Survey of Research Activities

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Foreword

This report gives a survey of the research carried out by the Netherlands Central Organization for Applied Scientific Research (TNO).
The organization plays an active part in the process of continuous innovation in our industrial society. Teams of experts specializing in product innovation and services, are available. They are experts on micro-processors and computer systems, are well aware of the markets and have expertise in industrial design and production.
Attention to good quality is also of importance in this context.
Research in the fields of labour, nutrition, health, safety and the environment is also carried out. In the past few years special attention has been paid to energy saving and biotechnology.
The report is based on the situation as at the start of 1982. Specific data and information can be obtained from the TNO Guide, whose address and telephone number we give opposite.
The addresses and telephone numbers of the TNO institutes are listed at the back of this report.

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Prof. dr. ir. A. Rörsch
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Health Research
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Industrial Products and Services
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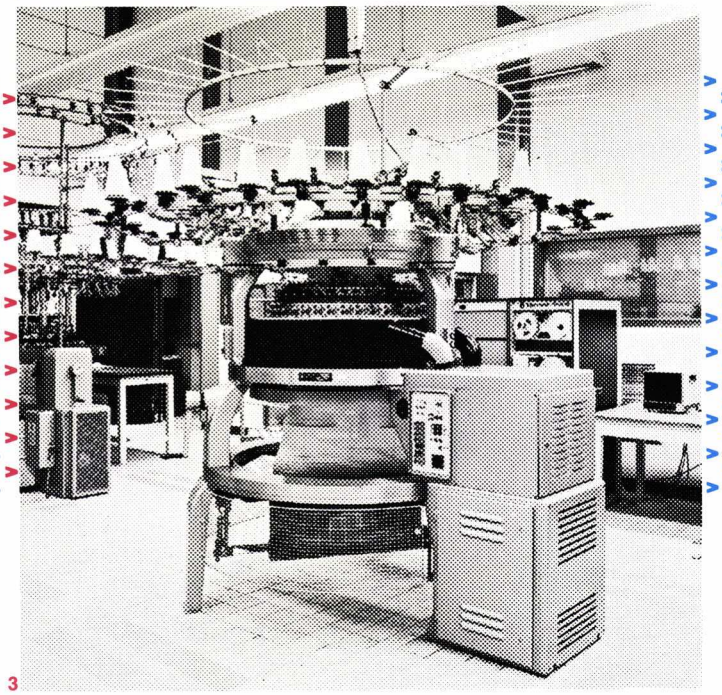
Ir. H. de Zeeuw

Nutrition and Food Research
Prof. ir. B. Krol

Group Policy Studies and Information
Prof. W.C.L. Zegveld



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1/2. The cover photographs show some of TNO's important fields of activities.

3. Using the computer-controlled circular knitting machine, the Fibre Research Institute is pioneering new activities for the textile industry.

Industrial Technology and Innovation

Industrial products and services

The Division for Industrial Products and Services (IPD) comprises a number of institutes which each, to a greater or lesser extent, work on matters relevant to a particular trade or industry. These institutes are concerned with industrial technology in a variety of ways. This section of the report deals with the product and the production process in the narrower sense. Matters such as energy, the environment and safety are discussed under these headings in subsequent sections of the report. This restriction also applies in the case of the other divisions which are mentioned in this part of the report.

A significant proportion of the services provided relates to quality and quality control. The cost of these services is about 12 million guilders, three quarters of which is provided by external funding. Two thirds of the total sum is spent on activities which are carried out within the framework of product evaluation and tests for the comparison of consumer goods. A great deal of the work carried out relates to production processes and procedures, the drawing up of specifications and test methods and the evaluation of quality control systems, as well as other topics.

In the light of changing market demands, a review of the services offered by the IPD Division has been carried out this year. One of the changes being introduced relates to the way in which products are evaluated. To date this has in most cases been carried out on the basis of the results obtained from tests on the end product. For reasons of economy, this type of evaluation is to an increasing extent now being made, wherever possible, on the basis of an audit of the design (or prototype), taken together with an evaluation of the system for quality control which is used by the particular supplier. The IPD Division is adjusting to these and other changes and now has in its employ a number of experienced auditors. It is intended gradually to increase the number of auditors employed.

These auditors frequently work in a team with specialists from other service agencies.

A number of interesting examples of product innovation within the IPD Division relate to special polymer blends and the development of the 'Periloc' machine. This machine can felt yarns, slivers and very voluminous 'yarns'.

In 1981 the Plastics and Rubber Research Institute was intensively engaged in the development of applications for hydrophilic polymer blends. The institute was able to co-operate with an establishment which was set up specifically to commercialize the various applications of this blending system. In the case of the following applications, development has reached an advanced stage:*

- hydrogels for a controlled supply of moisture to laboratory animals;

* Patents will be applied for in respect of other applications not mentioned in this report.

McKinsey: textielindustrie heeft omvangrijke overheidssteun nodig

Zonder omvangrijke gerichte overheidssteun is er nauwelijks perspectief om te overleven voor grote delen van de Nederlandse textielindustrie.

Tot deze conclusie komt het adviesbureau McKinsey in een rapport over deze bedrijfstak, gemaakt op verzoek van de minister van Economische Zaken.

In de textielindustrie waren in 1975 nog 53.000 mensen werkzaam. Begin 1981 was dat aantal gedaald tot 32.600 man. Een verdere vermindering met minstens 10.000 arbeidsplaatsen ligt in het verschiet voor de komende vijf jaar wanneer het beleid bij de ondernemingen niet veranderd wordt, zo moet uit het rapport geconcludeerd worden.

McKinsey kreeg een jaar geleden opdracht een beeld te geven van de commerciële en financiële positie van de bedrijven en de mogelijkheden aan te ge-

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Onderwater-lassen in hemdsmouwen

APELDOORN — Volgende week gaat het duikbedrijf Vriens op de bodem van de Oosterschelde stukken pijp aan elkaar lassen. De lassers zullen dat karwei in hemdsmouwen kunnen klaren, zij besturen de apparatuur op afstand. Als dat goed gaat, is het een wereldprimeur.

„Ik denk dat we op het ogenblik leidend zijn", zegt ing. Dick van der Torre, hoofd van de afdeling Lassen en solderen van TNO in Apeldoorn, waar de apparatuur ontwikkeld werd. Op een internationale vakbeurs onlangs zag hij nog niemand die op dit punt kon wat in Apeldoorn in de simulatietank wèl kan en wat nu in de barre praktijk moet worden gedemonstreerd.

Een markt is er zeker. Er liggen voor het Nederlandse continentaal plat naar schatting voor tien miljard gulden investeringsplannen. „En de ervaring leert dat een derde daarvan pijpwerk is." De techniek is eigenlijk ontwikkeld voor reparaties aan pijpleidingen. Maar er blijkt ook levendige belangstelling te zijn voor produktiewerk. Het is dan de bedoeling, secties van één of twee kilometer in rustig water klaar te maken („in een fjord of zo"), die naar hun plaats te varen en ter plekke aan elkaar te lassen. Dat zou goedkoper zijn dan de huidige techniek met een pijpenlegger, die een kwart miljoen gulden per dag kost.

De techniek van het op afstand bestuurd lassen is ontwikkeld in het kader van de snelle kweekreactor (Kalkar), waar in een radioactieve omgeving inspecties en reparaties mogelijk moeten zijn. De onderwater-versie, in 1976 begonnen, is een project van 1,4 miljoen gulden dat voor de helft wordt betaald door het ministerie van economische zaken, voor de andere helft door TNO en enkele geïnteresseerde bedrijven. Dat is exclusief de praktijkproef van volgende week, die 0,7 miljoen vergt, wat illustreert dat de ontwikkelingskosten bescheiden zijn geweest.

De onderwaterlasser ziet op een tv-scherm in kleur van twee kanten tegelijk wat hij doet. De kleuren zijn niet natuurgetrouw („we moesten een paar optische trucjes bedenken om de grote lichtverschillen in één beeld te krijgen") maar leveren alle informatie die hij nodig heeft om perfect werk te maken. De gebeurtenissen spelen zich af in een drooggeperste stalen kamer die, wel door duikers, om de laspiaats heen is aangebracht.

Het operationele prototype is geschikt voor werkdiepten tot 200 meter. Voor lassen met de hand geldt dat een duiker op 150 meter al zodanige fouten maakt dat de kwaliteit onaanvaardbaar wordt.

Maar, aldus Vriens, wij willen beginnen op het Nederlandse en Deense plat, waar de diepten tot vijftig meter gaan. Daar wordt nu met de hand gelast, maar „dat is niet de manier om het te doen".

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4. 'McKinsey: The textile industry needs substantial government aid' The problems faced by the textile industry are regularly reported in the newspapers. The Fibre Research Institute is currently engaged on a number of projects aimed at modernization and increasing productivity. Attention is also being paid to the development of new products.

5. 'Underwater welding in shirt-sleeves' The press were complimentary about the system developed by TNO for remote-controlled welding under water. An article appeared under the above headline in the 8th October 1981 edition of the daily newspaper 'Trouw'.

- 'controlled release' for use in agriculture. This application has been succesfully tested in field trials. The use of these blends for making insecticides selective has been developed on a laboratory scale;
- rapidly degradable shrouds. Development work will be continued;
- readily decomposable bags for 'stoma' patients (bags can be flushed down the toilet). There is good reason to hope that a solution will soon be found to this difficult problem;
- sausage skins for cured sausages. Further development of these casings will depend on whether or not financial support is received from the industry;
- synthetic skin (in connection with burns; a hydrophilic polymer blend acts as a moisture-regulating top layer).

In collaboration with the textile industry and the International Wool Secretatiat, a new method has been developed for the continuous felting of yarns. This revolutionary method has now been implemented in the Periloc machine, which has already been mentioned. This machine is suitable for felting all types of wool and wool blends, used in the manufacture of carpets and other products (e.g. hand-knitting yarns and yarns used in the furniture industry). Carpets made from Periloc yarns not only have high wear resistance coupled with low fibre loss but also retain a good appearance for longer time. Furthermore this process offers a number of new possibilities to carpet designers when developing new styles and structures. The process is a result of intensive research and development carried out by the Fibre Research Institute.

Industrial design and production processes

The computerization of industrial design and production processes is an important field of work for the Institutes of the Division for Building and Metal Research. New subjects are continually being tackled in this field, frequently in consultation with industrial groups. Methods which have already been developed are further refined and offered to the industry.

The 'remote controlled welding' project was a milestone for the Metal Research Institute. In early November 1981 a demonstration designed to show the possibilities offered by this system was given to the press in the Eastern Scheldt. Other welding research related to the use of microprocessors for the automation of induction welding and other machines. A project on gas shielded arc welding was also carried out in collaboration with the Netherlands Institute for Welding. The CAM (computer aided manufacturing), MICLASS/MIPLAN (planning) and MITURN (N/C lathe programming) systems have been further optimized. The CAM system in particular has been widely known in the USA for a number of years now, partly as a result of the close collaboration with the Organization for Industrial Research in America.

6. The mouth of the 'Waterweg' is one of the harbour mouths which has very heavy traffic. TNO developed mathematical simulation models for a good piloting system.

Within Europe there is now also a considerable growth in interest. Particular interest has been focussed on MITURN because a 'background' version of the program has been made operational and has resulted in a substantial saving in costs for the users.
Research into the possible applications of micro-computers in metalworking technology has also led to the development of 'computer aided design' (CAD) software for simple graphics on display screens. This software costs a fraction of the price of the programs currently on the market; it can therefore be of particular interest to small and medium-sized firms. The intention is to combine the MITURN and MICLASS systems with these low-cost graphics.
The Institute for Mechanical Constructions was involved in the work on the CAD/CAM systems. One of the areas in which work was carried out by this Institute was the automated design of force-measuring (transducer) elements with the aid of a computer-controlled drawing system.
The Institute for Building Materials and Building Structures was given the go-ahead by the Ministry of Economic Affairs for a CAD/CAM demonstration project in the field of steel structures. A firm of consultant engineers and three workshops engaged in the manufacture of steel structures are also involved in this project.
The 'CAD/CAM terminal' project instigated by this Institute has now led to the construction of a basic terminal, which is known as 'Geminix' and offers highly flexible facilities at low cost.
The increased scale and complexity of many processes and systems is reflected, in particular, in the type of work which the Institute for Mechanical Constructions is commissioned to carry out.
Frequently the work requested relates to processes and systems where the requirements to be met are conflicting and concerns a complex interaction between partial systems. The mass of information and data supplied is then processed in the appropriate manner to enable correct decisions to be taken when designing and operating the process. The design of the process and of the process operation, control and strategy requires an integrated approach. In the field of activities in which the Institute for Mechanical Constructions is engaged, this means the integration of techniques from theoretical and experimental mechanics, control and simulation techniques and measurement and regulating techniques.

Simulation techniques

One example of a complex project in which this integrated approach can be seen is a project which was completed in 1981 and involved the design and construction of a ship motion simulator: a moving platform for testing the efficiency of a fractionation column for operation at sea. Other examples which also entail product innovation are the design of an automatic recording system for shock measurements and, in the field of flexible automation (robotics), the design of machinery for a production line for the slaughter of pigs. Other design activities included calculations on vibration in ships, hydraulic systems and hoisting cranes and the improve-

TNO gaat op zakelijke basis samenwerken met bedrijven

Hoe stimuleren wij onze export, en vooral de export van kennisintensieve produkten, dat was de centrale vraag die ir M. J. Spanraft, lid van de Raad van Bestuur van TNO, zich stelde tijdens een recent gehouden lezing over „know how in de export" in het Rotterdamse Wereldhandelscentrum.

Als bestuurder van het TNO benaderde ir Spanraft de exportproblematiek vooral vanuit de invalshoek van de toegepaste wetenschappen en de technologie. Een belangrijke oorzaak voor het achterblijven van de export van kennisintensieve produkten is volgens hem het transfer-probleem, de grote afstand die er bestaat tussen wetenschap en bedrijfsleven. Volgens ir Spanraft kan het TNO een aandeel leveren in de oplossing van dit transferprobleem, door in zeer nauwe samenwerkingsverbanden te treden met ondernemingen.

In zijn lezing zoekt ir Spanraft naar oorzaken, die ertoe geleid hebben dat het „Miracle Hollandais", de ontstuimige groei van de Nederlandse economie in de jaren vijftig en zestig, is gestopt en in vele gevallen zelfs in het tegendeel is omgeslagen.

Als eerste noemt hij de veranderingen in exportmogelijkheden door de opkomst van de Derde Wereldlanden. Daarnaast wijst hij op de afneming van de herkenbaarheid van het Nederlandse

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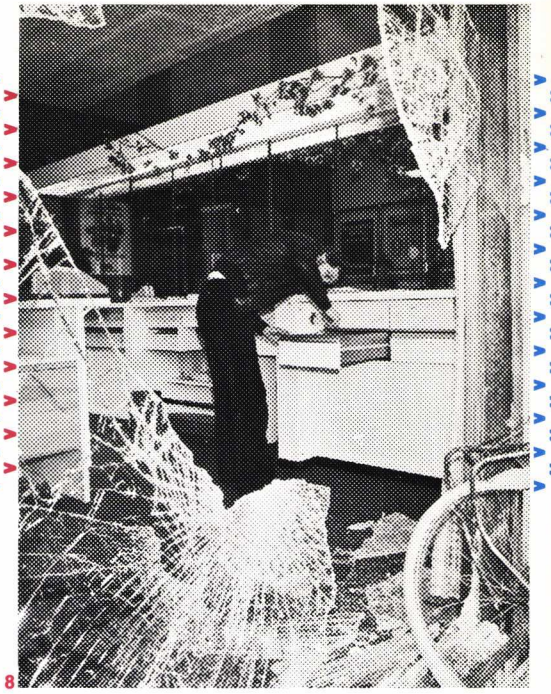

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7. 'TNO sets up frameworks for collaboration with industrial concerns' In the year under review TNO also paid attention to the development of structural frameworks for collaboration with the industrial sector. 'Know how in export' was the subject for discussion in the World Trade Centre in Rotterdam on 21st October.

8. It is not infrequently the case that plate glass proves to be the weak point in an otherwise well protected building. TNO has developed a glass/plastic/glass laminate which is extremely difficult to break.

ment of methods for the calculation of shock. In the marine and offshore constructions sector automatic control systems have been designed (frequently with the aid of simulation techniques) for a submarine and a drilling ship for the mining of metallic nodules. Recommendations have also been made on the condition monitoring of propulsion machinery in a submarine. With the aid of the ship's engine room simulator which is operated by the Institute, a start has been made on a study of the functions to be carried out by operators in automated systems. Examples of complex systems for which mathematical simulation models are also used are the Vessel Traffic Management System (VTMS) in the port of Rotterdam and the analysis of vessel traffic in the Western Scheldt. Design specifications have been drawn up for a simulator for a submarine central control room to be constructed for the Royal Dutch Navy. Design specifications have also been drawn up for a new ship's bridge simulator, which is to be manufactured, operated and financed jointly with the Ministry of Education and Science.
A start has been made on extending the application of the knowledge which has been gained in the fields of control and simulation to areas outside shipping and offshore fields and in particular to mechanical installations in power generating plants and the processing industry and to complex systems in general.
Partly because the demands in respect of accuracy are becoming much more stringent, both the development of force transducers - such as a transducer for use in very deep water - and measurement with these transducers on offshore installations are becoming more complex. To enable these more stringent demands to be met, calibration facilities are currently being improved. There is an increasing demand for stretch and force measurements, not only in the offshore sector but, for example, also in the processing industry. The fact that complex systems are in use frequently means that a complex control and monitoring system is required. Measuring and regulating instruments are following this trend. These instruments, often fitted with microprocessors, are being submitted for evaluation in ever increasing numbers.
The Metal Research Institute has a special department engaged in work on casting techniques for practical application. This department has made significant progress with regard to the development of permanent casting moulds.

Technical-scientific services

A good example of the research in the field of industrial technology which is carried out within the Division for Technical-Scientific Services is the work of the Institute of Applied Physics TNO-TH on improving and modifying the surface characteristics of glass products and the quality control procedures used for these products.
Dissemination of information on the possible applications and the safety aspects of safety glass is something to which the Institute has given a great deal of time. The Institute also received a large number of requests for tests relating to safety glass. A great deal of interest was shown in laminated safety glass. This product

Nederland een chipsnatie? Weinigen geloven daarin. Men vindt dat het maken van chips thuishoort in de Verenigde Staten en in Japan, alsof dat een natuurwet is. Deze bescheiden, respectievelijk negatieve benadering die voorbijgaat aan de leidende rol die Philips speelt, is volstrekt onterecht en getuigt van weinig inzicht in de veranderingen die gaande zijn. Nederland heeft alle instrumenten in huis om in te spelen op de toenemende vraag naar chipsproducerende apparatuur en naar chips die zijn toegesneden op toepassing of klant. H. J. Bosch, medewerker van het Transferpunt van de Technische Hogeschool Twente, onderzocht in opdracht van het Ministerie van Economische Zaken de mogelijkheden.

Nederland niet uitgespeeld in elektronika-industrie

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9. 'The Netherlands have not yet had their day in the electronics industry'
On 25th July 1981 the weekly 'Elseviers Weekblad' published a full page of information on the possibilities available within the Netherlands for micro-electronics. This is a field in which a number of TNO institutes are working. The TNO Centre for Micro-Electronics acts as the linking agency between these various institutes.

consists of two or more sheets of glass with a layer of tough plastic between every two sheets of glass. Nowadays this type of glass is not only used in the car industry but is also playing an increasingly important role in providing protection in banks, offices, computer rooms, etc.
Research was also carried out on the safety of thermally toughened glass using ultra-rapid photography. This type of safety glass is frequently used in ovens. It is obtained from ordinary glass by subjecting this to a special heat treatment. The effect of the material in which this glass is mounted on the safety characteristics has been established and the Institute has been able to draw up recommendations on measures which can be taken to further improve safety. Finally, there was once again a high demand for the facilities for testing the quality of the various types of edge seals used by the manufacturers of insulating double glazing.

Application of micro-electronics

In line with the policy of the TNO Board of Management, which is aimed towards concentrating work in the micro-electronics field to a certain extent within the Division for Technical-Scientific Services, initiatives have been taken by the Institute of Applied Physics TNO-TH in particular. One result of these initiatives has been a reorganization within the Institute. Preparations have also been made for the transfer of a number of electronics engineers from other TNO departments to this Institute. Discussions in depth have been held with the Delft University of Technology on the establishment of a Centre for Sub-micron Technology at this university. The increasing influence of micro-electronics was reflected in many research projects and in the development of new sensors. In close collaboration with the Delft University of Technology, the Institute has set up its own facilities for developing micro-electronic circuits.

Innovation

Within the Division for Technical-Scientific Services, it is Instrumentum in particular which is responsible for product innovation. This product development institute is being faced to an increasing extent with new subsidiary requirements which have to be met if a new process is to prove successful. The most important of these requirements are:
- efficient use of energy in the production process;
- minimum pollution resulting from the production process;
- the user-friendliness of a product
- optimum use-value and
- optimum life.

