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A SPANISH CONTRIBUTION

STUDY OF THE RELATIONS BETWEEN INDUSTRY-OFFICIAL RESEARCH CENTRES[1/]

by

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1.- INTRODUCTION

The under-development of Spain's research structure does not correspond to the economic development level which the country has reached, and this lack of own technology is going to compromise this development in the future. Actually, the trade balance deficit is largely due to the insufficient technological and innovation level of Spain's exports, and to a lesser extent, to the cost of importing technology (250 million dollars during the first six months of 1976), and also fundamentally it is due to the commercial limitations that this imposes.

In 1975, Spain's investments in the public sector of scientific and technical research amounted to 200 million dollars, which is 0,240 per 100 of the Gross Domestic Product. Comparing these figures with the research expenditure published by the O.E.C.D., it can be seen that countries such as Italy, Belgium and Holland (which is also classified low compared to the most endued), invest between 0,5 to 0,8 per 100 of their Gross Domestic Product in research in the public sector. Spain stands far below these figures, and to bring her to an acceptable level, investments made in research matters in Spain should be urgently raised to reach these same levels of the G.D.P. This would mean an appreciable drive for her technological and economic development and for improving living standards.

2.- THE SUPERIOR BOARD FOR SCIENTIFIC RESEARCH (C.S.I.C.)

The C.S.I.C. is an organism of the Ministry of Education and Science (M.E.C.) which groups and co-ordinates the research institutes that are dependent on it. Among these institutes are some that are devoted to Humanities which in all do not exceed 3,5% of the total resources assigned to the C.S.I.C., which in turn represent one fourth of the total research investments made in the public sector.

In 1975, the C.S.I.C. administered 50 million dollars. This is insufficient not only to move development of other activities, but even to sufficiently cover the work lines that are being exercised, to obtain satisfactory results.

Moreover, the expenses of the personnel of the C.S.I.C. on an average mean 85 per 100 of the total budget. If the infra-structure expenses are also considered, then there are no allowances over to execute the programs in the ordinary budget. In certain work areas, the centres have programs which fall within the Development Plan, but others do not have this. This means an anomaly for the work possibilities of the centres.

Prevision for expenses within the next few years should be made bearing in mind the studies that have been made by various countries on research costs, which show a 60 per 100 incidence of the total expenses for the personnel item.

ANNEX I gives a complete list of the research centres of the C.S.I.C., excluding those that correspond to Humanities.

3.- DESCRIPTION OF A RESEARCH CENTRE OF THE C.S.I.C.: THE INSTITUTE OF INDUSTRIAL AUTOMATICS

The Institute of Industrial Automatics (I.A.I.) has been formed based on two key functional concepts. Whilst the research and technical assistance activities are developed based on four specific fields of knowledge, the Centre's operative unit is made up of the research program which in each case is defined as a result of deep inter-action in the trinomial: Administration/Productive Sector/Research Centre.

By the term "Field of Knowledge" we mean the set of affined disciplines, within the general structure of Automatics, which embodies a team of research workers responsible for maintaining this speciality at a high scientific and technical level. The four fields of knowledge which we support are: Analogic and Digital Techniques; Supervision and Control of Processes by means of Computers; Control and Regulation of Industrial Processes; and Instrumentation and Metrology. Each research program is developed using personnel from one or various of the fields of knowledge, according to the scientific-technical specialities involved and the degree of development demanded by the concern to which the research program is directed.

Within the I.A.I.'s structure there is also an administrative type section and others with activities related with research (Prospectives Section and Project Control; Development and Standardization Section and Industrial Tests and Measurements Section) which permit the ensemble to form an essentially technological, harmonic body with a large working capacity within the sectors in its charge.

The Prospectives and Project Control Section incorporates a series of services aimed at facilitating the generation and execution of the research programs.

A program is generated based on a research subject which may arise through different channels:

-Relations with the Administration
-Relations with the Industry
-Prospective studies
-Transformation of other programs in force
-Initiatives of the research workers themselves.

