples chosen to bring out the most significant points.

Disposal of Liquid Radioactive Wastes

In the category of liquid wastes, consideration must first be given to the special problem of the *highly active liquids* which emerge from the chemical reprocessing of irradiated fuels. These involve millions of Curies (3) in a relatively small volume. Concentrations of up to 10,000 Ci per litre are normal. Wastes in this category represent more than 99.9 per cent of the radioactivity in wastes produced by the nuclear industry, and they present very special problems of shielding, cooling and containment.

There is no question of consigning such wastes untreated to the environment. Handling and treatment procedures must be designed to facilitate the rigorous control which is necessary. Current practice in most cases involves concentration of the liquids to achieve volume reduction, followed by storage in cooled double containment. It is also necessary to maintain a careful watch on the external radiation field from the storage containers, and if necessary, to control the approach of people. Obviously, this is not a permanent solution to the problem of this type of waste, particularly with the growing volume which must be expected as nuclear power becomes widespread.

It is for this reason that intensive efforts are being devoted in many countries to finding alternative solutions. The most favoured approach is solidification, and progress has been achieved in developing techniques for conversion of these highly active liquids into glass-like or other solids which are virtually insoluble. This represents a considerable advance because handling of the wastes in solid form is easier and the risk of leakage is eliminated. However, the problem of

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(1) Alpha radiation *consists of positively charged particles identical with the nucleus of the helium atom (2 neutrons and 2 protons). Alpha radiation is the least penetrating of the three common sorts of radiation (Alpha, Beta, Gamma) and is not dangerous to living things unless the alpha-emitting substance is inhaled or ingested.*

Beta radiation *comprises either electrons (negatively charged) or positrons (positively charged). Beta particles are emitted during certain types of radioactive decay : they can cause skin burns, and beta emitters are harmful if inhaled or ingested.*

Gamma radiation *is penetrating, high-energy, very short wave electromagnetic radiation, similar in nature to X-rays, which is emitted during radioactive decay.*

(2) Half life *is the time taken for the activity of a radioactive substance to decay to half its original value, that is, for half the atoms present to disintegrate. Half lives mays vary from less than a millionth of a second to millions of years, according to the isotope and element concerned.*

(3) *Curie (Ci) is the basic unit used to describe the intensity of radioactivity in a sample of material. One Curie equals approximately the radioactivity of 1 gram of radium.*

shielding remains and such materials cannot be transported for great distances without a very considerable economic penalty. One of the advantages of conversion to the solid form, however, is that deep ground burial becomes an attractive disposal possibility. This is referred to later.

At the other extreme in the general category of liquid radioactive wastes are the *large volume low-level liquids*.These arise at a relatively small number of places during the industrial phases of the nuclear fuel cycle. They also arise in less significant quantities from more widespread sources such as decontamination facilities or laboratory processes. In each case, the general objective is to determine a disposal method for discharge into the environment as liquids. However, the actual technique adopted involves determining any treatment procedures necessary to make them acceptable for the feasible disposal routes.

For coastal installations a procedure which can be adopted is a pipeline through which the liquids are pumped into the sea. Perhaps one of the best documented examples of this is at the Windscale establishment in the United Kingdom, where for nearly 20 years such discharges have been made into a relatively shallow sea. This has been possible only after a comprehensive physical and marine biological investigation to assess the capacity of the sea to accept such discharges, and a continuous programme of related monitoring has been maintained to observe the dispersal of the radioactivity discharged. A popular holiday beach exists within only a few kilometres of the discharge point and it has been established beyond any doubt that no harmful effects have resulted there. In fact, the limiting factor on the discharge is the capacity of a certain edible seaweed to take up and concentrate Ruthenium 106. This seaweed is harvested for processing and consumption elsewhere and the eating habits of the people concerned have had a direct influence on the permitted discharge levels from Windscale.

The essential procedure when contemplating a pipeline disposal from a coastal site is to evaluate carefully such factors as tidal and current movements, the species and quantity of fish, shellfish or edible seaweeds harvested from the relevant part of the sea, the scale of their consumption, the relationship between the proposed discharge point and beaches used for leisure and the extent to which other marine activities, such as dredging, may be relevant. It may be found in some cases that the contamination of fishing gear such as nets is more significant as a limiting factor on discharge levels than the uptake of radioactivity by the fish which are caught for human consumption. In relation to the discharge, there is also the consideration that, quite apart from its radioactivity, its chemical and physical composition must be considered very carefully and account taken of any studies previously performed concerning discharge of industrial wastes.

