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IWS – Getting the most from the golden fleece

H. R. Bush and P. Marshall

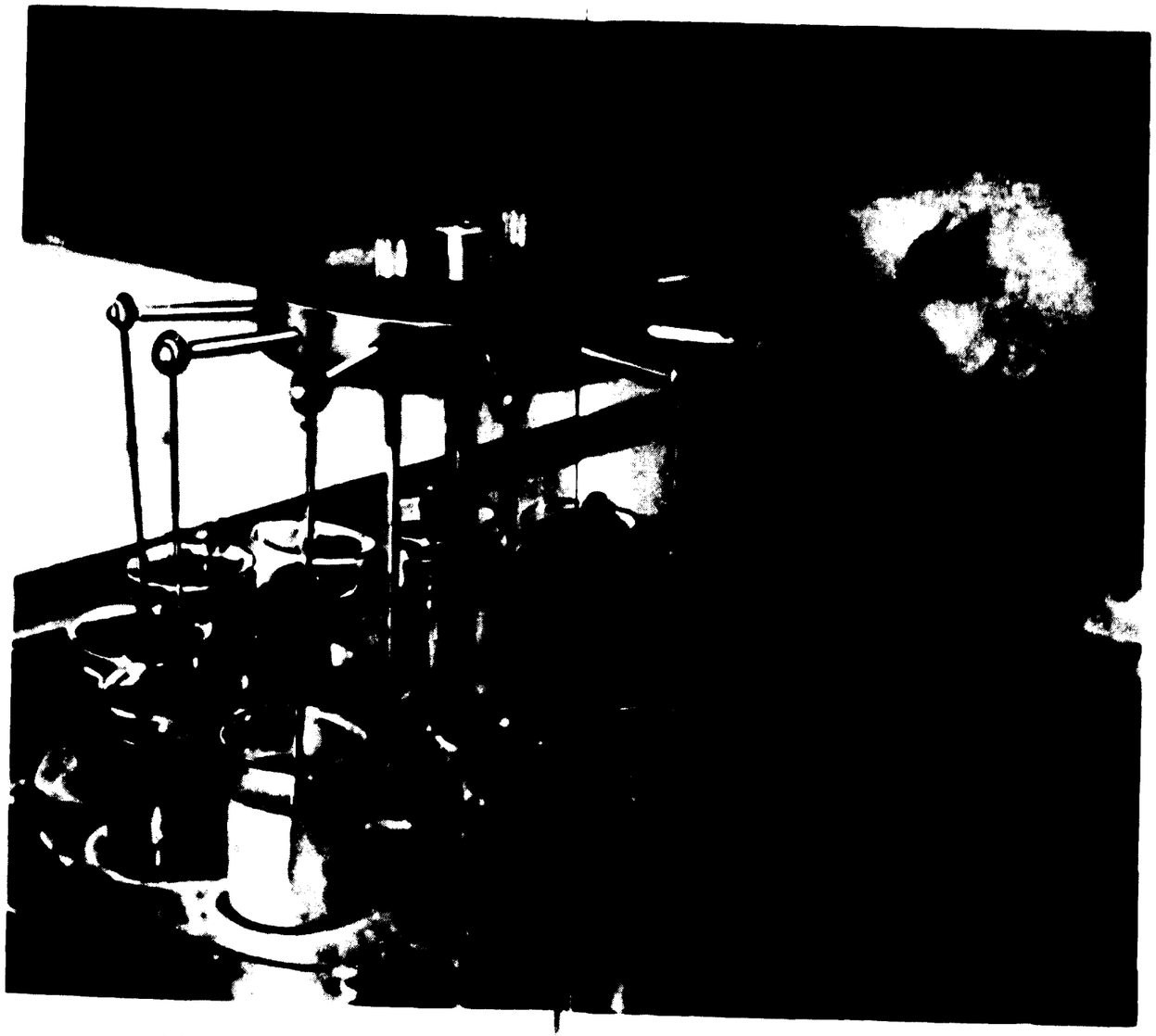
The International Wool Secretariat (IWS), established in 1937 to promote the use of wool throughout the world, has widened the scope of its activities within the past eight years. It now provides one of the most sophisticated technical advisory and consultancy services available to textile industries. Experienced manufacturing countries benefit from advanced IWS scientific research into the development of new processes and higher performance standards for the end product and, more important perhaps, developing countries, which may be making their first ventures into wool textile manufacture, can call on the accumulated experience, technical knowledge, and general guidance of an organization with world-wide ramifications.