The choice of subjects which will turn into programs is made based on assessing their social, economic profitability, their feasibility and their contribution towards the nation's technological estate.

In executing the research programs, the Prospectives and Project Control Section has a twofold job. On the one hand it offers the research team the necessary backing in terms of technical, scientific information and in providing material elements; on the other hand in collaboration with this team it develops a program of the work to be carried out.

This programming, which is sufficiently dynamic and flexible, at all times adapts to the changes that inevitably appear in the course of the research, permittingthe possibilities of Warehouse of Materials, Designing, Workshop (Mechanical and Electronic) and Development to be continuously suited to meet the program demands. It likewise permits a control to be kept over its progress in both questions of costs and execution dates.

It is the task of the Development and Standardization Section to establish the link between the Centre's research activity and the country's industrial reality in terms of manufacturing methods, technical specifications and fulfilment of norms.

Its task, which is especially important in an essentially technological Institute, consists of transforming the laboratory prototype into an industrial prototype, whose completion level will in each case depend on the wishes of the person handling the exploitation.

This task requires a thorough knowledge of the norms which the products have to conform with in their manufacture, use and maintenance, and the factors conditioning a choice of the components by reason of the real working conditions and the supply possibilities.

The Development and Standardization Section even issues technical papers, list of materials and standards to go by, and quality control.

Another important facet of this Section is in getting the research teams to know the requirements that the future industrialization of the prototype is imposing on their creative work.

Thus the double aspect of this Section's connections which it represents between the research worker and the beneficiary is completed.

The Industrial Tests and Measurements Section covers the needs which the Development and Standardization Section presents in questions of tests over fulfilling norms, regarding its own industrial prototypes. Its task is also to attend to those industrials and uses who request its help, issuing verdicts, technical reports or certificates based on national and international standards.

When executing its work this involves perfecting a wide range of measurement and test techniques; carrying out model elements or reference ones and even the design and construction of specific devices.

The following can be mentioned among all the research programs currently being carried out:

-Automatization of electric furnace steelworks.
-Tele-control and tele-measurement system with micro-processors.
-Automatic control of atmosphere composition.
-Digital simulation of a tactic process.
-Tension regulators.
-Optimal design by means of printed circuit computer.
-Automatic regulation of the ion dissolution concentration.
-Remote control programmable automatic system by party line.
-Numeric control of machine tools.

4.- TWO EXPERIENCES BY THE ADMINISTRATION TO PROMOTE RESEARCH

4.1 The Foreign Technology Transfer Contracts Register (TTE)

The Ministry of Industry has created this register, whose objectives are described below, and also the measures used:

Objectives:

-Detailed knowledge by the Public Administration of the contents of the technology acquired and the conditions of its acquisition.

-Clarification of the foreign technology acquisition market.

-Knowledge of the kinds of technology that are object of transfer, by the National Research Centres.

-Potentiate the engineering and national assessment.

-Promote adaptation of the transferred technology and the company's later technological development.

Measures:

-Requirement to submit a Report, in addition to the contract and corresponding documentary justification, which on a standardized form will include information and data about the contracting parties, technological contents of the transfer, scope and conditions of the agreement and payment previsions.

-Periodic diffusion of certain minimum data about the contracting parties and the object of the contract.

-Create a Data Bank based on the documentation of the TTE Contracts Register, to proceed with information to the industry, with the due precautions and protection of anything that could constitute an industrial secret.

-Establish a Clearing House to attract intermediaries in TTE.

-Periodic information to the National Research Centres about the technological contents of the contracts, safe-guarding its industrial secret.

-Obligation on the part of the companies with state participation or who enjoy industrial promotion benefits granted by the State, to ask the national engineering and consulting companies for tenders, before contracting technical services and studies with a foreign company.