In principle, similar factors are relevant if disposal into fresh water is contemplated, with the additional factor that fresh water normally has a considerably smaller volume and therefore more limited capacity to assimilate radioactivity without harmful consequences. Additional factors which are specially important in relation to fresh water disposals are the likely impact of thermal pollution (though there are well known examples where this has been beneficial); the extent to which the fresh water supply is used as a source of human or animal drinking water, for sensitive industrial purposes such as the manufacture or processing of photographic films, or for irrigation; and the potential effects of the composition of the waste discharged on the chemical quality of the receiving water.

An alternative possibility for low-level large-volume liquid radioactive wastes is discharge directly into the ground, usually into deep formations. Some interesting work has been done to demonstrate the feasibility of injecting low-level liquid wastes (for example in the form of a slurry or liquid concrete) under pressure into deep geological strata. These are then contained by the geological environment. However, if water movements indicate that sources used for human or animal consumption may be contaminated, this disposal method has to be avoided.

Disposal of Solid Radioactive Wastes

The major problem with solid radioactive wastes, a term which covers a very heterogeneous collection of possibilities, is more often their sheer volume than their level of radioactivity. Nevertheless, for purposes of control, it is necessary to assess, with reasonable accuracy, the level of radioactivity they contain. This can be done only if they are subjected to a strict management control to ensure that they are segregated according to their physical characteristics and range of activity, and in particular to ensure that unforeseen hazards are avoided.

The sort of basic consideration to be applied is the need to segregate combustible from non-combustible materials. In this connection, particular care is necessary in relation to plastics because polyvinylchloride (PVC), which may not be readily distinguishable from polyethylene, gives rise to difficult corrosion problems in incinerators. So far as possible alpha materials should be separated from beta-gamma, and particular care is necessary with any materials known to be either heavily contaminated or at a level of activity calling for special precautions in handling.

Subject to this, the first broad category of solid wastes to consider is the large volume of general laboratory and industrial trash. This includes, for example, a wide range of combustible materials such as paper, wood, fabric and some plastics, which may be only mildly contaminated, if at all, together with a whole range of mixed trash such as broken glassware, used filters, dismantled pipework, contaminated test rigs, dismantled glove boxes and so on. The first possibility which should always be considered for this category is *shallow burial*. Worked-out quarries are a possibility and also artificially constructed trenches into which such materials may be deposited in much the same way as domestic refuse. If such facilities can be found near the point of origin, this method of disposal is likely to be economically the most attractive.

There are, however, snags. The availability of

ENEA-sponsored waste disposal operation in the Deep Atlantic. Removal of lifting collars from waste drums before discharge.

suitable sites for shallow burial is essentially determined by the level of the water table, the direction of ground water movements and the potential routes by which the radioactivity involved could find its way to man or to animals. The geological nature of the land is therefore very important and if containment by impermeable strata can be achieved or (for example at coastal sites) the leaching can be shown to be into the sea, such disposal methods may be entirely feasible.

The disposal procedure has also to be acceptable from the aesthetic point of view, and usually this can be achieved more easily if responsibility is accepted for progressive restoration and landscaping of the surface. Nevertheless, during the period when such a site is being used for disposal, care must be taken to keep out scavenging animals and, according to the nature of the wastes, consideration must be given to the need to maintain controlled access after disposal operations have been completed.

It follows from this that the object with shallow burial should be, whenever possible, to return the land used without restrictions or delay. Given the decay rates for a normal make-up of mixed beta-gamma wastes, this need not be very long, but the inclusion

of long-lived alpha emitters would be an obstacle to removing access restrictions.

If shallow burial within a few kilometres of the point of origin of solid wastes is not practicable, the possibility of the same procedures at more remote sites introduces the significant additional factor of transport costs. In view of this, treatment methods such as incineration (which can give a volume reduction of as much as 60 : 1) or baling (which can achieve something between 6 and 10 : 1) are worth considering to offset transport costs. On the other hand, once the facilities required to apply these methods have been introduced, other possible disposal methods can also come into the reckoning.

