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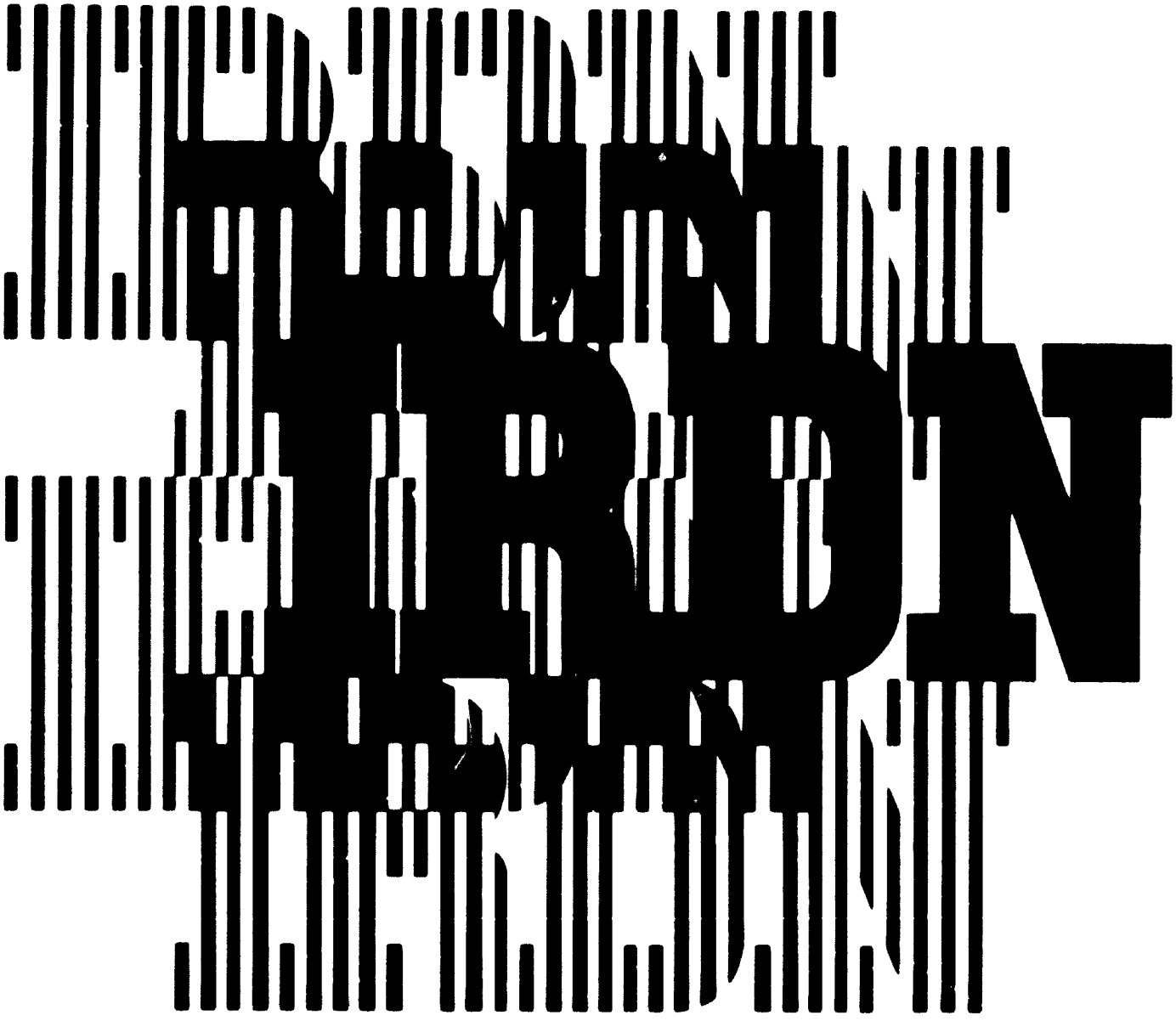
# Industrial Research and Development News

VOL. VI No. 2

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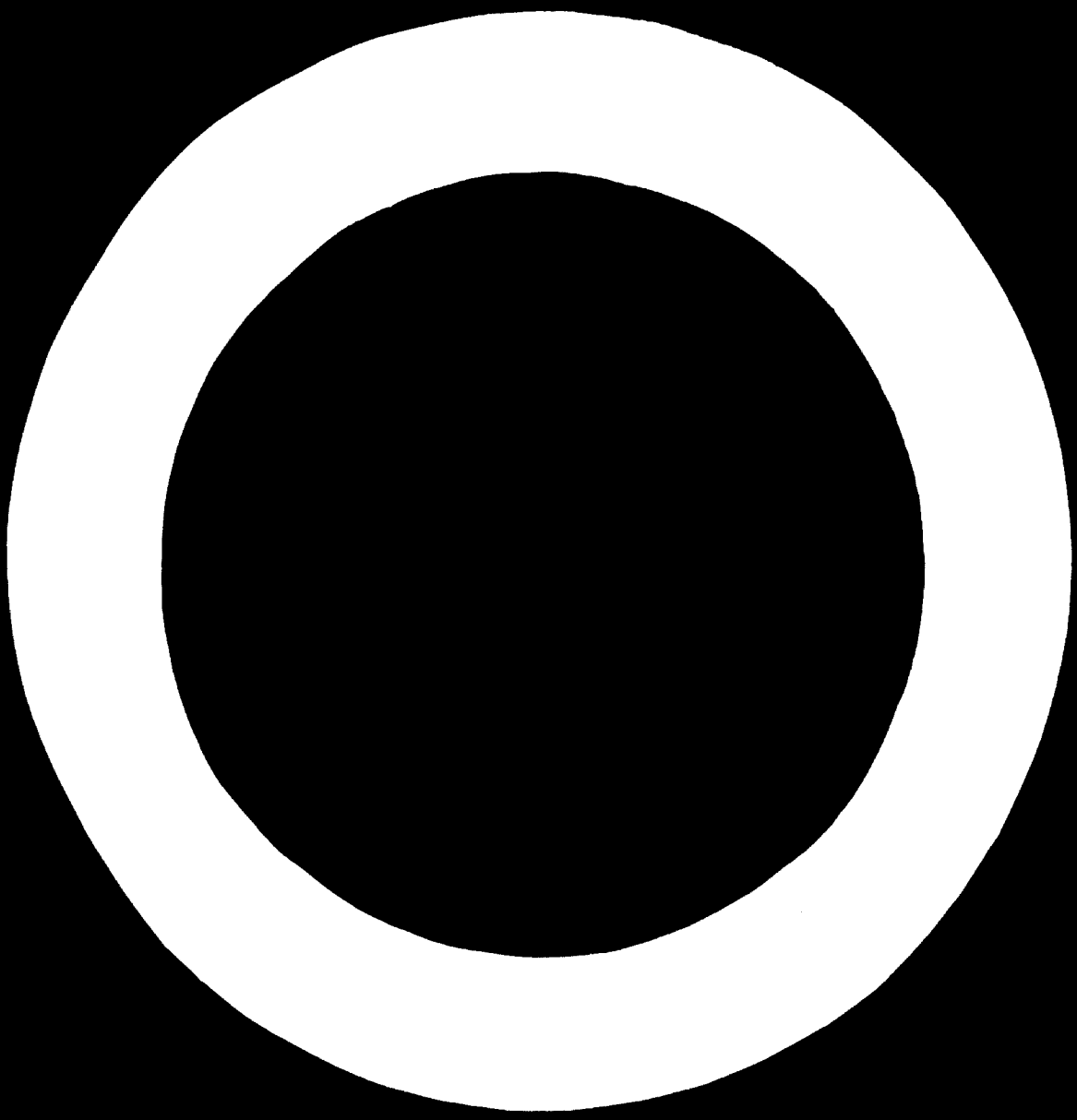

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# Industrial Research and Development News

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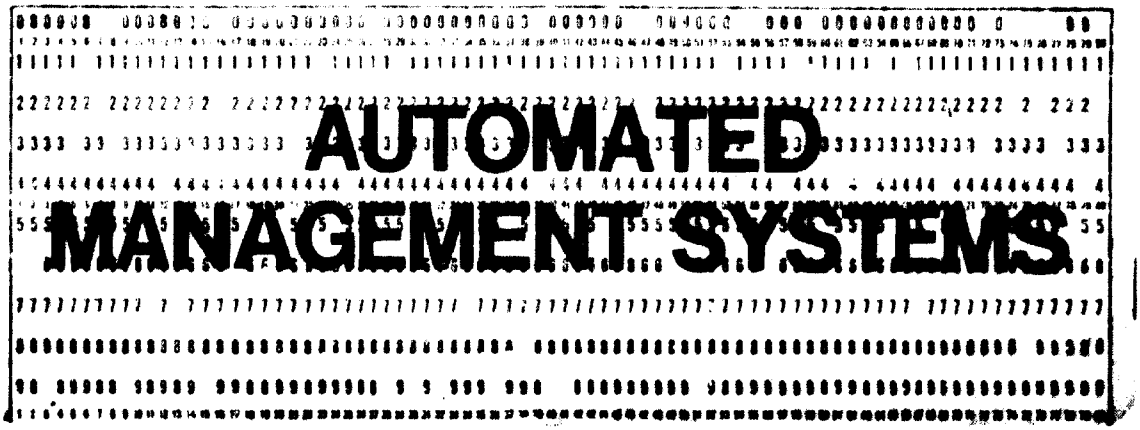



by M. A. Bermant, A. A. Modin, L. K. Semenov
and V. N. Sulitskii

One of the determining factors in the economic, scientific and technical development of a country is the availability of local skilled personnel. It is particularly important to have personnel qualified in the new fields of science that are opening up. One such field is automated management. Lack of personnel qualified to plan and operate an Automated Management System (AMS) can hinder the effective use of computers and the introduction of automation to management in various sectors of the economy.

However, before a country can successfully introduce an AMS it must have some means of forecasting the number of experts that will be required for its operation and of formulating a policy for their training.

The Central Mathematical Economics Institute of the Academy of Sciences of the USSR has developed a mathematical model that provides the answers to both these requirements. The model is divided into two stages: in the first stage the number of qualified personnel required – based on the expected growth of technology and science in the particular field – is determined; the second stage indicates the measures that should be taken to train this personnel.

### *First stage*

Curve IV in figure 1 shows the expected growth rate of new AMS over the period covered by the curve. The number of specialists required is determined by comparing a certain base with the curves representing the sets of conditions possible. [1] Curve I shows the growth of intake into higher educational institutions. Curves II and III show, respectively, the growth of intake into upgrading courses and advanced systems-analysis courses. On the basis of experience gained in the preparation and operation of trial AMS in various sectors of the USSR economy, it was found possible to break the personnel structure down into four categories, according to level of qualification:

*Project managers.* The project manager is an economist or engineer highly skilled in systems analysis who has the responsibility for organizing and carrying through an AMS project for a particular economic unit.

*Deputy project managers.* The deputy project manager is also an economist or engineer, but less highly qualified in systems analysis. He is responsible for organizing and carrying through a part ("sub-system") of an AMS project.

*Sub-system managers.* The sub-system manager performs a specific function in the planning of certain sectors of the AMS. He must have a good knowledge of programming and analysis (data processing and information flow) and specializes in planning and organizing the following:

Production
Material supplies
Marketing
Personnel and salaries
Subsidiary production
Data processing and information systems
Mathematical services
Technical services
Electronic and computer systems

*Operational staff.* The operational staff is composed of specialists with academic qualifications who carry out specific tasks under the supervision of the sub-system managers.

The following specialists are needed to prepare an AMS:

| | |
|---|---|
| Project manager: | 1 |
| Deputy project managers: | 3 |
| Sub-system managers: | 10 |
| Operational staff: | 10 |

This list does not include less qualified personnel such as technicians, programmers and service staff.

### *Second stage*

The second stage of the model is based on a system of recurrent ratios. The most important factor in this calculation is the internal dynamics of the personnel structure. This means the movement of specialists from one level of skill to another, as shown in the block diagram (figure 2). The blocks represent the various categories of specialist: 1-operational staff; 3-sub-system managers; 5-deputy project managers; 6-project managers. Blocks 0, 2 and 4 represent higher educational institutions, upgrading courses, and advanced courses for systems analysis, respectively.

Each block in the system may be filled externally (arrows pointing towards blocks 1–6 of the system) or from the personnel training system (arrows from blocks 0, 2 and 4, respectively, to blocks 1, 3, 5 and 6).

Specialists move from one level of skill to another (excluding blocks 5 and 6) only through the personnel training system. Trainees can be brought into this system (blocks 2 and 4) either from outside (arrows from outside the system to blocks 2 and 4) or from within the system itself (arrows from block 1 to block 2 and from block 3 to block 4).

The following assumptions are made with respect to the movement of specialists from one block to another within a given personnel training system:

*(a)* Operational staff may enter the upgrading courses after having carried out practical AMS project work for not less than $K_1$ years;

*(b)* Upon completion of six-month upgrading courses, the trainees move to block 3;

*(c)* Sub-system managers may enter advanced courses for systems analysts after not less than $K_2$ years of practical experience in mathematical economics and the use of computers in production management;

*(d)* Upon completion of one-year courses, the trainees are distributed between blocks 5 and 6;

*(e)* The specialists in block 5 may move to block 6 after not less than $K_3$ years of practical experience as deputy project managers;

*(f)* The period for preparation of an AMS project is five years;

*(g)* The period of study in a higher educational establishment is five years;

*(h)* Upon completion of the preparation of one AMS project, the operational staff (block 1) either move on to the planning of a new AMS project, or continue operating the old one (arrows from block 1 to block 8);

*(i)* In the course of each year of the planning period, specialists drop out of each block of the system. These "drop-outs" are indicated by arrows from the blocks to a point outside the system, equivalent to moving to a fictitious block 7.

The following symbols are used in the model:

$x_{i*}^{n}$ = planning target for the number of specialists in block $i$ at the beginning of year $n$.

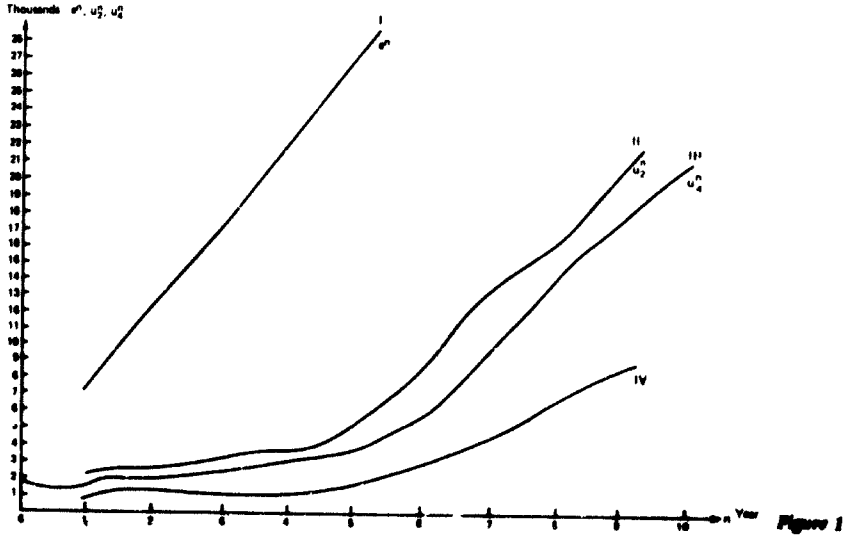
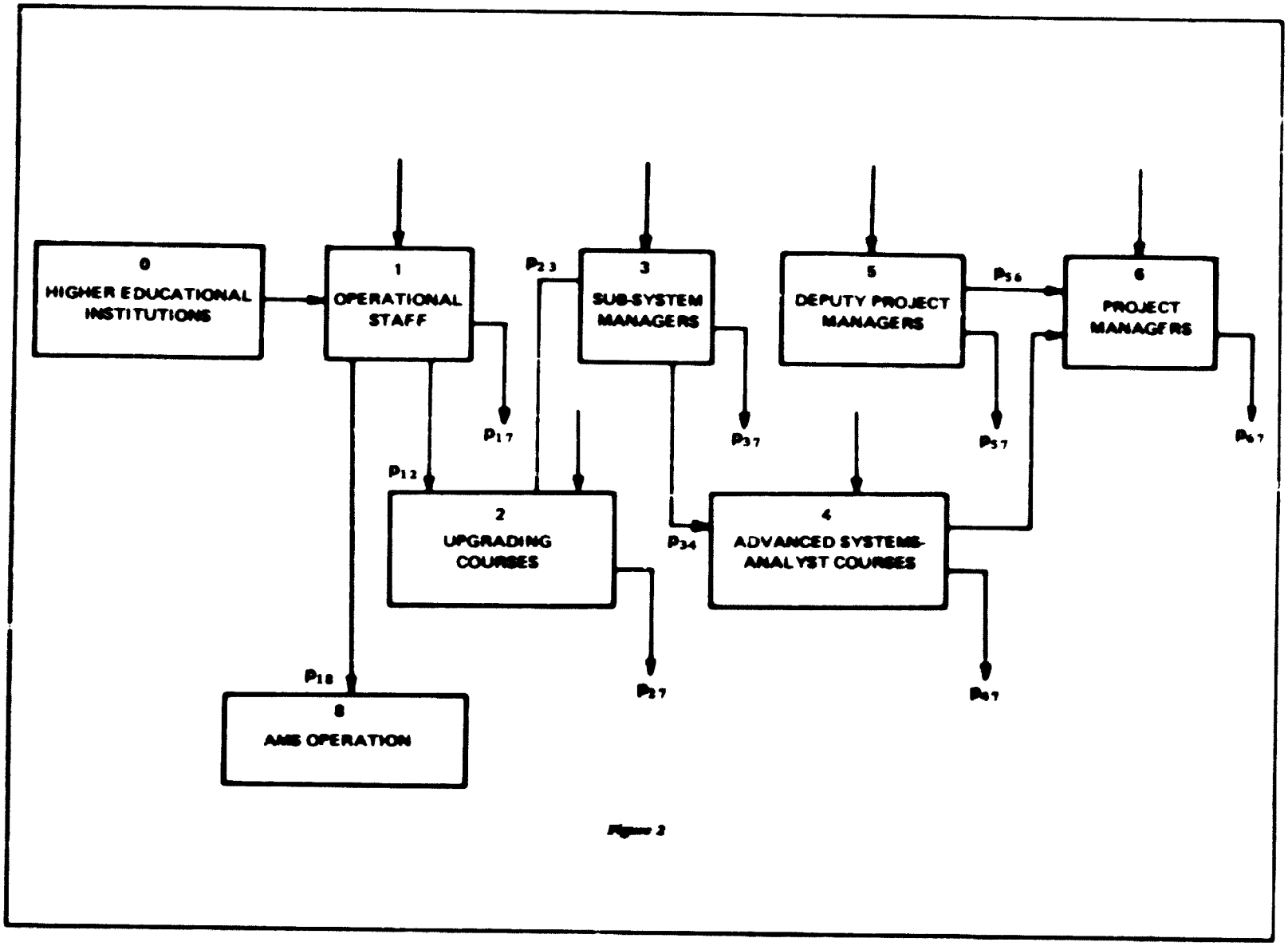



Figure 1


0
HIGHER EDUCATIONAL INSTITUTIONS
1
OPERATIONAL STAFF
2
UPGRADING COURSES
3
SUB-SYSTEM MANAGERS
4
ADVANCED SYSTEMS-ANALYST COURSES
5
DEPUTY PROJECT MANAGERS
6
PROJECT MANAGERS
8
AMS OPERATION
P12
P17
P18
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P34
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P47
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P67

*Figure 2*

$p_{ij}$ $(i=1, \ldots, 8;\ j=1, \ldots, 8)$ = proportional movement of specialists from one block to another, i.e. the proportion of the total number of specialists in block $i$ at the beginning of any year in the planning period that will move to block $j$ by the end of that year.

