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GOVERNMENT-SUBSIDISED APPLIED SCIENTIFIC RESEARCH FOR DUTCH BUSINESS ENTERPRISES

By

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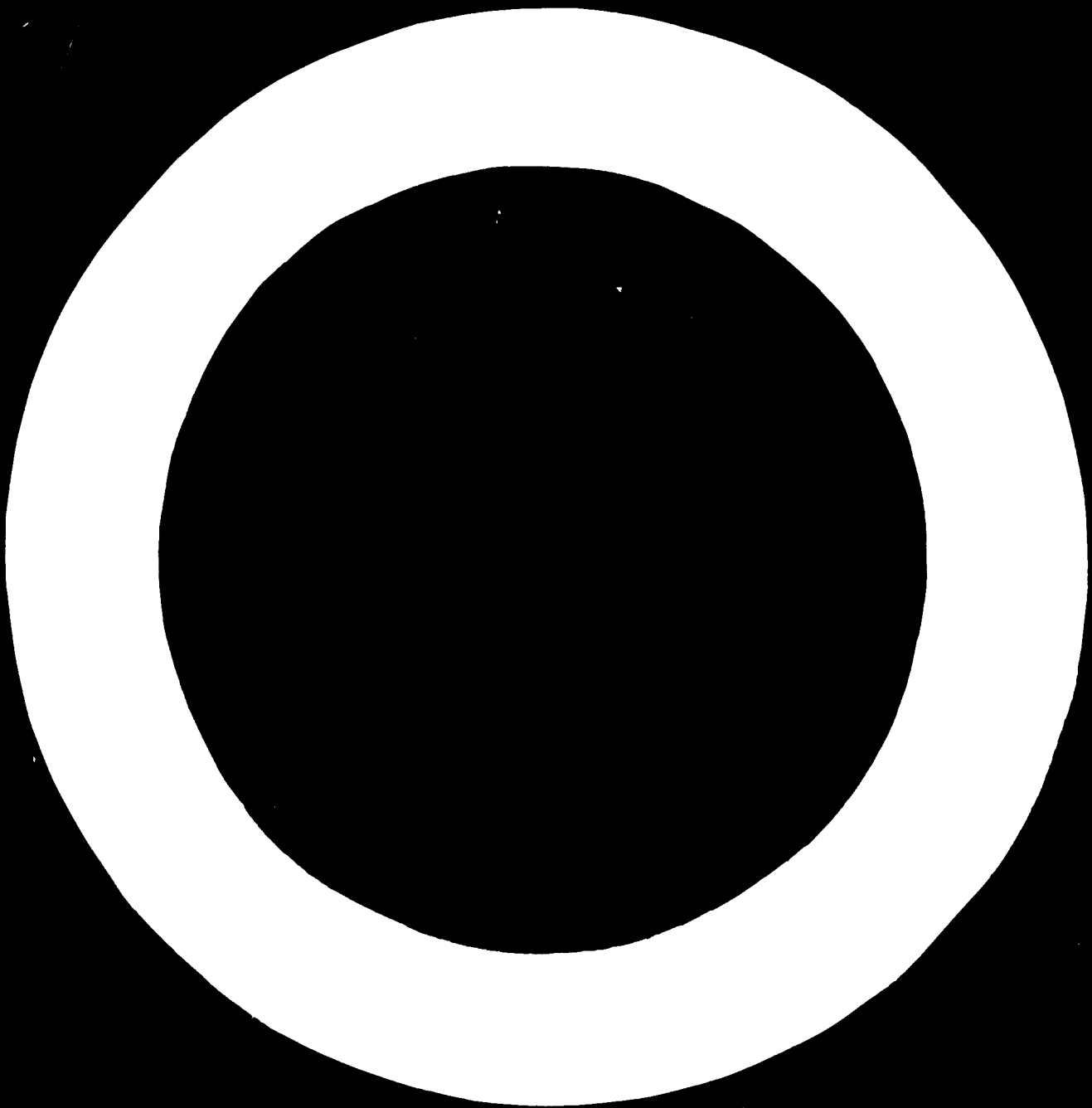

GOVERNMENT-SUBSIDISED APPLIED SCIENTIFIC RESEARCH FOR DUTCH BUSINESS ENTERPRISES

"If you want the world to smile upon you, you must work"

Introduction

Unlike research devoted solely to widening our knowledge, satisfying our curiosity, or making us bigger, cleverer or perhaps stronger than our neighbours, research focused upon making something or improving a particular product or production method is aimed at the direct application of its results. The latter kind is the subject of this paper.

When I use the word research, I am applying it not only to seeking entirely new products or production methods, but also for investigations whose sole purpose is to make existing world knowledge applicable to particular problems. In most cases this will be the essential aspect of the activities of researchers who make their work available to business firms.

Briefly, the object of our work is to assist technological progress. This is its primary aspect. The means of doing so we call research, ranging from innovation to information.

All the countries of the world, without exception, are undergoing development. One has advanced further than another in one way, the other has made more progress elsewhere. Some countries, of course, are well ahead in nearly all ways.

If we properly appreciate this, it will be obvious that research will have to proceed at the rate of a country's progress or, in other words, one must know how far a particular country or industry has developed before the most useful kind of research and research organisation can be indicated.

The question of what research should be undertaken elsewhere in the world may thus be illustrated by outlining the Netherlands' development since 1850, showing what research activities arose and when, and how they have progressed.

The various activities will, then, be reviewed in historical sequence.

Research and information for farmers

After becoming an independent nation at the end of the sixteenth century, the Netherlands was for many years an important wealthy country with a leading position in agriculture and services such as trade, banking and transport. For centuries, there was no material change. A number of universities were in fact founded, but their scientific research was aimed purely at satisfying people's curiosity. It was attractive to be part of the world of science; it gave some (often poor) status, but the universities contributed nothing to the country's development.

We may therefore pass this period by, and start from the middle of last century.

As an illustration, table I shows the growth of the population since the middle of last century. The needs of a rapidly growing nation can only be supplied if everyone rolls his sleeves up and puts his back into providing for himself and his family.