The IWS is not a trading body and, while it serves the primary object of encouraging the greater use of wool, its services are completely disinterested in the commercial sense. It is a grower-financed organization with branches and offices in 26 countries and it operates promotional programmes with 13,000 firms in 39 countries. Wool is promoted regardless of origin. Funds, which come from 200,000 wool growers in the chief wool exporting countries of the world, are augmented by the Governments of these countries. Both the grower contribution, raised by a levy on output, and the Government share have been boosted over the years to provide for work of extended scope.

When the IWS was founded, in the wake of the depression of the 1930s, developments in viscose fibres were beginning to concern wool growers in the southern hemisphere: they wanted, and obtained, a collective voice in the northern markets, where most of their products were being sold.

For many years, wool kept firm possession of its traditional, substantial share of the world fibres market. There was little need for promotional activities other than open lines of communication and an exchange of information. As late as 1960, the IWS was still operating on a modest budget in only 14 countries.

However, the shortages and transportation problems of the Second World War when wool had to be shipped from countries thousands of perilous miles away gave an urgent impetus to the development of man-made fibres. After the war, these new fibres continued to develop and by the late 1950s, they were beginning to compete with wool in a number of its traditional end-users.



When it became clear to the wool growers that this development would continue, and that price competition would intensify as man-made fibre capacity increased, they decided to offer serious competition by trying to cater for the growing fibre needs of countries all over the world. The IWS therefore sought, and obtained, from its sponsors a massive increase in funds to face this challenge.

In 1964, a new quality control label was launched by the IWS–the "Woolmark", which has become perhaps the most widely recognized and understood textile label in use in the world. The programme has more than 13,000 licensees in 39 countries, and label sales are about £196 million a year.

When synthetics introduced new properties into the wool textile business (in particular, new standards of machine-washability and easy care), however, it was no longer sufficient merely to identify virgin wool in order to expound its undoubted merits. Though they were still unable to rival the comfort and aesthetic appeal of wool, man-made fibres were offering durability and convenience to the housewife, at costs that could be reduced as capacity expanded.

The IWS therefore–without reducing its emphasis on promotion–began to move increasingly into a very wide range of technical and product development programmes designed to improve manufacturing efficiency, to find new market outlets, and to augment the inherent qualities of the wool fibre with new performance properties (e.g. easy care). This work was rewarded by considerable technological and marketing success.

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Laboratory assistant at IWS Technical Centre checks a dyeing machine that allows 12 rapid, well-controlled laboratory dyeings to be carried out simultaneously

Fundamental research is not a basic part of the IWS programme. The IWS monitors wool research on a world-wide basis and draws heavily on the work of fundamental research laboratories of international repute (such as the Commonwealth Scientific and Industrial Research Organisation in Australia). It then converts this fundamental research into viable commercial technology. By providing processes that have been fully proved in trials before they are offered to the industry, it bridges a long-standing gap between the pure-research specialist and the factory floor.

Product development is carried out at the IWS Technical Centre at Ilkley, England. Opened in 1968 at a cost of about £1.5 million, the Centre has a staff of 200, which includes scientists and technologists from many parts of the world. It carries out research and development work on a growing range of specific projects and circulates its finding to all interested parties. Primary use is made of the organization's own network of branches and offices in more than 30 widely dispersed countries.

While still predominantly dedicated to the promotion of pure new wool and its products, the IWS recently added a new weapon to its armoury by introducing, for international use, the "Woolblendmark", a symbol which identifies a range of selected products containing a minimum of 60 per cent pure new wool. The introduction of this multi-fibre element considerably extends the range of services offered by the IWS to the textile industry.

A major achievement of the Technical Centre has been the development of completely machine-washable qualities of pure new wool machine-knitted garments and fabrics and hand-knitting yarns. Other advances include the development of a machine, designed to fit into conventional production lines, for imparting additional crimp to certain coarse wools that are deficient in natural crimp. This provides the carpet industry, in particular, with a virtually new raw material, offering added appearance retention and resilience in wear.

Another new process provides a radical improvement in the flame-resistant properties of wool, which already has very considerable natural fire resistance. This permits new levels of safety in carpets and furnishing fabrics for airliners, and higher standards than ever before in a wide range of other wool products. Other projects being promoted will give wool products new easy-care properties that will enable them to stand up to domestic washing machines as well as dry-cleaning. These include non-iron finishes. Indeed, a machine-washable men's suit is on the point of commercial introduction.

In addition to these new activities, the IWS has developed a consultancy service which places at the disposal of all countries the technical skill and expertise it has accumulated over the years in all aspects of conventional processing. The broad aim of the consultancy service is: "To advise internationally on the most competitive methods available for converting wool fibres into a quality end-product".