-Requirement to justify the need to contract with the foreign company when there is a proven capacity that the Spanish engineering can supply the service with an equivalent quality and reliability as the foreign firm.
-Condition of the inscription in the Technology Transfer Contracts Register, upon suspension of contractual clauses that condition or limit generation of improvements and innovations in the technology received, on the part of the Spanish firm. There will be a notification to the receiver so he can justify the situation, and if necessary modify or adapt the clauses in question.
-Establish an incentives system for the adaptation efforts of the technology received or generation of mixed technologies and stimuli for re-export of technology adapted by the receiver.

4.2 The Scientific and Technical Research Advisory Commission

Within the Ministry of the Presidency of the Government, there is an organism called the Scientific and Technical Research Advisory Commission, whose job it is to promote research in the country. In 1975 this organism handled around 20 million dollars. These funds are channelled in three different ways, according to which entities will receive the aid.

Although its main purpose is not really to improve cooperation between industries and official centres, we understand it can and in fact has been an efficient weapon for this cooperation.

The research promotion methods used are: Research Aid; Concerted Plans and Research Associations.

Research Aid

These are subsidies awarded to official research centres belonging to the University, to the Higher Board for Scientific Research or to other Ministeries (Nuclear Energy Board; Agronomic Research Institute; Aero-spacial Research Institute etc.).

Each year it convokes offers in the Official State Gazette, and the centres should present a detailed program of the research work they propose carrying out, indicating: interest of the subject, programming of jobs, approximate execution dates, background of the research-workers who are going to undertake this and expressly mentioning their experience in the matter; the necessary estimate duly justified, etc.

The programs presented are judged by a group of experts on the matter. Those who obtain a subsidy are compelled to present six monthly reports to the Advisory Commission. For each one, there is also an administrator appointed by the Advisory Commission who should supervise that the Plan is being fulfilled, and at the same time advise and help the subsidized centre as far as possible. Although its current operation does not signify an increase in the industry/official research centres relations, we feel that as it raises a need for programming, for marking times, for fixing interest in the results, it could prove an efficient instrument in this collaboration. To defend the above, we would consider the interest that would be had if regarding the official centres/industry contacts it become compulsory that the application for this subsidy be accompanied by a critical opinion on the feasibility and interest of the use of the possible results, issued by national companies

in the sector and on which this research would incide. By issuing this report, the companies would not only know the success but also their projects and form of work and the centre, for its part would know the possibilities and needs of the companies in the sector, and in this way would be able to accomodate its research plans better.

Also very often and with these contacts, research subjects would be found of such industrial interest that the possible research aid could turn into a contract between the centre and the company. In all events we understand that this subsidy method should preferably cover the basic research subjects or ones which even being applied, constitute a long term investment. This research is hardly ever undertaken by an industrial company in a developing nation, and it should therefore be carried out with State backing, but demanding a serious execution regarding the country's future possibilities of making use of same. In our opinion, this is potentiated with the method described which involves all the companies in the sector, with their possibilities and problematics, within the program.

Concerted Research Plans

These consist of contracts with a private company whereby this agrees to develop research with a determined estimate, deadline and form. The Advisory Commission grants the company a loan of up to 50% of the total estimate, with reimbursement conditions that are extremely beneficial to the Company. The research programs that the companies present are usually medium and short term development or applied research.

These projects are studied by members of the Advisory Commission who are experts on the matter, obtaining the advice of those whom they consider appropriate. The approved programs are supervised all the time they are being executed by an eight member Executive Commission: two belonging to the company and six to the Administration. This Executive Commission will supervise the success of the project, and its task will not only be to supervise but also to assess.

In these Executive Commissions there are two members representing the Higher Board of Scientific Research and one member for the public research organisms, who is also normally member of the Higher Board of Scientific Research. As this Executive Commission is in close touch with the company during the years that the program is in force, a very important relation is obtained between industry and official centres, and in many cases this relationship has led to research contracts on these or completely different subjects.