Figure I shows the great importance of agriculture in the last century in comparison with industry. Industry was of minor importance.

Services include transport, which in the Netherlands is traditionally transport by sea, and by river to inland Europe, plus road transport in Europe in the more recent past.

The speciality of the Dutch - once the carriers for Europe - is the transport of goods. This goes together with a brisk trade. Since the Netherlands has benefited from trade, and trade flourishes best without barriers, the Netherlands has always championed free trade, although this has not been achieved at all times or in all respects.

The free trade which the Netherlands advocated as a trading and shipping nation automatically involved dangers for its own products. In the nineteenth century these were still mainly agricultural products. It is hardly surprising, therefore, that in the second half of the century there was an agricultural crisis, when Dutch farmers were unable to produce at world market prices.

This agricultural crisis of 1878 to 1895 prompted the government to assist agriculture with scientific knowledge.

Fortunately, the knowledge was available, because in reality all a farmer does is to operate a biological laboratory, and biological science had long been practised at the universities. It is from this time that agricultural information and research originate *). From the very beginning, information and research were kept separate. The information is furnished by people who repeatedly refresh their knowledge from the research workers' store and, with it, advise farmers individually on crop rotation and fertilisation, choice of varieties and drainage: in fact everything that good farming needs.

Separating information from research has proved effective, and not on geographical grounds alone. Information has to be spread throughout the country, while research can more effectively be concentrated because the research workers help one another. But there is a more important reason. A consultant must be able to speak the farmer's language at the farmer's level if he is to gain recognition. This calls for a different type of man than the research worker. Even to-day, a consultant on agricultural problems calling at a mixed farm with large cattle stocks must be able to talk about the cows before he can give his advice, say on crop fertilisation.

Tables 2 and 3 and figure 2 illustrate the importance of this. Table 2 shows the number of farms in the Netherlands (horticulture excluded). The initial increase came from cultivation of the "wastelands"; the subsequent decline from the combination of small farms and closing down of marginal ones. In comparing this with figure 2 one sees that the numbers employed in information services increase even when the number of farms starts to decline.

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*) "Agriculture" in the present context is a collective name for agriculture, cattle farming and horticulture.

Table 3 clearly shows the influence of information in agriculture. It shows it clearer then any statistics for industry can do. In industry products change: in agriculture they remain the same, though wheat in 1950 is undoubtedly better than that in 1850.

Before going further, let me add something about one aspect of agricultural information and research. They are financed almost entirely out of government funds. The farmer has to pay for any soil analyses himself, while a small proportion of his contribution to the farmers' organisation is spent on research. These two contributions are negligible compared with what the government provides.

In agriculture, this is possible because all farmers benefit equally form information and research. Each accounts for such a small part of production that they are a collective group: they are colleagues and not competitors.

But as soon as machines are developed for improving agricultural efficien., for instance for lifting potatoes, the situation changes. Few factories in the Netherlands can build these. If the designs are handed to all these factories, each will be able to supply so few machines that no one will be interested. It is therefore better to hand the design to one manufacturer only, but it will have to be sold to him, for else other manufacturers would rightly ask why he and not they should be supported out of the taxes.

The Technical Consulting Service for Industry

At a very early stage, in 1910, it was realised that it could be necessary that small industrial firms would have to be assisted in the same way as farmers. The government at that tim set up a Technical Consulting Service, staffed entirely by civil servants. The numbers of staff are shown in figure 3.

Although it is my intention to discuss the place and role of government subsidised research and I am now speaking of a consulting service with very limited and highly specialised facilities for research, it may be as well to emphasise a few points of wider importance from the Service's experience.

The Technical Service is intended for small firms, employing from, say, ten to a hundred workers, though those with fewer than ten are not excluded.

A common feature [illegible] of products, [illegible] industry [illegible] these firms and have [illegible] to convey technical information [illegible] assimilate and put to use.

[illegible] with Dutch public, [illegible] "Know-how to the millions". The scientific principle [illegible] small firms is the Consultant was born in Holland.

When the Consultant [illegible], it already had twenty-five years' experience [illegible] small firms. The decisions taken by Point 4 along the [illegible] with the following principles:

1. The relationship between a consultant and a small industrial firm is hardly ever a business relationship, but is nearly always of a personal nature. The consultant's ability to gain the proprietor's confidence is therefore of prime importance.

2. Small firms' problems are rarely clearly defined. Hence the consultant must discover the exact nature of the difficulties by visiting the firm.

3. Written advice will often be unsatisfactory, as small firms will not be able to understand it or make use of it.

4. Once the small industrialist's confidence is won, he will raise all his difficulties, and often they will not be technical ones at all. The Consultant must be able to understand these problems, give advice himself or show the way to other specialists or specialised organisations or institutes. In those cases he helps to formulate the questions and interpret the answers.

The emphasis is therefore on contact rather than on know-how. In order to make this contact as effective as possible, the organisation has staffed an office with field engineers in each of the country's eleven provinces.

Point 4 stated that the small firm's problems are often non-technical. In

many cases, these problems, such as inadequate costing or bad layout, and problems of finance, cannot be solved by the field engineers. Consequently, the Technical Consulting Service started a department for advising firms on managerial and organisation problems. After some initial difficulties, it has now become a very important department doing essential work for small firms.

Field engineers spend 50% of their effective working time giving technical advice and 50% on managerial, organisation or financial problems, with a total of 6600 items. The Management Consulting Department provides another 250 detailed items.

Of the total, 85% go to firms employing fewer than fifty workers.

Besides being limited technically, therefore, the nature of the problems requires no research or even more general investigation. An endeavour has been made to link the Technical Consulting Service and the TNO, the research organisation that will be discussed in the following section, but it has become obvious that the field engineers are rarely confronted with problems that require research.

The great lesson of this section is that Dutch industrial firms employing one hundred or fewer workers can be assisted firstly by making use of advice on management, organisation or finance, and that sufficient technical assistance can mostly be provided by tracing and applying existing know-how. It is very important to establish the right contacts. As this would be made infinitely more difficult by asking for payment, no bills are sent for the field engineers' work. But the management consultant department does charge for its services.