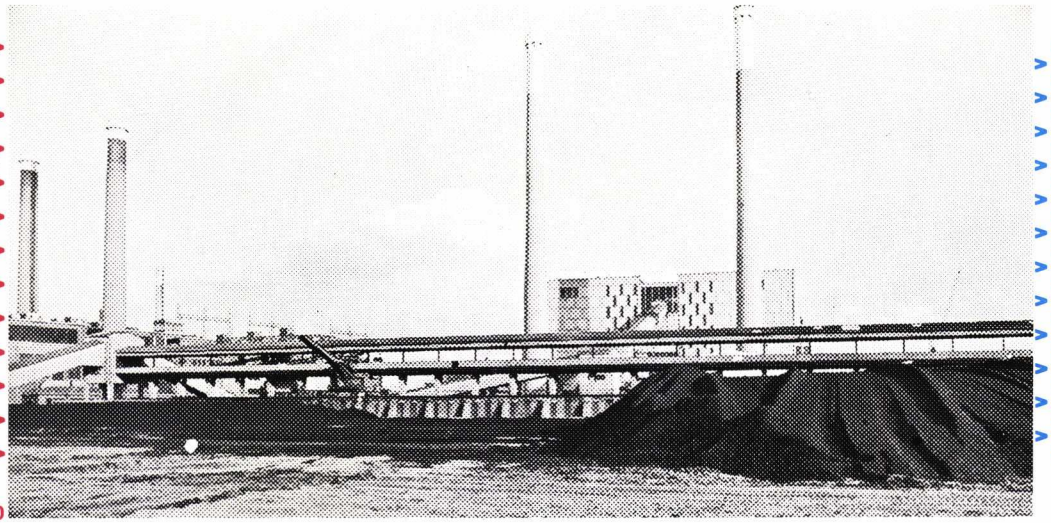
In the light of these subsidiary requirements, the considerable importance of the linking function of Instrumentum was once again significant in the year under review: the work of this Institute ranges over both the acquisition of know-how and the practical application of new concepts. The Institute once again had a successful year: work was carried out not only for other TNO institutes but also for a large

number of outside clients. The shift away from mechanical towards electronic equipment, frequently based on micro-electronics, has continued. In the field of automated production control also there has been a similar shift away from mechanical scanning and towards opto-electronic sensing. The following examples are just some of the projects carried out by the Institute in the past year:
- the design of small household equipment, such as a grill-oven, a vacuum cleaner, an adjustable suction tube for a vacuum cleaner and a coffee-maker, was commissioned by a large industrial concern;
- a system for the recognition of bank notes was developed and a working model was produced in collaboration with the Institute of Applied Physics TNO-TH;
- a study on the use of tickets which can be scanned by machine was carried out and draft proposals for new equipment were drawn up; this study was commissioned by the Ministry of Transport and Public Works in connection with the cancellation of the multi-strip tickets used on buses and trams throughout the Netherlands;
- in collaboration with the Institute for Mechanical Constructions, a team was set up to work on Computer Aided Design ('CAD') in connection with the design of mechanical equipment;
- in collaboration with the same Institute, measuring equipment was manufactured to study the dynamic characteristics of a very long pump shaft. Rotor dynamics plays a substantial role here;
- a 'badge sampler' was designed for the Radiological Service Unit and four of these samplers were manufactured for use in processing large numbers of 'TLD' badges for recording the radiation dose received by workers exposed to radiation. The level of exposure to radiation can be monitored efficiently by recording the radiation in this way.

Policy studies

Within the Group Policy Studies and Information, the Centre for Technology is engaged in innovation issues. Projects have been carried out on behalf of the Ministry of Economic Affairs, the Minister of Science Policy, the European Economic Community, and the Organization for Economic Co-operation and Development. An analysis to determine the strengths and weaknesses of the Dutch metal industry was completed. This project was commissioned by the Division for Building and Metal Research. A project relating to technology and regional development has been carried out in collaboration with the Netherlands Economic Institute in connection with the EEC - FAST programme.

At the end of 1981 agreement was reached between the (external) steering committee of the Industrial Innovation Project and the Ministry of Economic Affairs on the extension of this project. TNO provides staff and services for the supervision of this project. The extension of the project affects the Innovation Advisory Group (IAG) of the Centre of Technology and Policy. The IAG provides



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10. The PGEM power station in Nijmegen changed over to coal firing several years ago. A number of other Dutch power stations will be doing the same. TNO is working on solutions to the problems associated with the introduction of coal into our energy system.

11. 'TNO given funds for petrol/alcohol trial with car engines' Back in 1980 TNO attracted a great deal of attention with a device which provides a possibility for filling up with either petrol or alcohol. A sensor and the necessary micro-electronics ensure that the fuel reaches the engine in the correct fuel/air mixture; the engine works happily whether it is supplied with petrol or alcohol or a mixture of the two.
In 1981 the 'Utrechts Nieuwsblad' reported on 5th October that the Ministry of Economic Affairs had commissioned TNO to carry out further development work on the system.

back-up services for the consultants involved in this project and studies the progress made. This back-up role will be continued in the future. In 1981 the IAG also provided consultancy services for clients from the industrial sector.

Biotechnology

Recent developments abroad in the field of biotechnology have been such as to constitute a threat that the level of knowledge and the industrial potential in the Netherlands will fall behind those in various other countries to an unacceptable degree. For this reason a multi-discipline group has been set up within TNO in close collaboration with the former Ministry of Science Policy and the Ministry of Health and Environmental Protection. Ten departments and institutes drawn from the Divisions of Technology for Society, Nutrition and Food Research and Health Research are involved in this group.
The main topics under study are: the immobilization of enzymes and enzymatic two-phase reactors, biotechnological degradation of cellulose-containing waste (the aim being the production of ethanol), and the removal of heavy metals from the fly ashes produced in coal-fired power stations.

Technology for society

The Division of Technology for Society supports activities in the industrial sector in various ways. The solution of odour problems in the Nederlandse Bank building and research into the formation of nitrosamines on activated carbon filters of the type used in kitchens are but two examples.
Development work on a radial blade mixer for industrial applications has led to an extremely practical solution to the problem; a patent has been applied for.
Elaborate flow measurements have been carried out on the canals of various lock systems for the Public Works Department (Rijkswaterstaat). For some measurements use has been made of a simulation model with air flow. Two research units in the electronics sector, i.e. the computerization unit and the communications unit, were transferred from the Division of Technology for Society to the Division for Technical-Scientific Services. For the former these transfers marked the end of a period in which a great deal of innovative industrial research had been carried out. Some of the more striking projects in 1981 involved work on a fuel-mixture sensor, an electronic control device for a heat pump system, a de-frosting sensor for refrigerator freezers, a muskrat detection system, a specific set-point programming control system, a control system for a cheese factory, and central heating systems. Microprocessors have been used extensively in the development of this equipment.

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12. Waste paper can supply a considerable proportion of the raw material needed to make new paper. TNO has been involved in work on measures which will ensure energy-conscious paper-making, in part with the utilization of waste paper.

Energy

Energy research at TNO is concentrated on energy saving, coal and new sources of energy, such as solar energy and geothermal heat. Attention is also devoted to the application of alternative fuels and of nuclear energy.

Energy saving

One of the subjects to which the Division of Technology for Society is directing its attention is the heat pump. A study on the applications of heat pumps with no moving parts has shown that the absorption heat pump is clearly to be preferred to other types. A physico-chemical evaluation of combinations of refrigerants led to the conclusion that the ammonia/water (NH_3/H_2O) combination has first consideration for application in such pumps. A test set-up for generator testing is now ready for use. Research on a gas-engine driven heat pump has now entered the second heating season. Installations in a building project in Spijkenisse have been evaluated and tests have been carried out to determine the efficiency of floor heating systems from the energy consumption view-point. Tests were also carried out on the use of the earth as a heat storage buffer for heat pumps and on the consumption of energy by asphalt mixing installations. Studies to establish the possibilities for energy saving in shipping and domestic appliance have also been carried out.

A large-scale research project on the operation of thermostatic radiator valves, which are extremely important for domestic use, has been completed. A study on the heat balance of indoor swimming pools (which was followed by measurements and an opinion poll on the comfort of indoor swimming pools), which was carried out in Culemborg, gave results which attracted a great deal of interest. The majority of the activities mentioned receive support from the Ministry of Economic Affairs and the Ministry of Housing and Physical Planning. The dynamic behaviour of heat transport meters has been evaluated in collaboration with PEGUS, a power company in Utrecht. Further subjects of investigation have been the dynamic behaviour of heating installations and the results achieved by heat-saving measures in newly built houses. Measurements in one such project in Almere have now entered the second season.

In the refrigeration sector, energy saving in compressors, the storage of cold in refrigerators, and the emission of fluorohydrocarbons were studied. In addition, a new method for energy saving in open display cabinets for shop use has been developed by modifying the air-curtain which is required for this equipment.

With regard to energy saving research in the industrial sector, six asphalt mixing installations have been assessed. Recommendations have been made to three companies. Activities of this nature were also undertaken by the Division of

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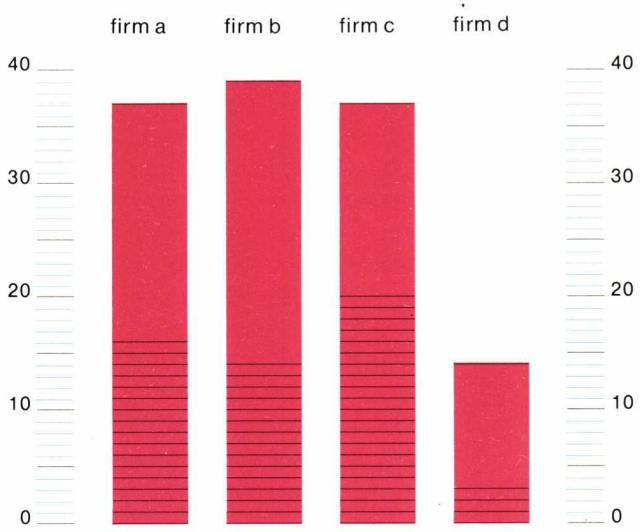
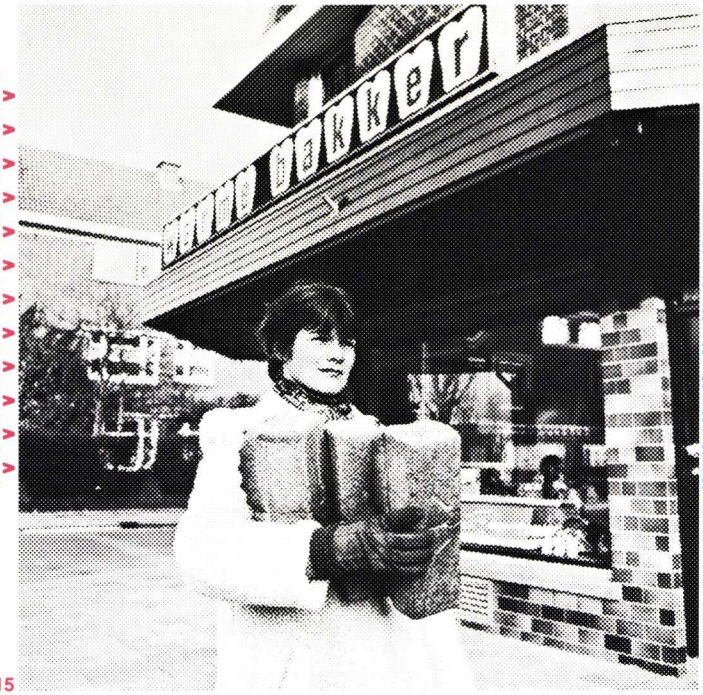
14. A ship with substantial fouling below the waterline uses considerably more energy than a ship with a smooth hull. TNO is working on the development of anti-fouling paints.

Industrial Products and Services. Two examples relate to the paper and cardboard industry and the fibres industry.

Approximately 80% of the paper and cardboard used in the Netherlands is produced by the Dutch paper and board industry (annual production 1,700,000 tonnes). More than 50% of the raw material required comes from within the Netherlands and in the main consists of waste paper.
Energy costs for the paper-making industry currently amount to 30% of the value added. Since, moreover, energy charges in the Netherlands are higher than those in the surrounding countries, energy saving is of vital importance. The initiative for joint research to look into the possibilities which exist for energy saving was taken by the industry itself after the first energy crisis. This research has been vigorously supported by the Ministry of Economic Affairs. Over an approximately four-year period, a team of researchers drawn from the Fibre Research Institute and the Association of Users of Water, Heat and Power ('Vereniging Krachtwerktuigen') examined and tested 51 paper and board machines (accounting for 82% of the Dutch paper and board production). The efficiency of each machine was determined with the aid of measurements and on the basis of the results obtained energy-saving measures were proposed. The total savings proposed amounted to 15% of the energy consumption, or 80 million m^3 of natural gas per year.
Partly as a result of this investigation, paper makers, who have always been alive to the need for productivity, have recently also become energy-conscious.
Just as with the paper and board industry, a rise in energy prices led to a substantial increase in costs in the energy-intensive textile finishing industry (bleaching, dyeing, printing and finishing). For this reason the branch organization for the cotton, rayon and linen industry commissioned the Association of Users of Water,

13. Percentage savings in annual energy costs
Shaded column
Percentage saving without investment
Total column
Sum of the percentage savings without and with investment





15

15. It takes a great deal of fuel to produce the bread eaten by fourteen million Dutch. TNO is looking into how we can cut energy consumption and still enjoy our daily bread.

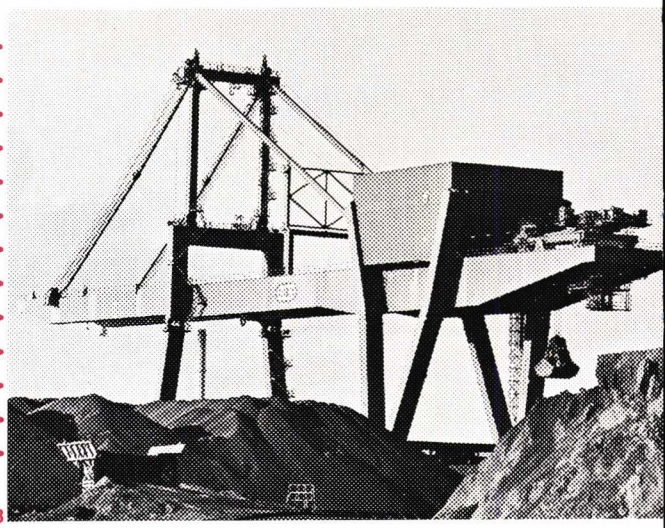
Heat and Power ('Vereniging Krachtwerktuigen') and the Fibre Research Institute to carry out research into the possibilities of energy saving in this sector. Seventeen mills participated in this project, which was financed by the Ministry of Economic Affairs. The research results, which relate to four mills, show that substantial energy savings are possible, as illustrated in the bar chart given on page 16. These measures will pay for themselves in less than two years.
Fouling by vegetable and animal organisms is a normal phenomenon on ships and constructions in the sea. With progressive fouling the surface becomes increasingly rough. For ships at sea this results either in a higher fuel consumption or in a loss of speed. Information provided by shipowners shows that over a two-year period between dry docks fouling can easily give rise to a loss in speed of half a knot for a supertanker. This corresponds to a loss of approximately f1 million per period. Virtually the only method employed to combat the build-up of organisms is the use of paint systems which contain a substance toxic to the organism responsible for fouling. This substance diffuses to the outside and kills the organisms which settle in the boundary surface between the top coat of paint and the seawater. The Paint Research Institute is conducting research in this area with the aim of improving anti-fouling paints by making increased use of organo-tin polymers as binders. The rate of decomposition of these binders can be varied, and by this means a continuous release of the toxic substance can be guaranteed. Moreover, as the polymer layer 'wears' the surface becomes smoother. The institute has developed equipment with which the roughness profile on the underwater section can be determined easily. Measurements are carried out on a more or less routine basis for a number of shipowners and shipyards and serve, inter alia, as a 'quality control' on the maintenance in drydocks. The effect of the roughness and the roughness profile on the frictional resistance of a ship is being studied in collaboration with bodies such as the Netherlands Ship Model Basin (NSP) and the Royal Dutch Navy. This research is being carried out with the aid of cylinders rotating in seawater, the frictional resistance being determined by measuring the torque.
The Division for Nutrition and Food Research has been investigating the possibilities for energy saving in the nutrition sector. An energy study of breadmaking has been started with a subsidy from the Netherlands Bakeries Foundation and the EEC. The energy consumption at a large number of points in the production process is being measured in a dozen bakeries and pastry manufacturers. The information already obtained has been incorporated in lectures which are held for Dutch bakers' associations.

A study on the possibilities for energy saving by the use of combined heat and power production in the oils and fats processing industry has been carried out with a subsidy from the EEC. An EEC subsidy was also granted for the study into the possibilities of energy saving in soya processing, which was already underway.

16

‚Nederland moet meer steenkool gebruiken'

17



18

16. The fluidized bed furnace is a coal-burning installation which does not pollute the environment. The possibilities offered by this furnace for industry and for district heating are good. TNO is carrying out practical trials with the fluidized bed furnace which has been built on the premises of the Apeldoorn branch.

17. 'The Netherlands must use more coal' At the start-up of the TNO fluidized bed furnace in Apeldoorn on 14th April 1981 Mr W.H.J. Tieleman, the Director-General for Energy at the Ministry of Economic Affairs, indicated that it is necessary to start using coal again. His remarks were taken up by the 'Eindhovens Dagblad'.

18. One of the problems associated with the reintroduction of coal into the Dutch energy system is the need to unload, store and further distribute the coal in the quantities required. Large unloading and loading stages and sites covering many acres are needed if coal is to be stored in an efficient and effective manner.

In the fisheries sector a study is being carried out to determine to what extent the storage temperature of frozen fish in cold-storage houses is unduly low. With the aid of a measurement system designed specifically for the purpose, it has also been shown that a better temperature control in cold-storage houses can result in considerable energy savings.
The Dutch malting industry has changed over from direct-contact heating with natural gas into indirect heating for the kiln-drying process. The reason for this was that the natural gas gave rise to nitrogen oxides (NO_x), which together with diamines, formed in the sprouting of barley, caused the formation of nitrosamines. However, a change-over to indirect heating involves a decrease in energy efficiency, and this made the introduction of energy-saving equipment, such as heat exchangers, worth considering. The National Institute for Malting Barley, Malt and Beer has found that where such equipment has already been procured by the malting industry it has indeed resulted in a more efficient use of energy.
The Institute of Applied Physics TNO-TH, which is part of the Division for Technical-Scientific Services, has developed a method of measurement for determining the thermal insulating quality of a dwelling. This method is based on the total heat balance for the dwelling. In general, the measurements can be completed in just a few days.

Coal

There are a number of problems associated with the planned large-scale use of coal as a raw material for energy production. Some of these problems are environmental and some are related to combustion. The working programme drawn up by TNO covers both of these aspects in detail. Some features of this programme are discussed in more detail below (the environmental problems are also discussed under the heading Environment).
Within the framework of the coal technology project, the major part of which has been commissioned by the Ministry of Economic Affairs, the Division of Technology for Society has completed the construction of the 4 MW fluidized bed furnace according to plan and has purchased the requisite coal (1000 tonnes) and limestone (25 tonnes) of the desired quality and pre-treated these were necessary. Defects in a number of components have delayed the acceptance tests. An initial provisional acceptance procedure has been carried out by evaluating sampling techniques over a period of five days with the plant in non-automatic, continuous operation and by producing residues once the equilibrium state had been reached.

A preliminary study, in collaboration with the Eindhoven University of Technology, to establish the optimum conditions with regard to additives has been carried out by studying the sulphation of three types of limestone using, inter alia, the scanning electron microscope in the analytical department. A TNO development in the field of dust collection was found to function adequately for dust particle sizes between 0.3 μ m and 5 μ m, with low pressure losses.

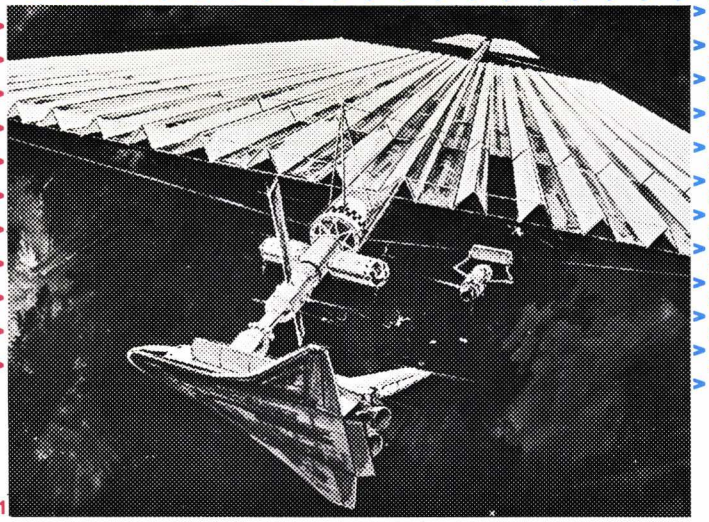
19

20

19. From the point of view of technology, coal mining in Limburg was at a reasonable level in the 1960s. The photograph shows semi-mechanical coal mining in Titan pillars. Whether or not the Limburg coalfields will once again supply raw material for the production of energy is something which depends on a large number of factors. TNO is drawing up an inventory of coal reserves in the Netherlands.

20. In 1981 TNO worked on a project for Philips in Eindhoven involving practical trials. In the houses on the right solar collectors on the roof collect energy which is used to provide hot water.
In the houses on the left tests were carried out to determine the possibilities offered by the recovery of heat from waste water.

The production of nitrogen oxides (NO_x) has been studied on a semi-laboratory scale. Development work has also been started on the determination of metallic elements (cadmium, chromium, copper and lead) in flue gases with the aid of an ICP (Inductive Coupled Plasma) spectrometer. In addition, a nickel carbonyl monitor has been developed, and the automatic analysis of polycyclic aromatic compounds with the aid of HPLC (High Pressure Liquid Chromatography) has been rendered operational. A feasibility study on the use of coal residues has been completed. An experimental installation for the recovery of aluminium from coal ash has also been constructed and leaching tests have been carried out on coal residues.
A great deal of attention has been paid to the possible harmful biological effects of fly ash, and research has been carried out into the enrichment of fifteen toxic trace elements in smoke-stock filters, as a function of the particle size. A study of the literature has also been made in respect of this topic.
Characterization techniques are indispensable for research into coal technology. For this reason one measure which has been undertaken is the statistical evaluation of sampling procedures. It has been found that in the case of Polish coal four to five sub-samples are necessary to determine the ash content with an accuracy of 0.5%. The automation of coal analysis has been considerably advanced by the use of FT/IR spectrometry (Fourier transformation/infra-red spectrometry) with the pertinent program and of a microscopic slide table with which the mechanism of motion is computer-controlled.
As a sequel to TNO activities within the framework of the Industrial Consultative Group for Energy-related Problems, TNO has collaborated in studies on the logistics of coal flows and the problems associated with coal(bulk) residues in the Netherlands.
The Division for Building and Metal Research is also actively involved in research programmes in the field of coal combustion and coal gasification. For instance, a number a preliminary studies have been carried out by the Metal Research Institute on the problems associated with the selection of materials for coal combustion and coal gasification plants. It has been found that it is to a significant extent the material characteristics which determine whether or not installations of this type will be reliable in operation. In the case of steam-generating equipment, a study has been carried out under realistic heat transfer conditions and the various structural materials which come into consideration have been tested to establish their resistance to stress corrosion. Special equipment has been constructed for testing the erosion characteristics of the material used for pipelines, pumps, etc. intended for transporting coal slurries. The materials which come into consideration for use are tested in this equipment under realistic conditions.



21. Man has high hopes of solar energy. American research workers employed by the Grumman company have drawn up plans for large energy stations in space. The majority of the research carried out by TNO in the solar energy field is directed towards the development of efficient solar collectors suitable for use in the everyday world.