The service, which was known as the Manufacturing Services Section when it was first set up in 1965, originally had two main functions:

(a) To advise on the setting up of wool textile industries, particularly in the emerging countries;

(b) To assist existing mills to improve their product quality and, thereby, their competitiveness.

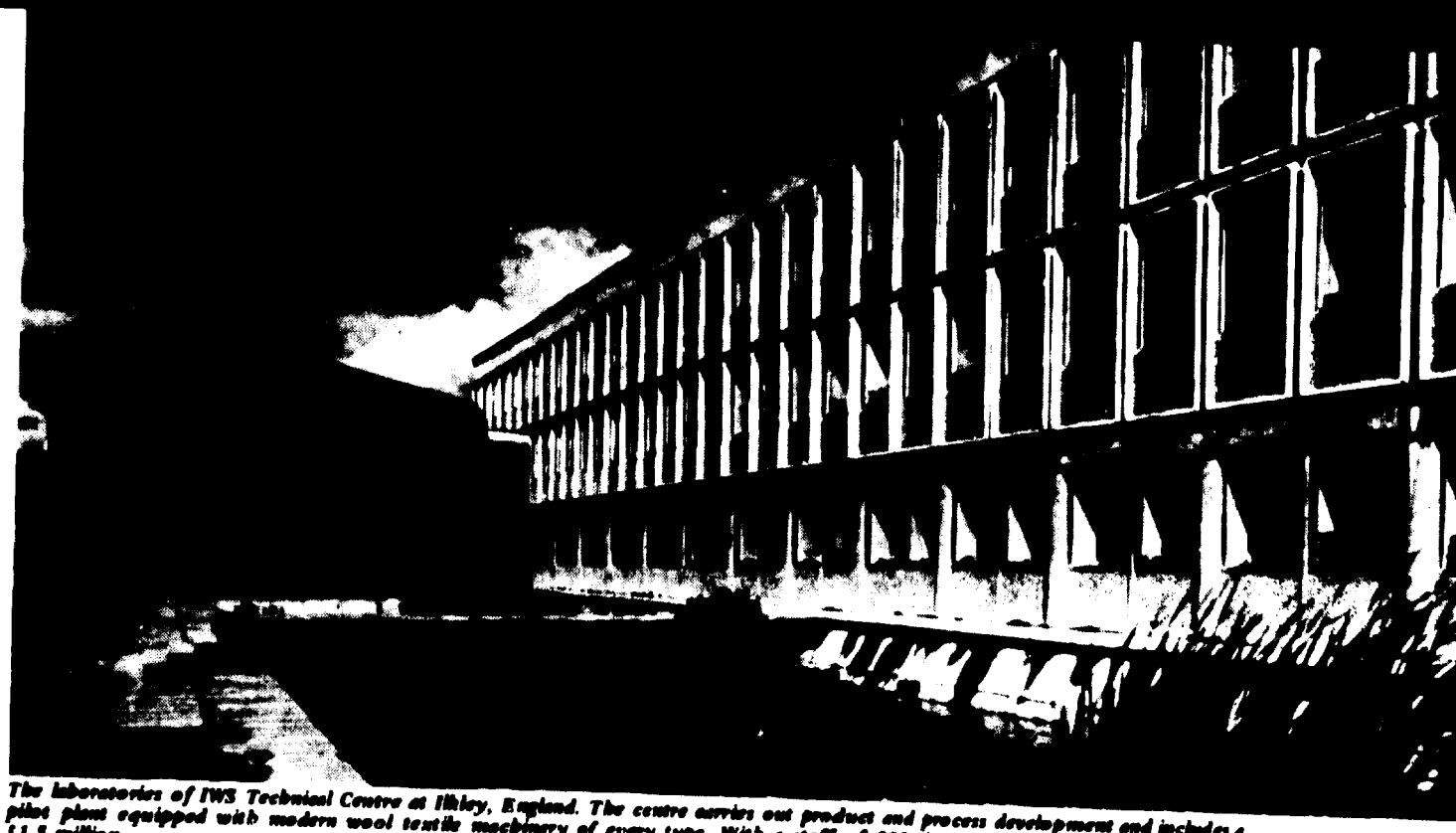
Experience in the first few years, however, showed that the developing countries needed a wider range of services and in 1971 the section was renamed the IWS Consultancy Service, and equipped to advise on such diverse subjects as complete plant layout, management problems, automation, marketing, design work, computers as an aid to production programming and control etc. It now seeks to cover all the disciplines which the industry expects of a large textile consultancy.