Rather outside the Technical Consulting Service's normal activities, but within the same organisation, is a mechanical workshop. A staff of six engineers with assistants and machine operators design and build prototypes of special machines, mostly at the request of their future users.

This workshop serves a useful purpose. Experience has shown that the engineering industry is not inclined to go to a lot of trouble in designing machines at the user's request. The user mostly wants to keep the design secret and will be

against constructing a whole series for sale on the open market. And yet the machine may be very important to him. So the government steps in with the workshop. The client is of course billed for these services.

The Organisation TNO

TNO stands for applied scientific research.

The main features of the TNO-organisation are shown in the annex; though they can be disregarded at the moment, one or two points should be mentioned. There is a Central Organisation, the parent body, with a number of special organisations, whose names indicate their particular activities. They are:

- the Organisation for Industrial Research TNO
- the Organisation for Nutrition and Food Research TNO
- the National Defence Research Organisation TNO
- the Organisation for Health Research TNO

Our main interest at present is in the Organisation for Industrial Research TNO, which aims at making the results of applied scientific research available as effectively as possible to trade, industry and traffic. These aims are pursued by various means: by subsidising existing research establishments and participating in the formation of new ones, by setting up laboratories, by advising on research, etc. There can be nothing but praise for the act of parliament establishing TNO, because of the many possibilities it provides. In practice all have proved necessary, and it is therefore no simple matter to describe how TNO in fact functions.

TNO was established in 1930 when the Act was adopted, but acquired no significance until after the Second World War (see figure 4).

This slow pre-war growth and rapid post-war growth is partly explained by the great difficulty of setting up a new organisation to absorb existing establishments. Before the last war, the Netherlands had a number of government bodies for

instance for assisting specific industries. The exceptional wartime conditions made it possible to transfer these to TNO - which was the intention from the very beginning. Nevertheless, TNO did not succeed all along the line: all the agricultural research institutes for instance were definitely grouped under the government outside TNO in 1957 after protracted negotiations.

The lesson of all this is that everything can be combined in one organisation much easier by setting up the organisation first than by attempting later on to combine research establishments that have already grown into autonomous units.

Is it really so important for them to be in a single organisation? Most certainly so. However difficult it may be to co-ordinate work at different research laboratories, the problems met with in our modern, complex society are so manysided that co-ordination is imperative and, in fact, often comes about automatically.

Air pollution obviously interests the Organisation for Health Research, where the health of human beings, animals and plants is concerned. Perhaps besides examining its effects on health, the Organisation may investigate whether the polluted air can be purified. This brings its field of operations to that of the Organisation for Industrial Research. But as soon as the question arised of modifying the factory process so that the air pollution ceases, this definitely is the latter's domain.

Many such examples could be quoted of how social or industrial problems cannot be chopped up like the divisions of an organisation chart. There are advantages in putting all the units together under one umbrella provided they have plenty of autonomy. The TNO structure provides for this.

This applies even more to the laboratories and institute together forming the Organisation for Industrial Research. They are:

A. Institutes administered by the Organisation for Industrial Research:
   1. Industrial Liaison Department TNO
   2. Institute TNO for Building Materials and Building Structures
   3. Central Laboratory TNO
   4. Central Technical Institute TNO

5. Forest Products Research Institute TNO
6. Ceramics Research Institute TNO
7. Plastics Research Institute TNO
8. Leather Research Institute TNO
9. Metal Research Institute TNO
10. Rubber Research Institute TNO
11. Netherlands Ship Research Centre TNO
12. Paint Research Institute TNO
13. Institute TNO for Packaging Research
14. Fibre Research Institute TNO
15. Institute TNO for Mechanical Constructions

B. Foundations in which the Organisation for Industrial Research is financially engaged:

1. Experiment Station for the Utilization of Potatoes
2. National Institute for Malting Barley, Malt and Beer TNO
3. Research Institute for Printing and Allied Industries TNO
4. Metrological Institute Bemetel-TNO
5. Institute of Textile Cleaning, TNO
6. RAI TNO Research Institute for Road Vehicles

The need for good lines of communication between the Fibre Research Institute and the Institute of Textile Cleaning, and between the Paint Research Institute and the Institute for Building Materials and Building Structures will be apparent. Less apparent, but of much greater practical significance: the Institute for Mechanical Constructions has helped the Plastics Research Institute by jointly designing a machine for making plastic piping one metre or more in diameter, while the Plastics Research Institute has assisted the Institute for Mechanical Constructions to make large, cheap runs of pneumatic switch elements with a special plastic-processing method.

No - we could not do without this link-up; in fact it should be even stronger still.

The objectives and institute enumerated above have shown that the Organisation for Industrial Research may be related to the institutes in a variety of ways. The reason for this variety usually becomes clear if the origins of the institutes are gone into.

TNO was founded through the initiative of the Professors of the Dutch Royal Academy of Science who offered the government, as it were, to ensure the social and industrial utilization of scientific research. It was not therefore a need felt by industry itself that gave rise to the first category of institutes. The second category were different; the Organisation for Industrial Research participated directly when the foundations were set up; but the initiatieve came from industry which felt the need to support their activities.

This difference in origin brought about a difference in approach. Because of industry's sense of ownership towards the independent foundations it makes a greater effort to benefit from their work. The foundations operate information services which regularly visit all the firms in the particular industry endeavouring to solve problems and disseminate the results of research. Relations with the client are much more direct and more personal than with the purely TNO institutes.

Nevertheless this form of organisation, which strongly recalls the British Research Association, has its drawbacks. In the independent foundations there is a predominance of collective research , into problems deemed of importance to nearly all firms in the industry. In choosing subjects, firms tend to exclude problems, the exclusive solution of which would be to their own benefit. Consequently, though the firms' standards can be expected to improve by research, there will be no innovation. True modernisation of products or production methods will be achieved only if a manager believes his own form will benefit. Such benefits are more likely to accrue from large production runs, and for this reason he will first want to introduce the innovation himself. He will be ready to bear risks because he will not have to share the benefits with others.