23. Solar energy storage: the heat which passes into the ground via a helical coil in the soil is transferred to a storage tank by means of a heat pump system. This is just one of the technological aspects of the Veldhoven project on which TNO collaborated.

The Ground Water Survey, which is part of the Division for Technical-Scientific Services, has made a start on drawing up an inventory of coal deposits in the Netherlands. The first area in which seismic exploration has been carried out is South Limburg.

New sources of energy

The most important activities of TNO in the field of what are termed alternative energy sources relate to research into the possible applications of solar energy and geothermal heat. TNO is also involved in the National Research Programme on Wind Energy.

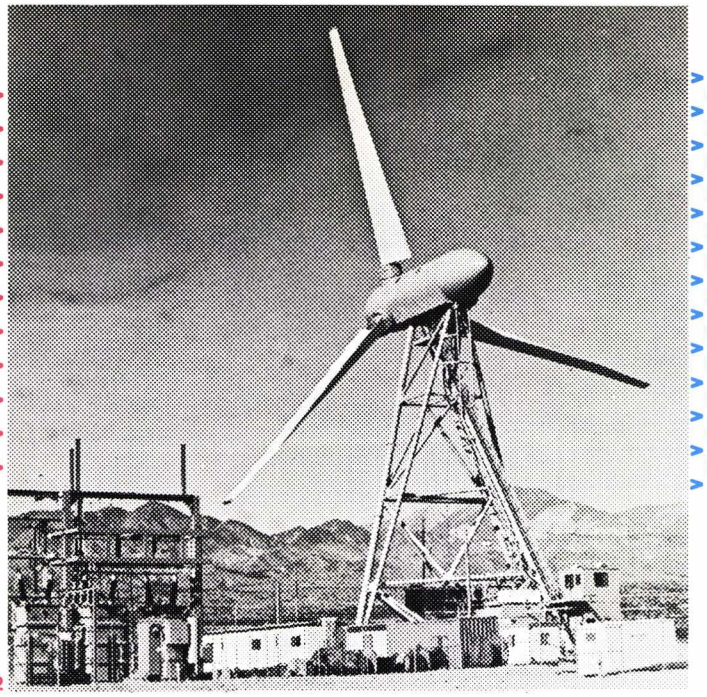
Within the framework of the National Research Programme on Geothermal Heat, the Ground Water Survey has drawn up a chart of the shallow temperature field in the Netherlands and has carried out preparatory work on a number of demonstration projects.

The work of the Institute of Applied Physics TNO-TH on the measurement and evaluation of practical and demonstration projects in the solar energy field is still increasing. To name but two examples: 32 dwellings in Veldhoven in which solar boilers, solar heating installations, heat pumps and heat recovery equipment have been installed, have been evaluated, and measurements have been taken for Philips N.V.; likewise, a collective solar installation in Amstelveen which supplies 54 flats with hot tap water has been evaluated. In addition, the Institute of Applied Physics TNO-TH is playing an increasingly important role in research on possible means of solar energy storage, both in the national and in the international sphere (National Research Programme on Solar Energy, the EEC, and the International Energy Agency). For example, the institute has been involved in setting up an estate of 100 solar-heated dwellings grouped around a central system for seasonal solar heat storage in the ground.

The Metal Research Institute and the Institute of Applied Physics TNO-TH are working together on the development of cobalt oxide coatings for solar panels. This type of surface coating on, for example, stainless steel collectors has both a good absorption/emission ratio and high thermal stability. The research work is directed in particular towards the practical applicability of these coatings on solar panels for heating purpose.

Within the Division of Technology for Society photo-electrochemical research is being carried out into the production of hydrogen and the reduction of carbon dioxide (CO_2). The ultimate aim of this research is the production of methanol. The research, which is being carried out in close collaboration with the Chemistry of Solids Department of the State University in Utrecht, has shown, inter alia, that the oxidation step of intermediate products formed seems to be more important than the reduction step.

Research on windmill parks and the effect of turbulence on the operation of wind



22

22. A small wind-powered power station (3000 kilowatt) is in operation in California. The Netherlands have a National Programme on Wind Energy. TNO is involved in studies on the operation of windmill parks and on the influence of turbulence on the functioning of wind turbines.

turbines is continuing within the framework of the National Research Programme on Wind Energy.

Nuclear energy

Research carried out by TNO into the possible applications of nuclear energy is concentrated mainly on the problems associated with the materials used. This applies in particular to those materials which have to be used in the heat exchangers of the fast breeder reactor which is being built in Kalkar. Liquid sodium is used as the heat transfer medium in the primary and secondary cooling circuits. The use of liquid sodium demands special technology, the development of which requires considerable research. A substantial proportion of this research work is being carried out on the 50 MW Test Circuit which is managed by the Division of Technology for Society. Commercial companies in the Netherlands (hot machine construction sector) have been and are closely involved with this work.
A corrosion study on ten test sections of steam generator tubes has been carried out within the framework of the testing and operation of the 50 MW Test Circuit. The first milestone in this project was reached when a test period of 3000 hours was clocked up. In the year under review a large number of simulation tests on leak detection in steam generator tubes have been carried out in the technological test circuit. The first phase of these experiments, which are rather difficult to carry out, has been successfully completed.
At the end of the period under review the Ministry of Economic Affairs announced their intention to close down the test circuit in 1982. This puts an end to the two years of uncertainty with regard to the future of this circuit. Because this decision had already been anticipated by TNO, it will be possible to make a start in the near future on drawing up measures for winding up the project and on putting these measures into effect as soon as possible. A draft social plan will have to be approved, and detailed schemes which have already been worked out will be put into operation. The decision taken by the Ministry signifies the end of approximately ten years' work on the sodium technology project. Scores of TNO employees have been involved in this project and have achieved results which have aroused a great deal of interest. It is worthy of note that in the year under review Mr. H.C. Unal presented his Ph.D. thesis on two-phase flows in sodium-heated high-pressure steam generators. The experimental data collected must be regarded as unique in many respects and some of these data will be incorporated in the 'Wärme Atlas' (Heat Atlas), the publication providing general information on the field concerned.
Within the Division for Building and Metal Research, the Institute for Mechanical Constructions has been working on the further development of finite element computer programs, material models, fracture analysis, reliability analysis, rotardynamics calculations and methods for the calculation of fluid bearings and seals. These techniques are being used or will be used for the design of pumps, heat exchangers, and piping systems for nuclear power stations. The Metal Research

Institute carried out extensive material testing for these components. The knowledge gained is to an increasing extent being put to use by both institutes in research work for other installations, such as installations for the process industry and conventional power generation.

Other energy research

The Research Institute for Road Vehicles, which is part of the Division for Industrial Products and Services, has developed an alcohol/petrol sensor in collaboration with the Division of Technology for Society. The system has been designed in such a way that it can be installed in existing cars so that these cars can run on any mixture of the two fuels, ranging from pure petrol to pure alcohol. With a system of this type it is simpler to introduce a new fuel such as alcohol on to the market because, since the car can also be filled up with petrol, it can be driven anywhere, even if there is only a limited network of stations selling alcohol. The history of the use of LPG in cars has shown the importance of such a system. The equipment has been so designed that all the functions are combined into one single unit, which means that it can be installed with a minimum number of connections. The basic idea is that by means of needles in the jet the fuel-jet area (and thus the fuel/air ratio in the carburetor) is completely automatically adjusted to the petrol/alcohol ratio. A demonstration model has been constructed and exhibited in the travelling Holland Expo exhibition in South East Asia and during the ASCOPE conference in Manilla. This innovation attracted a great deal of attention. Pilot units are now being tested by the car industry. In the meantime a start has also been made with a comprehensive fleet test project in the Netherlands, involving 30 cars equipped with the petrol/alcohol sensor. This project is being funded as part of the National Programme for Energy Research.
The Division of Technology for Society carried out a study on the effect of energy prices on industrial activity in the Netherlands. This study was commissioned by the SER (a Dutch government body). In addition, the cost price of ethanol manufactured from Dutch waste materials, the role of energy prices in the agricultural economy and the problems relating to energy and transport have all been studied.

24

24. It is becoming increasingly clear that particular attention must be paid to the residential environment when laying out groups of large, high-rise blocks of flats (the photograph shows flats at Bijlmer). Wind is one factor which can be studied beforehand. Planners can gain insight into wind behaviour from the study carried out on 'Wind in an urban environment', supplemented, if necessary, by data obtained from studies in a wind tunnel.

Living Conditions and Building

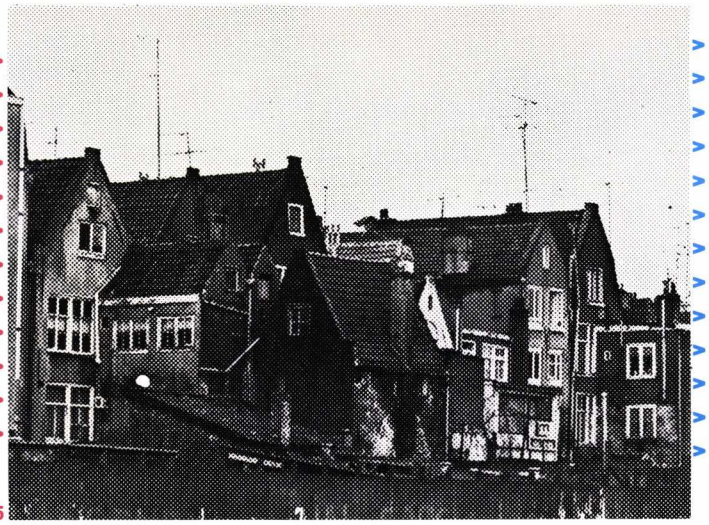
In the year under review TNO was engaged in research into a number of areas relating to living conditions and building. Knowledge and insight have been acquired both for the first phase, that of physical planning, and for the final phase, relating to actual living conditions experienced in the dwellings. A great deal of attention has also been paid to building technology itself and to quality control.

Physical planning

As a follow-up to research on physical planning carried out in earlier years, the emphasis in 1981 with regard to projects in this field was on:
- research into population trends;
- research in the field of decision making;
- research on physico/economic processes, specifically in growth areas.

The Research Centre for Physical Planning aims to interrelate research work on the social sciences and natural sciences in all projects where this is feasible. Thus, the specific facilities available within TNO are used in such a way that very concrete recommendations can be made on the basis of the research carried out. A good example is the research project on 'Wind in urban environments'. The Research Centre for Physical Planning worked on this project together with the Flow Technology Department of the Division of Technology for Society. The information obtained from research work of this type provides the architect of a building or groups of buildings with an insight into the way in which wind will behave in the estates which he envisages. The test method enables him to modify his design so that residents and traffic will be inconvenienced as little as possible by the wind.
In the course of 1981 research by the Research Centre for Physical Planning was directed more towards aspects such as:
- research into energy aspects;
- research into the effects of specific plans;
- research with regard to physical interaction and information systems.

It is anticipated that these three areas will continue to demand attention for some considerable time. Projects currently in preparation support this view. In this context it should be mentioned that physico-economic processes and population trends are two areas in which, in fact, studies will have to be carried out on a permanent basis.
Another factor which must be taken into consideration when planning residential estates is safety. Many estates built in recent years have been planned so that they incorporate open spaces and grassy areas providing the children with the



25

VLOERONDERZOEK

TILBURG – Deze week wordt de laatste hand gelegd aan het TNO-onderzoek naar de oplegging van de vloerplaten in de IBC-flats in Tilburg-Noord. De metingen worden verricht in twee boven elkaar liggende woningen: Bellinistraat 316 en 332. De bewoners van de IBC-flats in Tilburg Noord twijfelen al sinds 1977 aan de degelijkheid van hun woningen, omdat toen allerlei mankementen aan het licht kwamen.

Het tot nu toe gevoerde onderzoek, dat slechts theoretisch van aard was, heeft deze twijfel niet weg kunnen nemen. De gemeente besloot daarom in november jl. in overleg met de bouwer IBC, de eigenaar Stichting Verenigde Woningbouwcorporaties en de bewoners, een beslissend onderzoek uit te laten voeren door TNO uit Delft.

26

25. In many older towns and in villages it will be necessary to combine the renovation of old buildings with the construction of new buildings in order to obtain a good residential environment. TNO has designed a computerized data system which can be used by those concerned to obtain the necessary information.

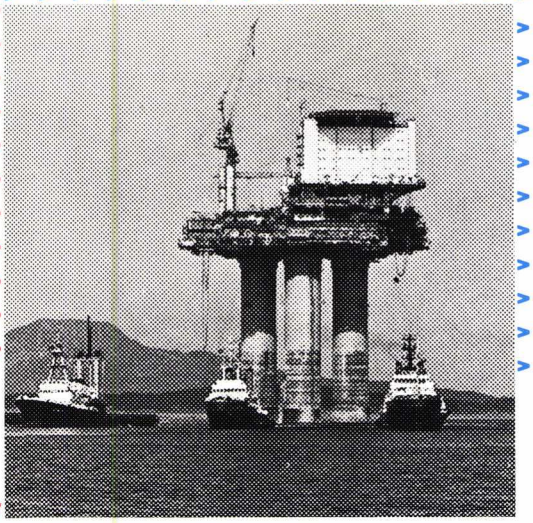
26. 'Floor testing' In Tilburg builders, the local authority and a housing association decided to engage the services of TNO to test the floors in a number of flats built in 1977 (as reported in the 'Nieuwsblad van het Zuiden'). In 1981 also, TNO's services were once again in substantial demand for checks in connection with buildings. The assistance of TNO specialists was also requested in a number of cases where damage had occurred.

opportunity for imaginative play and 'adventure' games between the residential blocks. In some cases it would appear that this approach can result in hidden dangers from the traffic view-point. The Netherlands Institute for Preventive Health Care has developed a method which can be used to evaluate the extent of the danger which traffic presents to children.
The Netherlands Institute for Preventive Health Care has carried out a study in a residential estate in Gouda to look into the possibilities available of grouping dwellings in such a way that both needs can be met.

In recent years renovation has featured prominently in building policy. In this context it is necessary to review the relationship between new buildings and renovated buildings. The Institute for Mathematics, Information Processing and Statistics has drawn up an automated information system for new buildings and the renovation of buildings in the Netherlands.

Building structures

The Institute for Building Materials and Building Structures has carried out a great deal of research into the strength and durability of materials and structures. Some of this work extends beyond the bounds of 'conventional' building. The Institute has acquired a world-wide reputation in the field of offshore structures. The building trade is now profiting from the results of this research. In 1981 an effective approach to the problems relating to building materials resulted from an offshore project which had already been underway for some time. A great deal of the work carried out by the Institute for Building Materials and Building Structures is commissioned because cases of damage have occurred. A publication entitled 'Bouwfouten nader bezien' ('A closer look at errors in building') gives further information on this.
Together with the Delft University of Technology and the Public Works Department (Rijkswaterstaat), the Institute is working on the 'Concrete Mechanics' project. The aim of this project is to describe the characteristics of concrete and reinforced concrete in a realistic manner, and to make this data accessible to computers. Initial results were presented at a symposium organized by the IABSE (International Association of Bridge and Structural Engineering) and have been published in three numbers of the Journal HERON, which is a joint publication of the Delft University of Technology and the Institute for Building Materials and Building Structures.
In the year under review the Institute once again made a contribution to the implementation of the Eastern Scheldt Project. The methods employed for implementation of the project have been examined with the aid of 'error tree' analyses and scenarios.
The Institute for Building Materials and Building Structures also carries out a large number of measurements on foundation piles, both in the Netherlands and abroad. The method employed is based on soil mechanics, and in order to extend



27

HOUTINSTITUUT TNO:

Nederland stelt hoogste eisen aan spaanplaat

29

28

27. Drilling platforms have to cope with severe conditions. TNO has developed computer programs for the purposes of increasing the strength of these platforms and has carried out studies on the way in which these structures can be protected against the effects of the sea and the weather.

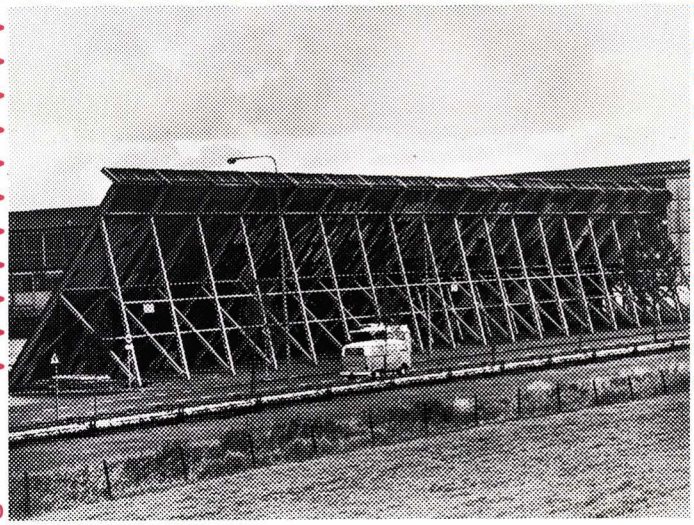
28. Double glazing not only saves on heating costs but also makes life indoors more pleasant, including by the windows. In the design model which TNO has developed for studying the indoor climate in houses and flats attention is also paid to optimum window size.

29. 'Forest Products Research Institute TNO: The Netherlands set very high standards for chipboard' TNO has carried out a study into the presence of formaldehyde in chipboard and on ways in which chipboard can be treated to prevent the release of the gas.

knowledge in this field a study has been started in collaboration with the Delft University of Technology and the Delft Soil Mechanics Laboratory. The equipment has been improved by adopting digital data processing. Use has also been made of the Geminix terminal described on page 10.
Within the Division of Technology for Society a study on frost damage to roofing tiles on insulated roofs has been carried out. It has been found that damage to tiles on insulated roofs is no greater than that to tiles on roofs which have not been insulated.

Indoor climate

A number of TNO institutes are collaborating on studies which have a bearing on the indoor climate provided in dwellings. The Research Institute for Environmental Hygiene developed a computer model which embodies all the factors which play a role when drawing up a draft design. Data from studies on the optimum window size (which is also extremely important for 'daylight illumination') and the pattern of air flow inside rooms are used in the model. In order to obtain concrete data on these various aspects, a model room of actual size in which a large number of situations encountered in practice can be reproduced has been designed and constructed within the Institute.
Studies on the indoor climate are being carried out by various TNO Institutes working in collaboration. In particular, a great deal of attention has been paid to the development of heating systems using a heating medium which is at a lower temperature than those with which we are familiar. The research carried out on heat pumps (see page 15 under 'Energy') justifies the expectation that it will be possible to use heating methods of this type in conventional buildings in only a few years' time. The indication is that by 1990 underfloor heating and hot air heating systems with low energy consumption will be able to provide a pleasant indoor climate. Society is regularly confronted with new products and this is also the case in the building trade. Various TNO institutes are working together on a project on 'Building materials and health'. The knowledge acquired from this project is beginning to bear fruit, in particular in the case of studies carried out to determine the possible consequences for our environment and health of the processing of waste materials of varying origin to produce materials for use in building or road building.
The Forest Products Research Institute completed a number of studies (commissioned by the Ministry of Housing and Physical Planning) in 1981. Field tests in Haarlem and Den Helder to reduce formaldehyde concentrations resulting from the emission of this substance from chipboard have been completed and a final report has been produced. The Ministry has published a summary of this report. From the technical point of view, the treatment of chipboard with paint or films produces a good result; the formaldehyde concentrations which initially considerably exceeded the permitted level were brought down to below the limiting value in virtually all the rooms treated. In practice, chipboard has in some cases been



30

30. Noise nuisance is not a necessary evil. TNO has carried out studies on the prevention of noise nuisance and on ways in which existing nuisance can be reduced. Studies on effective protection against noise pollution by means of sound barriers of various types have been underway for some years now. A project on 'sound insulation in renovated buildings' was completed in 1981.

replaced (for different reasons) by other materials, including in cases where a good surface coating would have the desired effect. A questionnaire has been sent to the corresponding institutes abroad in order to establish which of the countries that produce or process chipboard have introduced regulations on the use of chipboard, specifically imposing restraints with regard to possible formaldehyde emission. In addition to the work carried out at the request of industry, local authorities and users, an important contribution has also been made to the work of the CEN (Commission Européen de Normalisation). At the end of 1981 a draft method for determining the emission of formaldehyde from chipboard was accepted in principle by all the countries party to the CEN/TC 91. These countries included Germany, Belgium and France, the most important suppliers of chipboard to the Netherlands.

It is anticipated that the definitive version of the EN-120 Standard for the determination of the formaldehyde content of chipboard by the 'perforator method' will be published shortly. This method is intended specifically for quality control in the factory.

The problem of noise nuisance has received a lot of attention in the year under review. There are limits to the ability of man to cope with high-decibel noise. A number of TNO institutes carried out work to establish where the limits lie and also worked on the solution of the problems by means of sound-insulating and sound-absorbing structures and materials.

The Institute of Applied Physics TNO-TH and the Delft University of Technology were able to utilize the expertise acquired in the field of noise prevention inside and between houses to good effect in a number of renovation projects. A research project entitled 'Noise prevention in renovated buildings', which was commissioned by the Foundation for Building Research, has been provisionally completed and has provided as complete as possible a picture of the problems associated with noise prevention measures in the renovation of buildings. It was the fact that the problems associated with noise prevention are still being handled in too fragmentary a manner that led the Foundation to commissioning this project. It is also worthy of mention that the final touches have been put to the work on the acoustics of the Arnold Schönberg Hall in the new Royal School of Music in the Hague and that good results have been achieved.

It may confidently be anticipated that the newly established collaboration between the Institute of Applied Physics TNO-TH and the group working on 'Physical Aspects of Built-up Areas' at the Eindhoven University of Technology will prove successful and effective.

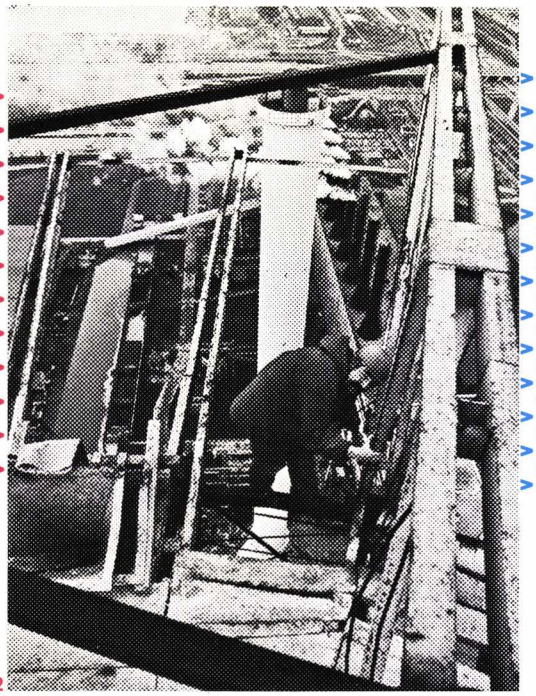
A separate aspect of building concerns the security of the finished buildings. The Working Group for Security Research which is part of the Division of Technology for Society, has completed a study on electronic protection of bank buildings. A number of orders, mostly relating to the evaluation and testing of security equipment, have also been carried out. Studies have also been done in the field of site protection, and it has been possible to make practical recommendations.