An alternative method of land burial, which is growing in popularity where suitable facilities exist, involves the *deposit of wastes in deep situations* such as worked-out mines. Essentially the same considerations apply and the dominant influence of ground water movements again asserts itself. Ideally, deep burial sites should provide geologically sure containment such as would be offered by impermeable rock structures. Salt or gypsum mines are particularly attractive.

Procedures can be evolved by which the wastes become contained and virtually inaccessible at the position where they are consigned to the ground. Alternatively, long-term storage (by which is meant continued accessibility) can also be achieved in deep burial sites. This approach is particularly attractive for more highly active materials, to which recovery processes may be applied at some future date or for which the factor of decay before ultimate disposal can be taken into account. As a matter of practical convenience, the deposit of waste at deep burial sites will normally have to be preceded by treatment and packaging to facilitate transport and handling. For this reason, the techniques already mentioned for achieving significant volume reduction should always be considered.

Particularly troublesome problems may require the construction of *artificial* sites. The construction in the ground of burial holes has been practised in many countries to provide fairly long-term storage for individual items which are particularly awkward to deal with by other means. This applies, for example, to relatively small but highly active items with beta-gamma contamination, where the problems of transport, at least before a cooling period, would be formidable.

All these methods of ground disposal are valuable when available but, in certain countries, the combination of geology, geography and population distribution may make them either extremely difficult or even impossible. It is for this reason that the alternative of *disposal of contained solid wastes in the deep ocean* has attracted many countries which recognise the tremendous capacity of the sea as an environment for the disposal of radioactive wastes. The suitability of the sea and of the particular areas to be considered must equally be the subject of detailed investigations in each particular case; but against the standards which have evolved for controlling coastal discharge of liquid effluents the dumping of packaged solid radioactive wastes into the deep ocean is demonstrably an acceptable procedure.

When approaching the problem of choosing a suitable disposal area, it is as well first to consider a number of essentially operational requirements which are themselves severely limiting. For example, there must be no chance of waste containers being recovered by processes such as trawling, and this leads to the conclusion that the area considered should have a depth of at least 2,000 metres and be well clear of the Continental Shelf. Next, the area must be free from known undersea cables. It should also be suitable for the convenient conduct of the dumping operation, particularly to avoid unreasonable financial penalties by unnecessarily long steaming distances. In the interests of respect for control, the area should avoid undue navigational difficulties and the operation should be undertaken to avoid adverse weather conditions.

Subject to these operational factors, both the general area of the ocean and, to the extent to which it is relevant, the specific area chosen for disposal should be subjected to meticulous investigation from both the physical and the marine biological points of view and the results related to standards of radiation protection derived from the recommendations of ICRP. Such an investigation was undertaken under the auspices of ENEA in connection with an operation organised in 1967 and upon which a report has been published. (1)

Packaging, transport and disposal into the deep ocean of solid radioactive wastes also involves complex economic factors which need very careful assessment. The design and construction of the containers used, the means to be employed for inland transport, their handling, stowage and disposal at sea, all induce the adoption of treatment methods to achieve volume reduction. However, since volume reduction implies a concentration of the radioactivity, the consequence for shielding must also be given careful thought. To improve the level of security, the process of incorporating solids or sludges in bitumen or concrete is also important.

Ocean disposal of packaged solid radioactive wastes has been particularly controversial from time to time, but its justification, both from the safety and from the economic points of view, has been demonstrated by ENEA's work. It is not always the right answer, and in particular it is bound to be relatively costly compared with land disposal, when this is possible. However, ocean disposal deserves objective consideration, together with all other possibilities, not least because this method of disposal under properly controlled conditions involves adding only insignificantly to the radioactivity already naturally present in the sea.

* * *

Radioactive waste management, which is an inevitable associate of nuclear development, has been approached with a sense of considerable responsibility and the accumulated experience in many countries is the best guide to the solution of new problems emerging. Waste management systems designed in future will always be better received if they can be shown to be continuing the tradition that nuclear development has been pursued with meticulous consideration both for the public health and for man's environment.

(1) *Radioactive Waste Disposal Operation into the Atlantic*, 1967, *OECD, September* 1968.