This is illustrated by the story of the disabled ex-serviceman who had the true inventor's mind. After years of research and development he ultimately arrived

at a whole range of improvements to existing wheelchairs which he had protected by patents. He was so concerned about the lot of his fellow sufferers that he wanted them all to have the improved chair at the lowest conceivable price. He therefore offered potential manufacturers a free licence for all the patents. No one showed any interest. It was only when the investor adjusted his approach to the general industrial set-up by offering an exclusive licence that applicants appeared and the chairs were ultimately made.

This is the type of consideration on which the government based its decision that TNO may offer research results to a single firm even though they are obtained with government money; this is a right which has by no means been granted to all government aided research establishments in other countries.

The problem of selecting the firm seems more difficult than it is in practice. A particular development usually fits in with only a few firms' activities, and often only one of them is genuinely interested.

It must not be thought from the foregoing that the independent foundations do collective research only, while the purely TNO institute do not. The TNO institute also make use of contributions provided collectively by a number of industrial firms to subsidise work on a particular subject, while some foundations also do sponsored research.

As already stated in regard to agricultural research, the need to ask for payment is directly related to the right to deal with a specific problem exclusively for one enterprise. The aim of the Organisation for Industrial Research is to obtain fifty per cent of its income from industry by way of individual sponsorings, and grants from groups of firms. The other fifty per cent, provided by the government, is generally employed in four different ways. One part is spent on giving free advice to all who ask for it, provided not much work is involved; another is used to do more work for the subsidising industries than corresponds with the industrial subsidy; the research effort is usually twice as great as the subsidy Thirdly, it is used for general research, whose results are published; and lastly it enables TNO to take the initiative in work which forms a basis for subsequent sponsoring by individual firms.

The organisation has long been aware that good research is the first step, but that transmitting its results to industry and getting them applied must be the second and perhaps much more difficult field of activity. All further effort will be worthless if the findings are not applied. In co-operation with large enterprises possessing their own research teams or even laboratories there is no difficulty in this, but in a large number of firms for which TNO works we encounter the same problems as in regard to agricultural information and the Technical Consulting Service. This is the weak spot in every independent research establishment whose object, in addition to its other work, is to help small and medium-sized businesses to solve problems both large and small.

The Metal Research Institute, for instance, proved by research that considerable improvement is possible in the ordinary metalworking operations that are carried out in very workshop, for instance turning. It is all a matter of choice of tool, tool positioning and speed. This can be set forth in reports; but does not help.

Workshop foremen have been gathered together for courses of instruction, but this too has often proved insufficient. Imparting knowledge is not just a matter of the man's schooling and level, but more often than not a matter of mental attitude. Ultimately, it was decided to visit course candidates in their own workshops beforehand; and often the result was that other candidates were suggested instead. With one thing and another, success eventually crowns our efforts!

It will now be clear that the Organisation for Industrial Research can adapt its methods to prevailing circumstances. This it aims, in fact, to do because research can then be made more serviceable to industry and to society than if a given course is obstinately persisted in. This makes it no simple matter to say in a few words how research and information are organised. For example, take the formulation of the research programme. Where research is carried out for an industrial group which gives financial support, the programme is formulated together with the group's representatives. Initiative is taken both by industry and TNO.

The programme which the institutes carry out with government grants is usually selected by the institute directors and their colleagues and is submitted to advisory committees and institute boards for comment and criticism.

The choice is sometimes governed by the desire to serve the public interest, but mostly in the hope of interesting industry in the project later (water demineralisation for instance); very often it is merely the initial step before seeking sponsors (for instance studying the technology of glass-fibre reinforced plastics).

Both these examples are comparatively extensive and hence long-term projects. But much work is of a totally different nature, being aimed at assisting industry with trouble shooting, and must produce very quick results.

Economic aspects must always be the major factor in deciding whether a research project is worth while or not. It is all a matter of better and/or cheaper production. Economic considerations must therefore often be taken into account in formulating the programme.

During the agricultural crisis in the Netherlands in 1880, the decision was rightly taken to use research for agricultural improvement. Farming was then the main source of income. All farms had the same problems. At that time an improvement of 10% in agriculture achieved more than research for industry would have done where the problems were more widespread and the economic effect would have been far less.