31. The Conditions at Work Act was adopted on 8th November 1980. Dr. W. Albeda, the then Minister for Social Affairs, believed practice to be at least as important as theory. Here he is on his way up to see for himself what life is like as a crane-driver working high above the ground. The crane-driver's cabin was just one location in which TNO carried out a work study.

Man and Work

A number of TNO institutes are engaged in studies with regard to man and work. The Co-ordinating Bureau for Activities in the Area of Humanization of Work co-ordinates activities which are aimed at providing the best possible relationship between man and his work in the present day and age. The aim must be not merely to ensure that the work itself is carried out properly but also to ensure that those carrying out the work are able to find job satisfaction. The Netherlands Institute for Preventive Health Care has developed a test method which can be used to evaluate a person's feelings with regard to his job. The new Conditions at Work Act demands insight and knowledge. The method for the 'Periodic Testing of Functioning within the Job Situation' will probably be found by many companies and other establishments to be an efficient means of collecting the requisite information.
The work of the Bureau covers a large number of specific problem areas. The problems experienced with display screens some years ago led to research projects being set up. These projects were carried out in collaboration with the Institute for Preventive Health Care and the TNO Institute for Perception and resulted in a number of recommendations being made. These recommendations are not restricted to the display screens themselves but can also incorporate advice on various aspects of the rooms and offices in which these screens are to be used.
Hygiene at work is another topic which has brought together a number of TNO institutes working on projects relating to the humanization of work. It has been possible to tackle projects in the field of industrial toxicology together with the Medical Biological Laboratory (utilizing the extensive knowledge of toxicology and the research facilities available in this laboratory) and the Research Institute for Environmental Hygiene, which has a department specializing in measuring and sampling. Health surveys have been carried out in various companies. The recommendations made may signify distinct improvements in conditions at work. Asbestos can cause mesothelioma, which is a dangerous disease of the lungs. The TNO Committee for Asbestos and Other Mineral Fibres is able to make important recommendations with regard to the humanization of work, partly because of the measurement facilities available at the Research Institute for Environmental Hygiene.

Noise nuisance can be thoroughly pernicious to working conditions. In the year under review TNO has not only carried out measurements on hearing but has also made recommendations on measures for eliminating noise. The Institute of Applied Physics TNO-TH, in particular, has been able to provide insight into methods for combatting noise at work.
It is not always the case that the consequences of working conditions which are



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32. Working on safety for building workers.

33. Bus drivers who found their work too demanding...
TNO carried out a study on the stress which is imposed on bus drivers by their work in present-day traffic.

less than perfect can be measured directly in physical units. The Netherlands Institute for Preventive Health Care has carried out a study to assess the psychic consequences. A study on stress and on the awareness of risks showed that the mental strain imposed by certain sorts of work is something to which consideration must certainly be given.
A great deal of attention has been paid to safety at work. Institutes working in this field included the Institute for Cereals, Flour and Bread, which is part of the Division for Nutrition and Food Research, in collaboration with the Prins Maurits Laboratory (Institute for Chemical and Technological Research), which is part of the Division for National Defence Research.
In consultation with representatives of the government and the agricultural products storage, transshipment and processing trade sectors, work has been carried out on drawing up a set of guidelines designed to prevent or to limit the consequences of industrial dust explosions and dust fires. On the basis of multiple-momentous situation assessments in a dozen butcher's shops, conclusions were drawn and recommendations made for improving conditions at work. Proposals for noise abatement in sawing operations have been made to the meat industries.
The Division of Technology for Society produced a report on safety at work. The data bank on dangerous substances which is kept by this Division was consulted on numerous occasions. Highly practical recommendations were also made by the Division for Industrial Products and Services: the safety shoes and work gloves designed by this Division provide the users with good protection at work.
The Institute of Medical Physics carried out further specialized studies on safety for personnel who have to work with electrical equipment in hospitals and for the patients who receive treatment in which this equipment is used.
The Netherlands Institute for Preventive Health Care also considered a number of individual trades. Many aspects of the work carried out by plasterers, bus drivers and workers in the building trade were analysed and recommendations have been drawn up. By adopting these recommendations it will be possible to avoid certain problem areas. The Co-ordinating Bureau for Activities in the Area of Humanization of Work also worked in collaboration with the Group Policy Studies and Information. The project on short-cycle work, which was concerned with production line work and the effects of this, was completed. The findings have been reported in various publications.
As a sequel to the work on the mobility of scientific research workers which was completed in 1980, the Group Policy Studies and Information has completed the first phase of a study on mobility within TNO. This study was commissioned by the Central Staff Department for Social Affairs. A number of research workers from the Group collaborated with the Centre for Technology and Poiicy on a pilot study to determine the relationships between technological developments and various aspects of the labour market (conditions at work, work contents, terms of employment, etc.) with respect to the printing industry in particular.

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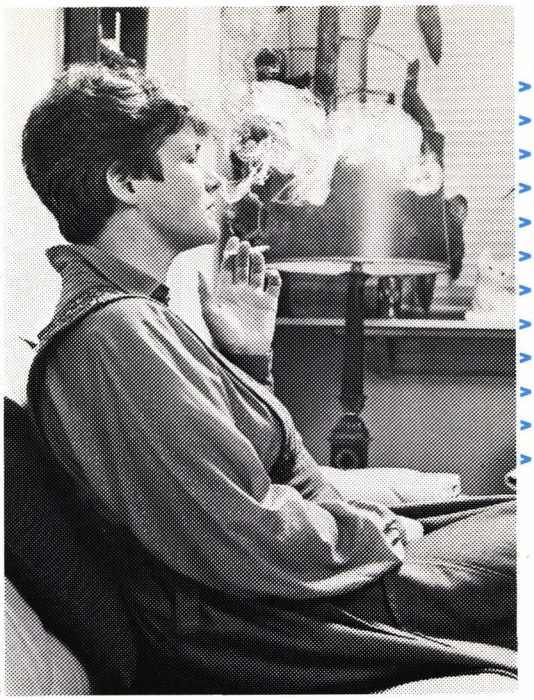

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34. A man is worth his...bread.

35. Research on smoking. Amongst other things, TNO looked at the relationship between birth weight and smoking during pregnancy: the children of mothers who smoke during pregnancy are lighter...

Nutrition and Food Research

Virtually all of TNO research on nutrition and food is carried out by the Division for Nutrition and Food Research. The most important fields in which research is carried out and on which information is provided within this sector are nutrition, toxicology, technology, and the analysis of foodstuffs and raw materials. The most important activities in these various fields are reported below.

Nutritional status of various sections of the population

Amongst other projects, the Institute CIVO-Toxicology and Nutrition is carrying out research on the nutritional status of various sections of the population, and on medical aspects, such as the relationship between nutrition and cancer. A great deal of attention has been paid to the methodology for examining populations to establish their eating and drinking habits and the effects of these habits on the condition of the nutrition of the body. With the aim of establishing procedures for continuous monitoring of the entire Dutch population, a study has been carried out to establish whether this type of screening can be carried out through regional surveying. The results have so far indicated that continuous monitoring on this basis would be possible only at the cost of a very great deal of effort.

The nutritional status of a group of vegetarians was measured by a large number of parameters and was found to be hardly any different from that of non-vegetarians, despite the great differences in the type of food taken. One finding was that in vegetarians the ferritin content of the blood serum is somewhat lower; this points to a somewhat lower reserve of iron in the body than in non-vegetarians, but there is no difference in physical performance.

A study to determine whether the nutrition of an expectant mother has any influence on her pregnancy showed that when the pregnancy proceeds without complications no relationship can be established between the food consumption of the mother and the birth weight of the child, or between the weight gain of the mother and the duration of pregnancy. What does affect the birth weight, however, is the smoking habits of the mother, although there is no significant difference between smokers and non-smokers in respect of the energy uptake. Changes in nutritional status parameters, in particular vitamin concentrations, can not be traced to changes in the absorption of nutrients, but have to be considered endogenic. Thus the depletion of a number of water-soluble vitamins in plasma, which is already evident early in the pregnancy, seems to be primarily a result of increased retention of these vitamins in the body tissues.

Experimental work on animals to evaluate the effect of vegetable and animal proteins on the blood pressure of rats showed that a vegetable protein diet and the substitution of potassium for sodium in the salt counteract the pressure raising action of table salt administered in quantities corresponding to a high daily con-

36. Bread is important to the Dutch. They demand good quality, each day and every day. TNO is studying various varieties of wheat to determine their processing properties.

sumption by humans (more than 15 g per day). It has to be investigated to what extent these experimental results also hold good for humans.
A comprehensive experimental study of the relationship between nutrition and cancer is being carried out, the emphasis in the research programme of the Institute CIVO-Toxicology and Nutrition being on prostatic, colon and pulmonary cancers. The first findings are now starting to come out of this study. It would appear that the experimental production of a prostatic cancer model in laboratory animals has now succeeded. This is particularly important because this type of cancer is not only already frequently encountered in man but also would appear to be on the increase all over the world.
Evidence was obtained with rats that the diet (carbohydrates and fats) affects the endocrine balance, which in turn can be decisive in the onset of cancer.
It was discovered several years ago that fatty spherules can develop in the lung fibroplasts of hamsters, rats and mice. A supposed relationship with vitamin A was confirmed; overdosage of vitamin A favoured the formation of these spherules. However, it turned out that this was no proof of any relationship between vitamin A and pulmonary cancer: in hamsters experimentally induced pulmonary cancer of a type similar to human pulmonary cancer is not affected by a low-vitamin A or vitamin A-rich diet. A comprehensive study has been started on the biochemistry of migraine, a complaint which in many individuals is connected with their nutrition. Because the requisite techniques for biochemical analysis were in many cases not adequately developed to enable a sufficiently accurate determination of enzymes, fatty acids, etc. to be made, work on increasing the accuracy of a large number of these techniques was started in 1981.

Cereals, flour and bread

Fundamental research on protein carried out at the Institute for Cereals, Flour and Bread (IGMB) has shown that the baking properties of wheat flour used for bread are mainly determined by the amount and the composition of one specific protein fraction, i.e. the glutelins. As dough is mixed, the glutenin molecules are almost all degraded to smaller units which, during the subsequent fermentation process, to a greater or lesser extent recombine to form the original molecules again. A great deal of work has been carried out to throw more light on the biochemical processes involved here.
The glutenins mentioned can also be degraded chemically to a limited number of smaller units which can be separated by electrophoresis, resulting in a number of visible bands. The band pattern thus obtained is determined genetically. An important result of this study was the discovery that a certain combination of bands occurs in particular in wheats of good baking quality and another combination is found in wheats with poor baking properties. This finding provides growers with a new and simple, but nevertheless reliable, method for selecting the most suited cultivars from their cross-breed descendants.
Hundreds of wheat varieties and new cultivars have been tested for growers to

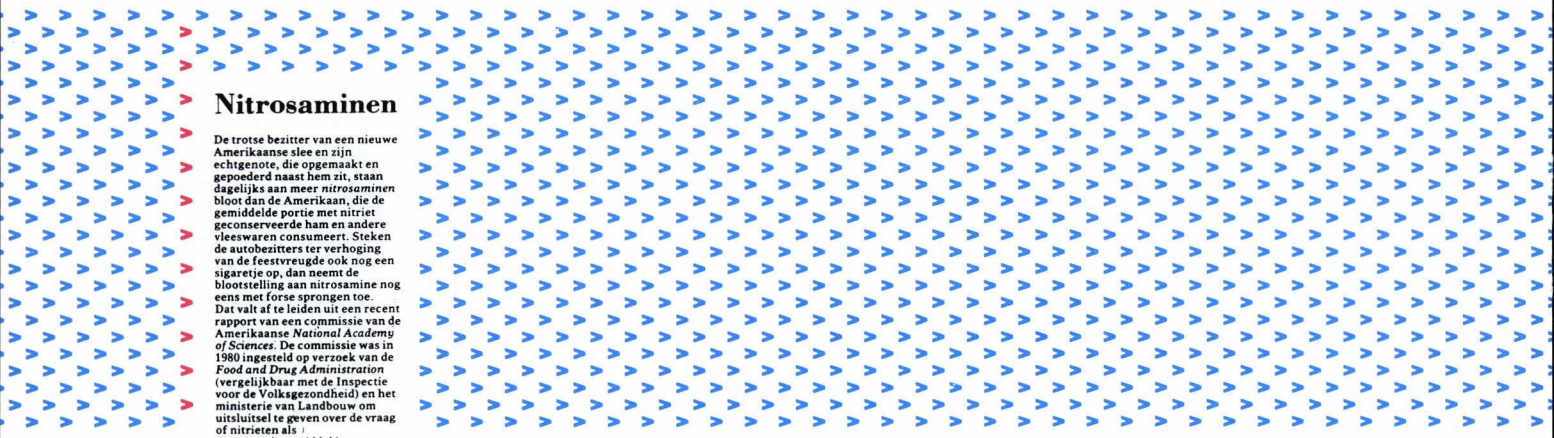
determine their processing characteristics. One of the tests used is the micro-baking test. In addition, germination tests and 800-gramme-baking tests were carried out to determine the propensity to premature germination, and the bread-making properties of new varieties considered for inclusion in the Varieties List. The propensity to sprouting of the varieties prevalent in the Netherlands has also been determined to enable the 'Research Station for Arable Farming and Field Production of Vegetables' to issue national sprout warnings to farmers during harvest time. Partly because of the favourable weather conditions, the Dutch wheat crop in 1981 was virtually free from sprouting.

The Baked Goods Decree of the Food and Drug Act which is now in preparation lays down specifications for, inter alia, the microbiological quality of confectionery. To assist bakeries to meet these requirements, the IGMB is carrying out a study, in collaboration with the Experimental Station of Milling and Baking, on the microbiological quality of the so-called 'wet' confectionery manufactured and the hygiene precautions taken during manufacturing in some hundred bakery businesses which have subscribed. After every inspection and sampling, the results are made directly available to the bakery business concerned, in the form of recommendations. The same Institutes have collaborated on the testing of 40,000 samples of bread and smaller numbers of samples of pastries, rusks, cakes, and bakery ingredients in respect of one or more of the following aspects: dry matter content, composition, taste, odour, appearance, tenderness, crispness, and related properties.

Manufacturers all over the country have received individual reports and regional surveys on these tests. The aim of the determination of the dry matter content is to protect the baker against infringing the Food Act. The other aspects lead to recommendations for improving the quality. Retail packages bearing a weight specification must contain legally fixed minimum weights. As far as the manufacturer is concerned, this means that the lower the precision of proportioning, the higher the nominal weight setting he has to make. Investigations were carried out in ten factories manufacturing honey cake, to determine the causes of the wide range of actual weights. It was found that the differences in weight result in the main from the weight of the mixture and its distribution over the oven tray, although other causes were found too. Recommendations for narrowing the range of weights had to be drawn up individually for each company and were different in each case.

In another study carried out for manufacturers of biscuits, moulded cookies, and spritz cookies, the IGMB, in collaboration with the Institute for Mathematics, Information Processing and Statistics, dealt with the elaboration of a model for the determination of optimum weight settings of production machinery, based on weight ranges recorded over periods of varying lengths. The application of this model is currently under test in the various companies to determine its usefelness.

The Health Council advises that, for health reasons, the average Dutchman should use less salt. The IGMB carried out a study to determine what the consequences of



Nitrosaminen

De trotse bezitter van een nieuwe Amerikaanse slee en zijn echtgenote, die opgemaakt en gepoederd naast hem zit, staan dagelijks aan meer *nitrosaminen* bloot dan de Amerikaan, die de gemiddelde portie met nitriet geconserveerde ham en andere vleeswaren consumeert. Steken de autobezitters ter verhoging van de feestvreugde ook nog een sigaretje op, dan neemt de blootstelling aan nitrosamine nog eens met forse sprongen toe. Dat valt af te leiden uit een recent rapport van een commissie van de Amerikaanse *National Academy of Sciences*. De commissie was in 1980 ingesteld op verzoek van de *Food and Drug Administration* (vergelijkbaar met de Inspectie voor de Volksgezondheid) en het ministerie van Landbouw om uitsluitsel te geven over de vraag of nitrieten als conserveringsmiddel in vleeswaren moeten worden verboden.

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37. 'Nitrosamines' Many research workers consider that the presence of nitrite is linked with the formation of nitrosamines. TNO discovered that the amount of nitrite customarily added to raw meat products can be substantially reduced without any loss in the inhibiting effect on microbial growth in these products.
The 'Volkskrant' devoted an article to nitrosamines in cigarettes and...new cars.

a decreased salt content in bread would be. At present the salt content is approximately 2% (based on the flour). A test panel of 25 individuals was readily able to discriminate between bread containing 2% and bread containing 1.5% salt. The majority of the group appeared to prefer 2% salt. Dough measurements showed that when the salt content is reduced from 2% to 1% the dough becomes somewhat stickier; this effect becomes very pronounced with further lowering of the salt content. A compulsory decrease in the salt content of bread could thus have unwanted effects such as lower bread consumption and an increased likelihood of technological trouble in breadmaking.
Pastries with a filling, such as almond-filled pastries, have a relatively short shelf-life because the fillings tend to re-crystallize and become hard; the immediate cause of this is not the loss or migration of moisture. An investigation revealed a number of factors which have an influence on the shelf-life, namely: the quality of the filling, the time for which the product is allowed to cool between baking and packaging, and the sugar content of the mixture. Under optimum conditions a shelf-life of six weeks has been achieved.
In the process of dough mixing, the occluded gas must be in a sufficiently fine dispersion, otherwise the bread will have a coarse texture. In order to establish what relationship exists between the quality of the bread and the size distribution of the gas cells in dough, various techniques for determining this distribution have been tested. Observations on sections of steamed dough with an optical microscope and on sections of freeze-dried dough with a scanning electron microscope have confirmed that the gas cells are finer and more numerous in a dough to which an emulsifier has been added. The IGMB has also set up a comparative test study on different types of extruders (a device for opening up starch granules in flour), the first goal being to prepare suitable raw materials for the pastry portion of filled pastries and for honey cake, on the basis of wheat and rye flours. Honey cake mixture can be produced directly using a twin-screw extruder, dispensing with the conventional mixing of rye floor with boiling water and treacle.
Recommendations on numerous technical points have been made to bakeries and feed manufacturers. The IGMB advised four mixed-feed factories on equipment and apparatus. These four factories came into operation in 1981 and three of them, which have capacities ranging from 40 to 50 tonnes are largely automated and computer-controlled.

Food technology

The work of the Institute CIVO-Technology has in the main been concentrated on meat and meat products, fishery products, edible oils and fats, cocoa and chocolate, and the commercial preparation of snacks and meals. At the request of the Foodstuffs Chief Inspectorate an inventory has been made of processes and products in which direct contact between the product and combustion gases may result in the formation of nitrosamines. This nitrite which is usually added to meat products in order to ensure a stable meat-like colour and to suppress the growth of

38. Fishing has been a source of income for many Dutchmen for far longer than any of us can remember. In collaboration with about a dozen processing companies, TNO is studying a 'new' type of fish, the blue whiting. Results so far seem to indicate that a tasty future is in store.

bacteria is another alleged source of nitrosamines. At the request of the afore-said Inspectorate, a study has been carried out to determine by what extent the quantity of nitrite added to raw meat products, such as Salami-type sausage, can be reduced without this affecting their shelf-life and safety. It was found that even a drastic reduction in the amount of nitrite added did not result in any extra growth of pathogenic micro-organisms during the manufacturing process.

Other experimental studies in the field of meat processing dealt with the transportation of 'meat batters' by pipe-line, the agitation (i.e. the keeping in motion by mechanical means) of hams in order to reduce cooking loss, and the automation of the preparation of meat batters in cutters (mincers).

The hormone androstenone is one of the substances which can cause a subjectively unpleasant odour (the so-called 'boar taint') in the meat of lean-carcass boars (male hogs). An objective method of determination for this compound has been developed, and in the period under review the results of this method have been compared with the commonly used subjective appraisals. A useful correlation has been found.

With the support of the Fisheries Development and Reorganization Fund and in collaboration with about a dozen processing companies a study has been made of the possibilities for processing blue whiting which is landed in deep-frozen blocks. Another aim of the study was to investigate the possibilities which exist for the preparation of ready to eat products from comminuted blue whiting (i.e. the muscular tissue) such as is obtained by mechanical deboning. Particular attention has been paid to the prevention of denaturation and to maintaining a good colour. The results indicate that there are prospects for the development of new products from this type of fish provided that the industry is prepared to introduce non-conventional methods of processing.

In the refining of oils (and in particular soya oil) to edible products a correlation has been found between certain parameters of the crude oil and the stability of the finished products. On the basis of this correlation it has been possible to formulate quality requirements which must be met by the raw material if stable finished products are to be obtained. In many cases, oils obtained from rape-seed are able to compete with oil obtained from imported soya beans. However, hydrogenated oils obtained from certain rape-seed varieties developed especially to eliminate the nutritionally undesirable erucic acid sometimes impart a sandy taste to margarines or other fat-containing products, as a result of rapid re-crystallization. Research is being carried out to determine whether this defect can be avoided by adding other fats or emulsifiers.