$\bar{x}_i^n$ = number of specialists in block $i$ at the beginning of year $n$ produced by the inner dynamics of the system.

$u_i^n$ $(i=1, 2, \ldots, 6)$ = necessary intake of specialists into block $i$ at the beginning of year $n$.

$e^n$ = necessary intake of students into the higher education system in year $n$.

$d$ = proportion of students dropping out of higher educational institutions over the whole period of the course.

Thus:

If the necessary intake of operational staff into block 1 at the beginning of year $n$ $-u_1^n$ is known, then the intake of students into higher educational institutions at the beginning of year $n-5$ is calculated according to the formula:

$$e^{n-5} = \frac{u_1^n}{1-d}$$

where $u_1^n = x_{1^\circ}^n - \bar{x}_1^n$

In order to calculate the value of $\bar{x}_1^n$, it is necessary to take into account the dropout of specialists in the course of the five years of preparation of one AMS, and also the movement of operational staff to upgrading courses after $K_1$ years of practical training ($K_1$ is assumed to be less than 5) and to the operation of the AMS upon completion of its preparation:

$$\bar{x}_1^n = p_{18}(1-p_{17})^5 (1-p_{12})^{5-K_1+1} (x_{1^\circ}^{n-5} - \bar{x}_1^{n-5})$$

In determining the necessary intake of trainees into the upgrading courses in year $n-1$, it is necessary to take into account the estimated shortage of project managers in year $n$ and the estimated number of specialists in block 3 having practical experience of not less than $K_2$ years ($K_2 < 5$), who will enter advanced systems-analyst courses in year $n$:

$$u_2^{n-1} = u_3^n + (1-p_{37})^{K_2} p_{34} (x_{3^\circ}^{n-5} - \bar{x}_3^{n-5})$$

where $u_3^n = x_{3^\circ}^n - \bar{x}_3^n$

The value of $\bar{x}_3^n$ is calculated in the same way as $\bar{x}_1^n$

$$\bar{x}_3^n = (1-p_{37})^5 (1-p_{34})^{5-K_2+1} (x_{3^\circ}^{n-5} - \bar{x}_3^{n-5})$$

The intake into advanced systems-analyst courses in year $n-1$ is made up of two components: the estimated shortage of project managers in year $n$ plus the estimated shortage of deputy project managers in year $n$:

$$u_4^{n-1} = u_6^n + u_5^n$$

where $u_6^n = x_{6^\circ}^n - \bar{x}_6^n$ and $u_5^n = x_{5^\circ}^n - \bar{x}_5^n$

The value $\bar{x}_5^n$ is calculated taking into account the dropout of specialists from block 5 during the five years of preparation of one AMS and the movement of specialists with not less than $K_3$ years' practical experience from block 5 to block 6:

$$\bar{x}_5^n = (1-p_{57})^5 (1-p_{56})^{5-K_3+1} (x_{5^\circ}^{n-5} - \bar{x}_5^{n-5})$$

In calculating the value of $\bar{x}_6^n$, the dropout of specialists from the block during the five years of preparation of one AMS and the intake of specialists from block 5 with not less than $K_3$ years' practical experience are taken into account:

$$\bar{x}_6^n = (1-p_{67})^5 x_{6^\circ}^{n-5} + p_{56}(1-p_{57})^{K_3} (x_{5^\circ}^{n-5} - \bar{x}_5^{n-5})$$

With the help of this model, the intake of students into higher educational institutions and the intake of trainees into upgrading courses and advanced systems-analyst courses during the forecasting period were calculated. In this connexion, the following assumptions were made concerning the proportional movement $p_{ij}$ on the basis of experience acquired in the use of the methods of mathematical economics and of computers in production management:

$$p_{12} = 0.35; \quad p_{23} = 1; \quad p_{34} = 0.04; \quad p_{56} = 0.05;$$

$$p_{17} = p_{37} = p_{57} = p_{67} = 0.03; \quad p_{27} = p_{47} = 0, \quad p_{18} = 0.5$$

$$K_1 = 4; \quad K_2 = 4; \quad K_3 = 5$$

---

**REFERENCE**

[1] M. A. Bermant, L. K. Semenov and V. N. Sulitskii, "A mathematical model for planning and managing the process of meeting the need for specialist cadres", *Materials on Scientific Management*, No. 6, Third Kiev Symposium on Scientific Management and Scientific and Technical Forecasting, Kiev, 1970.

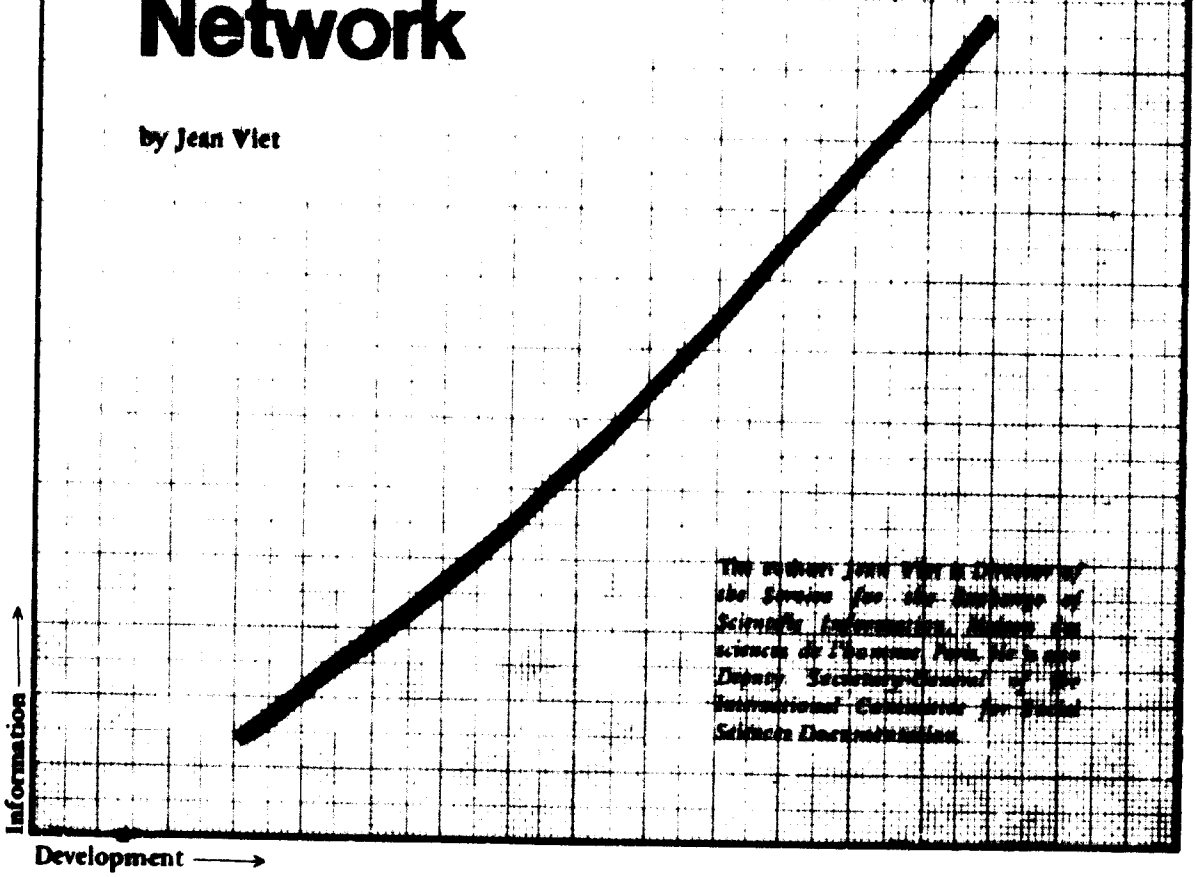
**The authors:** *M. A. Bermant, A. A. Modin, L. K. Semenov and V. N. Sulitskii are members of the Central Mathematical Economics Institute of the Academy of Sciences of the Union of Soviet Socialist Republics.*

# An International Documentation Network

by Jean Viet

It is impossible to emphasize too strongly the part played by the dissemination of information in economic and social development. The importance of this factor has been borne out time and time again in the past and is today a matter of course in industrialized countries, both to business management and government. Confirmed in practice every day, it would perhaps go unnoticed if it were not for the universal proliferation of information aids and if the phenomenon of the so-called "documentation explosion" did not indirectly call attention to it.

It cannot, therefore, be ignored by the developing countries. At the end of the first United Nations Development Decade it became apparent that the transfer of experience was more important than the transfer of capital, and that the exchange of information was more useful in the long run than the exchange of goods. Even if the need for information is not always clearly felt and does not manage to express itself, it is certain that in every one of these countries there exists a latent demand for information, linked with an urgent need for development. If the first impetus is given and a start made, the ultimate success or failure of the operation will depend to a large extent on the receipt of satisfactory replies to requests for information. A report published in 1969 by Sir Robert Jackson (*A Study of the Capacity of the United Nations Development System*, Vol I and II, Geneva, United Nations, DP/5)




*The author, Jean Viet is Director of the Service for the Exchange of Scientific Information, Maison des sciences de l'homme, Paris. He is also Deputy Secretary-General of the International Committee for Social Sciences Documentation.*

stresses this point and the importance of a world-wide information exchange system directly geared to economic and social development. Without such a system the aid policy as a whole might well be jeopardized.

This article seeks to describe what has been done towards the progressive establishment of such a system, to give a general idea of its organization and methods, and to forecast its development in the near future. Naturally, the attention given to the system as a whole should not ignore the efforts of each participant body within its own particular field of competence. It is merely intended to show here that an undertaking of this order in the documentation field achieves maximum efficiency by functioning through an international network which guarantees the most varied information and offers wider possibilities of dissemination.

## Establishment of an international documentation network

It was as a direct result of the Development Enquiry Service being set up at the Development Centre of OECD (Organisation for Economic Co-operation and Development)[1] that an international documentation network was progressively established.

The OECD Development Enquiry Service was created for the purpose of helping developing countries to solve their documentation problems and from the outset took on the task of collecting, processing and disseminating, on request, available information on the multifarious subjects connected with economic and social development. As its own documentary resources were limited, and it was not geared to deal with all fields of development, it immediately based its action on the collaboration of the main national, regional and international centres of specialized information, and aimed at building them up into a network. In order to avoid any overlap with similar activities that might have been undertaken by another international organization, OECD contacted the United Nations, which recognized the advantages of the programme submitted to it and noted that this programme met a need that the United Nations could not itself satisfy because of its organizational structure. The UN then decided to co-operate in its implementation.

In October 1964, the first stage in the establishment of an international documentation network was completed at a conference held in Berlin by the German Foundation for the Developing Countries (Deutsche Stiftung für Entwicklungsländer). In the course of an exchange of views on the various aspects of an international exchange of information relating to development, the participants warmly welcomed the plan placed before them by the Development Centre, and some of them, such as the German Foundation itself and the International Committee for Social Sciences Documentation, resolved to assist in carrying it out.

The second stage involved approaching the international organizations belonging to the United Nations family, whose co-operation was essential to the success of the project. The International Labour Organisation (ILO) and the Food and Agriculture Organization of the United Nations (FAO) were already, in their own spheres, processing a considerable volume of documentation, and they had worked out methods of giving potential inquirers, especially in the developing countries, easy access to their stocks of information. It was necessary to draw on their experience in establishing the joint system and to decide with them on the procedure for addressing questions to the members of the network best qualified to reply to them.

Since national sources of information could on no account be neglected, the documentation network was at the same time extended to the member countries of OECD, and a certain number of exchange and co-operation agreements signalled their willingness to take part in the venture.

Finally, the developing countries themselves were urged to join the network, and some of them agreed to be not only beneficiaries but also active members of an international exchange system. The ways in which they would collaborate were decided upon at a meeting organized in Paris at the OECD Development Centre in March 1967, when the functions of the relay stations set up in each of the countries concerned were defined as follows:

- To act as intermediary between the user and the Development Enquiry Service.
- To be in a position to describe the precise conditions in which the information is circulated, and to supply the users with any explanations they may require about the operation of the Service and the help they may expect from it.
- To transmit to the Enquiry Service the questions received and also to send it any useful documentation obtained from local sources.
- To make an on-the-spot evaluation of the service rendered, taking into account the final destination of the documentary material procured.
- To make the Enquiry Service known and to help enlarge its audience.

## Composition of the network

As composed at present, the documentation network is a profoundly original creation. It brings together, in the same economic and social venture, institutions of very different kinds.

[1] OECD, Development Centre, 94 rue Chardon-Lagache, 75, Paris 16e.

Many of them are world-wide such as ILO, FAO, UNESCO, UNIDO and the United Nations, with which they are linked. Others, like OECD, are inter-governmental institutions covering well-defined regions, such as the Commission of the European Communities, the Economic Commissions for Africa, Asia, Europe and Latin America, and the European Conference of Ministers of Transport (ECMT). Others, again, are non-governmental and represent rather varied interests, such as the International Council of Voluntary Agencies and the World Council of Churches, some specialize in the field of documentation, such as the International Federation for Documentation and the International Committee for Social Sciences Documentation.

National institutions of equal diversity that belong to industrialized countries (member countries of OECD) and others to developing countries, work side by side within the network with these international organizations. The first group are mainly institutions specializing in co-operation and technical assistance, whether they are governmental (ministries, secretariats of state, etc.) or enjoy some measure of autonomy vis-à-vis the government, as, for example, the German Foundation for the Developing Countries and numerous specialized research institutes. The second category mainly involves government bodies engaged in planning or responsible for economic and social policy.

The efficiency of the network depends to a large extent on the diversity of the institutions associated with it. The fact that it includes bodies located in developing countries which can receive requests or redistribute the information, in itself guarantees that the information services of the developed countries and those of international organizations will not be working in a vacuum. Similarly, the exchange of documentation between developing countries undoubtedly means better utilization of the experience being gained in the various regions of the world with regard to development.

This diversity could have in the long run threatened the existence of the network, in spite of the links forged by the constant exchange of information, if a certain number of measures had not been taken to ensure cohesion. One of these measures was the publication by the OECD Development Enquiry Service of a *Bulletin des Correspondants* (correspondents' bulletin), in which every member of the network can recount his own experiences and make criticisms and suggestions. More important is the regular convening of these correspondents at meetings where satisfactory operation of the system which they run together is checked on the basis of the practical experience of each. Sometimes these meetings are held at the OECD Development Centre, at other times at the headquarters of one of the main participating organizations. The two most recent were held respectively at FAO, in Rome, on 24, 25 and 26 March 1969 and at the ILO, in Geneva, on 9, 10 and 11 December 1970.