We consider that the Concerted Plans are a very interesting way of promoting the industrial development that should be taken into consideration for developing nations. However we also understand that its effectiveness would improve a great deal if the following innovation were introduced:

All the projects received would be informed on by the official research centres specialized in the matter, in addition to the reports that are currently received. These official centres would not only give their opinion on the interest and feasibility of the matter, but they would indicate repetitions of efforts, and also the possibility of carrying out part of the research in

official centres, justifving this possibility and also the cost of this part. In all events this report would be forwarded to the petitioner company without this having more than a merely informative value for them. The main advantages of this report would be:

-The official centres would have a more thorough knowledge of the true problems and wishes of the companies in their sector, as they would have to make a deep study of all the projects presented.

-The companies would know the interest and the possibilities of the research centres regarding the subjects that really interest them.

-Some projects which could not be subsidized by the Advisory Commission could perhaps be made between the company and the official centre, in accordance with the new outlook and estimate that is deduced from the report.

-Another variant that could promote this relationship between industry/official organism is the possibility that if there is a cooperation with an official organism to carry out part of the research, the Advisory Commission would grant special treatment regarding repaying that part of the loan used to pay the contract with this official organism.

Finally it is important to bear in mind for developing countries that could establish a similar system, that these methods for promoting research are maimed unless the State creates a special posterior promotion system for those products which arise from these technologies. The industrial is more in need of a policy on the part of the Administration regarding own technology

products than loans and even subsidies that permit them to develop technologies which cover non-saleable products. We should not forget that in developing countries, the main client of advanced technology products is usually the Administration and organisms that depend on same.

Research Associations

The Advisory Commission promotes the creation of Research Associations. These Associations are made up of companies that have similar industrial activities and their objective is to develop work programs of common interest, constituting what are known as Cooperative Research Centres. As Annex II we have included a list of current Research Associations.

The Advisory Commission subsidizes these Associations in part of their budget, which may reach up to 50% in the first years of its operation. Later on, the State contribution drops until it only depends on the quotas of the associate companies, as it is considered that the Advisory Commission's role is fundamentally to promote and get as many of these Associations underway as possible.

As for the subject we are concerned with here, namely the Industry-Official Research Centres relation, the Research Associations play an important role, in view of the following reasons:

-Should they be expecting to obtain State subvention, they are obliged by law to use those official centres that exist, as research centres, provided they cover the areas of interest of their speciality. In this way

efforts are not doubled and the State's investments in research are taken advantage of better.

-A large number of Associations have a strong connection with Research Centres of the C.S.I.C., and some of them have actually arisen around these Centres. In these cases, the communication between industrial sector and the research workers working in the disciplines that affect them, is strongly potentiated.

-The research programs, many of which are developed in Official Centres, are approved, followed and supervised by the Association Board, made up of a majority of company men. These company men start getting to know the possibilities of the Centres and co-lateral relations are established between their companies and the research centres.

-The Research Associations usually take charge, amongst others, of tasks relating to achieving a technical standardization for the industrial sector. For this, Commissions are formed which join representatives of the official research centres with those of the industrial companies. When the possible standards are discussed, the real nature of the problems of manufacture, quality control, and measures regarding homologation become known far more thoroughly than in any other way, in short: the real state of the sector's technology.

5.- PRIVATE INITIATIVE: THE UNIVERSITY-COMPANY FOUNDATION

Sponsored by the Official Chamber of Industry and Commerce in Madrid, this foundation has recently been created. The following points are worth mentioning in its by-laws:

-Promote and develop the fields of knowledge, dialogue and cooperation between the University and the Company. In other words, between the Universities with headquarters in Madrid, and the Companies which this unites, interesting it in the latter's activities and reciprocally.

-Look for means of cooperation between one Institution and the other, so that their mutual knowledge permits them to resolve the problems that the Company is faced with today regarding training its leaders, and also in developing the Applied Technical Research, and correlatively, the University, which perhaps ignores the latter's needs in formulating its Study Plans, and those of reform and modernization of the General Technical Education.