Research on the roasting of cocoa beans, i.e. the process which largely determines the typical odour and taste of the finished products, has been directed towards maximizing the process yields of this relatively expensive raw material. One of the aspects studied was the effect of the traditionally employed alkaline treatment (alkalinization or 'Dutch Processing'). A great deal of attention has been paid to the functioning of catering services in institutions and companies where meals are

BENZOPYREEN

STORM IN EEN KOP KOFFIE

De stichting Konsumenten Kontakt heeft vastgesteld, dat de meeste merken koffie meer benzo(a)pyreen (een sterk kankerverwekkende stof) bevatten, dan tot nu toe werd aangenomen. Vooral oploskoffie is rijk aan deze gevaarlijke stof. Dit staat in het decembernummer van Koopkracht, het orgaan van Konsumenten Kontakt. De stichting vindt het voorkomen van benzo(a)pyreen in koffie en ook in andere levensmiddelen zo alarmerend, dat zij bij de overheid aandringt op verder onderzoek en maatregelen in het belang van de volksgezondheid... De Nederlandse Vereniging van Kofflebranders heeft meegedeeld, dat zij de publikatie in Koopkracht betreurt en meent, dat Konsumenten Kontakt totaal verkeerde conclusies trekt uit het eigen onderzoek. De vereniging heeft mevrouw Lambers-Hacquebard, staatssecretaris van Volksgezondheid, laten weten, dat zij hun kennis op het gebied van benzo(a)pyreen in koffie beschikbaar stellen en mee willen werken aan verder onderzoek.

soortgelijk onderzoek laten doen door het Centraal Instituut voor Voedingsonderzoek TNO te Zeist. Hieruit blijkt, dat zowel gemalen koffie als oplos-koffie niet meer dan 0,5 ppb benzo(a)pyreen bevatten. Bij TNO is de detectiegrens bij 0,1 ppb gelegen. Volgens dr. G. H. D. van der Stegen van Douwe Egberts moet verschil gemaakt worden tussen twee isomeren van benzopyreen: 3,4 benzo-pyreen (benzo(a)pyreen) en 1,2 benzopyreen (benzo(e)py-reen). Vooral benzo(a)pyreen (BaP) is een gevaarlijke kan-kerverwekkende stof. Bij het TNO-onderzoek is daarom uit-sluitend naar benzo(a)pyreen

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TNO: blikken ananas niet gevaarlijk

(Van onze correspondent)

ALKMAAR — De 24.000 blikken ananas van Siam Food die begin deze maand uit de handel moesten worden genomen zijn niet gevaar-lijk. Uit onderzoek van TNO blijkt dat alleen op de papieren wikkels rond de blikken het landbouwgif dichloorfenol zat. Het onderzoek was ingesteld nadat een gezin in Drenthe ziek was geworden na het eten van ananas.

Uit onderzoek van de importeur, Klaver bv uit Alkmaar, en de fabri-kant, is komen vast te staan dat de wikkels zijn verontreinigd tijdens het transport van de blikken van-uit Thailand. De vorige lading van de container waar de ananas in werd vervoerd had bestaan uit een chemische stof waar dichloorfenol in voorkomt.

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39. 'Benzopyrene. Storm in a coffee cup' As reported by the 'Chemisch Weekblad' a storm was raging in our coffee cups in November 1981. The substance all the fuss was about was *benzo(a)pyrene* and TNO developed an analytical method for determining this. From the analytical results it would appear that coffee adds only a very small amount of benzo(a)pyrene to our intake, if we look at the number of microgrammes already taken in via the air we breath and with our water and food.

40. 'TNO: tins of pineapple not dangerous' It regularly occurs that TNO is asked to solve cases where doubt exists. Suspect pine-apple was found to be in perfect condition. However, the wrappers on the tins contain-ing the pineapple were found to have come into contact with dichlorophenol, a poison used in agriculture.
This case was reported in 'Het Parool' on 12th December 1981.

prepared for, and distributed to, people requiring special attention, such as hospital patients, and aged persons living independently. One aim of the study was to draw up an inventory of the risks of microbial growth during the preparation and distribution of custard to determine measures for eliminating these risks. Another aim of the study was to find means of combatting the detrimental effects (loss of vitamins, taste, flavour and texture) which result when meals are kept at high tem-peratures for prolonged periods during distribution. An example of research on process technology is a study on the heat exchange in so-called 'scraped heat exchangers' in which viscous fluids flow through externally cooled pipes. The results obtained from this study may be used in designing new production lines for the food industries. In addition, a great deal of attention has been paid to the application of micro-electronics in the food industry, for example, for the control of sterilization processes.

Analysis and hygiene

The Institute CIVO-Analysis and the Department of Psychological Studies of the State University of Utrecht have arranged to collaborate in the field of sensory-analytical research. The aim is, on the one hand, to co-ordinate research activities so as to avoid duplication and, on the other hand, to make the joint fund of knowledge and experience available to the food industries. A number of interesting projects already resulted from this collaboration in 1981. A pilot installation which can be used to study the ease of cleaning fittings and accessories used in the food processing industry has been built with the aim of improving the hygienic quality of various foodstuffs. This installation has been designed in collaboration with the margarine industry.
The analytical method for the determination of benzo(a)pyrene was further refined and was applied to various heat-treated foods and related substances, including coffee. It has been found that this analytical method requires a great deal of expertise, as it can easily yield results which are too high.
At the request of the EEC, methods for the analysis of preservatives in cosmetics have been elaborated. This project will be further extended in 1982.
In an international context, guidelines for foodstuff testing are being drawn up. As a contribution to this project, the Institute for Mathematics, Information Process-sing and Statistics has provided the Foodstuffs Chief Inspectorate of the Ministry of Health and Environmental Protection with recommendations from the statistics point of view. Recently, work has been concentrated in the main on pesticide residues in fruit, moisure contents in cereals and contaminants.
The Wageningen branches of the Institute for Mathematics, Information Process-sing and Statistics have held a symposium to celebrate the twenty fifth anniversary of the establishment of the department. At present, eleven consultant statisticians and a varying number of intermediate grade staff are involved in the supervision of agricultural research. Research fields cover both the arable farming and stock farming sectors and land management, horticulture and nature conservancy.

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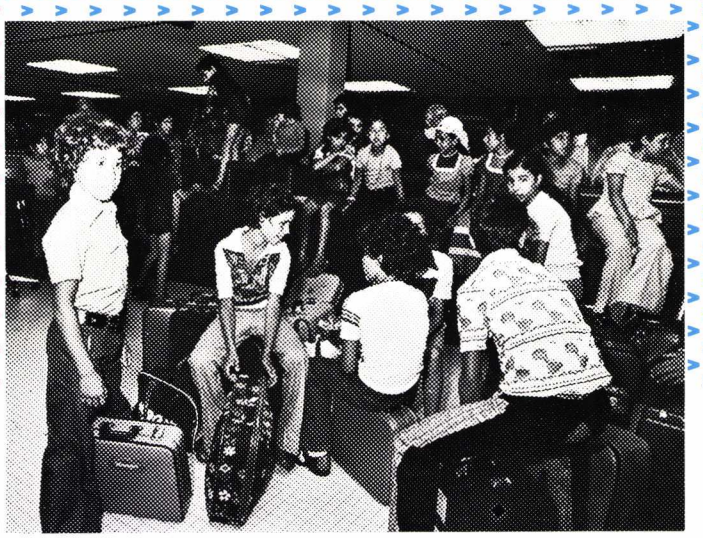

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41. The health of the children of immigrant workers demands special care. In particular, a great deal of attention is being paid to vaccination programmes.

42. The Netherlands could be turning into a country where everyone does something to keep fit. More and more of the Dutch are deciding to go by bike or are finding time to run or jog before or after work.
A healthy way of life is one of the prerequisites for good health. Various studies have indicated this, including those carried out by TNO.

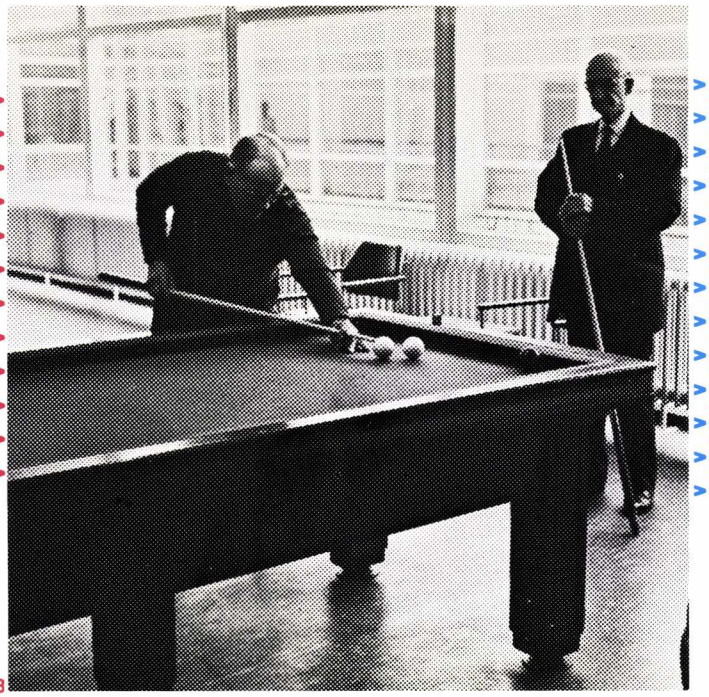
Health Research

Health and welfare

In the past a significant proportion of health research was directed towards the treatment of diseases. Nowadays, the prevention of diseases is demanding (and getting) more and more attention. A person's way of life would appear to be a factor of great importance. Studies on the young and the elderly as groups with their own specific problems are being carried out by the Netherlands Institute for Preventive Health Care.
A lot of young people are currently leaving school at too early an age. They are no longer so convinced that there is any point in their education; they do not have a very high opinion of many of their teachers and absenteeism is rife. A study on this specific problem has shown that the majority of early school leavers stand little chance of reasonable carreer prospects. Although in the early stages they do not experience much more difficulty in finding a job than children who have completed their schooling (to final examination level), it would seem that they have difficulty in maintaining their position, to say nothing of improving their skills.
The children of immigrant workers have a hard time. Naturally, they experience the difficulties associated with living in another country. Frequently, they are also not in the best of health. The health care of this group demands a separate approach: there appears to be a need for information on vaccination programmes, TB screening, prenatal care and a number of other aspects of preventive health care.

The elderly

The percentage of elderly people in the population is increasing. The Institute for Experimental Gerontology (in collaboration with other TNO Institutes) is carrying out a study on the elderly. A large number of medicaments are prescribed for the aged. Whether or not this is justified is something which must be considered for each individual patient. However, it is a fact that one third of all medicines taken are prescribed for the elderly patient. The Institute is carrying our research into the possible adverse consequences of a number of groups of medicines. An initial finding is that restraint in dosage is called for: a large number of patients experience adverse effects. In this connection work was started in 1981 on a research programme to evaluate the role played by the liver in the variable reactions shown by elderly patients to medicaments administered. In collaboration with hospitals in Nijmegen and Leiden, a study was carried out on thiopental, which is a narcotic used for general anaesthesia and which in elderly patients may be the cause of the confusion frequently observed after this type of anaesthesia. A method for the measurement of this substance and its metabolites in the blood is being drawn up. Moreover, the metabolism in isolated rat liver cells is being studied.
The Institute has also been carrying out work on other aspects of ageing. In collab-



43

Vooruitzichten kankerpatiënten zijn verbeterd

De kankerbestrijding heeft in de laatste jaren geen spectaculaire vooruitgang geboekt. Het is echter niet juist om te stellen, dat er niets is verbeterd. Er is op verschillende terreinen van de behandeling duidelijk winst geboekt, zij het dat dergelijke terreinwinst niet de koppen haalt, zoals met interferon het geval is.

44

43. The elderly are making up an increasing proportion of the population in the Netherlands. According to the Central Bureau for Statistics, by 1990 there will be some 1,458,000 women and 1,078,000 men over sixty, making up some two and a half million in all. TNO is engaged on studies to determine whether it would not be possible to provide the means which would enable the elderly to retain their independence and live in their own homes for a longer time if they so wish.

44. 'Improved prospects for cancer patients' TNO is engaged in cancer research and is collaborating with other bodies in the Comprehensive Cancer Centre in Rotterdam. By means of this collaboration closer links are being forged between research and treatment. On 19th September 1981 'De Telegraaf' published an article on the improved prospects for cancer patients.

oration with staff of the Institute of Medical Physics, a preliminary study has been started to assess whether it would be possible to use the 'brain slices technique', i.e. the study of neurophysiological characteristics using thin slices of brain tissue in vitro, to study the ageing process in the brain. Initial, provisional results support the opinion recently expressed by Dr. H. Rigter, who is engaged in research in this field, that 'it will be possible to design useful animal models for the "normal" ageing of memory functions'.

There is (understandably) a tendency to pay a great deal of attention to the care of the elderly. Some groups (including the elderly themselves) are resisting this trend. The Netherlands Institute for Preventive Health Care is engaged in a study to determine whether it would not be possible for the elderly to remain independent for longer than has previously been assumed: nowhere near all the old are pressing for residential homes. The provision of just a few simple facilities would make their lives in their own homes much more pleasant.

The importance of prevention, and of cure

In the first paragraph of this section of the report it has been stated that it is desirable to concentrate a significant proportion of research on prevention. The Radiobiological Institute is investigating the role played by radiation in the development and the treatment of cancer. A method has been developed which can be used to investigate the effects of regular exposure to relatively small doses of radiation. It has been shown that experimental research into certain effects of radiation on cells gives an insight into radiobiological mechanisms. With the aid of these it is possible to use the epidemiological data on the development of cancer in man after exposure to relatively high doses of radiation to deduce the risks attached to exposure to small doses.

The Radiobiological Institute carries out a great deal of fundamental research, but it is the involvement of this Institute with the Comprehensive Cancer Centre in Rotterdam (IKR), with which the University Hospital of the Erasmus University and the Rotterdam Radiotherapeutic Institute also collaborate, which renders it possible to make the results obtained available to medical practitioners within a reasonable time.

One of the tasks which the Radiobiological Institute is carrying out for the IKR is the preparation of a population-based cancer register for the Rotterdam region. This Institute is also participating in a combined experimental and clinical research programme which is looking into the use of heat in combination with radiation for the treatment of specific types of cancer. As a result of collaboration with the Institute of Applied Chemistry it has been possible to bring a new anti-cancer agent, named TNO-6, into clinical use. This is the first time that the Netherlands has made a contribution in this field. Advanced methods of cell separation which are used, inter alia, in clinical bone marrow transplants have made it possible in part to identify in the immunological system the 'precursor cell' which is present in the bone marrow and is further developed in the thymus. By this means it is now

TNO boekt succes met interferon-research

Door onze redactie wetenschappen

AMSTERDAM, 23 jan. TNO-Rijswijk heeft plannen ingediend om zelf interferon te gaan maken, door middel van genetische manipulatie. Een reeks projecten waaronder dit, ligt bij Economische Zaken in Den Haag te wachten op goedkeuring. Er zullen enkele miljoenen guldens mee gemoeid zijn.

Interferon, een eiwit dat het lichaam zelf produceert als onderdeel van het afweersysteem tegen virussen en andere indringers, wordt in ons land nog niet volgens deze methode geproduceerd. Er bestaan grote verwachtingen van deze stof als toekomstig geneesmiddel.

45

TBC: een vergeten ziekte met stijgende sterfte

46

'Experimenten met bacteriën (DNA) nauwelijks riskant'

Door onze redactie wetenschappen

LEIDSCHENDAM, 31 maart — Er zijn nauwelijks risico's aan het zogenaamde DNA-onderzoek verbonden. De gevaren van dit soort experimenten met het DNA-molecuul waarbij men de erfelijke eigenschappen van bacteriën probeert te wijzigen, zijn uitzonderlijk klein.

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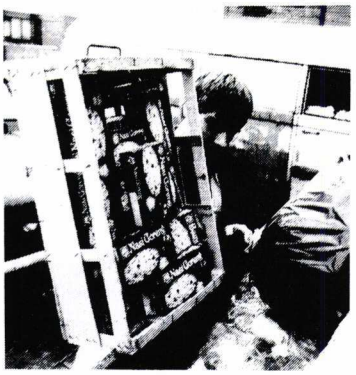
45. 'TNO research on interferon meets with success' In 1981 the newspapers published many articles on interferon, the group of new substances which hold out a great deal of promise for medicine in the future. On 23rd January 1981 the 'NRC-Handelsblad' published an article on interferon research.

46. 'TB: a forgotten disease with an increasing number of victims'
TB is a disease from which an estimated three million people throughout the world die every year. Moreover, five million people contract the disease every year. The threat is if anything increasing rather than decreasing. TNO is teaching the vaccination methods to local inhabitants in the developing countries.

47. 'Hardly any risks associated with experiments with bacteria (DNA)' DNA-recombination is opening up possibilities for research, in the fields of cancer and rheumatism amongst others. TNO urged the municipal council of Rijswijk to consent to the building of a laboratory in which work on DNA can be carried out at high (C III) level.

possible to investigate the role played by these precursor cells in the development of leukaemia caused by radiation.
The Gaubius Institute carried out fundamental research on diseases of the blood vessels and the heart. The fat metabolism in the blood, the fibrinolysis (the mechanism by which blood clots are broken down) and the role of the vascular wall are being studied in the Institute. Just how relevant this type of research is to practical problems was shown when the research workers found a substance which plays an important role in the formation of plasmin in the blood. Plasmin is a compound which helps to break down clots of blood in our vascular system. This finding has very quickly been taken up, in Louvain and elsewhere. The substance has been successfully tested in medical practice in the Rotterdam University Hospital.
Interferon, the group of new substances which appear promising for, inter alia, the treatment of virus infections, is being tested in the Primate Centre. Tests carried out on various laboratory animals have indicated that the prospects for combatting virus infections, such as hepatitis B, are good.
Once again a significant step forward towards achieving the aim of compiling research results for distribution to medical practitioners as quickly as possible has been made via the work of the various Research Units of the Division of Health Research. The Research Unit for Clinical Neurophysiology has made progress with the analysis of electroencephalograms by computer. Diagnostic techniques have been further improved in this way. The Caries Research Unit continued to work on the development of preventive measures for combatting dental caries, and to this end has fitted out a bus to be used for regional check-ups. Good results were also achieved by the Tuberculin Research Unit, the work of which is focussed on practical application. The system for teaching vaccination methods to the inhabitants of developing countries has proved its worth more clearly than ever before. A striking fact was that the services of this Unit were also required in the Netherlands, where, in particular, the small outbreak of tuberculosis in Zeeland demonstrated the necessity of maintaining constant vigilance.
Another way in which the Division collaborates with those engaged in day-to-day medical practice is through the work of the Committees.
The Research Committee on Epilepsy, the Research Committee on Occupational Health and the Committee for Asbestos and other Mineral Fibres have carried out this liaison work to good effect.
DNA-recombination would appear to open up possibilities for health research. In particular, this technique is a very important means by which insight can be gained into diseases such as cancer and rheumatism. A significant proportion of TNO research on recombinant DNA is carried out in the Medical Biological Laboratory. This laboratory works in collaboration with research groups in universities and other institutions. Vectors have been developed for cloning DNA from another species in various host organisms. The nature and the mode of action of enzymes

Scherper toezicht op voedselfabricage



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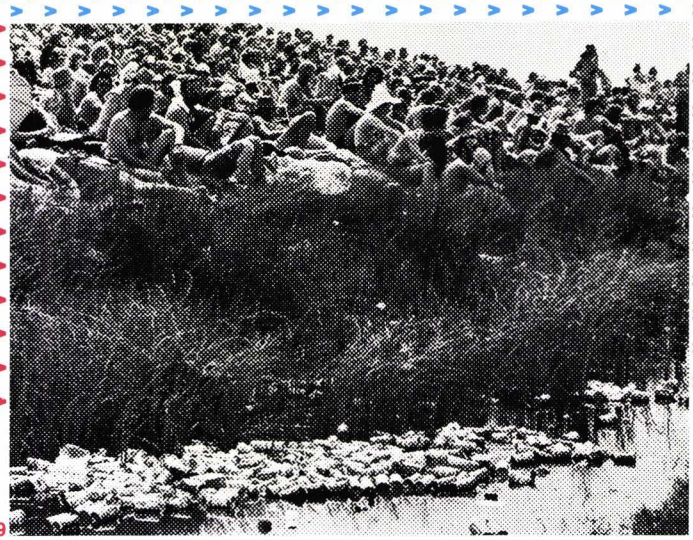
48. 'Stricter control for food manufacture' Voices are increasingly being raised in pressing for research to establish whether new products may have any harmful effects and for control on manufacture and distribution. Projects on which TNO was engaged in the year under review included the development of effective standard procedures and determinations. The cutting is from the NRC-Handelsblad of 13th August 1981.

involved in the repair of damaged DNA in human and animal cells and in micro-organisms are also being studied.
Ultimately TNO will be able to carry out DNA-recombination work on a larger scale within the 'CII' and 'CIII' safety categories.

Toxicological assessment of substances

In many cases new products are investigated to determine whether they have any properties which could be harmful to man and the environment. The Institute CIVO-Toxicology and Nutrition plays an important role here. In the year under review a study, commissioned by the Ministry of Health and Environmental Protection, was set up in this Institute to evaluate the importance of standard procedures and tests that are run routinely for the toxicological appraisal of substances. Results obtained from studies carried out during the past ten years showed that abridging a toxicity test from the usual 90 to 28 days will frequently result in a different 'no-effect level' being obtained for a given substance. Nonetheless, the 'no-effect level' pertaining to a 90-day trial can often be reproduced in the shorter trial. This implies that in a number of cases a 28-day test will suffice. On the other hand it has been found that fertility reproductiveness and the animal species can be decisive in determining the no-effect levels. If, for example, besides the rat a second species (usually the dog) was used, the no-effect level turned out to be lower in 60% of the cases, although this level was rarely lowered by more than a factor of 10.
Most of the traditional clinico-chemical and haematological tests in toxicity experiments prove to be justified. These determinations, namely, are indispensable both for establishing no-effect levels and for the correct interpretation of the effects observed. Other parameters, such as sex hormones and cholesterol, deserve more attention; if inhaled toxicants are to be tested, analyses of dissolved gases in the blood seem to be necessary.
Hamsters contracted cancer of the nose and larynx after prolonged inhalation of acetaldehyde. In the course of 1981 it became known that a related substance, formaldehyde, is carcinogenic: this prompted the continuation of the study on the carcinogenicity of acetaldehyde, now using rats. Acetaldehyde is an important constituent of cigarette smoke.
A project on which the Division of Technology for Society has been working for several years in collaboration with an industrial company was completed with the synthesis of 10 kg of active natural product for medical use and an application for a patent in respect of the compounds synthesized. Research on, and the development of, organo-germanium and tin compounds has been so successful that these anti-tumor chemotherapeutic agents are now in clinical application.



49. In a densely populated country such as the Netherlands environmental problems easily arise. The Assen TT races attract tens of thousands of spectators. All eyes are on the races - and all the rubbish goes into the ditch...