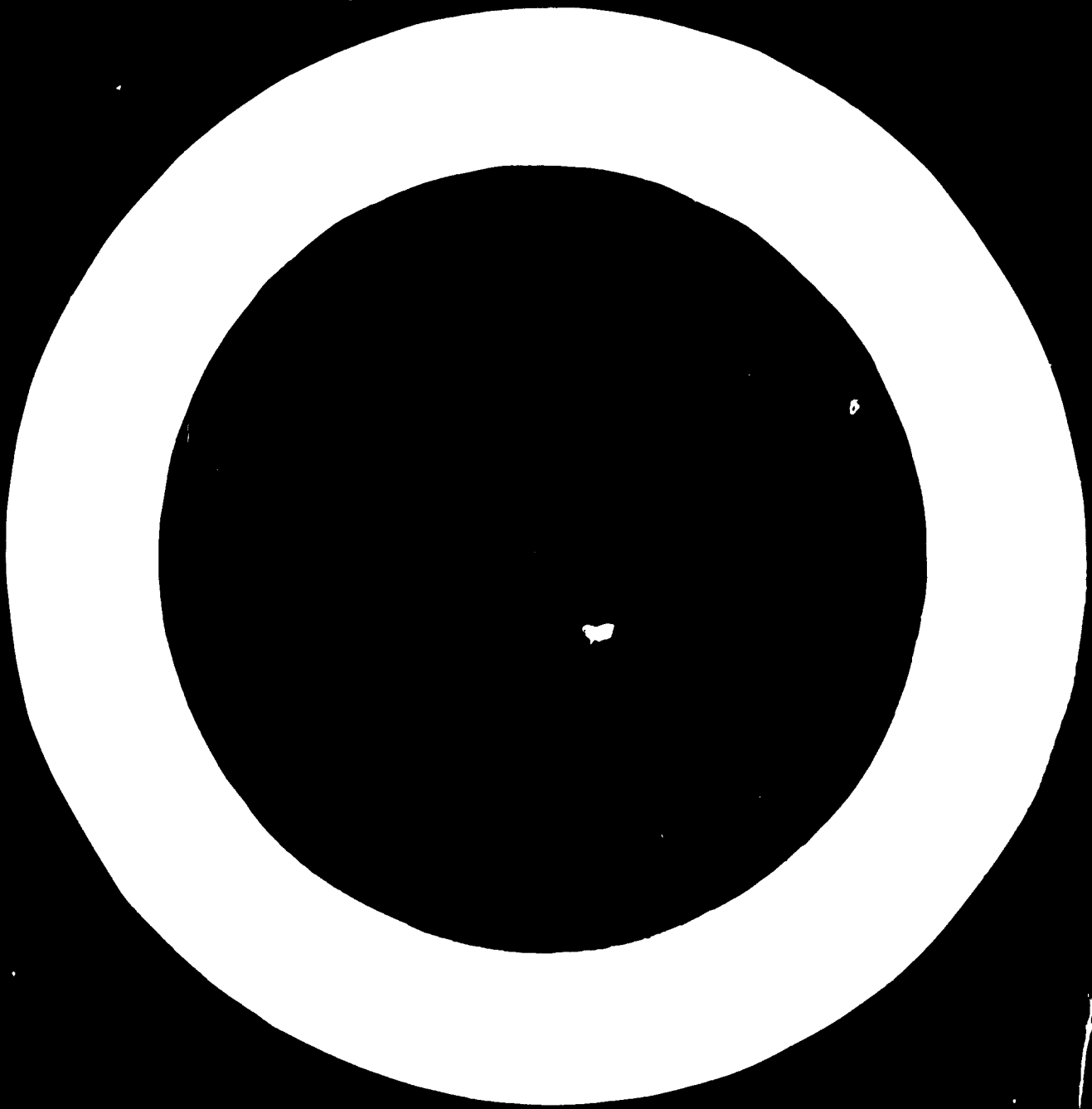
In seeking to improve a situation in a business or industry, it is first better to find out the main cost factors and then try to improve these. Besides economic factors, the possibility of success is of course also a determinant in the choice of project.

The polishing of diamonds respresents 50% of the added value, cutting them less than 10%. Which aspect would you choose first?

Finally, I ought to repeat that proper adjustment to practical needs and to the possibilities of conveying information to industry are factors of such importance that they must be allowed for, together with the factor of research capacity, in selecting personnel.

Annexes : I, Tables: 3, Figures: 4

May 8, 1967



TNO : The Netherlands Central Organisation for Applied Scientific Research

(Nederlandse Centrale Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek)

This organisation was created by an Act which was passed in 1930 and came into force in 1932. In the Netherlands it is generally known by its initials TNO, this name covering the entire complex of central and special organisations and institutes.

According to the TNO-Act, the Central Organisation has the following tasks:

- To ensure that applied scientific research serves the public interest in the most effective manner;
- To co-ordinate and encourage applied scientific research and the application of its results;
- To promote co-ordination in government-action towards it;
- To advise the Ministers, if so requested, or on its own initiative.

As it had been foreseen that a single organisation could never cover the entire field, the Act provides that the Central Organisation may propose to various Ministries the setting up of "Specialized Organisations", that are entrusted, within their individual technical branches, with the same tasks. At present there are four specialized organisations, with the same autonomy in their respective fields as the Central Organisation: the Organisation for Industrial Research TNO, the Organisation for Nutrition and Food Research TNO, the National Defence Research Organisation TNO, and the Organisation for Health Research TNO.

Specialized organisations have specialized tasks. That of the Organisation for Industrial Research is to ensure that applied scientific research serves the interests of industry and traffic in the most effective way.

Up to January 1957, there existed an Organisation TNO for Applied Scientific Research in Agriculture, which had a few research institutes. The majority of the institutes, however, were institute established by agriculture itself, some of them receiving government-subsidies. A number of institutes under

the authority of the government formed a third category.

In 1957, these three groups of institutes were converted into foundations organised on a uniform pattern under the National Council for Agricultural Research, an advisory body for the Ministry of Agriculture and Fisheries. The staff of the institutes received the status of civil servants.

The Central Organisation is headed by a Board. It is composed of:

(a) The Presidents of the Boards of the Specialized Organisations;

(b) Ordinary members, appointed by the Crown on the recommendation of the Ministers that co-operated in the foundation of TNO. Half of the members are scientists, half are economic experts. The Royal Netherlands Academy of Sciences and Letters proposes the names of scientists, which are then submitted to Ministries and finally to the Crown for approval and appointment. The economic experts are appointed on the recommendation of the Social and Economic Council.

(c) Temporary members, appointed, when it is deemed advisable to do so, by the Crown, on the recommendation of the Minister of Education, Arts and Sciences.

The meetings of the Board are attended by delegates of most of the Ministries. The Delegates have the power of veto, as concerns decisions on the spending of the Government-subsidy. If a Delegate makes use of his power of veto, the final decision rests with the Minister whom he represents. If no objection is put forward by the Minister within a period of 30 days, the decision of the Board stands.

All Board meetings are usually held twice a year.

The management of current affairs is entrusted to an Executive Committee that holds frequent meetings. Ordinary members of the Executive Committee are:

- The President of the Board of the Central Organisation and his deputy, and the Presidents of the Specialized Organisations.

The Secretary-General of the Central Organisation, the Treasurer, and the President of the National Council for Agricultural Research attend

the meetings of the Board and its Executive Committee in an advisory capacity.

The Specialized Organisations are also managed by Boards which, in their turn, may establish Executive Committees. Instead of having only an advisory capacity, the Delegates of the Ministers are ordinary members of the Boards of the Specialized Organisations. They have the power of veto. If they choose to make use of it, the procedure is similar to that outlined for vetoing the decisions of the Board of the Central Organisation.