The list of institutions actually represented at these two meetings clearly shows the extent and complexity of the network

## I. INTERNATIONAL ORGANIZATIONS

### Operating on a regional basis:

Afro-Asian Organization for Economic Co-operation (AFRASEC)
Asian Productivity Organization (APO)
Commission of the European Communities (CCE)
Economic Commission for Africa (ECA)
Economic Commission for Asia and the Far East (ECAFE)
Economic Commission for Europe (ECE)
Economic Commission for Latin America (ECLA)
European Conference of Ministers of Transport (ECMT)
Industrial Development Centre for Arab States
Inter-American Development Bank (IDB)
Organization of American States (OAS)

### Intergovernmental:

Food and Agriculture Organization of the United Nations (FAO)
International Bank for Reconstruction and Development (IBRD)
International Labour Organisation (ISO)
International Trade Centre (ITC)
Organisation for Economic Cooperation and Development (OECD)
United Nations
United Nations Conference on Trade and Development (UNCTAD)
United Nations Development Programme (UNDP)
United Nations Educational, Scientific and Cultural Organization (UNESCO)
United Nations Industrial Development Organization (UNIDO)

### Non-governmental:

International Centre for African Social and Economic Documentation
International Committee for Social Sciences Documentation (ICSSD)
International Council of Voluntary Agencies
International Federation for Documentation (FID)
International Union of Railways (UIC)
Latin American Centre for Research in the Social Sciences (LACRSS)
World Council of Churches (WCC)

## II. NATIONAL INSTITUTIONS

| | |
|---|---|
| *Argentina* | National Institute for Industrial Technology |
| *Belgium* | Office de la coopération au développement |
| *Bolivia* | Centro Nacional Boliviano de Documentación Científica y Técnica |
| *Brazil* | Instituto Brasileiro de Bibliografia e Documentação (IBBD) |
| *Chile* | Centro Nacional de Información y Documentación |
| *Denmark* | Danish International Development Agency |
| *Ethiopia* | Planning Commission |
| *Federal Republic of Germany* | Deutsche Stiftung für Entwicklungsländer (DSE) |
| *Finland* | Bureau of Technical Assistance, Ministry of Foreign Affairs |
| *France* | Documentation Centre of the Secretariat of State for Foreign Affairs<br>Centre national d'information pour la productivité des entreprises (CNIPE) |
| *India* | Institute of Economic Growth<br>Planning Commission |
| *Israel* | Jewish Colonization Association in Israel |
| *Italy* | Cassa per il Mezzogiorno<br>Instituto Nazionale per l'Incremento della Produttività (INIP) |
| *Japan* | Overseas Technical Co-operation Agency |
| *Netherlands* | Documentation Division, Ministry of Foreign Affairs |
| *Norway* | Norwegian Agency for International Development |
| *Peru* | Centro Nacional de Productividad |
| *Philippines* | Productivity and Development Center, National Economic Council |
| *Portugal* | Technical Secretariat of the Prime Minister's Office |
| *Senegal* | Archives nationales |
| *Spain* | Directorate-General for International Technical Co-operation |
| *Sweden* | Swedish International Development Authority |
| *Switzerland* | Service information et documentation de la coopération technique |
| *Thailand* | National Economic Development Board |
| *Tunisia* | Société tunisienne de banque |
| *United Arab Republic* | Federation of Egyptian Industries |
| *United Kingdom* | Overseas Development Administration |
| *United Republic of Tanzania* | Ministry of Economic Affairs and Development Planning |
| *United States of America* | Agency for International Development (AID) |

(This list is in no sense complete, since new members are constantly joining.)

### The mechanism of information exchange

The mechanism governing the exchange of information in the international documentation network is relatively simple. It works on two levels, closely connected with each other: from the inquirer to the supplier of information on the one hand, and between information services on the other.

Only official or semi-official bodies concerned with development problems, and their experts, have access to the system; information is not given to commercial firms nor to students or research workers in the preparation of theses. An inquiry may be placed at any point in the network, whether or not it is received at government level, or reaches an international specialized agency, or comes direct to OECD's Enquiry Service.

In all these cases, the preparation of replies follows the same procedure. Either the organization consulted considers that it is able to deal with the question adequately out of its own documentary resources, and draws up an answer immediately, or the question calls for assistance from several bodies with complementary fields of competence, and these are approached to furnish the relevant documents or information.

The part played inside the system by OECD's Enquiry Service is fundamentally that of a clearing-house—a central office which re-routes the requests for information from all parts of the developing world to the specialized bodies best qualified to deal with them, collecting from such bodies the data for as precise and complete a reply as possible, and then transmitting this data to the inquirer. Such thoroughness is an absolute necessity in a sphere as vast as economic and social development, with its many varied problems that may require help from several different quarters in order to provide a solution. It is very different from the role that is played by most members of the network, particularly the specialized agencies of the United Nations family that possess a store of documentation only in a particular field. Far from duplicating their activities, the Enquiry Service enlists their help when necessary.

After several years of operation the Service has built up its own store of documentation by keeping a copy of all the replies supplied and filing the studies produced by OECD. The percentage of questions it forwards elsewhere is no less important, and this procedure remains the general rule as it is the policy of the Service to procure diversified pertinent information. The distribution of questions among the various members of

the network is fairly wide (see table 1). Out of the 880 addressed to the Enquiry Service between March 1969 and October 1970, 595 questions were rerouted to network members.

## Questions and answers

On the basis of experience to date, queries range from techniques for promoting the export of books to the application of modular co-ordination in the construction of buildings, the use of the airship as a means of transport, or a bibliography on community development. They also cover a broad spectrum of information: bibliographical data, statistics, assistance projects, current research, development projects, research or training institutes, experts, conferences, etc.

The time taken to reply naturally depends on the level of technicality of the question, and takes longer if it proves necessary to refer the question to distant members within the network. Everything possible is done to reduce the time when an urgent reply is sought. The following description outlines the procedure initiated by the OECD Enquiry Service when a query is made.

Upon receipt of a question a file is opened and given a registration number, and the inquirer receives by return of post an acknowledgement which indicates the interpretation placed upon his request and informs him that research is in hand to supply an answer.

In some cases, the Service already has all the data required for a reply, as the question may have been dealt with previously for another user (in which case the material is photocopied) or OECD publications contain the requested information or a "summary" has been devoted to it, which sums up the information available on the subject.[2] The reply is then dispatched within four or five days.

In all other cases, it may be estimated that each question receives, on average, three successive replies. The first is given within three weeks after registration. It consists of data collected by the Service itself after research in its own store of documentation or obtained from specialized information sources in Paris. This usually takes the form of bibliographies of books and documents, together with relevant extracts from the passages quoted (or even the passages in full if they are especially pertinent), a selection of photocopied articles, notes describing specialized bodies which would be helpful for the user to contact, data taken from files already built up for replying to questions of an allied or similar character, OECD publications, etc.

Further replies are mainly based on contributions sent by Enquiry Service correspondents to whom the question was referred. Through these contributions, the documentary resources of the entire international network are opened up to users, who may utilize the expertise offered by national and international organizations throughout their specialized fields. The dossiers supplied to them are thus as complete as possible and contain several very different approaches to the solution of their problem. An example of this is given in page 27 (box), which shows the components of a reply sent to an inquirer over a period of time in response to a given question.

A dossier is finally closed when all the correspondents questioned have replied, even if only negatively, or when the user has let it be known that the documentation received covers his needs.

A circular letter is addressed every four months to users who have not reacted to the material sent, asking them whether or not they have been able to use the information supplied and whether or not the documentary research should be continued.

Two card-index files of questions classified by subject and by country are maintained. They make it possible to take regular stock of the demand (see table 2). Three times a year the questions are entered in a list showing the correspondents consulted. This list is sent out systematically to all members of the network who also receive acknowledgements of their contributions.

The increasing speed with which questions arrive and the constantly growing production of replies prove the usefulness of the system just described.

As far as the questions received and answered by the OECD Enquiry Service since 1961 are concerned, they show, after an initial "running-in" period, a steady increase, and in 1970 the number doubled in 1967 there were 343 questions, in 1968, 342, in 1969, 395, and in 1970, 740. These were mainly questions which required wide-ranging consultation of the network thus generating a number of replies complementing one another and sometimes needing synthetization. They were, therefore, rather different in character from those that member organizations of the network would have been able to answer, from their own documentary resources.

This increase of inquiries reflects a growing awareness of the virtues of information which one can only hope will become more widespread. The upward trend is particularly marked at the ILO, where the Central Library and Documentation Branch has, since 1966, been supplying on request analytical bibliographies based on its acquisitions. The number of these bibliographies has grown from 240 in 1966 and 249 in 1967 to 472 in 1968, 1,262 in 1969 and 1,982 in 1970. In 1970, 1,090 requests came from the Organization

Continued on page 20

[2] These "summaries", designed to speed the drafting of replies, are kept constantly up to date. At present they deal with the following subjects: (1) Regional planning and regional development; (2) Tourism and development; (3) Export promotion; (4) Small-scale and medium-scale industries; (5) Ports and free zones; (6) Problems of land-locked countries; (7) Mobilization of private savings for investment; (8) Public administration and development; (9) Planning of education; (10) Reference works on economic and social development; (11) Development of indigenous languages; (12) Bearing of transport on development; (13) Mass communication media.

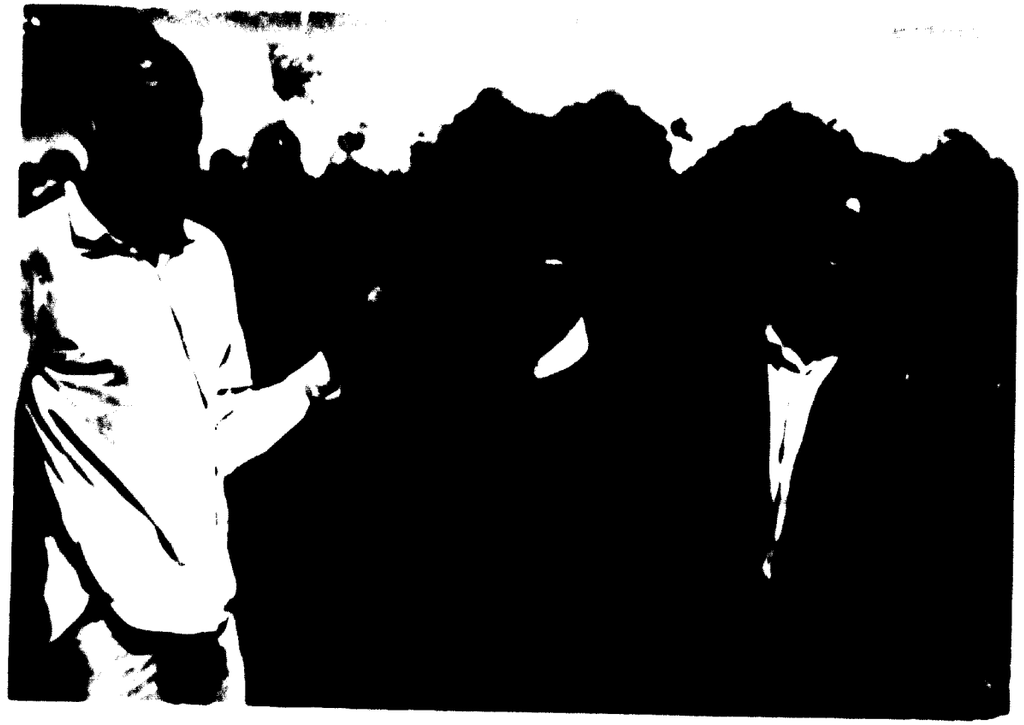


# NETHERLANDS BUREAU FOR INTERNATIONAL PROJECTS, TNO

by J. C. Gerritsen

**Established some 40 years ago with the primary aim of assisting Netherlands industrialists in matters relating to technical information, adaptive research and the training of scientists and engineers, the Central Organization for Applied Scientific Research, TNO[1] has on numerous occasions applied its vast storehouse of knowledge and expertise to the benefit of the developing countries. Its Bureau for International Projects is prepared to mobilize and co-ordinate the efforts of more than 40 institutes and a staff of 5,000, over half of them scientific personnel, including many specialists in the field of natural science, to assist a developing country with a specific problem. This article will highlight the work of this leading independent research organization by examining some of the many diverse projects handled by it in recent years.**

*Long-fish caught in Lake Victoria*



## Feasibility Studies: Morocco—the Philippines—Uganda

It is frequently necessary to initiate feasibility studies before introducing an applied scientific research and information programme. TNO, which is actively involved in this area, carried out one of its most

extensive feasibility studies at the request of the Government of Morocco. The work involved drafting a structural pattern for a cold chain that could handle that country's rapidly growing demand for perishable produce such as citrus fruits, vegetables, meat, fish and other seafood for consumption at home and for the export market.

The initial query submitted by the Moroccan authorities was: "What types of buildings and installations, means of transport, cooling, freezing and storage would be best, bearing in mind the nature of the foodstuffs, climatic conditions and present and future market demands?" At first, this appeared to be a purely technical problem, but a supplementary question of how to draft the network of cold storage facilities, both geographically and in terms of capacity and turnover, was a more complex economic problem with deep-rooted implications for agriculture, internal and external trade and the national growth rate.

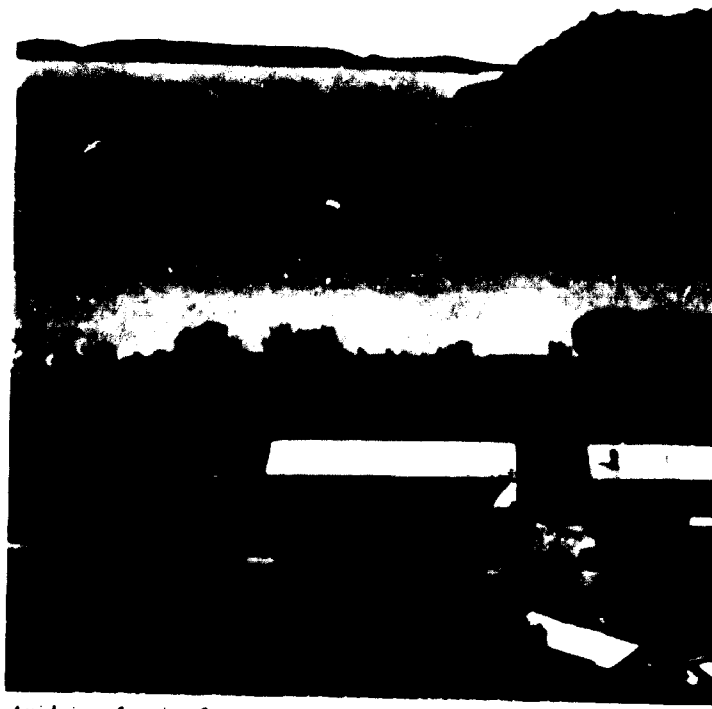
An over-all appraisal of both questions led to careful studies by a team of experts specialized in economics, engineering, horticulture, fish processing, etc. The field work and subsequent desk studies were carried out in close co-operation with the sponsor in Morocco. These activities were critically scrutinized by an interdepartmental committee of the Moroccan Government which later prepared the ground for policy decisions based on their common findings. A series of similar studies have been carried out in various other countries; for example

- The Philippines, in the island of Panay, to pin-point opportunities for promoting the fishing industry,
- Ethiopia, to evaluate the prospects of a new textile industry;
- Uganda, to advise the Government on measures for a more profitable textile industry in the East African Community;
- Uganda, to advise the Government on new industries to process domestic raw materials in order to improve its trade balance;
- The United Republic of Tanzania, to strengthen the sisal market by finding new applications for that material.

## Food Quality Control Project in Saudi Arabia

In 1967, the Central Institute for Nutrition and Food Research, TNO was invited by the Food and Agriculture Organization of the United Nations (FAO) to undertake a food quality control project in Saudi Arabia. This work was part of a programme of assistance to the Saudi Arabian Ministry of Commerce and Industry, under a Funds-in-Trust arrangement.

A three-year contract was drawn up between FAO and TNO, and work on the project was started in April, 1967. The agreement was extended until June, 1973.



*Aerial view of station for experimental fish-processing at Nyegezi*

The main objectives of the project were:

- To train Saudi Arabian chemists and technicians, in the Netherlands, in food science and food analysis;
- To establish food control laboratories in Jidda (Red Sea) and Dammam (Persian Gulf),
- To assist in drafting Food Standards for Saudi Arabia.

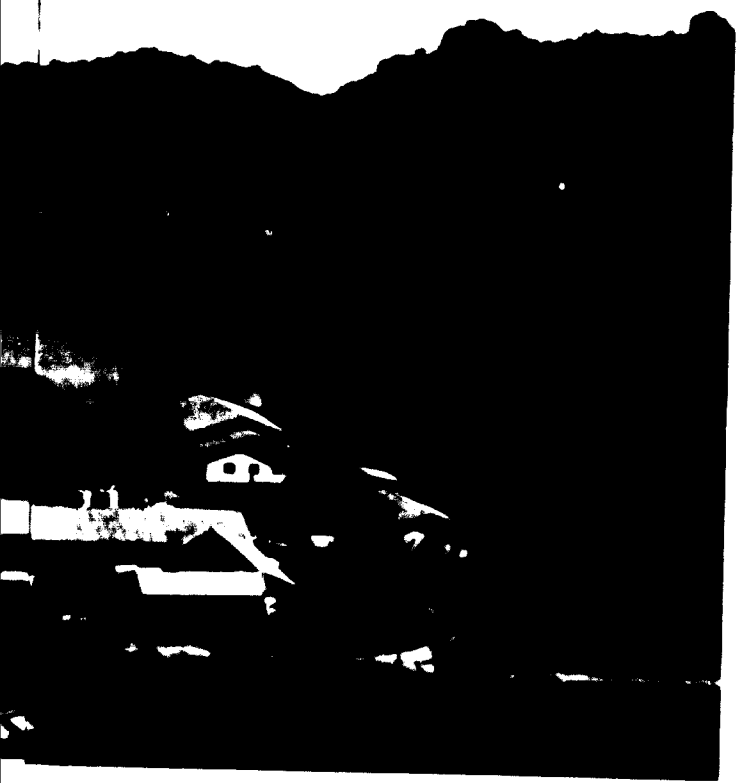
### *Training of students*

A total of 12 Saudi Arabian students were trained at the Central Institute for Nutrition and Food Research, TNO, for periods varying from 4 to 12 months. Most of the trainees were B.Sc. graduates of Riyadh University, the remainder were graduates of Saudi Arabian high schools.

The students easily adapted themselves to the working conditions and the way of life in the Netherlands and adjusted themselves to a critical and scientific approach towards the technical problems. The best results were obtained from students who completed training periods of twelve months.

### *Establishing food control laboratories*

In September 1967 a team of TNO experts was sent to Saudi Arabia. The team consisted of: chemists (of



M.Sc. or Ph.D. levels); technical assistants (certified by the Royal Dutch Chemical Society); and other experts such as laboratory managers and food inspectors.