The Environment

The environmental research carried out by TNO is very wide-ranging and very extensive. There is not a single Division which is not involved in this research in one way or another. The problems posed by this research are frequently of a multi-disciplinary nature. This demands an approach involving the close collaboration of experts in diverse fields, such as analytical, organic and inorganic chemists, biologists, chemical engineers, physical technologists and aerodynamic engineers, as well as specialists in the fields of combustion technology, environmental measurement techniques and computer model design, and operational research. Within TNO these various activities are co-ordinated by the Bureau for the Environment. Within this framework a joint programme of work has now also been set up for the first time by the Division of Technology for Society and the Research Institute for Environmental Hygiene, two bodies which are responsible for a significant part of the environmental research carried out within TNO.
To bring some sort of order in the multiplicity of projects on which work has been started during the past year it would be possible to sub-divide these projects according to the aspect of the environment to which they relate, such as soil, water, air, etc. We have chosen a rather different method of sub-division, i.e.: analysis of environmental pollution, control of environmental pollution, prevention of environmental problems and other environmental acitivities.

Analysis of environmental pollution

Various sections of TNO are involved in activities relating to the analysis of environmental pollution. Let us first consider the Division of Technology for Society.
During the past year good results have been achieved with four sophisticated measurement techniques developed under the management of this Division. With the aid of diode/laser equipment ammonia in the atmosphere was determined in concentrations down to 5 ppb (5 parts per billion). A light path of 2 km was produced for this purpose. The Ministry of Health and Environmental Protection carried out an evaluation study (a comparative study on the sensitivity of specific equipment) in the field of olfactometry, i.e. detection by using the human sense of smell. The olfactometer developed by TNO was found to be the most sensitive tested, having a sensitivity of 0.4 $\mu g/m^3$. At long last a sampling method has also been developed which enables 100% of the heavy metal vapours present in air and dry flue gases to be collected. After the reliability of a modulation fluorimeter designed by TNO had been demonstrated, an order was obtained from the Public Works Department (Rijkswaterstaat) for the construction of a more sophisticated type of fluorimeter with which the dispersion of these substances in Lake IJssel and the North Sea can be measured. Work on this order is now in progress.

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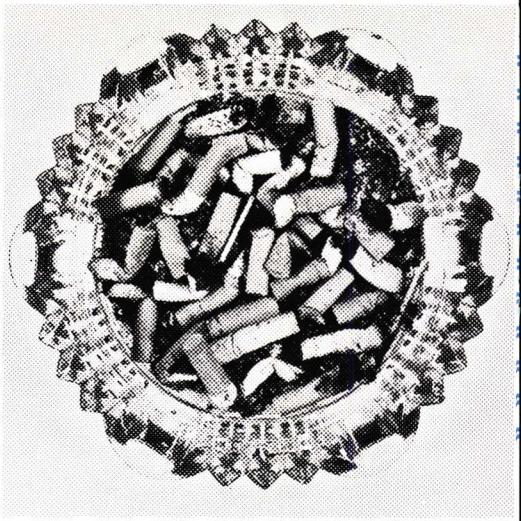

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50. It was in part the results obtained from the study carried out by TNO which led to the decision to excavate the dangerously contaminated ground in Lekkerkerk-west. TNO also analysed contaminated soil in other locations.

51. The indoor environment.

Research on aerosols constitutes an ever more important part of studies on the prevention of atmospheric pollution. With the aid of the Amestest (a rapid method for obtaining an indication of the mutagenic properties of chemical substances by exposing a very specific strain of bacteria to these) it has been shown in a study carried out along a SW-NE line in the Rotterdam Europoort area that as atmospheric pollution increases the mutagenic effect revealed by the test is also intensified. It would thus seem to be possible to differentiate between specific locations.

With the aid of the KNMI (Royal Dutch Meteorological Institute) measuring tower in Cabouw it has been found that the amount of ozone or PAN (peroxy-acetyl nitrate) formed above or in inversion layers (a horizontal separating region in the atmosphere where the temperature changes sharply) is twice as large as had been assumed.

A study has been carried out for the Norht Sea Division of the Public Works Department (Rijkswaterstaat) to establish whether a particular species of mussel (Dreissenecia) can be used to determine heavy metals and organic micro-contaminants in the North Sea. The results which have been achieved using this new method for determining the level of pollution by cadmium and PCBs (polychlorobiphenyls) have attracted much interest. One area to which attention is now being turned is the question of PCB accumulation in sediments and any resultant harmful effects.

TNO has been asked to analyse widely differing types of polluted soils. This is soil, taken from the vicinity of old or former dumping sites, which has become heavily contaminated with chemical waste. Lekkerkerk, Dordrecht, Delft, Den Helder, Utrecht, Apeldoorn and Wierden are just some of the locations where investigations have been carried out or are currently in progress.

Environmental research (just like research on biotechnology and on energy) would not be possible without the intensive support provided by an experienced analytical chemistry department with very modern and up-to-date equipment. A very large volume of work in connection with the cleaning up of refuse dumping sites has had to be dealt with, not only for the locations mentioned above but also for the municipalities of Schoonhoven, Roosendaal, Capelle, Middelharnis and Rotterdam. Some of the analytical methods required for these investigations have been specially developed for this purpose.

Further activities which may be mentioned are the study on the waste slag produced by the AVR in Rijnmond, the use of the recently obtained ICP (Induced Coupled Plasma) spectrometer for effluent measurements in Groningen, the checking of the nicotine contents of cigarettes and the determination of lead contents in the blood (this latter project being carried out in collaboration with the Medical Biological Laboratory). In total, some 11,000 determinations have been carried out for the purpose of elementary analysis and approximately 4,500 analyses have been carried out in connection with the environmental research project in which the Research Institute for Environmental Hygiene is engaged. Work

Methyl-bromide ook in de lucht

52

52. 'Methyl bromide in the air too' As a result of the studies carried out by TNO, the use of methyl bromide for treating the soil in which vegetables are grown in greenhouses can be brought within reasonable bounds. The local newspaper in Zwolle devoted an article to this on 6th February 1981.

on the emission registration project, which is a major project on which TNO has been engaged for a number of years, was virtually completed in 1981. It was then assumed that completion of the project would signify the end of TNO activities in this field. However, after further consultation the Ministry of Health and Environmental Protection decided to renew the contract for a further three years to enable a new registration of the emission from about 1,400 installations, which together account for approximately 77% of the total industrial emission, to be carried out. The cost of this project will be about three million guilders per year.
In the environmental sector, the Division for Nutrition and Food Research has been engaged in analyses of various types. Studies have been carried out to establish the structures of organic compounds of arsenic found in a few fish species.* After a few days the substance leaves the body unchanged.
Other items of investigation in connection with fishery products were the testing of analytical methods for biogenic amines, the determination of these substances in smoked or heat-preserved fish, and, as a part a regular surveillance scheme, the determination of the trace elements mercury, lead, cadmium, chromium, zinc and copper.
In addition, soil and water samples were analysed for residues of herbicide, insecticide and fungicide, and a study on the degradability of disinfectants was started. The reason for this latter study is the considerable nuisance which these substances can cause in sewage treatment installations (by poisoning the bacteria responsible for the degradation processes).
As a result of the discussions on the use of methyl bromide for treatment of the soil in greenhouses used for the cultivation of vegetables, the analysis of large numbers of vegetable samples has now been extended to include tests for bromide as well as for diverse agents used for crop protection. This has been done in close collaboration with the Central Bureau for Horticultural Auctions in the Netherlands.
The Institute of Applied Physics TNO-TH has employed the optical heterodyne measurement technique to determine atmospheric constituents such as PAN and ozone over a measuring path of 500 metres.

Control of environmental pollution

The Division of Technology for Society has been engaged in a number of activities in connection with the control of environmental pollution. Studies were carried out on the combustion aspects of, and the emission of a noxious stench from, an industrial incinerator and on improving the economy and the purification efficiency of a direct tunnel dryer used for the purification of contaminated soil. A study has also been carried out on the removal of iron from groundwater with the aid of HGMS (High Gradient Magnetic Separation). As a follow-up to the work carried out in connection with major contracts for the analysis of soil, from old or

* In plaice, flounder and lemonsole these substances have been indentified as arseno-betains.

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53. In dock areas the dust from coal and ores can disperse over wide districts, especially when there is a strong wind. TNO is looking into ways of preventing this.

former dumping sites, which had become highly contaminated with chemical waste, the Division is now working intensively on techniques for the removal of harmful inorganic and organic waste substances from the soil. A development project is being set up in collaboration with an industrial company.
Noise pollution is a more immediately apparent form of environmental pollution. The control of this type of pollution is a matter which demands a great deal of attention and which falls in particular within the scope of activities of the Division for Technical-Scientific Services. The phased introduction of the Noise Abatement Act plays an important role here.

Prevention of environmental problems

The bulk of TNO activities in the field of environmental research are directed towards the prevention of an unacceptable level of pollution of the environment. In this connection the Division of Technology for Society has been active in the following fields.
Research carried out in the 'smog room', and the theoretical models derived from this, are important elements in a number of large projects in the field of photochemical air pollution which have been commissioned by the government. One of the aspects studied was the formation of aerosols on solar irradiation of sulphur dioxide, nitrogen oxides and hydrocarbons. The major project on a 'Computing System for Application to Air Pollution Problems', carried out for the Ministry of Health and Environmental Protection, were completed in the year under review. The final reports were submitted to the State Secretary. These reports not only deal with various processes with regard to sulphur dioxides, nitrogen oxides, carbon monoxide and sulphate, but also cover in depth the role played by traffic and the use of wind tunnels and computer models; moreover they provide an overall survey of the computer programming systems designed.
A study has been carried out for the Ministry of Economic Affairs and the Ministry of Health and Environmental Protecion to determine the biological effects of the fine fraction of the fly-ash emitted by smoke stacks. This ash is able to penetrate deeply into the lungs. Test samples have been taken behind the E-filters of the Nijmegen power station. In collaboration with the Research Institute for Environmental Hygiene, a wind tunnel investigation has also been carried out into the blow-up and dispersion of coal and ore dust from large stores. In collaboration with, amongst other bodies, the Netherlands Energy Centre (ECN), a study has been started on the burden which is placed on the soil by the dry deposition resulting from sulphate- and nitrate-containing aerosols.
In collaboration with SAI (System Application Inc. USA), the dispersal of atmospheric pollution was determined for the Cologne/Bonn region with the aid of a computer program which TNO had purchased and supplemented. A wind tunnel study on chemically reactive smoke plumes showed for the first time that modelling of these plumes is indeed possible. This finding attracted a great deal of attention internationally. This wind tunnel is also being used to carry out a model

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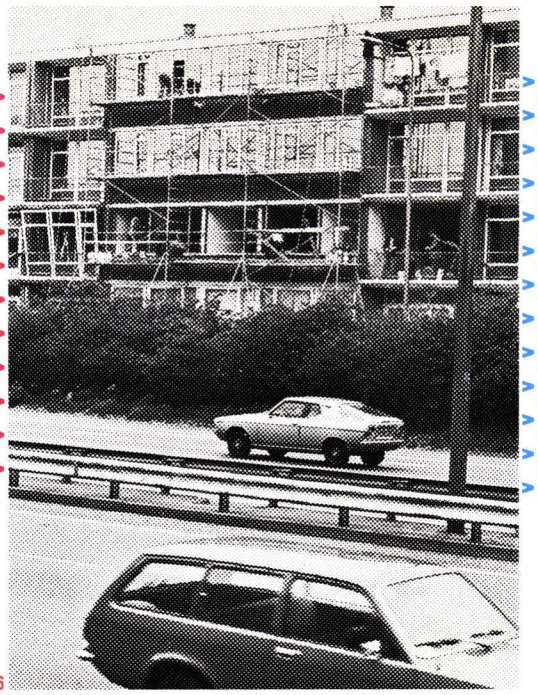
54. Pig breeding on a large scale can produce unpleasant smells which are a nuisance to local residents. TNO is investigating how pig manure must be treated in order to prevent this nuisance.

55. Building and demolition waste is an eyesore and a blot on the landscape in many places. TNO is carrying out studies to determine how this type of waste can be collected and re-used.

study on the dispersal of heavy gases (LPG, LNG, etc.), which can be released into the atmosphere should any leakage occur.
With the completion of work on a number of large model eco-systems, the comparison of the results obtained with these systems with the measured values obtained in the laboratory, and the drawing up of a 'minimum package of toxicity tests' for the Ministry of Health and Environmental Protection, TNO has now at its disposal an extensive range of possiblities of determining possible mutagenic effects, when requested to do so by industrial concerns. The determination of what are termed 'no observed effect concentrations' is central to these tests. It is partly in this connection that a great deal of attention is currently being paid to the correct statistical processing of this type of measurement results, the computerized processing of these results, and the drawing up of forecasting models.
In the more technologically-orientated environmental research projects the emphasis is on process management, waste problems, and soil protection and decontamination. Now that a study on the combustion of sewage sludge with varying dry matter contents in a fluidized bed furnace has been completed, this installation is available for adaptations for a large-scale study on the combustion of domestic refuse. This study has been commisioned by, and is being carried out in close consultation with, industrial companies and the Ministry of Economic Affairs and the Ministry of Health and Environmental Protection. This research programme will take several years to complete and concentrates on combustion economy, process management, the development of equipment and environmental aspects.
In the study on the emission of nitrogen oxides (NO_x) from incinerators, a matter which is of vital importance for the environment, it has been found that in most cases a reduction of more than 20 to 30% in this emission will result in soot formation or in an increased emission of carbon monoxide. A large number of projects relating to the measurement of the emission from waste combustion installations have been commissioned and carried out.
A great deal of work was carried out on the treatment of industrial effluent and sludges, examples being the detoxification of natural gas sludge (i.e. the sludge which remains after the production of natural gas and which contains mercury and glycol as well as other substances), the removal of cadmium from the effluent produced by a large concern, the treatment of industrial effluent with the aid of a recently developed compact installation for aerobic biological purification, the separation of particles from pig manure and the hydrolysis of this manure. (This latter project has been commissioned by the Committee Nuisance Prevention Cattle Industries).

Once again there was quite a lot of demand for studies into the re-use of various types of waste (domestic waste, shredder, building and demolition wastes, waste wood). Projects which may be mentioned include: a study on the properties of fuel manufactured from domestic refuse (known as Refuse Derived Fuel; the project



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56. These flats in Amsterdam have been fitted with double glazing. The main aim here was not to improve the heat insulation but to provide good noise insulation.

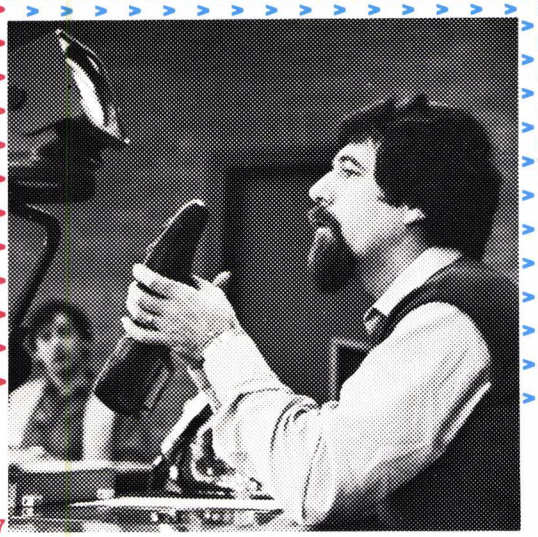
was commissioned by the Ministry of Economic Affairs), the separation of pre-sorted domestic refuse (multi-receptacle refuse) and the separation of wood, cork and paper from building and demolition waste. The development work which has been carried out on a semi-industrial scale on the separation of galvanic sludges in order to recover the heavy metals has been succesfully completed. Consultations on the application of this process are now in progress with the Government and industry. Despite the recession in the building market there has been a normal level of demand for model investigations in our wind tunnels to assess wind nuisance. Work has been carried out on 17 projects involving relatively large buildings and housing estates.

Within the framework of national MER programmes (Environmental Effect Reporting programmes) work has been carried out on the improvement and perfection of techniques for drawing up and implementing programmes of this type.

Insecticides used for pest control often have a broad spectrum of action, which means that they also damage all sorts of useful animals. Pheromones, on the other hand, make very selective control possible. In the year under review, work has been carried out on identifying these pheromones in nine insects, including the housefly. A patent has been applied for in respect of the greenfly pheromone. Research has also been carried out on the biochemical mode of action of (agricultural) fungicides and insecticides, on dichloroanilines in the soil and on the degradation process for fungicides.

A patent has been applied for in respect of a process for removing ferric iron from metal hydroxide sludges. The removal of ferric iron is a prerequisite for further purification of these sludges and for the recovery of the heavy metals which they contain. The Division for Nutrition and Food Research was engaged in 1981 on further research into the re-use or other possible applications of waste bleaching earth from the edible oils industry. In regeneration tests a product with 50% of the original bleaching power was obtained. The dried sludge resulting after boiling and the extraction of waste bleaching earth was found to be well suited as an admixture in cement. A start has been made on the development of techniques for tackling the problem of sewage treatment associated with the refining of oils and fats. In collaboration with the Institute for Waste Materials Research, experiments have been started on the processing of collected domestic refuse to fodder.

Within the Division for Technical-Scientific Services, the Operations Research Group of the Institute for Mathematics, Information Processing and Statistics has once again carried out a great deal of work on various projects with regard to the environment. For example, sensitivity analyses have been carried out using the model set up previously for photochemical air pollution in a zone covering the Netherlands, Belgium and the Ruhr. Within the framework of the project on a 'Computing System for Application to Air Pollution Problems', which is being carried out for the Ministry of Health and Environmental Protection in collaboration with other TNO Institutes, work has been carried out on computer programs which calculate and present concentrations at ground level using data on



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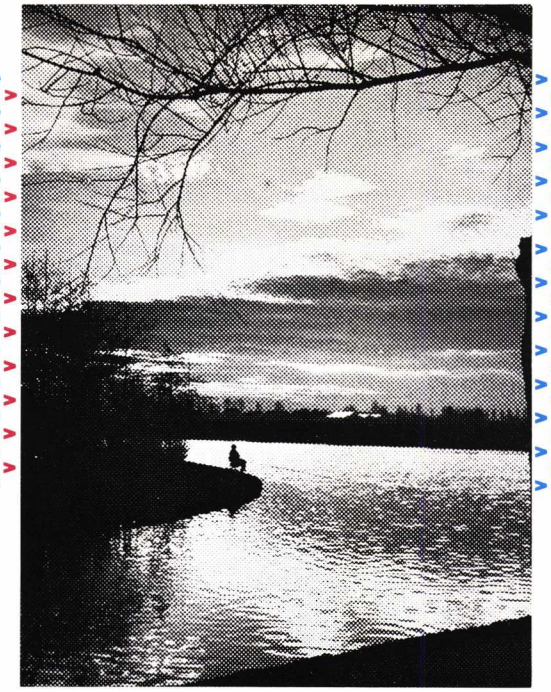
57. TNO is carrying out research to determine how the shoe industry can produce the best shoes in the most economical way. One aspect involved here is the recycling of the chromium not bonded during tanning.

58. Pollution of surface water repeatedly results in the death of fish. TNO is carrying out a great deal of research aimed at prevention. Measurement and treatment are also regularly called for.

individual and collective sources and on the basis of general data and, inter alia, data on the climate for the region concerned. The system is currently already being employed in respect of sulphur dioxide and nitrogen oxides. The Division of Technology for Society is also using this software for sulphur dioxide dispersion calculations.

The Noise Abatement Act is being brought into force in phases and this has demanded considerable effort on the part of the Institute of Applied Physics TNO-TH in the noise nuisance field. For the purposes of this Act measurement and calculation methods for traffic noise and industrial noise have to be drawn up. In the meantime, as much progress as possible has been made on the other research which is being carried out for the Interministerial Committee on Noise Abatement and which will form the basis for the policy to be formulated. The Institute also received many requests from industry for recommendations with regard to noise pollution and has carried out a great deal of work in this field. The recommendations made did not always relate exclusively to the 'noise nuisance to local residents' but in some cases, in the light of the stricter statutory regulations to be anticipated, were also related to adequate provisions for the noise regulations indoors. The Division for Industrial Products and Services has also afforded the necessary attention to environmental problems in the year under review. The consequences of the Chemical Substances Act (WCA) for trade and industry are not inconsiderable, partly because the associated costs can be appreciable. The costs entailed include analysis costs, packaging costs, transport costs and costs for disposal, dumping, processing, treatment or destruction, as well as various levies. Excluding analysis costs, these costs can soon amount to 300 guilders for 1000 kg of chemical waste. It is for this reason that in a project on policy concepts particular attention has been paid to the problems which the Chemical Substances Act poses for various branches of industry. The Paint Research Institute was responsible for this project and as a first step organized a number of publicity campaigns in, amongst others, the paint industry and the carpentry industry.

In addition, various projects have been carried out with the aim of reducing the amount of waste produced in various branches of industry. One process on which such a study has been carried out is the leather tanning process. In this case the chromium content is reduced to the minimum so that the waste no longer falls under the Chemical Substances Act. It is estimated that the effluent produced by the leather industry world-wide releases 20,000 tonnes of the heavy metal chromium into the environment. The figure for the Netherlands alone is about 75 tonnes; the effluents from chromium tannage contain approximately 6000 mg of chromium per litre, whilst the maximum permitted level is 2 mg per litre. An obvious chemical treatment for the removal of chromium from the effluent is the precipitation of the chromium as chromium hydroxide. When this is carried out by the known methods the result is often a highly voluminous precipitate which is difficult to filter off. The Institute for Leather and Shoe Research has found that when alkaline substances of low solubility, and in particular magnesium oxide, are



59. Where cultivated land borders on natural landscape this is frequently a cause of friction. TNO is carrying out studies to determine how pesticides and methods which are not harmful to the environment can be used to serve the interests not only of arable and stock farming but also of nature.

used, a very compact precipitate is formed which settles rapidly. This precipitate can be separated from the afore-said liquor even without filtering, i.e. by simply decanting off the liquid. If the chromium hydroxide precipitate is then dissolved in acid, it is possible to prepare a chromium salt which can be re-used as a tanning material. Virtually complete recycling of the chromium not bonded during tanning is thus achieved. The effluent treatment technique described is already being widely used both within the Netherlands and abroad.