RESEARCH INTO NEW FORMS OF WORK ORGANISATION

A new type of international collaboration is being inaugurated under the auspices of OECD's Manpower and Social Affairs Directorate in which representatives of management and labour from several countries will visit another OECD Member country to study how some particular economic or social problem of common interest is being tackled. The programme, still experimental in nature, is being carried out in co-operation with OECD's Business and Industry Advisory Committee (BIAC) and its Trade Union Advisory Committee (TUAC).
The first subject accepted by BIAC and TUAC for this programme was new methods of involving workers in decision-making at the level of the work place ; the country chosen was Norway where comprehensive experiments in this field have been going on since the early 1960's. Two trade union and two management representatives from each of four countries - Austria, Belgium, Germany and Sweden - participated. The following article by Franz Stendenbach of OECD's Social Affairs Division, who organised the group visit, describes the Norwegian experience and some other research in this area.

At the beginning of the 1960's, when there was considerable concern in Norway about whether the country was making optimal use of its manpower resources, Norwegian unions and employers, in co-operation with the Government and with the help of a group of researchers from London's Tavistock Institute and Oslo's Work Research Institute, began experiments to see whether new forms of work organisation at the level of the workplace could help to improve work involvement and satisfaction, worker-management relations, potential for adjustment and also productivity.

Under the sponsorship of a joint committee set up by the Norwegian Confederation of Employers (NAF) and the Norwegian Trade Union Congress (LO) four firms were selected from the metal and chemical sectors of industry, considered by the Committee as strategic to the economy. These test cases were conceived of as demonstration projects, the results of which might be further diffused in Norwegian industry.

Several approaches have been taken in experiments with new forms of work organisation, some concentrating on job enlargement or job rotation, others simply on improving the skills of the individual worker so that he can perform a wider variety of tasks. In the Norwegian case the method chosen was creation of a " semi-autonomous work group ", i.e. a group which is given more scope for organising its own work than it had previously had.

As a first step in this action-oriented research a team was set up in each department where the experiment was to be carried out, composed of the department head and representatives of operators, foremen, technical staff and the personnel department; these joint groups themselves elaborated the new organisation with the help of social science research workers from the London and Oslo Institutes.

Under the new structure each group could make its own decisions within an enlarged sphere about the organisation and implementation of the work, without consulting those higher up in the organisation's hierarchy. Although the exact form of organisation varied from one group to another to take account of differing technological and other conditions, the new structures had certain characteristics in common :

- The operators were given additional training so that they would be able to perform several jobs and to alternate between different occupational roles with in the group. In one department employees were enabled to handle four different jobs on average, and to change jobs at least once a day.
- All operators were kept continuously informed about the current status of the work being carried out by the group so as to be able immediately to detect breakdowns

and make necessary corrections in the work process.

- A repairman was made permanently available so that repairs could be carried out without bureaucratic procedures and consequent loss of time.
- The members of the autonomous groups met periodically so that they could discuss progress among themselves and establish an informal communications network.
- The foreman was prepared for a change in the nature of his work so that, as the group members took over more of the decision making, he would turn his attention away from detailed supervision, directing his efforts instead to coordinating the work of his group with that of others in the same or another department.
- The wage determination system was modified so as to reflect and stimulate improvements in output without disrupting the company's wage structure.

The Hypothesis and its Background

The hypothesis being tested in the four Norwegian firms was that the semi-autonomous group, by increasing a worker's chance to exert more control over his job, can release commitment and initiative that are often absent in traditional industrial hierarchies; to the extent that his involvement and work satisfaction increase, his alienation to work diminishes and he can adjust more rapidly to new situations; these conditions in turn favour an increase in productivity.

A number of experiments had already been carried out in other countries to test similar assumptions, beginning with the well-known Hawthorne human relations experiments in the 1930's in which the organisation structure was altered in the direction of more self determination, not as an end in itself but as a means of assuring the co-operation of the workers : the change was found to result in greater identification with company goals, an enhanced social status for the individual worker in his own perception; these factors in turn were found to increase work satisfaction and output.

Of the various experiments planned since to further explore this finding one of the best known and most rigorous was carried out in the late 1940's, in a US garment factory in Virginia (the Harwood Co.) by sociologists Lester Coch and John R.P. French (1) : it was intended to find methods of reducing resistance to the introduction of new production techniques among the company's predominantly (80 per cent) female and young (23 years average) labour force. Coch and French set up four types of groups — one, the control group, in which change was introduced in the traditional way so that results could be compared with those of the experimental structures; in this control group the production department of the factory unilaterally modified the job, set a new rate, and informed the workers of the need for the change as well as the nature of the new rates. In the three other groups the workers participated both in implementing the job changes and setting the new rates.