The work of the team comprised:

- Setting up the laboratories;
- Preparing lists of new equipment to be ordered (chemicals, glassware, instruments, scientific literature, etc.);
- Drafting standard methods of analysis; and
- Training Saudi Arabian staff in the daily routine of a food control laboratory.

By April 1968 the Jidda laboratory was operational and food samples were being analysed at a rate of about 500 a month. In July 1969, the Dammam laboratory was operational and the number of samples analysed approached the Jidda level.

Equipment was ordered by the Ministry of Commerce and Industry upon the Netherlands experts' recommendations and the laboratories were gradually able to perform their most essential chemical analyses.

Maintenance and repair work posed severe problems and scientific literature was slow to arrive. However, some 150 standard methods of analysis were drafted and Saudi Arabian chemists trained in their use. (Unfortunately, a food inspectorate for the control of the local market could not be established, largely because of organizational problems and lack of suitable candidates.)

***Drafting Food Standards***

Establishing Food Standards is part of a general standardization programme for Saudi Arabia and is a prime objective of the Ministry of Commerce and Industry. The Ministry of Health, for obvious reasons, is also interested. FAO assistance in this connexion consisted of submitting some 50 draft Food Standards. TNO assisted by sending experts to meetings of the two Ministries on food legislation and consumer protection.

## Experimental Fish-Processing in the United Republic of Tanzania

In 1966 an experimental fish-processing station was installed by the Tanzanian Ministry of Agriculture, in collaboration with the Institute for Fishery Products, TNO, at Nyegezi, near Mwanza on the southern shore of Lake Victoria. A bilateral agreement between Tanzania and the Netherlands was thus successfully carried into effect.

The fishing possibilities of Lake Victoria had never been fully exploited, owing to the difficulty of distributing catches to the hot interior of the country. Modern methods of preservation would have to be applied if this problem were to be overcome.

The fish-processing station would, therefore, investigate and experiment with several known methods of preservation and then adapt them to local conditions. Its programme of work would include investigation of the types of fish considered to be of commercial value, local climatic conditions, permissible costs and marketing studies.

Nyegezi was chosen as the site for the project as the Tanzanian Government already had a fisheries station there.

The project for the new station proceeded well. In April 1965 the Tanzanian and Netherlands Governments signed a treaty, and in July of the following year work started on the station. It was officially opened by the Tanzanian Minister of Agriculture on 20 March 1967 but, prior to that date, a number of promising methods for processing several types of Lake Victoria fish had already been developed. Investigations were carried out into the production of fish-meal, fish-protein concentrate, and the adaptation of various fish products to suit local tastes, but paramount in importance were preservation techniques, i.e. drying, salting, smoking, freezing and canning.

Medical research into the application of fish-protein concentrate as a curative for protein calorie malnutrition (*kwashiorkor* and other types) is also in progress.

The station is adequately equipped for all its tasks, with machines and apparatus that allow a fairly wide range of processing activities on a semi-technical scale. It

also has a small, but modern, laboratory for chemical and bacteriological investigations. The station's products are distributed through commercial channels: this affords, on a small scale, feedback from the consumer.

The station was initially headed by Netherlands experts, with a Tanzanian biologist later taking over control.

One of the station's most significant activities is that of educating and training Tanzanian technical staff to put fishing and fish-processing on a modern basis.

The experimental station will be upgraded to a research and training centre catering for all freshwater fisheries in Tanzania. At the same time the facilities of the station will be strengthened, partly by already realized biological support from the Tanzanian side, and partly by economic support from the Netherlands, promised for the second half year of 1972.

## Development of Animal Repellent

Rodent and insect attacks on cereals and flours in transport or storage are responsible for considerable damage and loss of revenue. In developing countries, this pest activity reaches alarming proportions and effective methods are being sought to curtail it. One method that seems to hold some promise involves the use of repellent elements found in specific subtropical and tropical plants such as araceae.

The araceae, which have an in-built protection against rodents, goats, sheep, birds, snails and insects, contain microscopically small, needle-shaped crystals of calcium oxalate that are called raphides. Though the mechanism of raphides is not yet fully understood, it is known that flour prepared from the raphide-containing rhizomes of certain araceae is avoided by animals. Raphides cause severe pain in the mouths of warm-blooded animals, which deters them from eating the flour; they also have a deterrent effect on insects.

A remarkable property of raphides is that no painful effect is generated once the flour containing them is baked or boiled. It would seem feasible, therefore, that they could be used to protect cereals and flour until these foodstuffs are prepared for human consumption.

With this in mind, the FAO requested the Institute for Physical Chemistry, TNO to subject the raphides to applied scientific research.

Natural raphides could hopefully be applied in practice by isolating them from araceae collected or cultivated especially for the purpose. It also seemed

*Microscopic view of a raphide*

attractive to synthetize raphides with a view to their subsequent industrial production. The problem of choice, however, was not the main concern: first and foremost ranked the need for determining the specific properties of raphides scientifically, and of establishing the conditions that would warrant their painful use.

TNO carried out intensive research and evolved refined analytical methods. Its staff found that, in principle, preparation of raphides was feasible but the pain-installing deterrent was generated only when raphides occurred in combination with other substances that formed a thin layer around them. The substances that caused the pain were detected by methods of separation and analysis, together with the help of a group of human "guinea pigs" who agreed to being experimented on. It was established that, from the hundreds of substances surrounding natural raphides, only two—when applied in combination and fixed on the raphides—played a part in causing the pain.

As far as is known, these substances are not harmful to man. In fact, raphide-containing flours such as *taro* are consumed in some areas of the Pacific without any known side-effects.

Although much further research will have to be carried out before the pain-inflicting agent can be practically applied as a preventive, it is now quite clear that its envisaged use is promising.

Dry, stable raphides are easily obtained from suitable plants, but the economically more attractive method, viz. that of commercially producing active synthetic raphides, still must satisfy two prerequisites: (1) the action of one of the two active components must be defined and explained, and (2) a technique must be evolved for fixing both components to the needles.

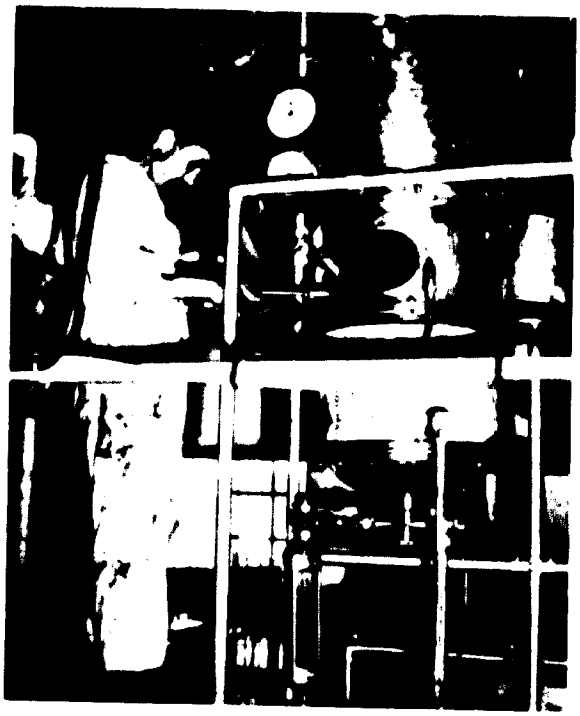
An advisory committee composed of representatives of various Netherlands institutions recommended that the Netherlands Government support the work of the Institute for Physical Chemistry, TNO in this field and that it be continued, in co-operation with institutes within and without the TNO family concerned with various aspects of technology, toxicology and entomology. For this purpose, a plantation to grow repellent supplying plants will be established in a tropical area.

## Pilot Plant for Date Syrup in the Libyan Arab Republic

Date-producing countries are often left with considerable surplus stocks of dates for which no export market is available.

In the late 1950s the Government of the Libyan Arab Republic, concerned with this problem, decided to investigate whether or not the surplus dates could be processed to syrup.

If this were feasible, the country's sugar imports could be reduced and the general diet of the population improved by the consumption of syrup. Following



*At work in the date syrup plant*

Government consultations with the FAO, the Central Technical Institute, TNO was asked to design a pilot plant. After the pilot plant had been built and tested in the Netherlands, by arrangement with the Agricultural University, Wageningen, it was transported to Libya and put into operation.

The pilot plant was thus fit for demonstration by December 1959, when the world's first congress on date-processing was held. The plant has been in operation ever since and the experience gained with it has prompted the design of another plant—one that will produce high-quality syrup on a commercial basis.

The plant will be established in the near future by a private company, with Government support.

This approach could also be adopted to improve other domestic foodstuffs, to the general benefit of producers, traders, consumers and the national economy of agriculture-oriented countries.

## Bread from Composite Flours

The object of this project was to produce bread from local sources of carbohydrates or cereals. Non-wheat composites provide a nutritious and palatable bread and their use can help to stimulate the economy of a developing country.

### *Background*

The FAO requested TNO to carry out some orienting research. The Institute for Cereals, Bread and

Flour, TNO was subsequently briefed to prepare bread from composite flours derived from produce that was abundant in tropical countries. Though the major requirement was nutritiousness, possible advantage to the economies of the countries concerned was also an important consideration.

There is a growing trend towards bread consumption throughout the world, even in countries where it is not part of the traditional diet. Obviously, it would be advantageous for the economy of such countries if bread could be made from local domestic produce.

### *Nutritiousness*

It is essential that a nutritive as staple as bread not only provide calories; it must also be a good source of protein. The flours for the preparationlof this new type of bread would, therefore, be composite in that they would have to have both a protein and a starch component, the protein share being substantial.

### *Protein and starch sources*

The "cakes" that remain after the oil has been removed from, for example, soya beans or peanuts are relatively rich in protein. Compared with the animal variety, this soya and peanut protein is inexpensive to produce and is available in large quantities in most developing countries.

Cassava (tapioca, manioc), the tuberous plant that is well known in all tropical countries, is a particularly eligible source of starch. This tuber thrives everywhere in the tropics; it is easily grown, has a good yield, can be harvested with a fair degree of certainty, and has many other favourable properties. There are several ways of preparing cassava-plant tubers and their flour for consumption. The flour and starch may be stored, as they have good "keeping" qualities, in contrast to fresh tubers, which must be consumed early. Other more tuberous plants, such as sweet potatoes and arrow-root, are also suitable starch sources.

### *Orienting research*

The orienting experiments have shown that, from a nutritional point of view, the combination of tuber starch and protein from de-fatted oil seeds is a very good basis for a composite flour and can be used to make bread. Incidentally, the nutritional value of soya protein is even higher than that of wheat protein. Using cassava starch and flour from de-fatted oil seeds, bread may be made that looks attractive, has good volume and a fine regular structure.

Bread made from cassava and soya is fairly neutral in taste, with a slight soya flavour; that made from peanut flour is slightly more pungent.

### *An experimental bakery in Colombia*

Before a developing country introduces the bread on a commercial scale, it should run a well-planned experiment. The experiment should cover: sampling of consumers' response, collecting of comments, and adaptation of the bread to local tastes, as and when necessary. However, in order to evaluate the attitude of the population toward a new product, it is desirable that it be commercially available for some length of time.

In 1971 an experimental bakery with a capacity of 500 kg bread per day was established in the Instituto de Investigaciones Tecnológicas (IIT) in Bogotá, Colombia.

*Several types of bread and pastry, baked from cassava/soya flour at the Institute for Cereals, Flour and Bread, TNO, Wageningen, Netherlands*

*Front view of Central Institute for Nutrition and Food Research, TNO, Zeist, Netherlands*

The project on stream is based on a bilateral agreement between Colombia and the Netherlands. Though the bakery is supervised by a team of staff members of the TNO institute, it is staffed by locally trained indigenous personnel who will later apply their experience to commercial bakeries.

The TNO team has been successful in using non-wheat composites for making bread and if it is accepted by the population, it will go a long way towards alleviating Colombia's serious wheat shortages.

Obviously, the situation in every country differs with respect to available produce and pattern of nutrition. However, the principle on which project and tests are based remains the same. Technological processes for several combinations of raw materials have been worked out and the work may be adapted to the conditions prevailing in any given country.

### *Equipment*

The experimental bakery is equipped with standard, commercially available ovens. When the bread is prepared from cassava/soya or cassava/peanut flour, dough is not obtained as with wheat flour, but a batter is formed. This was taken into account when selecting the machines.

### *Funding*

The Institute for Cereals, Flour and Bread, TNO started this work at the request of FAO, and, as a contribution to the initial expenditure for orienting research, received financial support from FAO. Once the orienting work had yielded a favourable result, and when it seemed justified to continue the project, the Netherlands Government began to support the project within the scope of its technical assistance programme for developing countries.

Accordingly, the Institute has for some years now received financial contributions from the Netherlands Ministry of Foreign Affairs.

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### *FOOTNOTE*

[1] For further information on this Organization, see IRDN Vol.I, No.1, page 67, "Organizational Patterns of Industrial Research Institutes", and Vol. II, No. 2, "Research Organization TNO Serves Dutch Community". The letters TNO stand for *Toegepast Natuurwetenschappelijk Onderzoek* (Applied Scientific Research).

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**The author:** *J. C. Gerritsen is Director of the Bureau for International Projects, TNO which was established by the Executive Committee of the Central Organization for Applied Scientific Research, TNO, the Netherlands, to help plan and co-ordinate all activities of the Central Organization, its Branch Organizations and their Institutes connected with the implementation of technical assistance projects in developing countries.*

# AMMONIA FROM AND LIGNITE

by Eberhard Goeke

Ammonia has been produced on a commercial scale for many years by the catalytic synthesis of hydrogen and nitrogen. In the early years of its production the hydrogen gas component was almost exclusively obtained from coke, coke-oven gas or direct from coal. After the Second World War the price of solid fuel, namely coal, rose steeply and it became necessary to introduce a more economic means of producing the synthesis gas. Natural gas and petroleum fractions such as fuel oil and naphtha were found suitable and these are used to provide the bulk of the world's supply of ammonia even to this day.

## Advantages to developing countries

For countries with large resources of cheap solid fuel such as coal and lignite, however, the manufacture of ammonia from these materials can be a sound economic proposition. In recent years several large coal- and lignite-based ammonia production plants have been built throughout the world and are operating on a competitive basis with the petroleum- and natural gas-based plants. This article will describe some of the processes being used by these solid fuel plants and give comparisons of various feedstocks.

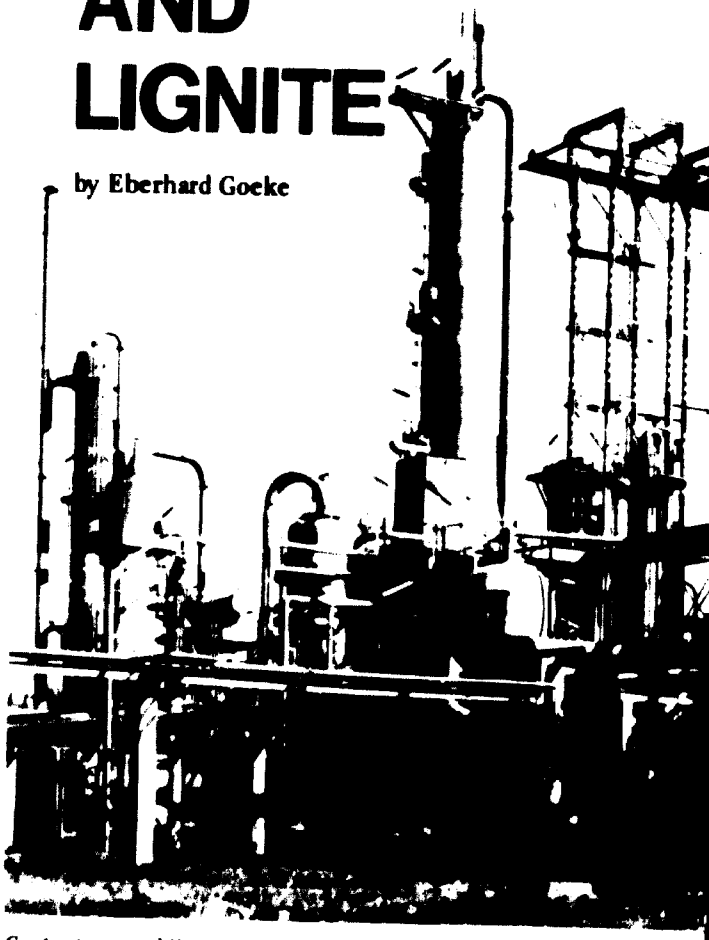
## Winkler gasifier

During the past 20 years ammonia synthesis plants using the Winkler gasifier have been built in Bulgaria, Czechoslovakia, the German Democratic Republic, India, Spain, Turkey, the USSR and Yugoslavia. The Winkler plant is capable of producing 160 tons of ammonia per day from small lumps of brown coal or coke. An analysis of the crude gas at the gasifier outlet is shown in the second column of table 1.