Other activities relating to the environment

The Study and Information Centre on Environmental Research, which is part of the Group Policy Studies and Information, has worked on programming, co-ordinating and stimulating environmental research, as part of a project carried out for the Council for Environmental and Nature Research (RMNO), the National Steering Committee on Environmental Research (LaSOM) and several other institutions. Within the framework of the LaSOM, support has been given to the development work carried out on what are termed 'LaSOM topics'. At the same time a number of activities of the Sub-committee on Air Pollution, the Netherlands Society for Landscape Ecology (WLO) and the Research Committee on Environmental Control, which is part of the Socio-Scientific Council (COM/SWR), have been brought within the framework of these studies. Subjects which play important roles in the work on LaSOM topics are, for example, the accumulation of substances, the effects of air pollution on health, acid rain, the assessment of the quality of surface water, methods for determining ecological effects, effects produced by the environment, dose/effect relationships with regard to soil, effects on the ecology, waste substances, the carbon dioxide cycle, eco-systems and monitoring systems. In addition to the support provided in carrying out this research, work has also been carried out on drawing up a report on the total field covered by the national programme. This so-called 'field report' was completed at the end of the year under review.

In December 1981 the Sub-committee on Air Pollution organized a symposium on the recommendations for the calculation of a long-term frequency distribution of air pollution. These recommendations were drawn up by the Working Group on the Dispersion of Air Pollution after close consultation with the Sub-committee.

A survey of the socio-scientific environmental research and the programming of this research within the framework of the COM/SWR has been largely completed.

In addition, TNO carried out its own studies on:

- the effects of medicaments on the environment;
- quality characteristics of the soil;
- the measurement and evaluation of the side effects of pesticides and related compounds.

The projects carried out within the Division for Technical-Scientific Services were the following. Within the framework of the geohydrological exploration of the Netherlands, the Ground Water Survey has been engaged in drawing up an

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60. The Ground Water Survey has put together a set of computer-controlled instruments for carrying out geohydrological pump trials and other tests. A great deal of attention has been paid to accuracy of measurement, flexibility and efficiency in data processing. The Ground Water Survey uses sophisticated pressure and acoustic transducers to record water levels. To enable long-term field work to be carried out the measuring and recording equipment has been installed in a caravan specially fitted out for the purpose.

61. The pollution of water can be prevented if both the private citizen and industry make every effort to solve the problem.
TNO is carrying out studies to determine whether alternative compounds can be developed which can be used instead of phosphate in washing powders.

inventory of data and in supplementary studies for the purposes of the groundwater map (scale 1:50,000). With regard to the other work commissioned, there was a discernible shift away from the more conventional work focussed on the establishment of water catchment areas and towards other topics, such as: groundwater pollution, flooding, and the reclamation of geothermal heat from shallow depths. Studies have also been carried out to provide supporting data for the groundwater management plans to be drawn up by the provincial authorities. The optimization studies on the density of the national groundwater measurement network and the frequency with which observations are made were continued. To enable a revised plan for the establishment of this measurement network to be drawn up per province, interested authorities in North Brabant, the Lake IJssel region and Gelderland were asked to take part in regional advisory groups. The measurement network was studied in three areas, and it was found that preventive maintenance of observation points can significantly increase the accuracy of the observations made.

Within the Division for Health Research, the Research Institute for Environmental Hygiene is working on problems associated with the air, water and the soil. As a result of these studies insight has been gained into problems such as: smog (ozone), the use of sludge in the agricultural sector and the pollution of the soil. With regard to soil pollution, the Institute is working together with the Division of Technology for Society on studies designed to establish quality characteristics. It is anticipated that these studies will provide criteria which can be employed to take a practical look at the nature of a given type of soil pollution.

If it is useful to determine the substances which pollute water, soil and air (indoors or outdoors) and to measure the quantities in which these substances are present, it is also extremely important that insight should be gained into the way in which these substances act on man and on the environment. The Medical Biological Laboratory is studying the harmful effects of a variety of substances and compounds and, of course, is also making efforts to find out whether or not there are substances able to neutralize any possible harmful effects. Two of the projects on which the Research Institute for Environmental Hygiene has been working are substitutes for phosphates in washing powders and the existence of underground oil storage tanks on the premises of private dwellings.

One factor which has demanded a great deal of attention in recent years is that of hygiene precautions in connection with radiation hazards, both in the natural environment and at the place of work. A great deal of work has been carried out in this field. As already mentioned, studies have been carried out by TNO to establish standards for (un)acceptable doses. The Radiological Service Unit has developed a system for recording the levels of radiation to which radiological workers are exposed. A problem with which the Research Institute for Environmental Hygiene and other Institutes are being confronted to an ever increasing extent is that of radon, which can be released from a building material which is in widespread use, i.e. plaster.

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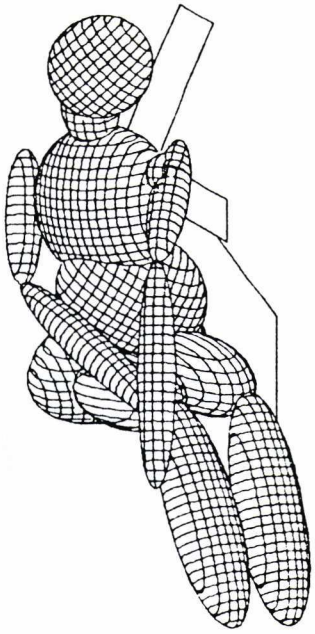

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62. With the current traffic density on our roads, traffic accidents are obviously difficult to prevent. TNO works not only on improving road safety but also on preventing injury.

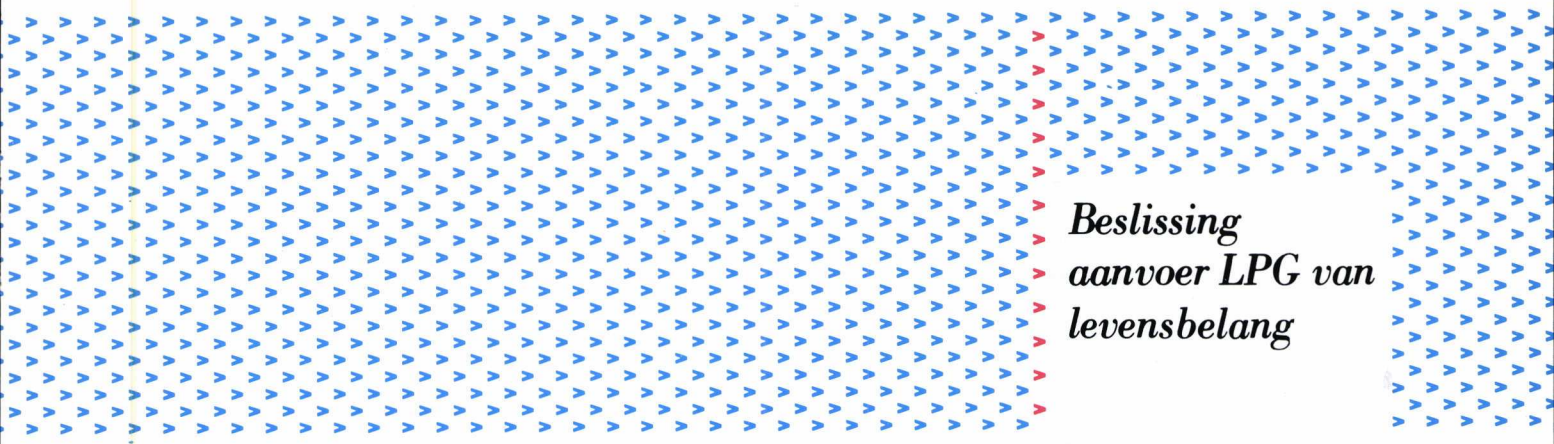
63. The MADYMO 'Crash Victim Simulation' computer program can excute two- and three-dimensional simulations.

Safety

In various TNO Divisions projects are carried out with relation to safety.

Road safety

That area which probably appeals most to the imagination is the research in the field of the prevention of injury to road users. This research is concerned both with regulations for vehicle safety and with the development and improvement of safety devices.
In addition to the indispensable, crash experiments with cars or test sleds, theoretical work is also necessary in order to obtain a better insight into current retention systems and systems still to be developed.
Since the interaction of forces and energy inside geometrically confined spaces during collisions is very complex, this theoretical work is done with the help of advanced, mathematical computer models. The models which formerly existed in this field were only suited for studying certain, specific problems and there was a need for a generally applicable model.
In 1974 the development of this was taken in hand by the Research Institute for Road Vehicles (IW) in close co-operation with the SWOV (the Road Safety Research Foundation), which also shared in the financing of the project.
This resulted in the MADYMO 'Crash Victim Simulation' computer program package, which can be described as a program which executes two- or three-dimensional simulations of the forces involved in the interaction of any number of elements linked by hinges, with each other or with the environment.
The MADYMO-package is currently being used in all sorts of projects. Recently a German manufacturer brought onto the market a revolutionary type of child's safety seat. This was developed with the help of MADYMO and is provided with a safety shield which is thrown upwards in case of accident. Another application of this package in the area of product development lies in the design of an abdominal section for a test dummy. This was developed by the Research Institute for Road Vehicles for the purposes of drawing up side impact regulations. In the same field, TNO has also used the MADYMO to analyse, on behalf of the European Economic Community, a number of reconstructions of lateral collisions (see illustration). At the moment collisions between cars and pedestrians are being simulated with the purpose, on the one hand, of establishing the requirements for future regulations, and on the other hand of arriving at designs for the front end of cars which would minimize the risk to pedestrians. Licences for the use of MADYMO are also being issued to third parties. The first MADYMO licence was sold to the Southwest Research Institute in Texas, and the issue of further licences is currently being negotiated.



Beslissing aanvoer LPG van levensbelang

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64. 'Decision on LPG landing of vital interest' The large scale introduction of liquidified petroleum gas (LPG) into the energy network was a subject for debate in the Rotterdam City Council in November 1981. TNO carried out a comprehensive study on LPG and compiled a well-ordered report giving all the information needed by advisers and policy-makers.

Transport of hazardous goods

Another safety problem is the transport of hazardous goods. Good packaging of hazardous goods is of great importance with respect to safety in transport, storage and handling.
There are statutory requirements with regard to the packaging which may be used when transporting such products. In this connection, packaging is tested and approved by the Institute for Packaging Research (IvV) and recommendations are made to packaging manufacturers and users. Until now there has been quite a diversity in regulations applied to the packaging of goods for transport by land, sea or air. In the near future, however, all regulations will be based internationally on recommendations made by the United Nations. TNO is closely involved in the production of these new rules and in their introduction in the Netherlands, and acts as intermediary between the government authorities and trade and industry.
In addition to mechanical tests, tests to determine the interaction between hazardous goods and (plastic) packaging will also have to be carried out in the near future. Preparations have been made for carrying out this type of research, which requires special facilities. A permanent test programme is necessary in order to evaluate the existing regulations in the light of their practical application. This applies in particular to the introduction of new types of packaging; one of the areas to which TNO has contributed is the drafting of regulations for flexible containers for bulk goods.

Industrial safety

Research in the field of industrial safety was dominated by a few large projects. The comprehensive study on LPG was substantially extended for the purposes of providing a sound basis for formulating a national policy with respect to liquified petroleum gas (LPG). TNO's expertise in this field has attracted attention internationally and has led to commissions from New Zealand and other countries and to contacts with Australia. Other large projects, in addition to a number of smaller, industrial commissions, are: a comparative study on the risks inherent in the transportation of hazardous goods through tunnels or on overground routes; a preliminary study of safety aspects in the DSM complex; research into the possibility of a 'risk map' for the South Holland Province; and a study of possible dangers involved in establishing a goods distribution centre next to the Kijfhoek railway yard.
The 'MT data base' for storing data on industrial safety has gradually been taken into operation this year with the support of the Ministry of Health and Environmental Protection and the Ministry of Transport and Public works. The number of commissions shows a clear increase. This data base may prove of substantial importance for our research in the future.
In co-operation with the Prins Maurits Laboratory (Division for National Defence Research) theoretical research has been carried out into providing a better basis for models for calculating pressure waves resulting from gas cloud explosions. The

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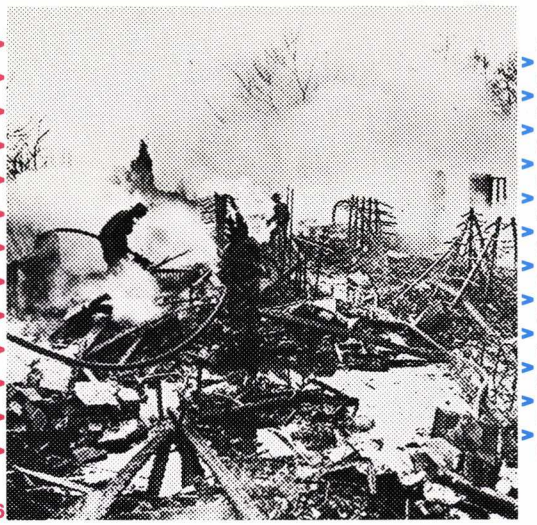

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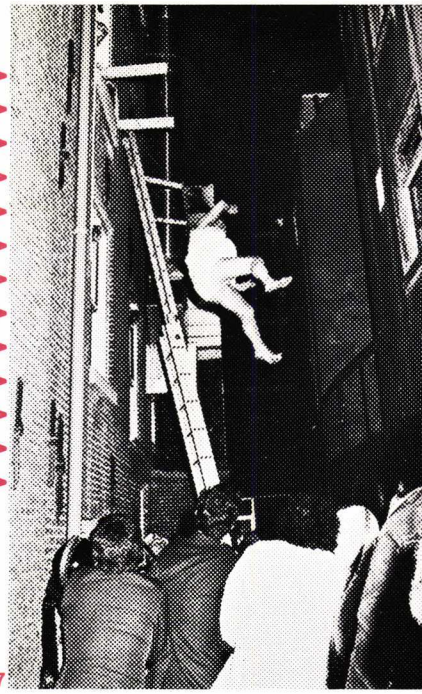

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65. Industrial safety is determined to a substantial extent by the degree of resistance to corrosion in the relevant structures. All facilities for this kind of research are included in the TNO industrial safety package.

66. Fire in a supermarket selling electrical equipment. Research into fire prevention techniques is a specialist field in which TNO has considerable experience.

67. Fire is dangerous. The risk of accidents is high and people must always be more important than any material damage resulting from a fire. The woman in the photograph escaped without injury, thanks to the excellent quality jumping-sheet used by the fireman.

ballistic research carried out within the field of 'technological research' (Division for National Defence Research) is also of importance for subjects such as industrial safety and risk analysis.

Safety of installations and buildings

Safety-related projects carried out by the Division for Building and Metal Research are largely aimed at establishing preventive measures. The projects carried out by the various Institutes were commissioned by the Government or by designers or users of installations, buildings, etc. One example is the research on the use of destruction testing to obtain reliable estimates of the service life of any given structure. This type of research is gaining ground.

In this area work was completed on a 'state-of-the-art' publication, entitled: 'The safety, reliability and service life of structures'. This publication was prepared jointly by the Institute for Building Materials and Building Structures (IBBC), the Institute for Mechanical Constructions and the Metal Research Institute. It encourages a more systematic approach to problems in this field, which are in the interface of metallurgy and mechanics. The Metal Research Institute has achieved interesting results in this field which are important for the service life prediction of materials and for the determination of scale effects (i.e. differences between the behaviour of specimens and structures). In co-operation with a firm of engineering consultants, IBBC has submitted suggestions for a multi-sponsored project on pipeline implosion. This project is now being worked out in more detail.

One aspect of safety which arouses great interest is fire safety. The scope of the Fire Safety Centre's work in this field has been extended, and in-depth studies are being carried out.

The field of study now includes the way in which materials caught in a fire affect its course, smoke-warning devices and special clothing for firemen; in-depth studies are being carried out in particular on the spread of smoke in buildings. In addition, the Centre hopes to bring a new 'oven room' into service towards the middle of 1983 for use in experiments.

The Institute for Mathematics, Information Processing and Statistics has provided a number of chapters for the 'Probabilities Book', which has been commissioned by the Directorate General of Labour and is intended as a manual on the use of probability theory, statistics, etc. in preparatory studies for future safety legislation.

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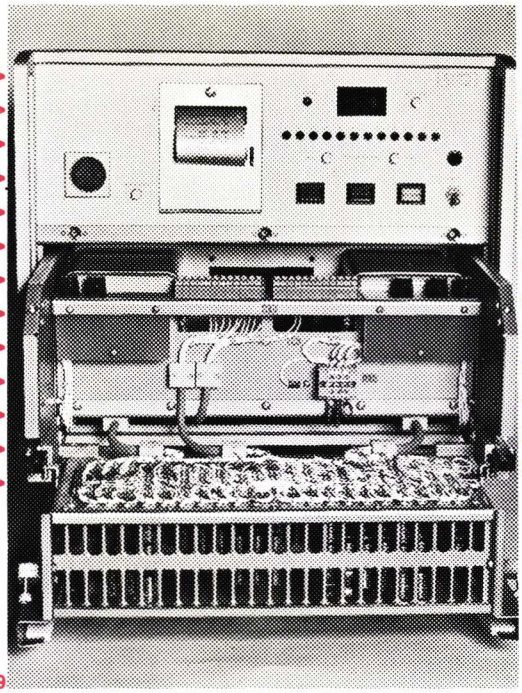
68. Measuring unit erected on the coast near Lorient in France for research into the propagation characteristics of millimetre waves above sea-water (Physics Laboratory).

Defence

Research for defence purposes is carried out mainly in the Division for National Defence Research (DO) Laboratories. It is dictated primarily by the requirements of the armed services as set out in the DO's long-term research programme, which covers a period of five years. This research programme is closely linked with the armed forces' long term plans for purchase, maintenance and improvement of military equipment.
In case where the expertise on a particular subject is not available within the DO laboratories, the DO contracts out research for the armed services to other TNO institutes or to a number of organizations outside the TNO umbrella. The topics concerned here include research in the combined fields of medicine and biology, research relating to nutrition and foodstuffs, mechanical structures, materials, hydrodynamics, noise prevention, stresses and vibration, and optics. Because of the knowledge and experience available within the DO laboratories, government, trade and industry and private institutions regularly call on the DO to carry out research or for advice. For the purpose of this TNO annual report only a selection of the activities carried out in 1981 is given.

Operations research simulation, radar, sonar and communications

In the Physics Laboratory, studies in the field of operational research have come to form an increasingly important part of the work. They also serve to provide support for research in other DO laboratories.
Much attention has been given to research into the consequences of the so-called Electro-Magnetic Pulse (EMP), which occurs at the time of a nuclear explosion. In order to investigate the extent to which electronic equipment and systems can withstand the EMP, installations are required with which the EMP can be simulated. The laboratory has two such simulators for testing equipment and vehicles containing equipment. In order to be able to investigate large systems, such as an aeroplane or a ship, a third, movable simulator is being built. This will be completed in 1982.
The use of wavelengths in the millimetre range for both observation and communication purposes is growing rapidly. The reasons for this are the overcrowding in the lower frequency bands, the need for greater band widths, and the advantage of the small dimensions of the equipment. Intensive research has been carried out into the many and varied possibilities for military application of mm wavelengths. In recent years a 'phased-array' radar antenna has been developed and built. This antenna was subsequently incorporated in an experimental radar system (FUCAS), with which the possibilities for this type of antenna were evaluated in detail. The substantial advantages in comparison with conventional radar became obvious, such as the possibilities for the detection and following of targets. In the



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69. Measuring cabinet for the Environmental Parameters Measuring Unit (MEINOPA). This Unit, which is completed by a towed rig carrying electrodes and a conductivity measurement cell, is used for automatic determination of the electrical characteristics of the sea water and sea bed when taken together.
Knowledge of these characteristics is necessary to determine the effectiveness of mine-sweeping rigs, equipped with current-carrying electrodes (Physics Laboratory).

70. Part of the Thin Film Department with equipment for preparing thin film circuits. (Laboratory for Electronic Developments of the Armed Forces).

year under review this FUCAS system has proved its usefulness in the design of a modern radar system with a rotating 'phased-array' antenna for the Royal Dutch Navy. This system is intended as the successor to the current 3D radar used by the Guided Missile-carrying frigates and will probably also be used on other Royal Dutch Navy ships.
It is well-known that in general the lower the frequency of sound waves the less the deadening effect in sea water. Low frequency sound can travel greater distances. In this process the sound follows sound paths, the features of which, as a function of frequency and time, are still relatively unknown. In order to provide this information data has been collected on the acoustic properties of sea water as a medium with regard to low frequency sound. For sonar applications at these low frequencies, the sensor has to be of relatively large dimensions. This sensor is then constructed in the form of a long, flexible chain of hydrophones, which is towed in a horizontal line behind the ship. This type of sensor has been in use for some time in what are known as passive sonar systems, which listen to the sound emanating from a target moving in the water.

The Physics Laboratory has also carried out a lot of work on telecommunications (including work concerned with the modernization of the communications network for the First Army Corps) and on mine-sweeping. Considerable attention has also been paid to research into new electronic components and to the development of data processing systems.
A small part of the activities consisted of non-military research. This was mainly in the area of modern air observation techniques (remote sensing). As in previous years this work was carried out on behalf of the interministerial Remote Sensing Steering Committee (BCRS). Another civil project was a study carried out on behalf of the Public Works Department (Rijkswaterstaat) on the undermining of dikes by river water, or 'dike-seepage'. This study was completed in 1981. In addition, the observations of wave patterns and current profiles along the Dutch coast made at an earlier stage have been analysed.

The Laboratory for Electronic Developments for the Armed Forces (LEOK) has acquired considerable experience in recent years in the use of computers for simulating systems and processes. By means of these simulations, processes can be studied without measurements having to be made on 'hardware'. These simulations can also be used for teaching purposes. The armed forces have called in the assistance of the Laboratory several times when simulation techniques were required in connection with the establishment of a training system. In such cases not only the simulation of the user's situation is important, but also the educational philosophy and didactics.
At the request of the Dutch Army the LEOK constructed a mobile and a fixed simulator for training on anti-aircraft guns, which were handed over in 1980 and 1981 respectively. This brought to a close a complex project which had involved

71. Checking fireworks; the photograph shows a rocket, the stars from which are still burning when they reach the ground (Prins Maurits Laboratory).

many different disciplines. In these training simulators teaching techniques are incorporated as an integral feature in the simulation of user situations, this being effected by using 'real-time' Computer-Assisted Instruction. This training simulator has shown the potential offered by this type of system both inside and outside the armed forces and has attracted a great deal of attention.
Computerization projects of this type demand the co-operation of specialists drawn from many disciplines and can also lead to new activities. During the year under review an order was received to computerize an armed services vehicle testing facility. This project includes, inter alia, the introduction of numeric, remote-controlled vehicle operation by robot techniques. During the year under review a system for observing bird-migration was also developed at the request of the Dutch Air Force. Air traffic control uses this system to direct aeroplanes away from large concentrations of birds, thereby improving air safety. In addition the Laboratory for Electronic Developments for the Armed Forces was called in to research the dangers which arise if personnel and the electronic fuses in weapons are exposed to electromagnetic radiation.