The researchers found that increase in output during the first 40 days after the introduction of the technological change was directly proportional to the degree of participation : in the control group there was found to be a deliberate restriction of output and a fall in productivity and morale, hostility against supervision and a quit rate of 17 per cent. In the participation groups, on the contrary, relearning was rapid, no hostility against supervision was evident, and no quits were reported.

After a period of time what remained of the control group was again subjected to change but this time given more say in the process. The results were in sharp contrast to those of the first experiment when change had been introduced in the traditional manner.

The Norwegian Results

In Norway the results of the experiment are considered by the diverse groups involved generally to bear out the original hypothesis. With one exception which is attributed to inadequate preparation in setting up the experiment, all four companies report increased satisfaction with their work on the part of employees. Greater responsibility and self determination are considered to be operative factors; better distribution of work over the shift, more contacts between workers and a reported feeling that " time passes more quickly " have also been noted. Productivity also increased in the experimental groups, in one case by 20 per cent during the experimental period and by another 10 per cent during the following year. A statistical quality control on finished products showed that quality had improved and the need for repairs become less frequent. These improvements, incorporated into a " bonus factor ", amounted to 11 per cent.

The Norwegian Employers' Federation views this experience with semi-autonomous work groups favourably, though the fact that it is still in an experimental stage precludes a final judgment. The Chairman of the Federation, Lars Aarvig, stresses particularly the improvement in attitudes and the spirit of co-operation rather than strict measurements of productivity. The Trade Union Congress has been somewhat hesitant in its preliminary judgment, but in 1969 the two groups agreed to introduce further experiments in eight other Norwegian companies. The Government has taken an increasing interest in this work and now bears the largest part of the costs involved.

The trade union and management members of OECD's study group, in summarising the lessons of the Norwegian visit, concluded unanimously that " the Norwegian experiments represent an important contribution on the way towards the realisation of democracy at the workplace ".

Other Experience

Other more limited experiments in this area are now underway in the Netherlands (Dutch Post and Telegraph under the direction of sociologist Hans van Beinum), in Canada (Eric Trist at Alcan), in the United Kindgom (Railway Workshop in Swindon under Michael Foster of the Tavistock Institute) and in the United States (at the University of Michigan under Professor Rensis Likert, at the University of California at Los Angeles under Louis Davis, and at the Harvard Business School). A great number of Swedish firms have asked for assistance from a joint research centre of industry and trade unions to carry out pilot applications of the Norwegian system.

The results of this research, in so far as they are already available, are nearly uniform as to increases in work satisfaction. They are less so with respect to productivity gains : in one large-scale experiment carried out by the Survey Research Centre of the University of Michigan, productivity increased more in a group from which decision-making power was withdrawn than in one for which this power was systematically increased. The latter group, however, showed a statistically significant gain in work satisfaction — with their supervisors at all levels, with the company, with their jobs and with opportunities for self fulfilment — whereas the more rigidly controlled group tended to be less satisfied in all these respects and had a turnover rate that was eight times higher. Professor Likert, who directed the research, suggests the possibility that forces may be building up in the more controlled group which would ultimately reduce its high productivity while the improved social organisation of the second group may lead to better overall results in the long run.

Future research may show whether or not this is the case. It may also reveal more about *how* work organisation affects the productive process, directly or through some " intervening variables ", and it may clarify the conditions necessary for such forms of work organisation to make their maximum contribution to job satisfaction, productivity and labour-management relations generally. OECD's Manpower and Social Affairs Directorate will devote more attention to these experiments in future.

(1) Coch, Lester, and French, John R.P. Jr., " Overcoming Resistance to Change ", Human Relations, 1948.

REGIONAL DEVELOPMENT AND ECONOMIC GROWTH

In order that the experience of individual OECD Member countries in the field of regional development might benefit all the others, the Industry Committee has undertaken to review the relevant national policies of the various countries. The Working Party responsible for this survey has dealt primarily with the economic aspects of regional development in the context of national economic policy.

The Working Party's report, to be published under the title "The Regional Factor in Economic Development: Policies in Fifteen Industrialised OECD countries" (1), analyses the background and techniques used in OECD Member countries. The following article spells out some of the facts appearing in the report and certain conclusions reached by the experts.