-Promote, protect and sponsor studies and research work about the University and the Company and make them known so that people are familiar with the actual problem of its relations and promote effective solutions and work, by fixing common objectives.

-Draw up, publish and edit books or publications of all kinds, periodically or circumstantially, on subjects and questions to do with the Foundation's objectives, and also collaborate in periodic publications and other means of diffusion that could help achieve a greater mutual knowledge of the Company and the University.

For the time being it is too early to issue an opinion on its efficiency, although the efforts it has been making must be recognised: these have led to two volumes being

published listing the research possibilities and resources of the two Madrid universities.

CONCLUSIONS

Below, a series of problems and possible solutions are listed, which reflect our experience in the subject: "Industry/Official Research Centres Relation" in a country which has recently surpassed the development barrier.

-There is a profound discrepancy over the following facts:

1. The scientific research worker feels a vocational need to carry out research work on an internationally publishable level; this need is normally strengthened by the promotion systems established.
2. In a developing nation, the technological level of research that can be used by industry is usually low.

We would like to list the following as a possible solution:

A clear distinction should be established between the Research Centres dedicated to free research (whether this be basic or applied) and those we shall call Technological Research Centres, which would develop directed research work.

The free Research Centres would carry out top level research tasks; they would be in close contact with the Universities and their benefit towards the country would mainly come through an improvement in teaching.

The Technological Research Centres would work on research programs aimed at promoting development of the national industries. At these centres, personnel promotion would be closely related with the results of the outcome of their work and hardly at all on classic academic type valuations.

-It is difficult to get the results of a research program developed behind the back of the industrial sector, to have acceptable characteristics for the industries. This means either that the research cannot be used, or that a new and considerable effort must again be made to get the results to have the characteristics demanded.

The possible solution is evidently to carry out a previous, exhaustive study in all cases, that would permit clearly fixing the specifications to be fulfilled, and also the authentic interest in managing to fulfil them.

From the start, the question should involve an industrial company. To help towards the research costs, this could pay an amount that would be approximately 50% of the expenses foreseen for the program. For this amount, the company would only have a right to use the patents, if any, under exclusive or merely prioritary conditions, but it should pay a royalty or fee for using same. Thus, the company would show a much warmer interest in fixing the characteristics, in providing the team with information, in facilitating its installations or models for the research work.

This kind of relationship is what we normally use at the I.A.I., and we call it "Shared Risk". It seems that the fact the risk is shared, strengthens the relationship.

-Very often the company and in particular the average company is very distrustful of the seriousness of the Official Research Centres.

Our experience as to how to resolve this question is as follows:

There should be an initial contact with a person capable of selling the Centre's seriousness and work capacity.

It is absolutely essential to avoid hurting the sensitive feelings of the industrial or those of his technical team. We moreover feel that in the vast majority of cases, the prudent scientist is aware that he has many possibilities of knowing less than the specialized labourer with years of experience behind him, regarding the peculiarities of a specific manufacture. The industrial and his team should be convinced that they are not to be taught but helped in the work and that they will all learn from this collaboration.

The presentation of a PERT or RPD graph of the jobs to be done, and also a programming of the delivery dates and an estimate of the program made based on this graph helps the company man to increase his confidence. Evidently these diagrams should at the time fulfil or reason the necessary changes.

Very often the companies are faced with problems in industrializing the results of the research.

We feel that the existence of a Development and Standardization Section, as we have defined it at the I.A.I., may render enormous services to industry and above all improve the level of understanding between the Company and the Centre.

-On the part of the companies, there is a strong need for services such as measurements, gages, tests, reports, etc.

Industrial Test Laboratories should be created at the Ressarch Centres to cover this function. These laboratories are fundamental in a nation's technological development.

Finally, we would like to advise that the I.A.I. is prepared to collaborate in the industrial development programs that the ONUDI undertakes.

We feel that our experience in the organization of an industrial research centre could prove of use.

We likewise offer the possibility of receiving scientists or specialists from developing countries, who are interested in questions of the Industrial Automatics sector.