Effects of toxic and explosive substances

Research at the Prins Maurits Laboratory centres on two fields: protecting personnel against the effects of toxic substances (particularly chemical weapons) and the effects of conventional weapons. For historical reasons these areas are known as 'Chemical Research' and 'Technological Research'. The 'Chemical Research' is primarily aimed at protecting military personnel against the effects of chemical warfare. In addition attention is also paid to more general chemical problems experienced by the armed forces. Where possible the knowledge gained is also used in research carried out for non-military clients. Protection against the effects of chemical weapons includes:
- keeping up-to-date with the characteristics of potential weapons for chemical warfare;
- developing and testing models for the dispersal of gas and aerosol clouds;
- alarm and detection systems which enable counter-measures to be taken in good time. These systems are based on the type and degree of (expected) contamination. An automatic detection and alarm device for nerve gas (ACAL) has been developed in the laboratory. Extensive, practical trials on this device have been carried out at an international level; the device performed well.
- physical protection, i.e. protection of the respiratory tract by gas masks, etc. and protection of the skin by means of special clothing.

Work on general, chemical problems encountered by the armed forces included hygiene precautions to be taken in military workshops. Research into the emergency production of drinking water from any source of surface water led to a detailed proposal for the construction of a prototype, mobile drinking-water plant, based on a combination of hyper-filtration, reverse osmosis and active carbon filtration.

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72. Ergonomic designs for ships' bridges are based on studies using mock-ups and on simulation of the navigation process (Institute for Perception).

In the non-military sector knowledge of the dispersion of gas and aerosol clouds was used in research carried out for the Ministry of Health and Environmental Protection into the nuisance caused by vapour and spray in areas down-wind of aerial crop-spraying. The knowledge of aerosol physics and the chemical analysis facilities available in the Prins Maurits Laboratory were utilized in that laboratory's contribution to environmental chemistry research carried out by TNO for the same Ministry.

The field of 'technological research' comprises the chemistry and physics of explosive substances, explosive reactions and matter flows, and the effects of explosions. Research in this area forms the basis of numerous contributions in the field of ballistics and the study of the effects of weapons. It is also important for risk analysis and with regard to industrial safety.

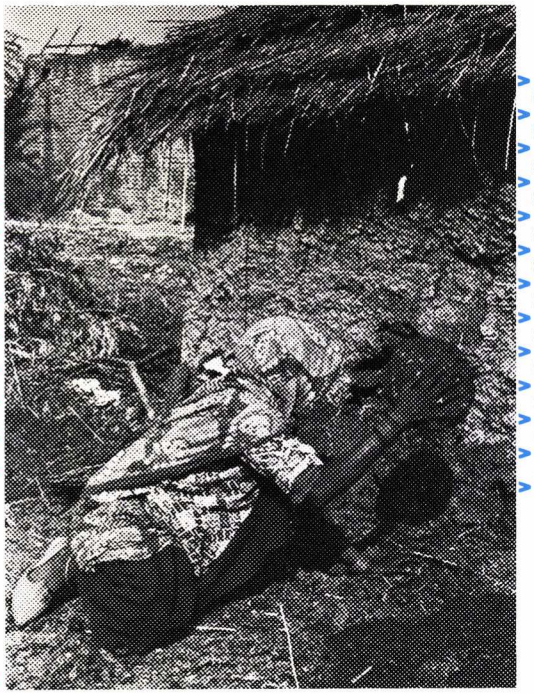
Technological research into explosives and pyrotechnic mixtures is directed in particular towards the application of synthetic binding agents which provide these substances with a structure. Sensitivity, mechanical characteristics, durability and operation have all been investigated. Practically all the research methods employed were developed in house. Research into the effects of thermal initiation has been started with a fundamental study of the interaction between energy-influx and reaction speed. In the area of explosion safeguards two research fields can be differentiated: on the one hand safety in munitions storage and architectural protection against the consequences of explosions, and on the other hand industrial safety. The latter form of research is frequently carried out in co-operation with other TNO institutes. Finally, the work on gas and material explosions should certainly also be mentioned. Contacts with various industries and government bodies led to very wide-ranging research. Work on explosions in free gas clouds is but one example of this. A substantial part of this research is carried out on behalf of the Division of Technology for Society, which makes use of the results in studies on safety in industry and in the environment.

Perception

Within the Division for National Defence Research it is without doubt the Institute for Perception which receives the most commissions from civilian principals. In the year under review a great deal of attention has been paid to studies on activities carried out in difficult circumstances, arising, for example, from tiredness due to the lack of sleep or from monotonous work or substantial stress. The aim of this research is to determine acceptability levels in the working environment and to develop training and selection criteria.

The ergonomic studies of the working and living environment on board Royal Dutch Navy ships were extended. A number of large mock-up studies were completed. The emphasis in the research carried out into process monitoring and control was on systems estimation. A study was carried out under commission from a non-TNO institute, the Maritime Research Institute Netherlands (MARIN),

into improvements in the instrumentation and equipment on the navigation bridge of 'Ship 80'.
For the Public Works Department (Rijkswaterstaat) research was undertaken to establish which objects one must be able to see when driving at night if there is to be safety on the roads; this study will serve as a basis for determining the desired level of lighting on the roads. In addition, behavioural studies for which video-recordings were used were carried out. Good progress has been made in developing a method for evaluating safety at intersections. Finally, a great deal of time was devoted to further development of criteria for evaluating protective clothing. Particular attention was paid in this respect to the combination of thermal and ergonomic factors.



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Holland Expo maakt reis langs landen Verre Oosten

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73. In India cow dung is frequently the solution to a micro-energy problem. Dung baked in the warm sun produces 'brickets' which will provide all the heat needed to cook a simple meal. TNO attempts to ensure that its research work in the field of development co-operation remains closely in touch with the real-life situations with which the developing countries are confronted.

74. "Holland Expo" arond Far East' TNO was represented on the 'Holland Expo II', the ship which was used tot take a Dutch exhibition to the Far East.

Development Co-operation

In 1981 projects within the framework of development co-operation were carried out by various TNO Institutes. The Bureau for International Projects (BIP), a part of the Central Staff Marketing Department, was involved in the preparation and supervision of these activities. On 31st December 1981 the order portfolio for projects of this type stood at more than 26 million guilders, of which approximately 7 million guilders was not yet covered by contracts. A brief summary of some important activities is given below.

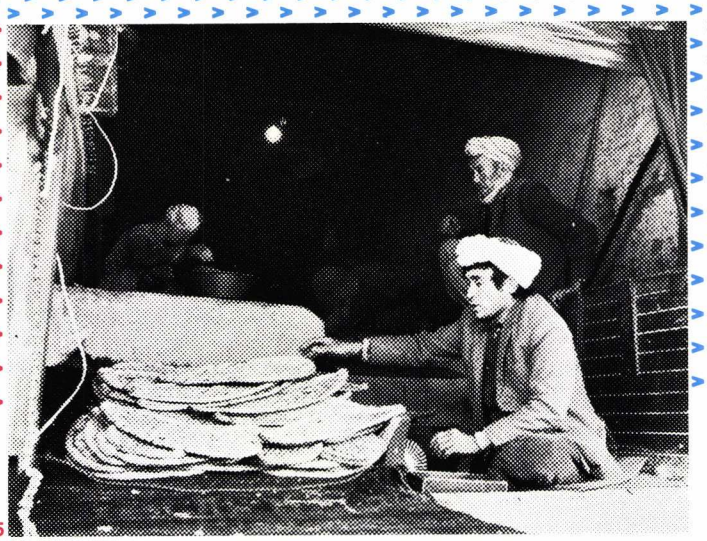
The 'Holland Expo II' ship which travelled throughout the Far East publicizing the Netherlands, provided the Metal Research Institute with several new contacts in a number of developing countries interested in the introduction of the methods and procedures for the production of nodular cast iron. The Metal Research Institute's existing contacts with Bangladesh in this field were maintained; a feasibility study was carried out in Tunisia. The Metal Research Institute and the Forest Products Research Institute organized training courses for teachers in the technical education field in the Netherlands Antilles. The Forest Products Research Institute continued work on the research project on wood and bamboo conservation in Vietnam.

The Fibre Research Institute has developed method for spinning flax and cotton in which the fibres are bonded. The twistless yarn obtained has the shape of a flat tape and can be used for both weaving and knitting. Extensive tests have shown that woven fabric produced with this yarn has several advantages, in particular a better handle, a higher cover factor, more gloss and better abrasion resistance. Investigations are being made in co-operation with the Indian Jute Research Industries' Association and the Bangladesh Jute Research Institute to establish whether this method of twistless spinning can be applied to jute. The two projects are being financed by the Development Co-operation Department. One of the principal aims is to improve the competitive position of jute fibres, particularly vis-a-vis synthetic fibres such as polypropylene.

As part of the Dutch development aid programme, a training course in leather technology was given during the last quarter of 1981 by the Institute for Leather and Shoe Research to eight employees from leather factories in Tanzania.

At the request of the Ministry of Foreign Affairs, the Division for Nutrition and Food Research supervised the establishment of institutes for child nutrition and grain processing in Cuba; work on these projects is expected to be completed in 1983. Trainees from Cuba, Egypt, Indonesia, Malaysia, Libya and Nigeria underwent training at the various institutes which make up this Division.

In Thailand a study was carried out into the possibilities for establishing simple regional research centres where the nutritional status of children can be moni-



75

75. Baking bread in the Far East cannot be compared with baking bread in The Netherlands. The starting point for TNO research directed towards finding solutions to the food and nutritional problems in the developing countries is therefore very different to the starting point for similar research in The Netherlands.

tored; another question looked into was the feasibility of supplying extra vitamins to the lower age groups.
The ten-month Food Inspectors Training Course started in Nairobi (Kenya) in July for a group of food inspectors from African countries. The Division is supplying a course leader for this course, which is partially financed by the Dutch government.
In Guinea Bissau the cashew apple harvest and the production of fruit juices (including cashew juice) were supervised for the fourth year in succession. In the same country, as also in Tanzania and on the Cape Verde Islands, assistance has been provided with the construction of a pilot plant for the production of bio-gas (methane gas).
The Insitute of Applied Physics TNO-TH continued work in the Sudan on a project the aim of which is the use of solar energy for cooling facilities.
The Ground Water Survey was engaged in an important part of the activities undertaken within the framework of development co-operation. The institute carried out a number of projects in the Sudan, Kenya, Pakistan, Colombia and North Yemen as well as other studies. Surveys in the fields of hydrology and geophysics were carried out in the countries mentioned. Finally we can report that the research project on stoves for the Sahel zone on which the Division of Technology for Society has been working for several years in collaboration with the Eindhoven University of Technology, has provided interesting data for comparison purposes.

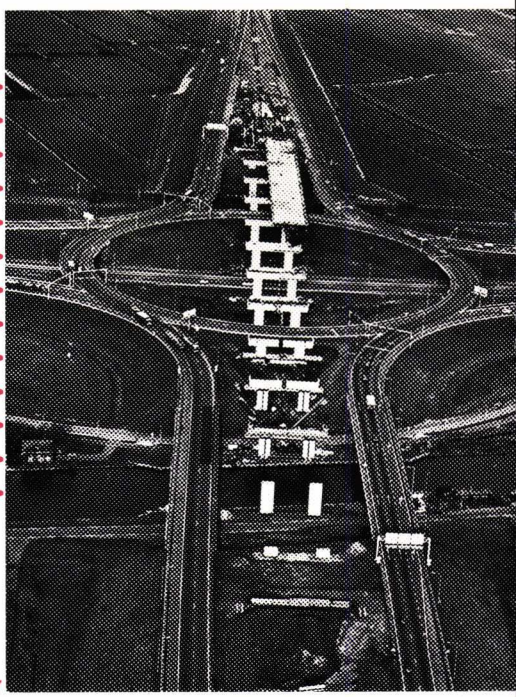
Nederland stormt tijdperk informatie-maatschappij binnen

Door een onzer redacteuren

DEN HAAG, 22 mei — Het Nederlandse publiek moet er van worden doordrongen dat ons land op het punt staat het tijdperk van de informatie binnen te stormen. We moeten ons bewust worden van de gevolgen van de 'informatisering' van economische activiteiten.

die zich speciaal met de informatievoorziening van de toekomst bezig gaat houden.' Giuliano ziet op grond van zijn ervaringen en studies zeker geen gevaar voor de werkgelegenheid in de maatschappij van het informatietijdperk. Maar de werkgelegenheid zal vooral groeien in die dienstensector van de informatie in brede zin.

76



77

76. 'The Netherlands dash into the information society' Business, Government and the general public are being swamped with a sea of information churned out by the modern computer. Indeed, there is so much data and so little order that the user is often lost in the maze. TNO used a number of data banks to organize the flow of information in such a way that short, up-to-date summaries can be given on every subject. The newspaper article is from the NRC-Handelsblad' of 22nd May 1981.

77. Residential plans must also include traffic plans. TNO participates in many areas in the development of traffic systems: from the initial rough drawings to the strength and durability calculations and finally to signposting and traffic safety.

Policy Studies and Information

Dissemination of information for purposes of policy formulation; policy studies

With the formation of the Group Policy Studies and Information, a strategic step has been taken in anticipating social and industrial developments which, to a substantial extent, require an integrated approach. Developments with regard to the provision of information were the following.

This year, once again, several dozen new data bases came into operation. At the end of the year under review the Centre for Technical and Scientific Information and Documentation (CID) had access to several hundred data bases in all. Once again, the scope of the services provided was extended and there was an increased volume of work carried out, both for other institutes within TNO and for outside bodies. A great deal of time was spent on presenting information to potential customers. The means employed included special exhibitions and open days and the arrangement of courses. A market research study was commissioned with a view to establishing a systematic marketing strategy. After the study has been completed a marketing plan will be drawn up in early 1982 and put into effect.

After substantial growth in 1979 and 1980 there was some decline in the year under review in the number of patent searches which the Patent Information Service was commissioned to carry out. The decline was most noticeable in the chemical field. However, the scope of the individual searches requested more than made up for the fall in the number of commissions. A striking feature in a relatively large number of patent search reports has been that aspects claimed as novel in the applications can quite often be found in, for example, publications dating from before 1940. This indicates once again the extreme importance of including this older material in the search.

Apart from carrying out research relevant to the physical planning field, the Research Centre for Physical Planning (PSC) is also required to make available the knowledge and insight gained for utilization in town and country planning investigations in the Netherlands and (Western) Europe. In this connection, members of the Research Centre for Physical Planning participated, as representatives of the Centre, in various committees and supervisory groups. We would mention in particular the External Safety Committee set up by the Health Council of the Netherlands.

Members also assisted in several conferences and seminars, such as the annual seminars on physical planning, the Transport Planning Research Conference and the international seminar on 'Managing the Metropolis'. As part of its duties the Study and Information Centre on Environmental Research (SCMO) published catalogues of environmental projects in 1972, 1975 and 1978. In 1981 a great deal of attention was paid to checking and updating the complete file held on research projects in the environmental field. The file was ready for printing at the end of

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78. Plans change the face of things. This glass noise barrier is intended to reduce noise reaching the Bijlmer district. TNO undertakes research aimed at anticipating the consequences of physical planning.

1981 and comprised 3,109 projects and approx. 7,000 publications and reports. The publication will take account of the results of an investigation into the usefulness of this type of document.

The data from the SCMO file are also passed on to the European Economic Community (EEC). In this connection a multi-lingual index has been produced, allowing each EEC country to use its own national language to search through the complete file of all environmental projects being carried out in the EEC countries. In addition, the SCMO was designated by the Dutch government as a 'National Focal Point' for information on the environment. This means that information is supplied, in accordance with standard instructions, to the environmental data systems used by the European Economic Community and the United Nations and that interested parties at a national and international level can have access to these systems via the SCMO.

Whereas in the case of the Research Centre for Physical Planning the emphasis with regard to research into policy making was on physical planning, the accent in the case of the Group Decision Making and Science Policy at the Centre for Technology and Policy was on research into the problems of safety. The largest project in this respect is in the area of risk perception in the Rijnmond district.

Organizational Structure

Board of Management

Central staff departments
Corporate Planning
Social Affairs and Personnel Services
Marketing
Finance and Administration
Corporate Communication
General Secretariat
Audit Department

Services
Company's Medical Service
Central Service for the Construction and Management of Buildings
Staff Safety Department (Company's Occupation, Safety and Hygiene)

Division of Technology for Society (MT)
Apeldoorn branch
Delft branch
Utrecht/Zeist branch (ITC)

Division for Technical-Scientific Services (TWD)
Institute of Applied Physics TNO-TH
Ground Water Survey
Instrumentum
Institute for Mathematics, Information Processing and Statistics
Centre for Micro-Electronics

Division for Building and Metal Research (BM)
Metal Research Institute
Institute for Building Materials and Building Structures
Institute for Mechanical Constructions

Division for Industrial Products and Services (IPD)
Forest Products Research Institute
Fibre Research Institute
Plastics and Rubber Research Institute
Institute for Leather and Shoe Research
Paint Research Institute
Institute for Packaging Research
Research Institute for Road Vehicles

Division for Nutrition and Food Research (VV)
Institute CIVO-Technology
Institute CIVO-Analysis
Institute CIVO-Toxicology and Nutrition
Institute for Cereals, Flour and Bread

Division for Health Research (GO)
Radiobiological Institute
Institute for Experimental Gerontology
Primate Centre
Netherlands Institute for Preventive Health Care
Medical Biological Laboratory
Gaubius Institute
Research Institute for Environmental Hygiene
Institute of Medical Physics
Central Institute for the Breeding of Laboratory Animals
Radiological Service Unit

Division for National Defence Research (DO)
Physics Laboratory
Prins Maurits Laboratory, Institute for Chemical and Technological Research
Institute for Perception
Laboratory for Electronic Developments for the Armed Forces

Group Policy Studies and Information (B and I)
Research Centre for Physical Planning
Study and Information Centre on Environmental Research
Centre for Technology and Policy
Centre for Technical and Scientific Information and Documentation
Patent Information Service
Bureau of the Netherlands Industrial Council for Oceanology
Burea of the Project Industrial Innovation

Bureaus Co-ordinating Multi-institute Research Activities
Bureau of the Planning Committee for Building Research (BM)
Co-ordinating Bureau for Activities in the Area of Humanization of Work (GO)
Bureau for the Environment (MT)
Bureau of the Steering Group on Energy Research (MT)
Bureau for Industrial Safety of the Committee on Risk Analysis (MT)
Bureau Toxicology (VV)

Affiliated Foundations
Potato Processing Research Institute (MT)
Netherlands Corrosion Centre (BM)
Research Institute for Printing and Allied Industries (IPD)
Netherlands Institute for Welding (BM)
Institute for Cleaning Techniques (IPD)
Netherlands Agency for Energy Conservation (MT)
National Institute for Malting Barley, Malt and Beer (VV)
Institute for Agricultural Research of Industrial Biological, Biochemical and Chemical Products (VV)

Addresses of Institutes and other Establishments

August 1982

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Apeldoorn Branch
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Telex 36395 tnoap nl
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Biological Fieldwork (Den Helder Branch)
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Phone 02230-3 29 24

Institute of Applied Chemistry Utrecht Branch (Institute for Organic Chemistry)
Croesestraat 79, 3522 AD Utrecht
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Zeist Branch (Institute for Physical Chemistry)
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Bureau for Industrial Safety TNO
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Phone 015-13 87 77

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Project for Emission Registration TNO
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Telex 36395 tnoap nl
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Energy Research Project Office TNO
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Metal Research Institute TNO
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Institute for Mechanical Constructions TNO
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Project Group for Nuclear Energy TNO
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Institute CIVO-Toxicology and Nutrition TNO
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Institute for Cereals, Flour and Bread TNO
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Phone 03404-5 22 44

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Central Institute for the Breeding of Laboratory Animals TNO
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Radiobiological Institute TNO
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Phone 015-14 09 30

Institute for Experimental Gerontology TNO
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P.O. Box 5815, 2280 HV Rijswijk
Telex 38191 repgo nl
Phone 015-14 09 30

Primate Centre TNO
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Academisch Ziekenhuis
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Phone 050-61 24 19

TNO Research Unit for Clinical Neurophysiology
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Caries Research Unit TNO
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Research Unit for Dental Materials TNO
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Ground Water Survey TNO
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Instrumentum TNO
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Curaçaostraat 2, Delft
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Telex 38071 zptno nl
Phone 015-56 93 30

Research Centre for Physical Planning TNO
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P.O. Box 45, 2600 AA Delft
Telex 38071 zptno nl
Phone 015-56 93 30

Study and Information Centre on Environmental Research TNO
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P.O. Box 186, 2600 AD Delft
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Centre for Technology and Policy TNO
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P.O. Box 541, 7300 AM Apeldoorn
Telex 36395 tnoap nl
Phone 055-77 33 44

Centre for Technical and Scientific Information and Documentation TNO
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P.O. Box 36, 2600 AA Delft
Telex 38071 zptno nl
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Patent Information Service TNO
Patentlaan 2, 2288 EE Rijswijk
P.O. Box 309, 2280 AH Rijswijk
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Phone 070-90 78 58

Group TNO Policy Studies and Information (BI-TNO), continued

Bureau of Netherlands Industrial Council for Oceanology
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Phone 015-56 93 30

Bureau for the Project Industrial Innovation
Laan van Westenenk 501, 7334 DT Apeldoorn
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Phone 055-33 97 91

Affiliated Foundations and Institutions co-operating with TNO

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Phone 050-13 03 41

Research Institute for Printing and Allied Industries
Ter Gouwstraat 1, 1093 JX Amsterdam
P.O. Box 4150, 1009 AD Amsterdam
Phone 020-94 95 25

Institute for Cleaning Techniques TNO
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P.O. Box 70, 2600 AB Delft
Phone 015-56 93 30

Netherlands Institute for Welding
Laan van Meerdervoort 2b, 2517 AJ Den Haag
Phone 070-60 09 37

Netherlands Agency for Energy Conservation
Laan van Westenenk 501, 7334 DT Apeldoorn
P.O. Box 503, 7300 AM Apeldoorn
Phone 055-33 07 50

Institute for Agricultural Research of Industrial Biological, Biochemical and Chemical Products TNO
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Netherlands Corrosion Centre
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Delft Hydraulics Laboratory
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Phone 015-56 93 53

Delft Soil Mechanics Laboratory
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Councils based on the TNO Act of 1930

Council for Health Research TNO
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National Council for Agricultural Research
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