TABLE 1. CRUDE GAS ANALYSES

*(Per cent volume)*

| | *Winkler gasifier* | *Lurgi pressure gasifier* | *Koppers-Totzek gasifier* | |
|---|---|---|---|---|
| *Feedstock* | *Brown coal coke* | *Hard coal* | *Hard coal* | *Lignite* |
| $CO_2+H_2S$ | 18.4–26.0 | 28.0–32.3 | 12.0 | 13.0 |
| $O_2$ | | 0.0–0.01 | Traces | Traces |
| CnHm | | 0.2–0.2 | – | – |
| CO | 30.0–40.0 | 22.4–16.4 | 58.1 | 55.9 |
| $H_2$ | 40.0–46.0 | 38.0–39.4 | 28.3 | 29.0 |
| $CH_4$ | 1.0–1.5 | 10.9–11.3 | 0.1 | 0.1 |
| $N_2+Ar$ | 0.5–1.5 | 0.5–0.4 | 1.5 | 2.0 |



*Gas treatment and $HN_3$ synthesis at the Kütahya plant, Turkey*

## Lurgi pressure gasifier

This process gasifies lignite or bituminous coal with oxygen and steam under pressure in a fixed bed on a grate. An advantage of the system is that, as it operates under pressure, only the oxygen need be compressed and not the proportionally larger amount of synthesis gas produced. Thus crude synthesis gas contains methane and higher hydrocarbons which must be removed in the course of the gas treatment. Methane can, for example, be separated and re-formed to synthesis gas by catalytic re-forming. The third column of table 2 gives an analysis of the crude gas at the gasifier outlet.

Plants using this process have been built recently in Pakistan and the Republic of Korea. In South Africa


there is a very large plant using Lurgi gasifiers to produce gas for the synthesis of hydrocarbons; the tail gas from this plant is processed to ammonia. Other plants have been built for the production of town gas.

## Koppers–Totzek gasifier

A mixture of coal dust, oxygen and, if necessary, a small amount of steam, is fed to the gasifier from several sides through special burners. Partial oxidation of the coal dust takes place at normal pressure. Temperatures of about 2,000°C prevail in the vicinity of the burner. The produced synthesis gas leaves the reactor at a temperature of about 1,500°C. Subsequently, the heat of the synthesis gas is utilized in a special steam boiler for the production of high-pressure steam.

Owing to the high reaction temperatures, the synthesis gas does not contain higher hydrocarbons. The methane content of the gas is only about 0.02 Vol. per cent. Depending on the reactivity of the coal, up to 99 per cent of the carbon is gasified. Practically any type of coal can be gasified, irrespective of size, caking quality, etc. A typical gas analysis at the outlet is shown in table 1, column 4.

Coal-based Koppers-Totzek plants for the production of synthesis gas for the synthesis of ammonia have been built in Finland, Greece, Japan, Spain, Thailand, Turkey and Zambia. Three plants in India, each with a daily capacity of 900 tons ammonia, and one plant in South Africa, with a daily capacity of 1,000 tons ammonia, are under construction.

## A typical plant

The production of ammonia from coal will now be described in detail, using a plant already constructed as an example. The plant is the Kütahya plant of Azot Sanayii TAS, Ankara, Turkey, which produces 340 tons of ammonia per day.

Figure 1 shows a simple block diagram of the plant. It illustrates that only lignite, water and electric power are necessary for the production of ammonia; and of course, small amounts of chemicals and catalysts.

The composition of the lignite charge is shown in table 2. The raw water is supplied from wells adjacent to the works. The cooling water is re-circulated and re-cooled. The boiler feed water is produced in an ion exchanger unit. The complete ammonia unit produces its own steam, and receives electric power from the local power grid.

## Coal preparation unit

The coal is supplied to the plant in railway wagons from an opencast mine about 15 km away. An open coal storage unit is provided in the plant which can stock coal to cover a period of about six weeks. From the storage unit the coal is crushed to a size smaller than 30 mm and passed to the coal crushing and drying unit. In this unit the coal is dried from a water content of about 45 to 8 per cent and is further crushed in a tube mill to a fineness of 80 per cent under 0.09 mm. The dust contained in the waste gas from the drying unit is almost completely removed in electrostatic precipitators to conform to regulations governing the prevention of the pollution of the environment. The coal-crushing unit comprises two streams, each of 60 per cent of the total capacity. The brown coal dust produced is fed pneumatically to the gasification plant.

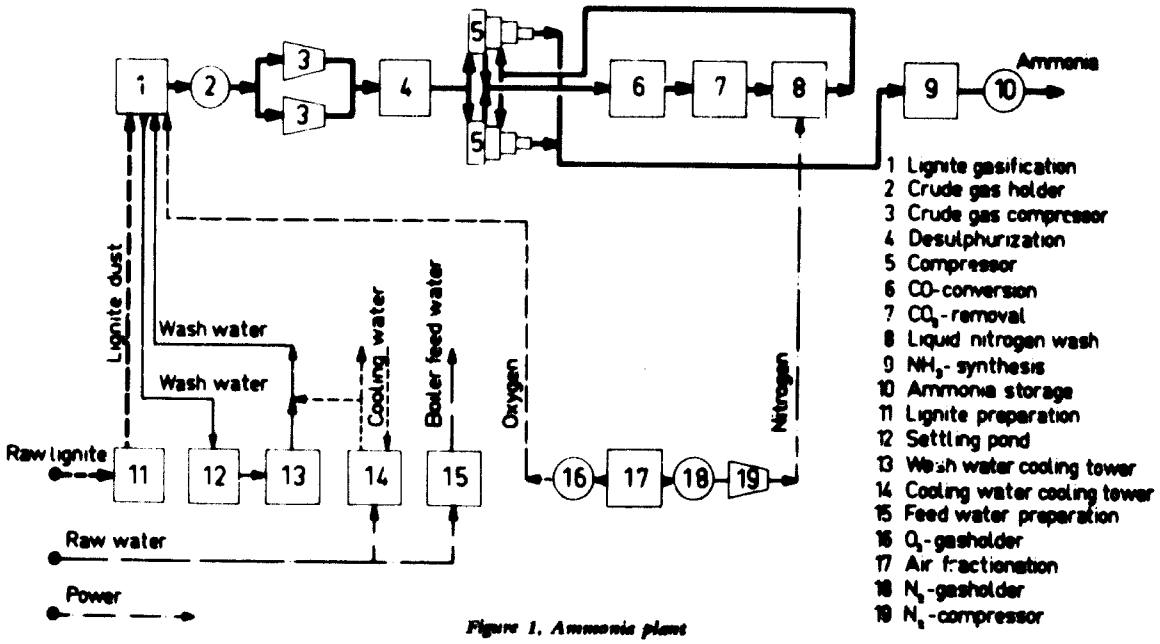



*Figure 1. Ammonia plant*

TABLE 2. KÜTAHYA LIGNITE

| *Lignite analysis* | *per cent wt.* |
|---|---|
| Water | 33.0 |
| Ash, wf. | 32.0 |
| C waf. | 65.0 |
| H waf. | 5.8 |
| S waf. | 1.2 |
| N waf. | 2.0 |
| O waf. | 26.0 |
| | 100.0 |

| *Ash analysis* | *per cent wt.* |
|---|---|
| $SiO_2$ | 46.0 |
| $Fe_2O_3$ | 15.8 |
| $Al_2O_3+TiO_2$ | 18.2 |
| CaO | 6.9 |
| MgO | 4.0 |
| $SO_3$ | 5.5 |

| *Ash melting behaviour* | °C |
|---|---|
| Softening point | 1,100 |
| Melting point | 1,150 |
| Flow point | 1,200 |

TABLE 3. FEEDSTOCK ANALYSES

| | *Lignite* | *Hard coal* | *Fuel oil* | *Naphtha* |
|---|---|---|---|---|
| | *per cent wt.* | | | |
| Water | 52.50 | 2.40 | -- | – |
| Ash | 15.45 | 15.23 | 0.07 | – |
| C | 20.83 | 67.72 | 84.60 | 84.00 |
| H | 1.62 | 3.87 | 11.30 | 15.96 |
| S | 0.86 | 0.57 | 3.50 | 0.04 |
| N | 0.64 | 1.65 | 0.40 | – |
| O | 8.10 | 8.56 | 0.13 | – |
| | 100.00 | 100.00 | 100.00 | 100.00 |
| | *kcal/kg* | | | |
| Lower heating value | 1,570 | 6,300 | 9,840 | 10,350 |

TABLE 4. CONSUMPTION FIGURES PER TON AMMONIA

| | | *Lignite* | *Hard coal* | *Fuel oil* | *Naphtha* |
|---|---|---|---|---|---|
| Lignite | kg | 8,700 | – | – | – |
| Hard coal | kg | – | 2,200 | – | – |
| Fuel oil | kg | – | – | 940 | – |
| Naphtha | kg | – | – | – | 890 |
| Power-current | kWh | 495 | 330 | 160 | 140 |
| Raw water | $m^3$ | 20 | 18 | 8 | 11 |

## Air fractionation unit

The oxygen necessary for the gasification plant, and the pure nitrogen required for the synthesis gas mixture, are recovered in an air fractionation plant consisting of two streams, each representing 60 per cent of the total capacity.

## Gasification plant

The gasification plant consists of four Koppers-Totzek gasifiers, three operational and one standby. A special feature is the high degree of carbon gasification, which in the Kütahya plant is about 99 per cent, although the ash content of the coal, referred to as dry coal, is between 35 and 40 per cent.

The larger part of the coal ash in the gasifier is liquid, and flows off in a continuous stream. In the ash extractor under the gasifier, the ash flows into a water bath where it is granulated to a size of about 3–5 mm. This slag is free of carbon, causes no dust and is suitable for making roads and paving.

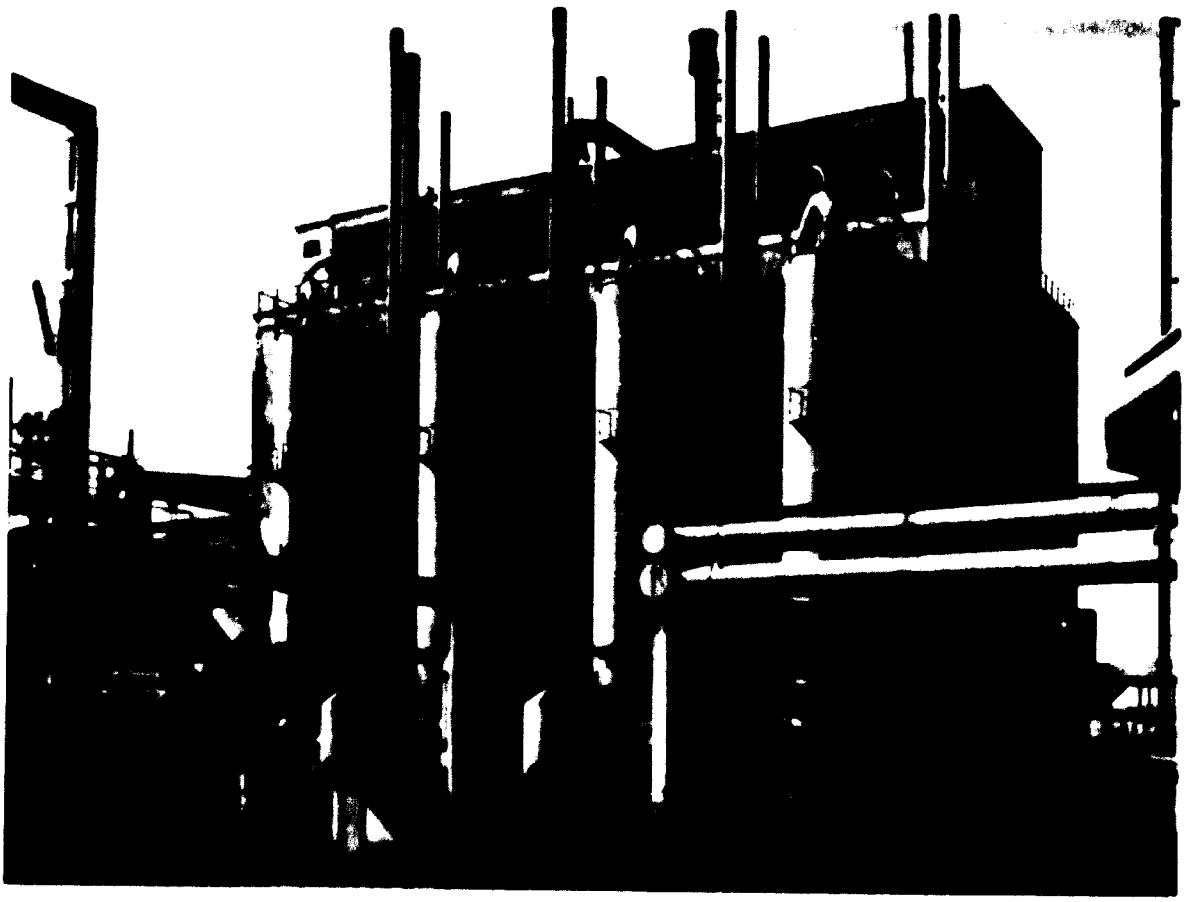
A minor part of the coal ash is entrained with the gas passing through the waste heat boiler downstream of the gasifiers, but is subsequently removed by scrubbers and mechanical washers. The wash water is circulated through the settling tanks and cooling tower. The sludge accumulated in the settling tanks is pumped through a pipeline to a disposal point about 2 km from the plant. The water discharged from the cooling water circuit is re-cycled as make-up water for the wash water circuit.

The entire low-pressure section (coal preparation unit, wash water system and gasification plant) is monitored and serviced from a central control unit.

## Gas treatment and ammonia synthesis units

From the gasification plant, the gas is passed through a gas holder to the crude gas compressors, where it is compressed to a pressure of about 10 atm. Two crude gas turbo-compressors are provided, each with a capacity of 60 per cent of the total capacity.

The gas is passed from the compressors to a Sulfinol desulphurization plant in which the $H_2S$ and organic



*Gasification at the Kütahya plant*

sulphur contained in the gas are removed to a total sulphur content of less than 20 ppm.

The gas is next conveyed to the high-pressure compressors (piston compressors), which compress the gas to a pressure of about 500 atm necessary for the synthesis. Two compressors, each with a capacity of 60 per cent of the total capacity, are provided.

After the first compression stage, CO conversion is carried out at a pressure of about 25 atm. Subsequently, the $CO_2$ is removed in a cold methanol wash, at about minus 45°C. The cold methanol wash is combined with the post-installed liquid nitrogen wash, where the residual CO and other impurities are removed from the gas and the synthesis mixture $3H_2 + N_2$ is adjusted.

The synthesis of ammonia takes place at a pressure of about 500 atm. The synthesis circulation is effected by an injector fed with fresh high-pressure synthesis gas. The ammonia synthesis plant is provided with a semi-cooled spherical ammonia tank that can accommodate the total ammonia production for one week.

The entire high-pressure section, including the air fractionation unit, is controlled and operated from a central control unit.

## Operational costs of lignite, coal, fuel oil and naphtha

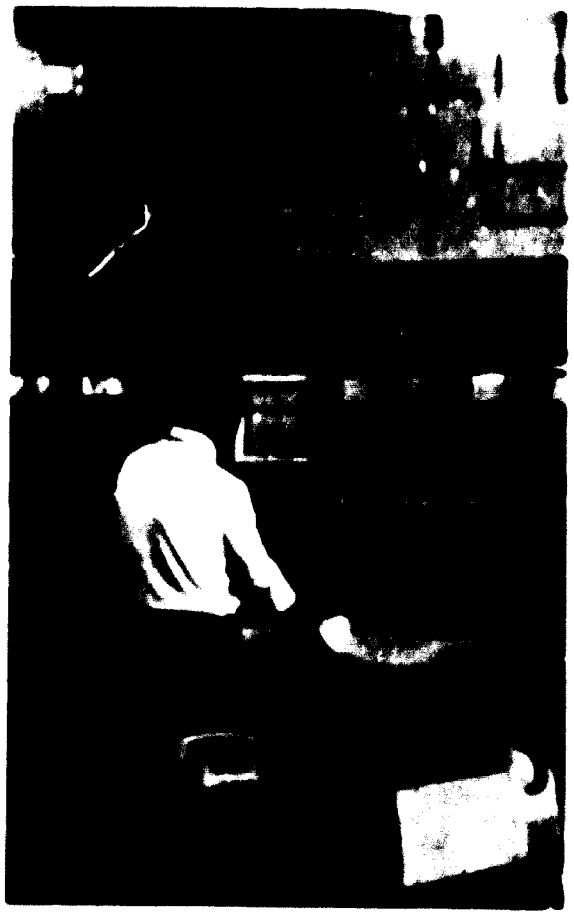
A comparison is now given of the most important operational figures for the production of ammonia when using the above feedstocks. Natural gas as a feedstock has not been included in this comparison, as coal would not be considered viable if natural gas were available locally.

The comparison is based on feedstocks with analytical data as shown in table 3. Table 4 shows the consumption figures for feedstock, water and power referred to 1 ton $NH_3$. The consumption figures for lignite and coal are understood to refer to wet coal with water contents as stated in table 3.