(1) Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Luxembourg, Netherlands, Norway, Sweden, United Kingdom and United States.

No economically advanced country is without its regional problems. In one, 40 per cent of the population contribute but one-fourth of national income; in another, early industrialisation based on coal production has created an urgent need for redevelopment of large areas; in yet another the country's capital accounts for 35 per cent of the total population; depressed areas may be still further handicapped by " dead frontiers " with the countries of Eastern Europe, while elsewhere special climatic conditions result in highly dispersed types of settlement.

The economic plight of depressed areas is commonly reflected by two main indicators : high unemployment and low incomes. In terms of scale and nature the problems are not the same for all countries, and the measures to be chosen vary accordingly. A distinction must be made between several main types of region.

Underdeveloped regions have a number of characteristics in common. Industrialisation is limited, agriculture no longer suffices as a source of livelihood, while emigration is heavy, especially among the young. Hence fresh difficulties arise in providing the remaining population with a standard of services comparable to that in other parts of the country. The decline in incomes and population creates a vicious circle of dwindling local official revenues accompanied by deterioration of the regional environment and shrinking private investment.

The absence of centres of sufficient size and drawing power is often partly responsible for underdevelopment. Regions exhibiting the symptoms include the vast, sparsely populated areas of Northern Europe (parts of Finland, Norway and Sweden), the mountain areas of Western Austria and Switzerland, most of the Mezzogiorno, the Belgian Campine and the Ardennes, parts of Western France and the Deep South in the United States.

Undeveloped regions are largely similar but call for different measures; these are mainly found in Northern Canada.

Redevelopment areas are marked by a high proportion of declining, stagnant or monolithic industries. The younger and better skilled elements of the population tend to leave; wages and employment patterns are below average. Many of these regions, which were industrialised in the nineteenth century, have outmoded, inadequate infrastructure and social overhead capital, which makes them unattractive to modern manufacturing and service industries. Such areas may decline or fail to grow at the average rate for the country. When national demand slows down, they are first to feel its effects, and serious unemployment results. Such areas are found in many parts of the British Isles, in Pennsylvania and the New England states, in Belgium, France and the Netherlands.

The problem of affluence

A problem of quite another kind, one often encountered in OECD countries and calling for distinctly different remedial measures, arises in densely populated urban areas. Classic examples are the great conurbations of London, Paris and Tokyo, but there are many other areas, such as the Randstad in the Netherlands, Copenhagen, the centres of many cities in North America, where the congestion following upon prosperity saddles the community with rapidly rising costs.

Here the need for co-ordinated physical plan-

ning is apparent. The experts thus consider that to overstrain resources in one part of the country must inevitably have repercussions in other parts. One effect is the uneconomic use of manpower resources elsewhere in the country combined with an outworn urban structure. Another effect is the great attraction exerted by densely populated areas, which drain people from rural and especially from outlying zones. This is a pattern which typically occurs in Norway and Sweden.

Regional policy is not therefore concerned with depressed areas alone. Regional problems arise when there is an upsurge in population growth (as in the Netherlands) a marked imbalance in the geographical distribution of population and in economic activity (as in Germany), or simply in case of increased affluence. Relevant instances are the increase in built-up acreage per inhabitant noted in a number of countries and the growth of motorisation, calling for heavy investment in motorway and road construction.

A final point is that in border areas regional problems acquire an international character, as in many areas where political barriers cut through geographical entities. One such example is Luxembourg : although small in area, it consists of three separate types of region bound by close economic ties to three neighbouring countries. In such instances the international harmonisation of regional policies becomes an essential step. Similar problems arise, sometimes even more acutely, in such federated types of country as Canada and the United States.

The regional as opposed to the national context

Each country seeks a solution to its regional problems by applying a regional development policy formulated in accordance with its own political, constitutional, economic and social requirements. The Industry Committee's Working Party thus notes that the general purpose in regional policy is to smooth the rate of development between various geographic areas of a country as its overall economy progresses. The goal may thus be a better balanced growth of regional GDP, personal incomes, population, employment, etc.

Another important objective of regional policy is to create the conditions which will enable all regions to help the entire nation progress in proportion to the resources of all types that they possess. Thus while regional policy's main purpose is to benefit depressed or backward areas or regions in which redevelopment problems are especially acute, another of its concerns is to take steps which will enable each and every area to maximise its contribution to nation-wide prosperity.