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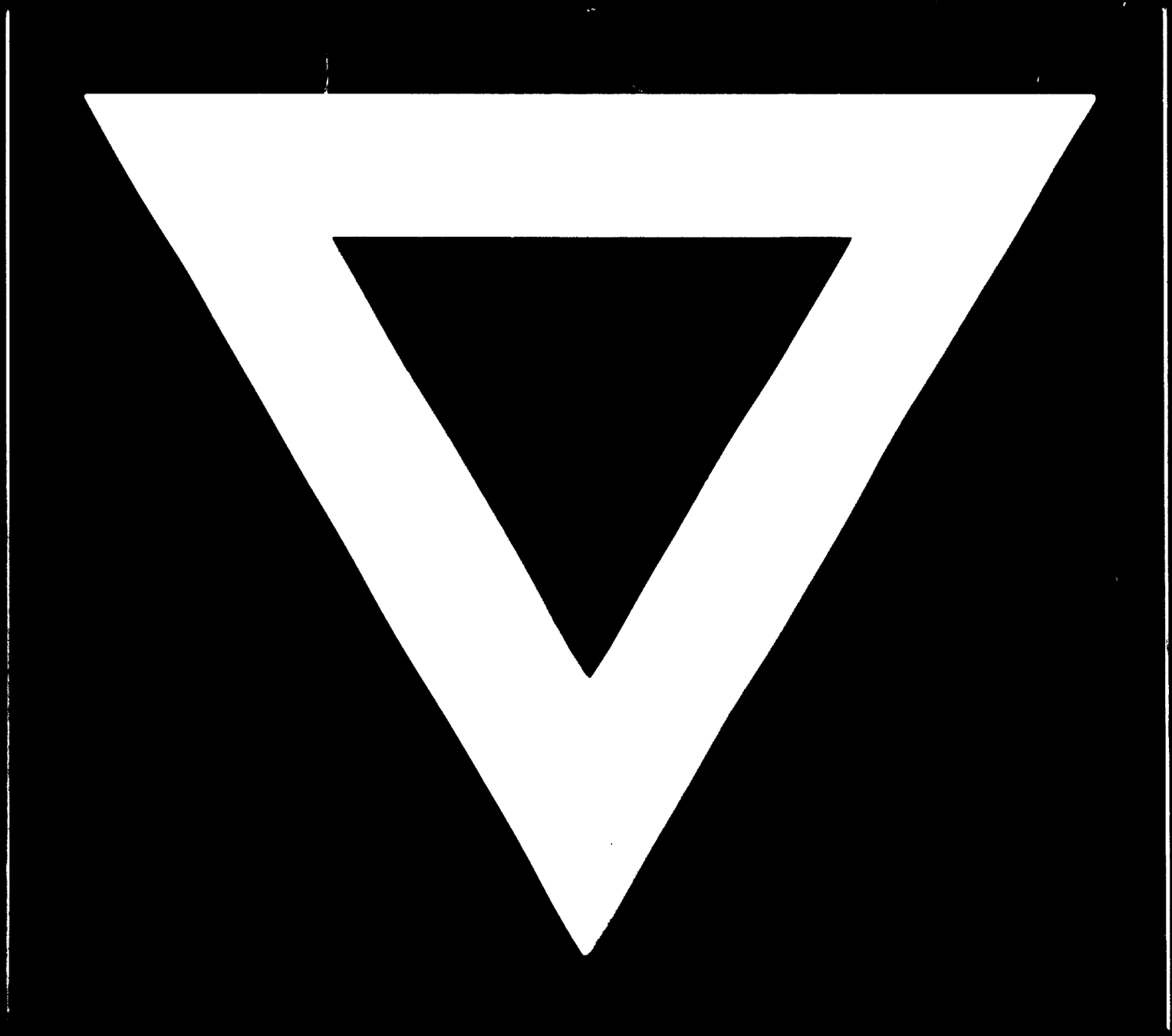

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