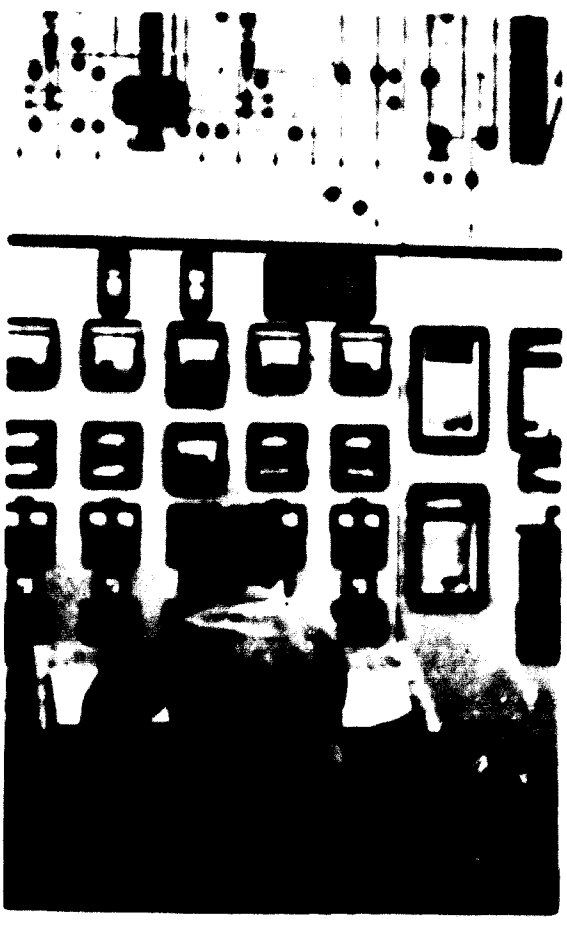
## Economic comparisons

When determining capital expenditure for such plants, ammonia production of 1,000 tons ammonia per day is used as a base. In each case, facilities are provided for storing a month's supply of feedstock and week's production of ammonia. Plant costs include units for

*Central room LP units*



*Central room HP units*



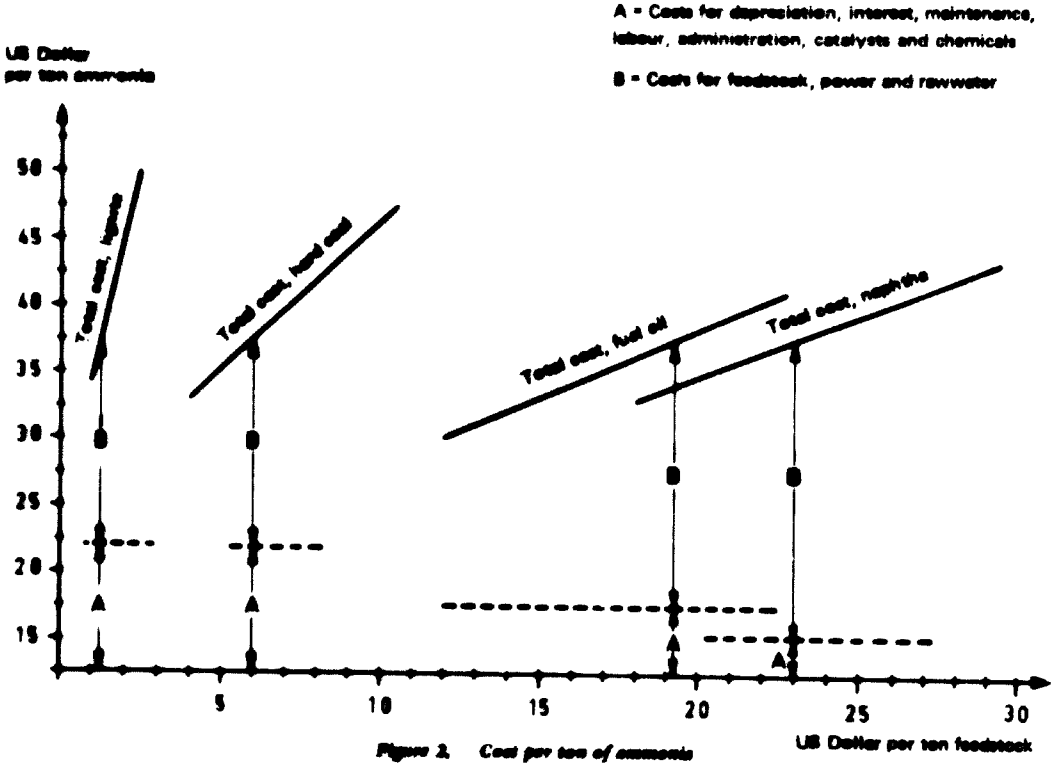



*Figure 2. Cost per ton of ammonia*

steam production, cooling water recovery and feed water preparation. Allowance is also made for such additional expenses as the acquisition of land, and the construction of tracks, roads, administration buildings, laboratories, repair workshops, fencing, etc.

The investment cost for a complete ammonia plant for the various fuels is as follows:

| | *$U.S. million* |
|---|---|
| Lignite | 40 |
| Coal | 39 |
| Fuel oil | 30 |
| Naphtha | 25 |

The capital costs per ton of ammonia have been calculated at a rate of interest of 7 per cent over a 12-year amortization period. The following considerations have been based on 8,000 operating hours per year.

The costs for feedstock, water and power, chemicals, servicing and administration have been taken into account when determining the operating costs. It is assumed that the necessary steam will be produced in the plant. The cost of electric power has been adapted by an utility reducing the relevant cost per BTU of the fuel. The capital and operating expenditure, calculated according to the previously mentioned prerequisites, is plotted in figure 2 against the cost of the various feedstocks. The cost of feedstock is understood to include the cost of transportation to the works.

From a technical point of view, the production of ammonia from lignite or coal presents no problems. For all types of coal there are suitable gasificatio processes of high standards.

Moreover, national economic considerations may favour the selection of coal as a feedstock for the production of ammonia. From a national point of view, the discovery of local coal deposits can offer many advantages, such as the creation of additional jobs. Once the coal resources are being exploited, the coal can also be used for other purposes. In many cases, rational mining methods and favourable coal prices can only be achieved when a large consumer, for instance, an ammonia plant, guarantees to accept large amounts of coal regularly. This means that coal will also be available to other consumers at favourable prices which, in turn, will attract other industries to the area, and domestic coal can be supplied to the community cheaply. The construction of an ammonia plant can be a great advantage to the development of a local economy.

## Foreign currency requirement

In a country which has its own coal resources but no crude oil, the shortage of foreign currency can favour the use of coal. Table 5 shows the foreign currency requirement for the construction and operation of

TABLE 5. FOREIGN EXCHANGE REQUIREMENTS FOR 1,000 TONS/DAY AMMONIA PLANT

*(Millions of US dollars)*

| | *Lignite* | *Hard coal* | *Fuel oil* | *Naphtha* | *Ammonia* |
|---|---|---|---|---|---|
| Foreign exchange requirement per year for interest and repayment of foreign exchange credit for investment costs | 5.04 | 4.91 | 3.78 | 3.02 | |
| Foreign exchange requirement per year for foreign exchange portion of feedstock | – | – | 3.75 | 7.12 | 13.35 |
| Total foreign exchange requirement per year | 5.04 | 4.91 | 7.53 | 10.14 | 13.35 |
| Total foreign exchange requirement in 12 years | 60.48 | 58.92 | 90.36 | 121.68 | 160.20 |
| Annual foreign exchange requirement after repayment of foreign exchange credit for investment costs | – | – | 3.75 | 7.12 | 13.35 |

ammonia plants using various feedstocks. For lignite and coal, it is assumed that 50 per cent of the total investment costs will have to be paid in foreign currency on credit, to be paid back over a period of 12 years, at an interest rate of 7 per cent per annum. This results in an annual capital service for depreciation and interest of 12.6 per cent of the plant capital. In the case of fuel oil and naphtha, it is also assumed that 50 per cent of the total investment costs will have to be paid with foreign currency credit, as above, and that the fuel oil or naphtha will have to be procured with foreign currency. For fuel oil, it is assumed that a foreign currency portion of $U.S.12 per ton, and for naphtha $24 per ton, will be required.

It can be seen that, under these conditions, a coal-based plant will require considerably less foreign currency than a plant for which the fuel has to be procured with foreign currency. The foreign currency which would be required to import liquid ammonia has also been entered in table 5. Foreign exchange for the price of ammonia has been assumed at $40 per ton.

## Conclusions

The production of synthesis gas based on coal or lignite, known for many decades, has been continuously developed and has now reached a technical standard on a par with that of other modern chemical industries. Although nowadays the bulk of ammonia is produced on the basis of natural gas or mineral oil products which in most parts of the world are usually cheaper than coal, coal- or lignite-based plants have been built in several countries and more plants are at present under construction. The manufacture of ammonia from coal or lignite can be economically competitive even today, especially when cheap solid fuels are available and mineral oil products are encumbered with high transportation costs and other charges. Other considerations, such as the saving of foreign exchange, may also favour the choice of solid fuels as feedstock for the synthesis of ammonia. In countries with adequate resources of cheap solid fuel, the production of ammonia on the basis of this indigenous raw material should be seriously taken into consideration.

*The author: Eberhard Goehe is Manager of the Synthesis Gas and Ammonia Department, Heinrich Koppers GmbH, Essen, Federal Republic of Germany. Graduating in engineering in 1947, he worked as Project Engineer for the design and construction of gasworks and participated in the development of many new processes. He assumed his present position in 1958.*

*Mr. continued from page 10*

itself and 812 from outside. The establishment of the bibliographies concerned required 1 580 new searches of documentation, since 322 replies could be drawn up on the basis of previous searches. Each reply involved, on average, the dispatch of 62 bibliographical references accompanied by an abstract of the contents of the documents quoted. In 1970 the total number of references thus sent out amounted to 118 000.

Equally significant figures could be given for FAO, for UNIDO, or for a particular national development information service. All these data make it clear that the creation of the international network meets a need, and that this need is becoming more and more recognized in countries intended to benefit from the system; they also provide indirect evidence in favour of the methods selected for the collection, processing and dissemination of information. These methods will now be examined further.

## Information tools

No documentation service could carry out its role if it had not built up some reserves of information and made them easily accessible. Belonging to a well-equipped international network would not relieve it of that task for long, since it would be constantly asked by its partners to supply information in its acknowledged field of competence. Members of the international network therefore began at a very early stage to gather together primary information tools, each within its own field, i.e. food and agriculture, industrial development, science, education and culture, labour, international trade, transport, etc.

These information tools were very varied in character and included catalogues, reference works and numerous card indexes giving references to technical assistance reports, development projects, descriptions of institutions, lists of experts, etc., together with library stocks and specialized archives. When an information category was crystallized sufficiently it often became the subject of a publication, which was then sent to all points of the network. Thus the ILO, after collecting and registering on "microcards" the most complete collection of development plans in the world (about a thousand), then sent a list of them to the various correspondents. In 1970, the OECD Development Centre, anxious to play its part as a clearing-house and source of information, sent out a list of works of reference on institutions used by the Enquiry Service and an inventory of institution catalogues and works of reference published by OECD.

Actual publication, however, is not necessary in order to bring the sources of information at the disposal of one member of the network to the attention of the rest; exchanges have been systematically organized, a task that has been made easier by the existence of liaison bulletins (the Enquiry Service's *Bulletin des Correspondants*, and also *ILO Panorama*, UNIDO's *Industrial Research and Development News*, etc.). This enabled the Enquiry Service to present a summary of the reference tools received from the correspondents to the general meeting of members of the network held at Geneva in December 1970.

For most of the organizations, however, the main sources of information are the documents they themselves constantly produce. International organizations such as UNESCO, the ILO, FAO, OECD or UNCTAD each produce several thousand documents annually, many of which concern development, be they scientific studies or reports of experts on mission. The very creation of an international documentation network keyed to development seems to require that these documents shall be indexed and processed in such a way as to make the information they contain available, and is not practicable by traditional documentation methods but can only be successfully handled by a computer.

## Computerized documentation and the "Aligned List of Descriptors"

It is now six years since the Central Library and Documentation Branch of the ILO introduced by stages a computer-based system called ISIS (Integrated Scientific Information Service) and was one of the first international organizations to make use of a computer for dealing with documentation.

Generally speaking, the documents are recognized by the computer by the use of an order number and a bibliographical address and their contents explained by abstract. The documents themselves are kept in a library or in archives, either in their original form or on microcards.

The regular transfer of information processed from one point to another of an international network needs to satisfy a number of criteria. First, the bibliographical address of the document must be recorded in a communication format in general acceptance at international level; secondly, the abstracts must be written in a common language possessing equivalents in several normal languages; finally, programmes written for computer storage and retrieval must be in some way compatible, having regard to the type of computers used.

The first of these conditions has been largely met since the perfecting of the Mark II system: the addresses of documents processed at the ILO, UNIDO and OECD are in the prescribed format. The last criterion is also on the way to being satisfied: the OECD Development Centre has carried out important work on programming in order to ensure the entry into the same system of programmes drawn up at different points of the network.

The second condition is the one that has most occupied the attention of network members. A common language for identifying and exchanging information was essential if the system was to function properly. In 1966 the ILO, FAO, the International Committee for Social Sciences Documentation, the German Foundation for the Developing Countries and OECD decided to combine all the lists of key words that they used in documentary analysis so as to obtain an *Economic and Social Development Aligned List of Descriptors*. After having been duly tested by processing some 2,500 documents by fourteen organizations belonging to the network, the list, drawn up in English, French and German, was published by the OECD Development Centre in 1969. For over two years it has enabled - and still enables - development information to be processed in a decentralized way. However, although successful in the past, it is inadequate by today's standards.

After the list was published, several organizations that did not take part in its compilation asked to enter the network, and requested that a list of descriptors be drawn up in accordance with their particular requirements. Such lists now exist for UNIDO, UNCTAD, UNESCO and ECMT, to mention only international organizations. As the lists grew more numerous, the problem of establishing a new joint vocabulary arose. There were two possible solutions: a new list of all the descriptors could be compiled at the risk of considerably enlarging the *Aligned List* and making it difficult to use, or the terms most often used or most suitable for forming the core of a macro-thesaurus could be extracted from the vocabulary, and specialized lists could be related to this.

A meeting of *Aligned List* experts held in Paris on 8 and 9 December 1969 opted for the latter solution. This choice, however, did nothing to reduce the difficulty of arriving at the essential components of the vocabulary and the definition of terms in general use. In order to settle the matter, various members of the network were asked to consider the usefulness of each descriptor and to state: (1) If they were using it for their own needs; (2) If they thought it sufficiently important and relevant to the problems of development to be included in the macro-thesaurus.

In 1970 some 6,000 descriptors were subjected to this scrutiny and the results were presented to a new meeting of *Aligned List* experts held in Geneva that December. At the same meeting the principles for the presentation of the macro-thesaurus were jointly decided, it being agreed that, in general, the thesaurus should reflect as far as possible the classification adopted by the United Nations Consultative Committee on Administrative Questions. The preparation of the macro-thesaurus, which would no longer be a simple list of descriptors but a documentary language whose components would be related to one another, occupied the year 1971. Everything necessary was done to ensure that an edition in five languages (English, French, German, Spanish and Portuguese) would be available in 1972, it having been decided to entrust this task to the OECD Development Centre, which at present acts as a secretariat for the international network.

It seems likely that the improvements thus effected in the *Aligned List of Descriptors* will make it a still more useful tool. They should in any case facilitate exchanges of information, promoting better utilization of the documentation published by the various organizations (such as ILO's *International Labour Documentation* or OECD's bulletin of abstracts of its documents and publications) and making possible the direct use of tapes on which documentary abstracts could be recorded.

## Future developments

The international documentation network is still of too recent creation for it to be possible to forecast accurately how it will develop, but its most solid advantages can be noted. In an article on "Information Retrieval in the Computer Age" which appeared in the September-October 1969 issue of *ILO Panorama*, Mr. George K. Thompson, who is in charge of the Central Library and Documentation Branch of the ILO, wrote about the network in these terms:

> "The development of this network and the tools needed to make it work represent a rather unique common effort on the part of research institutes and various national and international organizations. It may take another three or five years for the network to become fully operational. When it does, a very useful tool will have been created that may not only help to cut down on some of the billion-dollar wastage but also provide a means for making a vast storehouse of development information available to those who are attempting to solve the pressing economic and social problems of our time."

If this is to be the function of the network in the years ahead, it is perhaps not unreasonable to hope that it will bring about some changes in the most ingrained documentary habits at national level. Oriented towards the exchange, rather than the preservation, of information, resolutely brought into line with the electronic age and founded on a division of the labour of analysis, it is the only way to save effort and avoid duplication. The international network should rapidly persuade documentation institutions in every country to change their methods and act in concert. If "developed" countries set an example in this respect, each accepting responsibility for processing the documents it produces, the exchange of information will have maximum effect throughout the world and it will then become possible to win the collaboration of most of the countries that need such information.

# EXAMPLE OF INQUIRY AND REPLY

## INQUIRY

No. 2118, received 12 June 1970: "Public utility rates - electricity and water supply".

*Inquirer*: National Board for Public Utility Rates, National Planning Department, Bogotá, Colombia.

The inquiry was processed by the OECD Enquiry Service, which referred it to 14 national correspondents (Belgium, Denmark, Federal Republic of Germany, France, India, Israel, Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States).

## REPLY

15 June 1970 – Acknowledgement of receipt.

23 July 1970 – Dispatch of:

- A bibliographical list drawn up by the Enquiry Service, with photocopies of studies marked with an asterisk.
- A copy of the reply from the Belgian correspondent, accompanied by a document on "high voltage rates".
- Four documents sent by the Swedish correspondent: "Introduction to the general features of the supply of electricity in Sweden", "General stipulations for the supply of bulk power at high voltage", "Regulations for low voltage power supplies", and "The Swedish electricity law and especially its stipulations about regulation of price and other conditions for the delivery of electrical energy".

24 August 1970 – Dispatch of:

- A copy of the reply from the Swiss correspondent, with three collections of electricity rates and statistics on water supply in Switzerland.
- A copy of the reply from the United Kingdom correspondent, with bibliographical references.
- The brochure *Distribution des eaux: le calcul des prix* (Water supply: the calculation of rates), Paris, Centre régional d'éditions techniques, 1964, 80 pages.

9 October 1970 – Dispatch of:

- A copy of a letter from the Portuguese correspondent, accompanied by a document. A photocopy of the article by P. H. Prasad, "Electricity tariff in a developing country with special reference to India", *Economic and political weekly* 5 (23), 20 June 1970: 976–978.
- A study prepared in Latin America by the Regional Electrical Integration Committee (Comisión de Integración Eléctrica Regional), entitled "Panorama de las tarifas eléctricas en Argentina, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay y Venezuela" (Panorama of electricity tariffs in Argentina, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela), Montevideo, Hartmann, 1969.

18 December 1970 – Dispatch of:

- A copy of a memorandum prepared by the Spanish correspondent, giving current tariffs in Spain.
- A copy of a letter from the German Gas and Wasserworks Association (Verband der deutschen Gas and Wasserwerke), submitted by the correspondent from the Federal Republic of Germany, with copies of the publications mentioned in the letter.