Two broad aspects of regional policy may therefore be distinguished. First are the objectives and measures applying to regions with such special problems as the conversion of outmoded industrial structures; the industrialisation of hitherto exclusively agricultural regions; housing and employment for an expanding population; and the renewal of obsolete infrastructure. The scale or pace in dealing with these problems will differ according to the region.

The second aspect concerns objectives and measures largely relevant to the country as a whole. Included are those long since a component part of policy in most OECD Member countries but originally designed for implementation on a different geographical scale.

In other words the term " regional development " frequently covers quite a few traditional government activities formerly administered through some central agency but now handled lower down the geographical scale. The expression also designates other traditional activities which used to rest with a purely local government authority but which now come under some higher agency or regional body. " Regionalism " is thus often apt to imply a geographical reallocation of responsibility for largely traditional government tasks, as in the matter of education, health, culture, agriculture and tourism.

" Regional development " and other similar terms, even when used in connection with activities conducted on behalf of all regions but at a new geographical level, nevertheless connote somewhat more than the longer-established forms of government responsibility, in that consideration of the overall economic and social climate of some particular region is implied.

The trend towards administrative consolidation

In this age of rapid technological growth, marked by undertakings of all kinds conducted on an ever larger scale and by the constantly greater desire of the people from all parts of a country to share in the fruits of material and social progress, a belief held by several countries is that local administrative systems must urgently be recast. This means in many cases that the large numbers of local authorities whose boundaries are based on historic divisions must be amalgamated to form larger adminstrative units capable of planning for much wider areas.

At central government level a large number of agencies and departments, because of the nature of their functions (for example : civil engineering, industry, transport, housing, education), have certain planning and executive responsibilities where regional policy is concerned. But in many other countries the need has been felt for a central body with overall responsibility for the strategic planning and co-ordination of separate regional policy measures.

Such a body is able to exert continuous, comprehensive action on regional development, which can be tied in with the more general objectives of national planning. Several countries have carried this co-ordinated approach a stage further by setting up central financial institutions for funding regional development programmes (as the Cassa per il Mezzogiorno in Italy). *(continued on page 42)*

Various approaches to the same end

The means used to implement regional policy are many and varied. They may consist in promoting public works and infrastructure, of technical assistance or planning aids, manpower training, retraining and mobility aids, and of financial or other inducements to encourage industry in designated areas or sometimes to restrict the development of congested regions where the pressure on manpower and other resources has become too great.

The emphasis placed on some particular measure varies from country to country according to the problems encountered and to such local conditions as the degree of reliance placed on direct economic incentives, on controls or on the improvement of infrastructure and human resources. In all countries regional policy and planning extends to both public and private sectors, and measures designed to improve infrastructure are combined with others to influence the siting and growth of industry. The experience of Member countries suggests that no one type of measure is sufficient in itself to achieve these several objectives.

While the countries examined recognise the importance of suitable industrial siting policies, these are based to a varying extent on one of two main trends, which consist in either encouraging industry to move into areas of unemployment and underemployment or instead in promoting the industrial growth of areas to which people migrate.

The assistance which entrepreneurs receive to offset the disadvantages of settling in developing rather than congested areas may take the form of grants, loans, interest subsidies or fiscal concessions, which vary in amount, terms and conditions from country to country. The location of industry is moreover controlled with varying degrees of severity.

The experience of several countries shows that to be effective industrial aid schemes must be well publicised and continuous. Overfrequent changes in geographical coverage or in the rates and terms which are granted may introduce an element of uncertainty which can hinder investment planning, siting decisions and smooth economic expansion in those areas which the facilities are designed to assist over the long term.

In summing up, the Working Party notes that methods vary considerably in scope and effectiveness. Whereas in some cases they are beginning to have some impact, in others they have not yet gone beyond the initial stage. In a number of countries the gap between less-favoured areas and the rest of the country, especially as regards living standards and growth prospects, is still quite considerable. Productivity is much lower owing to unsatisfactory economic structures. Too many people are employed in unprofitable agricultural and craft activities and in declining industries. This means that, in conjunction with the policies for overall growth to which all OECD countries have subscribed, special policies of regional scope will continue to be necessary and will often be intensified in the years to come.

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