Several Bodies participate, separately or jointly, in the nomination of members of the Boards of Special Organisations, in so far as they are not Delegates of Ministers. When appointing the scientist members of the Board of the Organisation for Industrial Research, for instance, the Ministers request proposals from the following bodies:

- The Royal Institute of Engineers, the Netherlands Association of Chemists, the Faculties of Mathematics and Physics of the Universities, the Senates of the Technical Schools, and several other bodies.

Each of them recommends a certain number of members. When appointing economic experts, the following bodies are requested to submit proposals; the Industrial Council for the Middle Classes and the Trade Unions.

Boards are also responsible for the management of Research Institutes. In the case of those belonging to the Specialized Organisation for Industrial Research the members of the Board come mainly from industry. In many cases the Boards of Industrial Research Institutes are assisted by "Advisory Commissions", composed of experts from industry and science.

Of the various Specialized Organisations, the Organisation for Industrial Research TNO is by far the largest. It administrates a score of research institutes, among which the Central Laboratory TNO at Delft, where research of a more fundamental nature is performed, but still with the application in mind (for instance: physical properties of polymers, application of nuclear radiation to chemical

processes). Furthermore the Organisation subsidizes five independent research institutes.

The development of the institutes of the Industrial Research Organisation typifies the widening in scope of the organisation's activities. At first, institutes were set up for specific raw materials or branches of industry (e.g. the Metal Institute, the Leather Institute etc.), but afterwards the need was felt for a division on a more scientific basis. As a result a number of institutes were founded dealing mainly with processes, for instance the Central Technical Institute TNO, which carries out research on so-called "unit processes", such as drying, milling, mixing, etc., but also on problems like transformation of chemical energy into electrical energy, and heat-conduction at very low temperatures.

It is considered necessary that apart from research programs, related directly to immediate needs, a certain amount of "free research" is carried out that takes a broader approach and anticipates on possible future needs. Moreover it has become evident that the problems that TNO has to solve, do sometimes call for fundamental research.

In the field of industry, TNO aims at achieving better and cheaper production. Research activities are directed at improving existing techniques and products as well as finding new ones.

Whenever a new technique has been found, TNO tries to interest industry in it. When it has been tried out by industry and prospects for application look promising, the industry will endeavour to develop it further. As a rule this development work will entail contracts with TNO for further research on specific aspects, so that it can be said that in this stage TNO and industry act in co-operation.

If the new process does not meet with sufficient interest at home, foreign firms or international organisations may take an interest in it, which may also lead to a contract with TNO for further development.

Contract research is performed on behalf of small and medium sized as well as large enterprises.

To industrial enterprises in branches, where circumstances do not favour

plant-owned research, TNO offers the opportunity to fulfil their requirements in this respects, individually or collectively.

Research projects are financed either by public or by private means, or, in the case of subsidized collective research, by a combination of the two. Under an inducement-scheme, set up by the Ministry of Economic Affairs, subsidies can be granted for research, carried out on behalf of a number of firms collectively. In case a subsidy is granted, the Ministry doubles the amount, expended by the firms themselves or by their research organisation. Subsidies for collective research contracts, placed with TNO, amounted to a sum of 2,3 million hfl. in 1962.

The financial regulations concerning TNO are drawn up in a way that makes for co-ordination of the Special Organisations and safeguards the autonomy of the Organisation as a whole.

On the basis of the estimates forwarded by the Special Organisations, the Central Organisation drafts a budget for the organisation as a whole and submits a request to the Minister of Finance for a subsidy for the next year, together with a proposal for the distribution of the amount over the budgets of the various Ministries. Although subsidies for TNO figure on the budgets of the Ministries concerned, they are paid out by the Ministry of Education, Arts and Sciences in one amount to the Central Organisation, which allocates to each of the Specialized Organisations its share.

By adopting this procedure direct financial control by the Ministries over the Specialized Organisations has been avoided.

The amount of the subsidy, granted by each Ministry, reflects the amount of research which is done in its sphere of interest. Major grants are allocated by the Ministries of Economic Affairs, Defence, and Social Affairs and Public Health.

Subsidies from industry, earnings from invoiced services, etc. go directly to the respective Specialized Organisation. In the case of the TNO Organisation for Industrial Research, for instance, they account for about half of the entire budget, whereas the TNO Defence Organisation and TNO's Health Organisation rely entirely on Government support. It may be assumed that about 25 per cent of the running costs of all organisations is covered by earnings, contributions from industry etc.

TNO-customers are charged cost prices (a surcharge for overhead included); no profits are made.

As expenditure for research projects has shown a steadily rising trend, so have Government contributions to TNO, which increased from 37 million hfl. in 1959 to 99 million hfl. for 1966, capital expenditure in building included.

Table 1

POPULATION OF THE NETHERLANDS

Year	Number (x 1000)	Year	Number (x1000)
1849	3.056,9	1940	8.923,2
1859	3.309,1	1950	10.200,3
1869	3.579,5	1960	11.556,0
1879	4.012,7	1961	11.721,4
1889	4.511,4	1962	11.890,0
1899	5.104,1	1963	12.042,0
1909	5.858,2	1964	12.212,3
1920	6.865,3	1965	12.377,2
1930	7.935,6		