20 January 1971 – Dispatch of:

- Supplementary documentation (three articles and a book) sent in by the Swedish correspondent.

TABLE 1 QUESTIONS RECEIVED BY THE DEVELOPMENT ENQUIRY SERVICE FROM MARCH 1961 TO OCTOBER 1970 BREAKDOWN BY CORRESPONDENTS

SR. 1456 SR. 2335 880 questions[a]

I. International and regional organisations

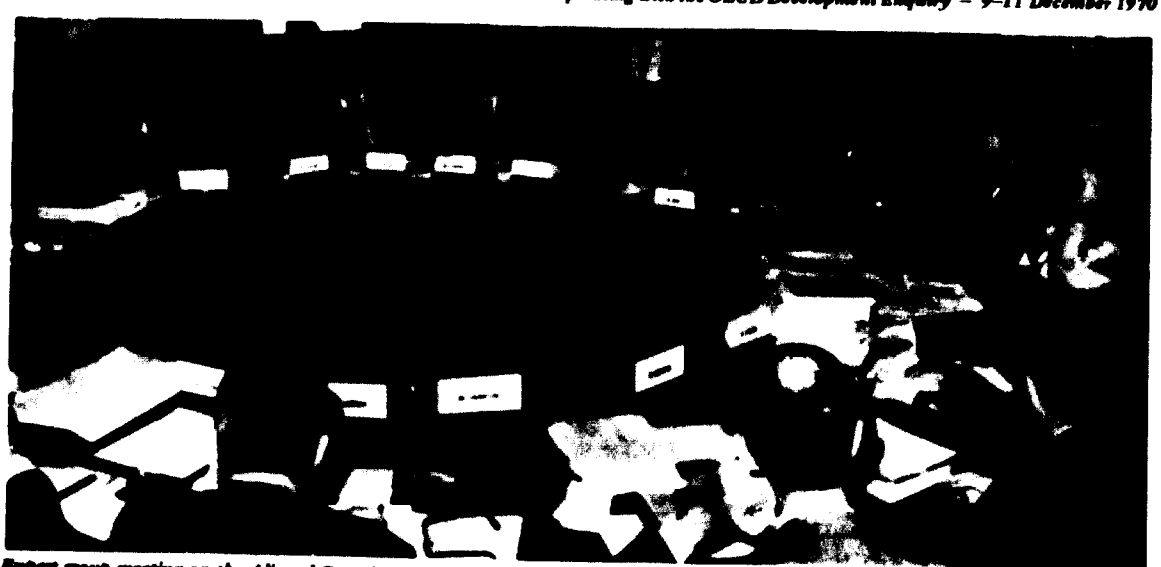
| | CCE | ECA | ECAFE | ECLA | FAO | IBRD | IDB | ILO | ITC/ UNCTAD | OAS | UNESCO | UNIDO | MISC. (BCMT, IBE, ICAO, UNICEF, WHO, APRASEC, APO, FID, HAS, UIC, WCC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 128 | 102 | 83 | 157 | 107 | 79 | 70 | 107 | 51 | 105 | 23 | 141 | 23 |
| Percentage | 21.51 | 17.14 | 13.94 | 26.38 | 17.98 | 13.27 | 11.76 | 17.98 | 8.57 | 17.64 | 3.86 | 23.69 | 3.86 |

II. Countries

| | Belgium | Brazil: IBRD | Brazil: LACRSS | Denmark | Finland | France: COOP | France: CNPF | Federal Republic of Germany | India | Israel | Italy: INAP | Italy: CASSA | Japan | Netherlands | Norway | Portugal | Spain | Sweden | Switzerland | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 184 | 5 | 26 | 84 | 15 | 82 | 143 | 239 | 106 | 83 | 109 | 51 | 44 | 109 | 29 | 56 | 122 | 91 | 109 | 235 | 234 |
| Percentage | 30.92 | 0.84 | 4.36 | 14.11 | 2.52 | 13.78 | 24.03 | 40.16 | 17.81 | 13.94 | 18.31 | 8.57 | 7.39 | 18.31 | 4.87 | 9.41 | 20.50 | 15.29 | 18.31 | 39.49 | 39.32 |

[a] The breakdown applies to 595 questions only. 285 were satisfactorily dealt with by sending "summaries"

*Annual meeting of the members of the international network co-operating with the OECD Development Enquiry – 9–11 December 1970*



*Expert group meeting on the Aligned Descriptor List – 8 and 9 December 1970*

TABLE 2. BREAKDOWN BY REGION AND SUBJECT OF QUESTIONS RECEIVED BY THE DEVELOPMENT ENQUIRY SERVICE

*March 1969–October 1970*

| | By region: Per cent | By region: Total | Industry[c] | Education. Training[d] | Development aid and international co-operation | Public finance and banking | General development problems[e] | Planning. Physical and geographical planning[f] | Agriculture. Rural economy | Social affairs, labour, wages | Technological questions[g] | Trade[b] | Transport[i] | Public administration | Investment. Capital formation | Tourism | Project analysis | Economic theory Political economy | Demography. Population questions | Small-scale and medium-scale industries. Craft production | Management | Requests for addresses and various documents |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| ***Africa*** | 31 | 272 | | | | | | | | | | | | | | | | | | | | |
| North Africa | | | 5 | 5 | | 1 | | 1 | 1 | 3 | 1 | 5 | | 1 | | 1 | 1 | 2 | | 2 | 1 | 3 |
| West Africa | | | 7 | 17 | 3 | 1 | 29 | 10 | 6 | 3 | 3 | 20 | 16 | 11 | 14 | 6 | 3 | 3 | 2 | 17 | 2 | 5 |
| East Africa | | | | 1 | 4 | 3 | 2 | 3 | 4 | 1 | | 2 | 1 | 1 | | 1 | 2 | | 1 | 2 | | |
| Southern Africa | | | | 6 | 2 | | 4 | 2 | 1 | | | 5 | 2 | 3 | 1 | 2 | | | | 5 | | |
| ***Latin America*** | 36 | 317 | | | | | | | | | | | | | | | | | | | | |
| Central America[a] | | | 2 | 8 | | 2 | | 7 | 3 | | 2 | 1 | 8 | 2 | | | | 1 | | | 1 | 4 |
| South America | | | 20 | 41 | 11 | 3 | 19 | 22 | 7 | 13 | 5 | 23 | 15 | 18 | 12 | 5 | 14 | 8 | 1 | 19 | 7 | 13 |
| ***Middle East*** | 12 | 110 | 28 | 25 | 2 | 1 | 2 | 6 | 7 | 7 | 2 | 4 | 1 | 2 | 2 | 2 | 3 | 3 | | 2 | 4 | 7 |
| ***Asia***[b] | 11 | 95 | 11 | 10 | 2 | 2 | 10 | 4 | 7 | 2 | 3 | 7 | 6 | 6 | 3 | 4 | 2 | 3 | 4 | 3 | 3 | 3 |
| ***Europe*** (developing countries) | 6 | 53 | 11 | 5 | 1 | 2 | 3 | 1 | 2 | 4 | 2 | 5 | 3 | 3 | 2 | 4 | | 2 | | 1 | 1 | 1 |
| ***International organizations*** | 4 | 33 | 4 | 5 | 1 | 1 | 2 | 1 | 4 | 1 | | 1 | 2 | 1 | | 1 | 1 | | 1 | | | 7 |
| Total | 100 | 880 | 88 | 123 | 26 | 16 | 71 | 57 | 42 | 34 | 18 | 73 | 54 | 48 | 34 | 26 | 26 | 22 | 9 | 51 | 19 | 43 |
| Per cent by subject | | | 10 | 14 | 3 | 2 | 8 | 7 | 5 | 4 | 2 | 8 | 6 | 5 | 4 | 3 | 3 | 2 | 1 | 6 | 2 | 5 |

Including: [a]Mexico; [b]Australasia; [c]Industrial promotion measures, information on particular industries, case studies, mining, plant location, etc.; [d]Mass communication media; [e]Questions on the sociology of development (acculturation, reactions to social changes, influence of technology on social progress), community development, social factors of economic development in general, and inquiries relating to procedures for establishing documentation centres and libraries; [f]Town planning and urbanization; [g]Questions on intermediate techniques, manufacturing processes for various products, conservation of foodstuffs, demineralization and desalination of water, etc.; [h]Questions on domestic aspects of trade (distribution channels, marketing of products) and problems of international trade; [i]Questions on special problems of land-locked countries.

# Rijksnijverheidsdienst (RND)

## Netherlands Industrial Consulting Service

by E. F. J. Janetzky

The Netherlands Industrial Consulting Service is not a private service but a division of the Netherlands Ministry of Economic Affairs. Its purpose is to give technical and technical-organizational information to Dutch industry and to promote and assist industry in the full sense of the word.

Although no strict regulations on eligibility exist in practice, it has been found that the main recipients of information and assistance are enterprises which, because of their limited size, are unable to support an extensive staff of technical or organizational experts, i.e. small and medium-sized industries. An exception must, however, be made for technical literature search, a service of which large enterprises and institutions in particular are making increasing use.

The work of the State Service for Technical Information to Industry, as the RND was officially called when it was set up in 1910, covers a very wide field. Whereas before 1940 industry was above all interested in advice and information regarding engineering topics, more and more information is being requested nowadays on chemical matters, corrosion problems, application and processing of plastics, electroplating techniques and other subjects. Furthermore, the RND is confronted increasingly with problems of a non-technical character.

Apart from the director and his immediate assistants, the RND employs a total of 108 persons, including 20 industrial consultants, practically all of whom are university graduates (engineering, electrical engineering, chemistry, physics). These consultants are assisted by 60 men and women with a lower technical school education. The RND has a clerical and accounting staff of almost 30.

The industrial consultants and technical assistants maintain direct contact with industry. There is an office of the RND in each province of the Netherlands, headed by a consultant. The consultants, the field engineers, are the backbone of the RND. The relation between a consultant and a client, the client being a small entrepreneur, is never on a business basis, but must be of a personal, confidential nature. It follows that the ability of the consultant to win the confidence of the entrepreneur is of prime importance, so that the consultant must not be too young and must have technical background and wide industrial experience.

The duties of the consultant can best be compared with those of a family doctor. The family doctor is the confidential source of information on many problems lying directly or only indirectly in the medical sphere, and the RND consultant has a similar role in the industrial sphere. He must be able to make a business diagnosis, which will often reveal that the matters on which advice is requested are not the most significant matters requiring attention. He will know many of the firms and industrialists in his province, since in most cases the problems will be examined not in his office but in the factories themselves. Problems of all kinds can be discussed with him: problems relating to techniques, composition, production, purchasing, finance, patents, exports, licences and the like. He himself will be able to give an answer to many questions. As required, the consultant will also consult with or call in the assistance of the various government, semi-government or private bodies dealing with matters of industry with which RND maintains close contacts. Thus he may turn to one of the TNO (applied scientific research) organizations for a special technical problem, to the NIDER (Netherlands Institute for Information, Documentation and Registration) for an extensive literature search, or to the Ministry of Economic Affairs for information on a particular sector of industry. He will also act as an intermediary in establishing contact between his client and government or municipal authorities, suppliers etc. As an independent expert his advice may be sought on legal problems of a technical nature, on examination matters or by the Chambers of Commerce.

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**The author:** *Dr. E. F. J. Janetzky, born 1914 at The Hague, the Netherlands, studied chemistry at Leyden University and received his Doctorate in Technical Sciences at Delft Technological University. He worked for some years in the chemical industry and then became a technical and chemical adviser with the Ministry of Economic Affairs. He was the proprietor of a small chemical factory from 1949 to 1965, and later joined the Netherlands Governmental Technical Service. His wide knowledge and experience make him qualified to observe the small entrepreneur from two points of view: that of the entrepreneur and that of a government consultant.*

The small industrialist is often hardly aware of the numerous existing institutes and services, so that he does not know to whom he should turn in a particular matter. And when he knows, he may not have the resourcefulness to contact the organization that could help him. The RND consultant, on the other hand, is familiar with the organization of industry in the Netherlands and knows how to approach the major research and scientific bodies and the machinery of the Government. He has access everywhere and is thus able to do a great deal for his client that the client himself would not have been able to do, or only with much effort and loss of time.

For the clients it is particularly important that the consultant be a non-interested party, so that he is in all circumstances able to give neutral and objective advice.

When we started the Service in 1910, we did so with two principles, two directives which, in our opinion, are essential to the existence of an efficiently working government consulting service:

*(a)* The work of the organization must be absolutely unbiased. Nobody is favoured and our staff members are sworn to secrecy. The information and help are given to the individual enterprises.

*(b)* In most cases the advice given by the organization is free of charge.

The RND does not grant loans to industry: these may be obtained in the usual way from banks or – if no security can be given by the applicant – from the Middenstandsbank, in which case the Government acts as guarantor. If necessary, the Government asks the RND to make a report on the technical and economic capacities of the client and his enterprise.

The RND has nine sector information officers: these are specialists whose task it is to assist and support craft industries and small industrial undertakings. The information provided is no longer limited solely to the technical aspects of the business in question, although these still remain important.

## Organization Information Department

Since 1945, there has been a shift in emphasis in the questions received from industry towards non-technical problems. Advice is sought on matters relating to cost, organization, administration and other matters that are not specifically technical in nature but are nevertheless an integral part of the problems of business. Very often these are matters on which a satisfactory answer can be given only after rather lengthy investigation. Such investigations require more time than the consultants can afford to devote to an individual firm. To meet this need, a special Organization Information Department was set up. The staff of this department has technical education and some years of operational experience, and, in addition, has received special training in cost-price calculation, organization and management techniques. Since, owing to the nature of its work, this department has to devote much more time to individual enterprises, its advice is not given free of charge; a fee is payable in accordance with a scale of charges established by the Ministry of Economic Affairs.

*The Government Industrial Laboratory at RND*

## The Government Industrial Laboratory

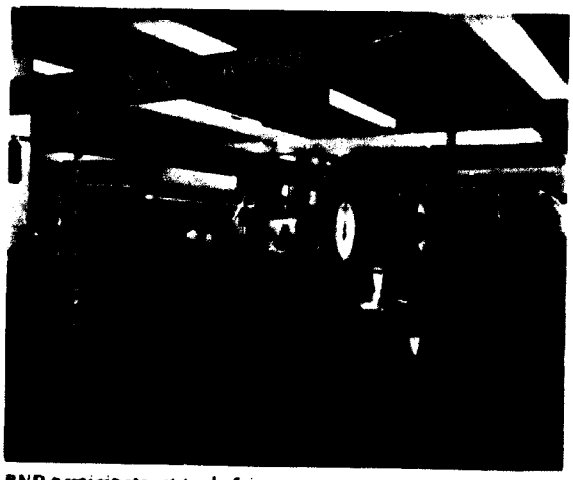
The Rijksnijverheidslaboratorium RNL (Government Industrial Laboratory) in Delft, set up in 1913, is a well-equipped development workshop. The object of this laboratory is to develop – in conjunction with and on behalf of an industrial enterprise – prototypes of machines and equipment in a number of fields, including the electrical engineering sector. Many an idea that has occurred to a manufacturer has resulted in the creation of a machine which, without the RNL, would probably never have reached the development stage. In recent years the RNL has developed several machines and items of equipment for the mechanization and automation of processes and manufacturing steps. Totally different production sectors are frequently involved. The materials and components involved are charged at cost. The time spent on assignments is charged in accordance with a fixed scale. The consultants often bring to the staff of this laboratory problems of a purely technical character.

## Documentation, Literature Search and Information Department

The RND has a small but well-equipped information centre at its disposal. Its starting point was the consideration that a significant source of reliable information is to be found in patents – documents drawn up with great care by experts skilled in technical matters – and that the RND's information centre should be located close to that source. As the Patent Office in The Hague has a world-wide reputation, and has at its disposal a collection of more than 20 million patent

specifications from every major industrialized country in the world (more than 20,000 books on technical and scientific subjects and 1,000 technical journals), proximity to this source has proved to be advantageous.

One of the tasks that the RND—and more particularly the Information Department—performs for industry is giving advice to entrepreneurs, or to persons who believe they have invented something and would like to apply for a patent. Some 800 inventors approach the RND each year, and this service is able to save most of them loss of time and money and disappointments. The few who remain are shown how to go about turning their invention into a patent or to profitable use. The RND does not here assume the role of patent agent, on the contrary, if it is felt that an invention has a chance of success, the inventor is directed to a patent agent.



*RND participates at trade fairs . . .*

## Extension Services

From an investigation carried out in 1965 by the NIVE (Netherlands Institute for Efficiency) it appeared that there was in the Netherlands a considerable lack of knowledge of the existence of government and semi-official organizations whose task it is to give information and to provide assistance to Dutch industry. Little was also known of the services provided by RND. To remedy this defect RND decided to promote its work more actively in the best interests of Dutch industry. For this purpose articles on the RND are regularly published in newspapers, journals, periodicals etc. In these numerous publications the purpose of the RND is clearly described: how it is organized and how it works. The articles are published free by the respective editors. Several broadcasts concerning the purpose and organization of the RND have been given on the radio and on television.

The RND keeps a stock of pamphlets, which are made available for trade fairs, exhibitions etc., where it is thought necessary to draw the attention of the public to the RND. Lectures on the tasks and methods of the RND are given by the head of the Department of Documentation, Literature Search and Information to foreign students in Delft and The Hague.

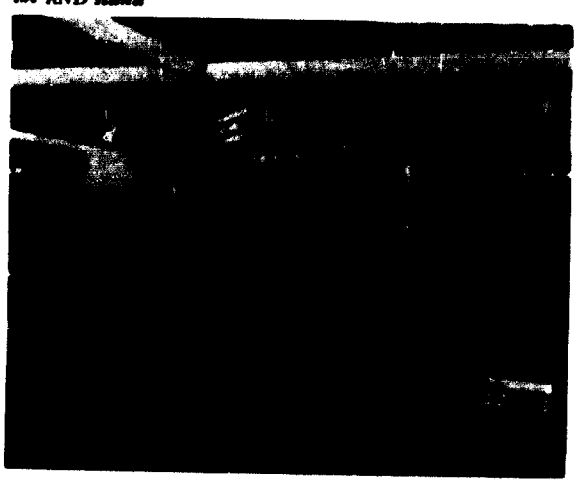
One method of encouraging and assisting industry and at the same time advertising the RND is participation by the RND in trade fairs or other exhibitions with collective stands. A small, promising company not yet large enough to afford a stand of its own is thus enabled to be represented at trade fairs. In addition, enterprises making products the RND considers to be of potential interest to Dutch industry are invited to participate in the RND stands. It may also occur that at small fairs of local importance the RND has only a small stand, at which a member of its staff gives demonstrations, e.g. in the field of metal welding.

The consultants do not sit passively in their offices awaiting their clients; they are generally active in visiting the various firms in their district. They often join committees and are members of the board of unions and of associations where the participation of a technical, impartial expert is appreciated.

The RND does not have its own journal. Although many articles are prepared by the RND in several fields of interest to Dutch industry, they are published in existing journals of which there are hundreds in the Netherlands. Editors gladly use this free copy, some of the articles indicating the authorship of RND, others not. Experts in this field generally agree that information published in the right journals is the best and most effective way of giving information to industry.

The RND has established and maintains numerous contacts with similar bodies in other countries and with international organizations, universities, colleges of advanced technology and factories.

*. . . and invites smaller enterprises to exhibit their products at the RND stand*



# Answers to Industrial Inquiries

*The UNIDO Industrial Inquiry Service receives requests from developing countries for possible solutions to a wide variety of industrial problems. To give readers an idea of the range of the topics covered, each issue of the Industrial Research and Development News carries a selected list of questions recently received by the Service in addition to an answer to a specific inquiry.*

*Readers are invited to write to the Industrial Inquiry Service for further information on answers to any of the questions published below, quoting the reference number, or to submit inquiries on similar or other industrial problems.*

**Information has been requested on the following:**

Investment data, production, techniques, etc., for gypsum plants
*A bank in Iran (X 1222)*

Techniques of rock salt production
*An institute in Kuwait (X 1227)*

Improving the condition of ammonium nitrate
*An institute in Pakistan (X 1240)*

Protein concentrates from waste material and petroleum
*An inquirer from Brasil (X 1243)*

Markets for sodium sulphate
*A company in Turkey (X 1244)*

The Worcra Copper Smelting process (the number of points)
*A company in Turkey (X 1250)*

Carboxymethylcellulose
*An institute in Spain (X 1257)*

Chemical plant for the production of furfural from corn cobs and other vegetable wastes
*A company in Pakistan (X 1267)*

Honeycomb sandwiches used for construction purposes
*A company in Colombia (X1206)*

Production of potato chips
*An inquirer from Turkey (X 1220)*

Technical know-how for the production of "bronze powders" in different colours
*A laboratory in India (X 1187)*

The purposes for which tripolite can be used
*A company in Syria (X 1194)*

Training of small-scale industrialists in the developing countries and the relevant staffing and credit arrangements
*An industrial centre in Madagascar (X 1197)*

## Sulphonated Detergents from Dodecyl Benzene

A request was received from Bolivia for information on the manufacture of sulphonated detergents from dodecyl benzene, the techniques used, and the equipment required. The following reply was received from VITA - Volunteers for International Technical Assistance, Inc., College Campus, Schenectady, New York, 12308, USA.

The manufacture of detergents from dodecyl benzene sulphonic acid is essentially a matter of neutralizing the acid with a suitable base (normally either sodium, potassium or ammonium) and then adding whatever may be desired in the way of thickening agents, dyes, scents and so forth. In general, there are two types of detergent to be considered: liquid and solid (in granular or powder form).

To make a good liquid, water and the calculated amount of the acid ("DDBSA") are placed in a stainless steel vessel (to protect colour) fitted with suitable means of agitation. For very small operations, the stirring can even be manual. The DDBSA is then trickled slowly into the aqueous fraction, allowing time for reaction. If quantities have been accurately calculated and the purity of the DDBSA is known, the result will be a neutral semi-finished product. In practice, however, some "balancing" will nearly always be required, in the form of addition of small amounts of either acid or alkali, to make sure the batch finally contains neither *free* acid nor *free* alkali. Thickening of the liquid product thus prepared can be accomplished by adding relatively small amounts of sodium tripolyphosphate or tetrapotassium pyrophosphate, and of course, by adjusting the total amount of water and thus the anhydrous content of the batch. Proprietary ethyleneoxide condensation products (non-ionic), and organic amides are also used.

To make a powdered or granular product, a powder mixer should be used, into which are poured such amounts of sodium carbonate, sodium bicarbonate, tetrasodium pyrophosphate, sodium tripolyphosphate and other ingredients (not excluding very small amounts of hydroxide) as are needed to add qualities to the finished product. The agitator is then started – it should turn at about 30 rpm in the dry powder mix – and the DDBSA is slowly trickled in. The agitation is continued until it is evident that the acid/alkali reaction is complete. If the batch becomes warm, it may be necessary to let it remain in the mixer for several hours, and then to re-run the agitator for a short time to break up lumps, and assure a permanently stable product, physically speaking. Obviously, any desired dye and odorant can be added toward the end of the mixing cycle.

UNIDO

# PROJECTS

During February 1972, UNIDO placed orders for equipment and contracts for consultant services worth almost $200,000.

Orders for industrial machinery and equipment for UNIDO field projects included precision instruments to be supplied by Carl Zeiss, Federal Republic of Germany, to the National Institute of Technology and Standards, Asunción, Paraguay; an asbestos testing machine from Lynn MacLeod Capital Equipment, Canada, for a pilot plant to be established in Bolivia under an UNIDO contract; duplicating equipment from Roneo Vickers, United Kingdom, for the documentation and information facilities at the Arab Organization for Standardization and Metrology (ASMO), Cairo, Egypt; a molecular distillation unit purchased from Arthur F. Smith Inc., United States, for the Technological Research Institute, Bangkok, Thailand; and under financing from voluntary contributions to UNIDO, an order with Metronex, Poland, covering industrial laboratory equipment to assist in the establishment of a central laboratory for the vegetable and essential oil industry in Guinea.

Details of the contracts, placed in seven different countries, are:

1. Contractor: Institut français de recherches fruitières Outremer (IFAC), France — $33,190
   Country: People's Republic of the Congo
   Project: Feasibility study for the establishment of an integrated agro-industrial pineapple processing combine.

UNIDO will assist the Government of the Congo by providing it with a comprehensive technical and economic feasibility study for the establishment of a modern agro-industrial combine comprising the plantation, processing and marketing aspects. The contractor will also have to analyse available data gathered during previous investigations. The results will also facilitate the Government's choice of the most appropriate form of investment to implement this industrial venture

## Thailand

2. Contractor: Berenschot Bosboom N.V. (Netherlands) — $25,200
   Country: Thailand
   Project: Manufacture of small internal combustion engines

The Government of Thailand has requested UNIDO assistance in determining the feasibility of manufacture within the country of such engines for water pumps, river transport and small agricultural appliances. The services of the consulting firm involve an assessment of the present foundry industry, recommendations for the improvement and expansion of manufacturing facilities, elaboration of a feasibility study covering technical and economic aspects, and the formulation of a programme of action. It is anticipated that the reinforcement of foundry technology and facilities will gradually lead to the manufacture of engines of higher rating for application in engineering, mining and agriculture.

## Mali

3. Contractor: Chemokomplex/Aluterv (Hungary) — $41,165
   Country: Mali
   Project: Pre-feasibility study for an integrated aluminium industry

The aim is to assess the technical and economic viability of an integrated aluminium industry based on extensive bauxite deposits. The consultancy will cover investigations as to the mining of bauxite, its processing on an industrial scale to alumina and the smelting of alumina to aluminium as well as the production of primary aluminium products. In this context, interregional plans for the construction of a power dam on the Senegal river create favourable prospects for electric energy generation in the region. The contractor is further required to assess the conditions for the establishment of an aluminium smelter in Mali and the prospects of producing primary aluminium products, estimate the investments required, determine the minimum economic capacity and recommend further steps to be taken, either in separate stages or as an integrated aluminium industry. The duties also include laboratory testing of bauxite samples.

## Swaziland

4. Contractor: Alfa-Laval A.B. (Sweden) — $27,000
   Country: Swaziland

Project: Services in connexion with the installation and commissioning of a tall oil production plant

One of the main by-products of the Usutu Pulp Mill at Bhunya is sulphate soap, disposal of which presents a problem. Since there exists a process for splitting the sulphate soap to yield crude tall oil for which there is a world-wide demand, the Government of Swaziland has requested UNIDO assistance in providing a complete layout for such a plant and initiating its production of crude tall oil. The consulting firm is required to prepare the site layout and plans for the factory, draw up detailed specifications for ancillary equipment, supervise local contractors in the assembly and installation of the various plant items, carry out tests to ensure proper functioning and instruct the plant manager on operation and maintenance.

### Senegal

5. Contractor: Norris Consultants Ltd. (United Kingdom) $12,000
   Country: Senegal
   Project: Assistance in the utilization of rattan cane

As part of the UNDP assistance programme to the Société nationale d'études et de promotion industrielles (SONEPI) in Senegal, this UNIDO-executed project covers the industrial use of locally grown rattan cane. The contractor is to advise on harvesting and pre-treatment methods, use of rattan for furniture and other products and to train personnel.

### India

Under financing from the Indian voluntary contributions to the UNIDO General Trust Fund, the following contract has been concluded:

6. Contractor: National Institute for Training in Industrial Engineering (NITIE), India $7,500
   Country: India
   Project: Study on computer utilization in the manufacturing industries

The object is to identify the areas of utilization of computers as related to the industrialization of India and developments during the last ten years, analyse problems, recommend corrective measures and ensure effective implementation of these recommendations. The contractor will also prepare guidelines for undertaking similar studies in other developing countries, to be used by UNIDO.

### *UNIDO Newsletter*

7. Contractor: State Committee of the USSR Council of Ministers for Science and Technology (GKNT), USSR $2,200
   Project: Russian edition of the UNIDO monthly *Newsletter* 1972

This is the second such contract placed with GKNT. It is financed from the Soviet voluntary contribution to UNIDO and covers translation, printing and distribution of the *Newsletter*.

# Calendar of Meetings

**International Conference on Reinforced Plastics**

Freudenstadt, 2–6 October. The Secretary, Association for Reinforced Plastics, Niddastrasse 44, 6000 Frankfurt-am-Main, Federal Republic of Germany.

**Symposium on Deformation and Rupture of Solids Subject to Multiaxial Loads**

Cannes, 4–6 October. Mr. R. G. L'Hermite, Secretary General, International Union of Testing and Research Laboratories for Materials and Structures, 12 rue Brancion, Paris 15e, France.

**Sixth Annual Iron and Steel Conference**

London, United Kingdom, 9–12 October. Mr. P. A. Benoit, Deputy Secretary General, International Iron and Steel Institute, Place du Champ de Mars 5, B–1050 Brussels, Belgium.

**International Deep Drawing Research Group Biennial Congress**

Amsterdam, Netherlands, 9–13 October. Mr. J. Hooper, Honorary General Secretary, International Deep Drawing Research Group, 17–19 John Adam Street, London W.C.2, England.

**Seventh Machine Tool Conference**

Budapest, 9–14 October. Scientific Society of Mechanical Engineers, P.O. Box 451, Budapest 5, Hungary.

**First Pacific Chemical Engineering Congress**

Kyoto, Japan, 11–14 October. American Institute of Chemical Engineers, 345 East 47th Street, New York N.Y. 10017, United States.

**Colloquium on Increasing (Glass) Furnace Output**

Sheffield, 25 October. Mr. D. Hoawksworth, Society of Glass Technology, Thornton, 20 Hallam Gate Road, Sheffield, England.

**Symposium on Jet Pumps and Ejectors**

London, 1 November. Mr. H. Stephens, BHRA Fluid Engineering, Cranfield, Bedford, England.

**International Electrotechnical Commission General Meeting**

Athens, Greece, 31 October–11 November. Mr. C. J. Stanford, General Secretary International Electrotechnical Commission, 1 rue de Varembe 1211 Geneva 20, Switzerland.

**Twelfth Congress and Exhibition on Automation and Instrumentation**

Milan, November. Federation of Scientific and Technical Associations, Piazzale Rodolfo Morandi, 2–20121, Milan, Italy.

**Third Conference on Plastics in Machinery and Vehicle Industry**

Budapest, 4–9 December. Scientific Society of Mechanical Engineers, P.O. Box 451, Budapest 5, Hungary.

**Twenty-First International Wire and Cable Symposium**

Atlantic City, New Jersey, 5–7 December. Mr. J. Spergel, Co-Chairman International Wire and Cable Symposium, US Army Electronics Command, Attn: AMSEL-TL-ME, Fort Monmouth, New Jersey 07703, United States.

**American Society for Testing and Materials Meeting**

Mexico City, Mexico, 10–15 December. Mrs. Joan McFadden, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103, United States.

**Indian Rubber Manufacturers Research Association Sixth Technical Seminar**

Madras, 18–20 December. Dr. Dankar, Officer-in-Charge, Indian Rubber Manufacturers Research Association, Plot B-88, Road A, Wagle Estate, Thana (Maharashtra), India.

**New Zealand Hydrological Society Symposium**

New Zealand, December. Mr. G. J. Blake, c/o Ministry of Works, New Zealand Hydrological Society, P.O. Box 12041, Wellington, North, New Zealand.

**Second International Symposium on Road Vehicle Aerodynamics**

Cambridge, 4–5 January. Mr. H. Stephens, BHRA Fluid Engineering, Cranfield, Bedford, England.

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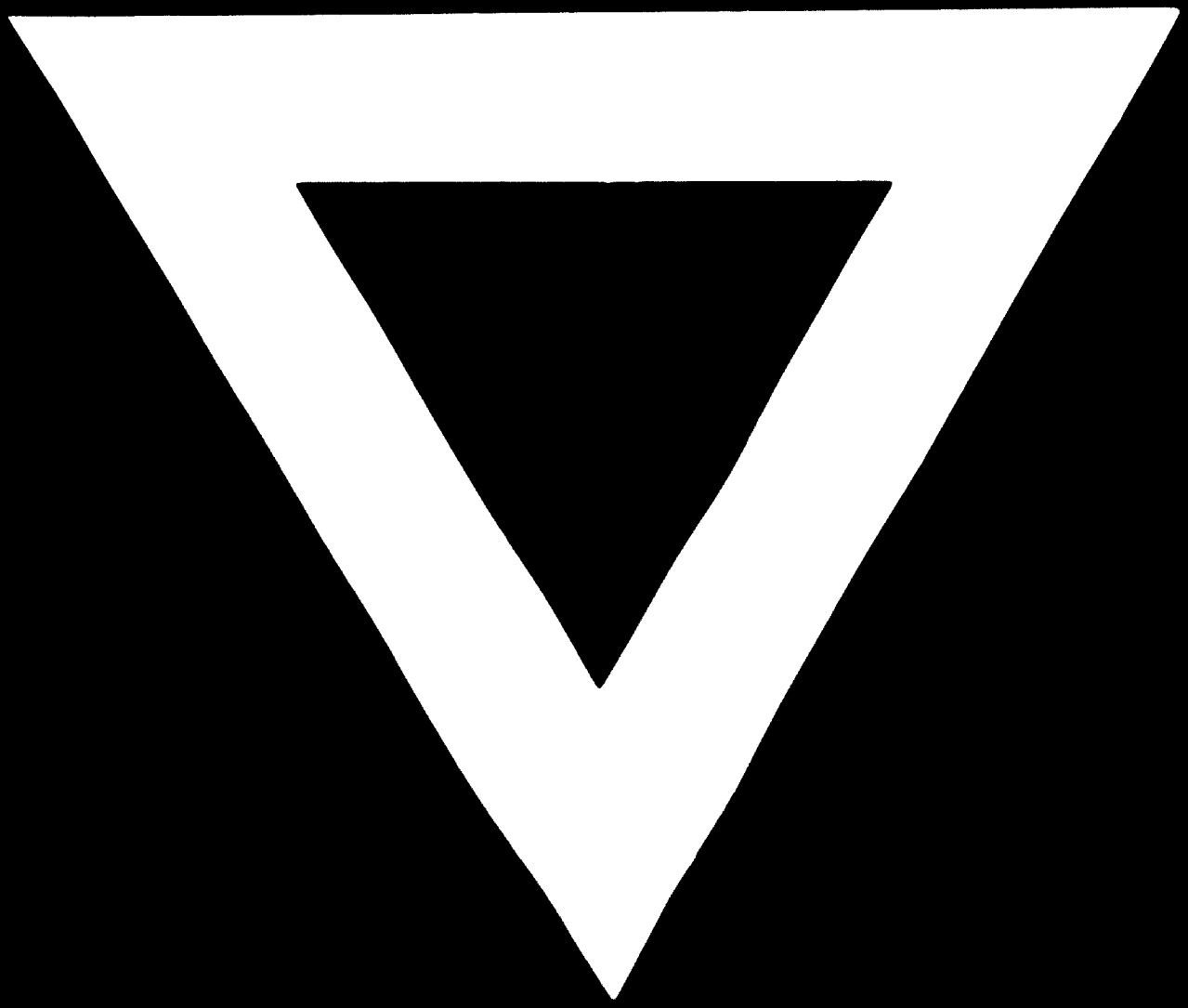

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