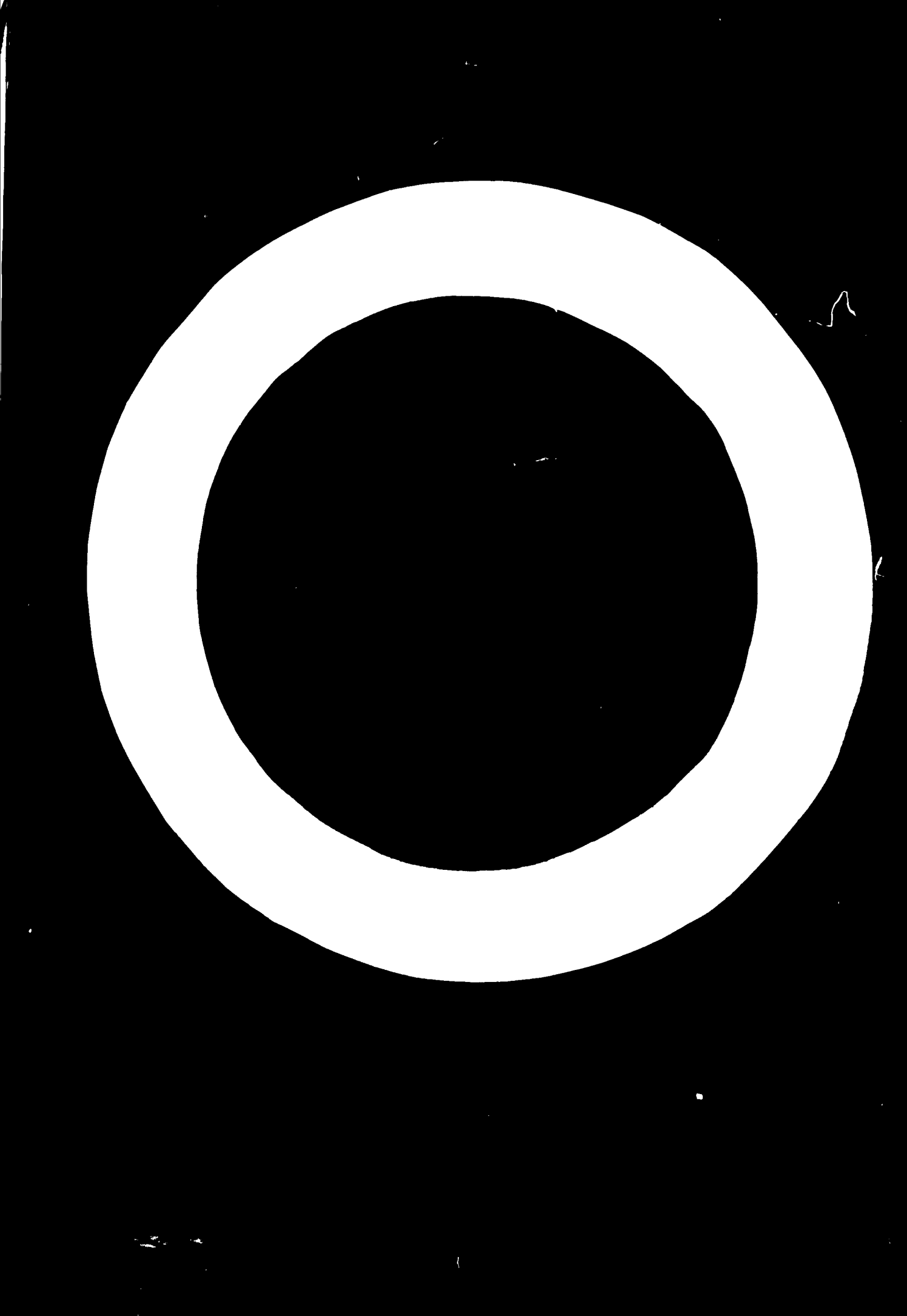


Table 2

FARMS IN THE NETHERLANDS (HORTICULTURE EXCLUDED)

Year	Number
1910	148.844
1921	163.075
1930	175.025
1950	194.299
1955	186.637
1959	171.538
1962	158.576
1965	148.919

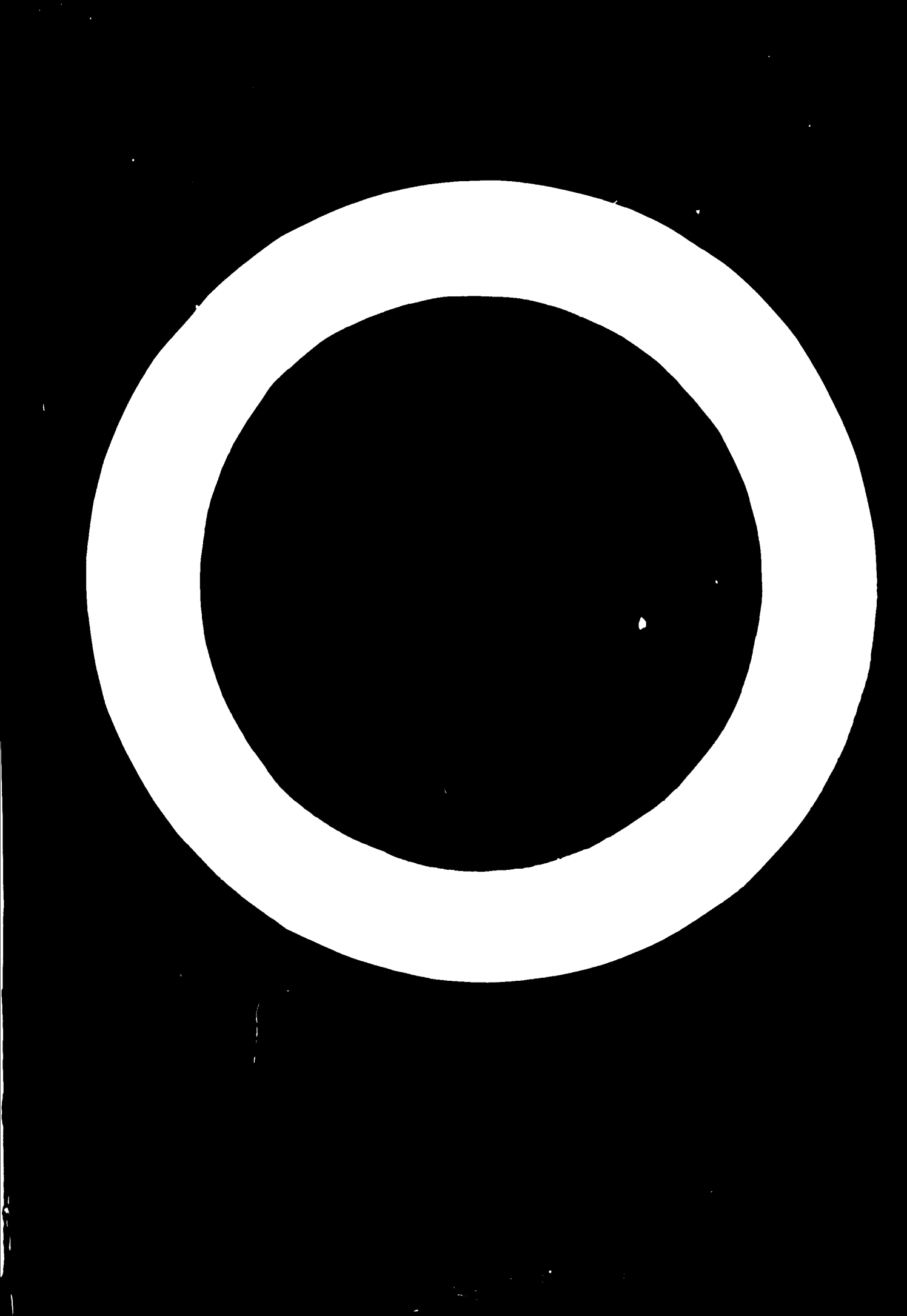
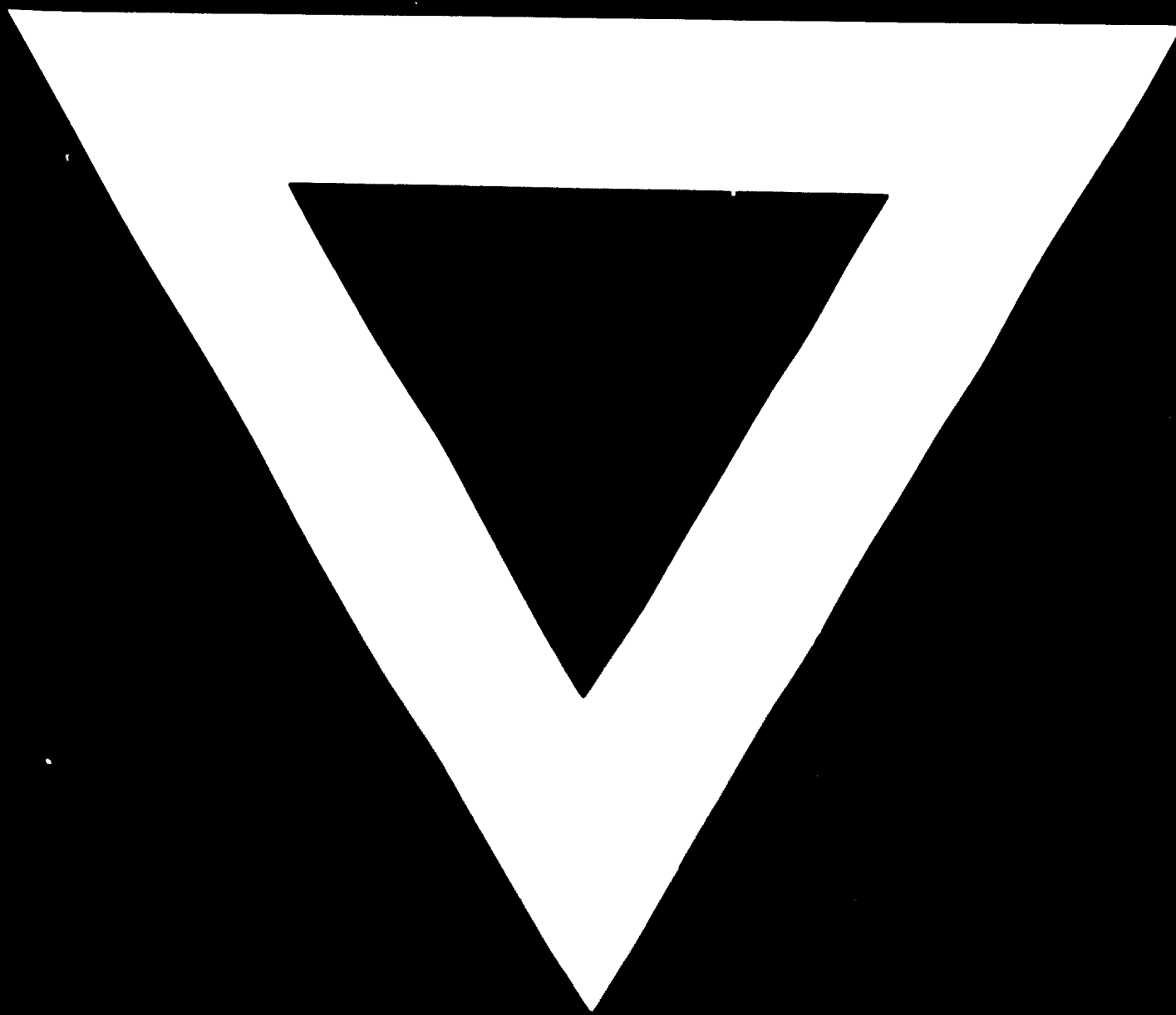


Table 3

AVERAGE YIELD OF SOME AGRICULTURAL PRODUCTS

Period	wheat	barley	potatoes	sugar beets
1851-1860	1,4	2,0	8,2	--
1861-1870	1,6	2,3	9,2	--
1871-1880	1,7	2,2	8,5	26,0
1881-1890	1,8	2,3	10,4	25,0
1891-1900	1,9	2,4	12,3	30,1
1901-1910	2,2	2,6	13,8	30,4
1911-1920	2,5	2,5	16,4	30,5
1921-1930	2,9	3,0	18,1	33,0
1931-1940	3,0	3,0	20,4	37,7
1948-1950	3,6	3,3	25,8	31,9
1951-1955	3,8	3,4	25,3	41,5
1956-1960	4,1	3,9	26,3	42,2



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