This reconstituted service makes available, anywhere in the world, advice and guidance from some of the best and most experienced technical, production, commercial and management personnel to be found in the European textile industry. In addition to its own staff, the Service has a roster of consultants with world-wide experience.

The Consultancy Service does not offer stock solutions for a company's problems. It recognizes that each firm's difficulties must be resolved within the framework of that particular firm. Whether a query concerns the proposed erection of a factory, or a relatively minor production hold-up, the same measure of detailed attention and assistance is available. The Service's experts come from all the fields of textile manufacture; from raw material to garment-making, including management, organization, planning, training and market research. The following is a listing of the main areas in which consultancy is currently provided:

Technical services

Raw material (buying; blending of different wool types or wool-synthetic mixtures)
Top production (scouring of wool; effluent treatment; combing of wool, wool blends and synthetics; combing machinery; sales of tops)
Yarn production (spinning of woollen, worsted and semi-worsted; spinning machinery for woollen, worsted and semi-worsted)
Cloth production (design of woollen and worsted; preparatory processes; fabric specification)
Mending
Finishing (wet systems for woollen and worsted; dry systems for woollen and worsted; additive finishes; solvent finishing)
Dyeing
Printing
Knitting (weft knitting, flat and circular; warp knitting, Co-We-Nit; specialized techniques; Mali and Arachne machines)



The laboratories of IWS Technical Centre at Ilkley, England. The centre carries out product and process development and includes a pilot plant equipped with modern wool textile machinery of every type. With a staff of 200, it was opened in 1968 at a cost of £1.5 million.

Carpet production (woven, tufted, needle-bonded and sliver knitted; latexing; design and styling)
Quality control (quality control techniques and systems; advice on setting up and maintaining quality standards)
Clothing manufacture

General management

Principles of organization
Staff (selection and recruitment)
Job evaluation
Costing
Project planning and control
Training (plant training; organization of training; training of individual key personnel remote from plant; production of training aids and programmes)

Marketing

Production rationalization
New product development
Industrial and consumer marketing

General production

Plant layout
Materials handling
Methods engineering (work study; transport of materials; storage; maintenance; building design etc.)
Use of computers for network analysis (scheduling, cost control, and general progressing of large or complex production schemes)

CONSULTANCY PROJECTS

To illustrate the geographical range and variety of the textile problems covered by the Consultancy Service, the following examples are given of projects undertaken by the IWS in the past two years:

ASIA

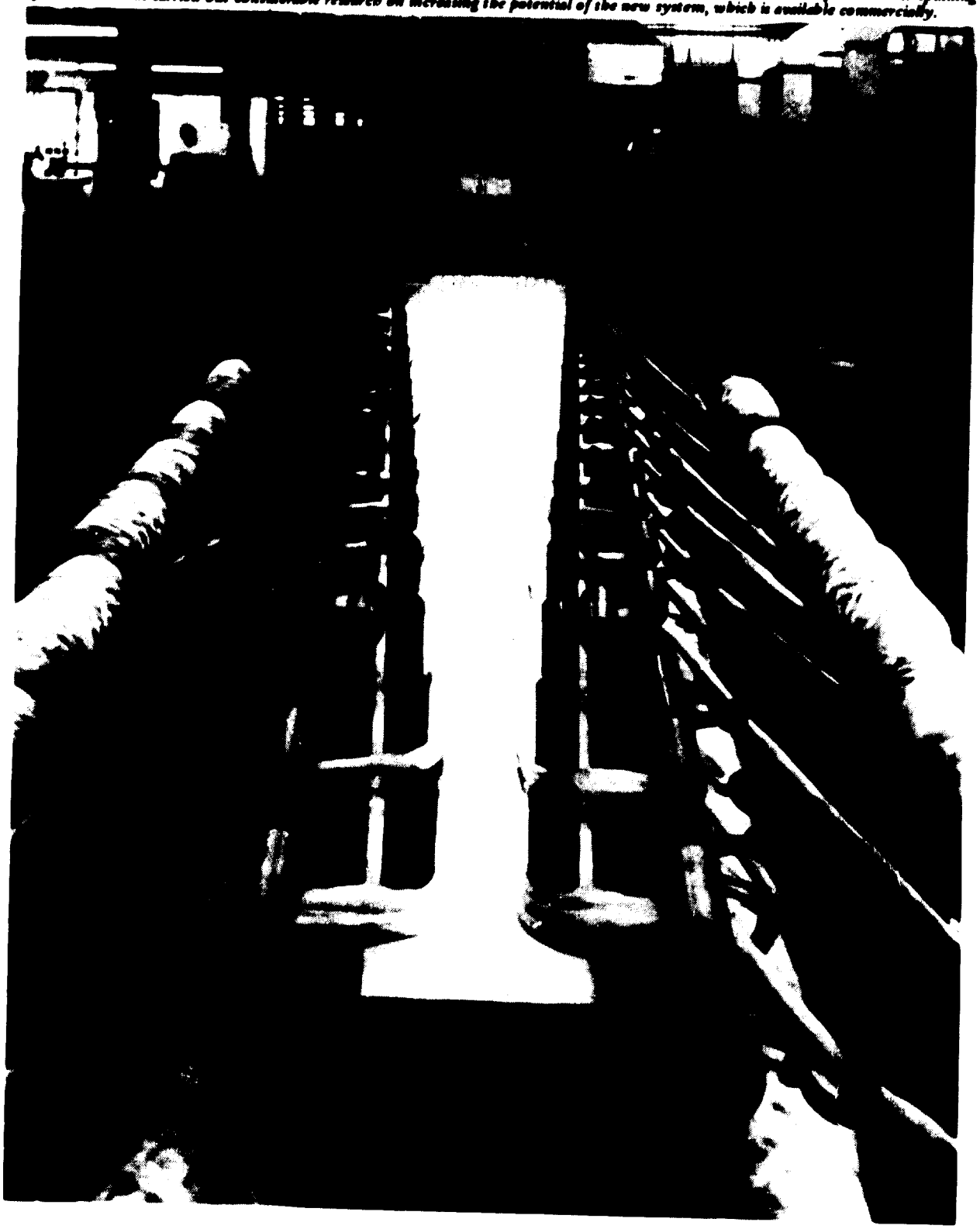
India

- A full-scale study of the Punjab spinning, knitting and dyeing industry was carried out in relation to a planned common facility centre to be set up in Ludhiana.

- A complete investigation was carried out at one of the largest vertical mills in the country. The investigation covered all processes, from raw material to finished fabric. Recommendations included the future rationalization of the firm. Special emphasis was placed on the need to improve quality and design if the firm were to establish an export trade.

- A thorough consultancy assignment was carried out at a large vertical mill, and advice was given on the installation of new equipment.

Below: *Wool tops feeding into a back-wash machine to undergo* Superwash *shrink-proofing treatment. The process involves a mild chlorination followed by the application of a microscopic coating of polymer resin to each wool fibre.* Superwash *products are designed for machine-washing in medium cycles at 40°C.* **Opposite:** *This revolutionary self-twist spinning system, originally developed by the Commonwealth Scientific and Industrial Research Organisation of Australia, provides greatly improved output with reduced costs for labour, power and space. An alternating twist is imposed on the wool fibres as they pass between rotating rollers that also reciprocate axially. The resultant yarns are competitive with conventional yarns for most purposes. The self-twist spinning machine is advantageous because it does not impose twist by rotating the yarn package—the fundamental limitation of traditional spinning systems. IWS has carried out considerable research on increasing the potential of the new system, which is available commercially.*



Iran

- A complete layout was provided for a new scouring plant.
- A complete new mill was constructed. This included finding a suitable site, designing the building, and making recommendations on the equipment to be purchased.
- A full investigation was carried out at a carpet-weaving mill, and suitable recommendations made.

Turkey

- Reconstruction of a knitting and garment-making factory included planning the site and layout of a new building, arranging water, steam and other services, and recommending new machinery and techniques.
- Planning details were provided for a new textile research centre at Bursa.
- Layout was provided for a new worsted spinning mill, with special attention to economic considerations.

Pakistan

- A survey of the wool industry of Pakistan was carried out by a team of consultants.

SOUTH AMERICA

Uruguay

- A vertical woollen and cotton mill was reorganized, with complete layout, including administration, accounting, costing (prime costs), labour requirements etc.
- A complete investigation was made of a large vertical mill, including reorganization of machinery, economics, product development and marketing.

Chile

- A large scouring plant was reconstructed.
- The Consultancy Service supervised the reorganization, layout and commencement of operations of a top-making plant.

OCEANIA

Australia

- A large woollen mill was reconstructed. The project included a complete new layout.
- A new dye-house was planned for a commission dyeing firm.

EUROPE

Greece

- The cloth styling and design centre of a large weaving mill was reorganized.

Yugoslavia

- Recommendations were made on the production of high quality velour fabrics.
- General consultancy was provided on the reorganization of the making-up section of a large vertical mill.
- Consultation was provided at a vertical mill on the dyeing and finishing of fabrics.
- A quality control system was established for tops, sliver and yarns at a large worsted spinning mill.

Poland

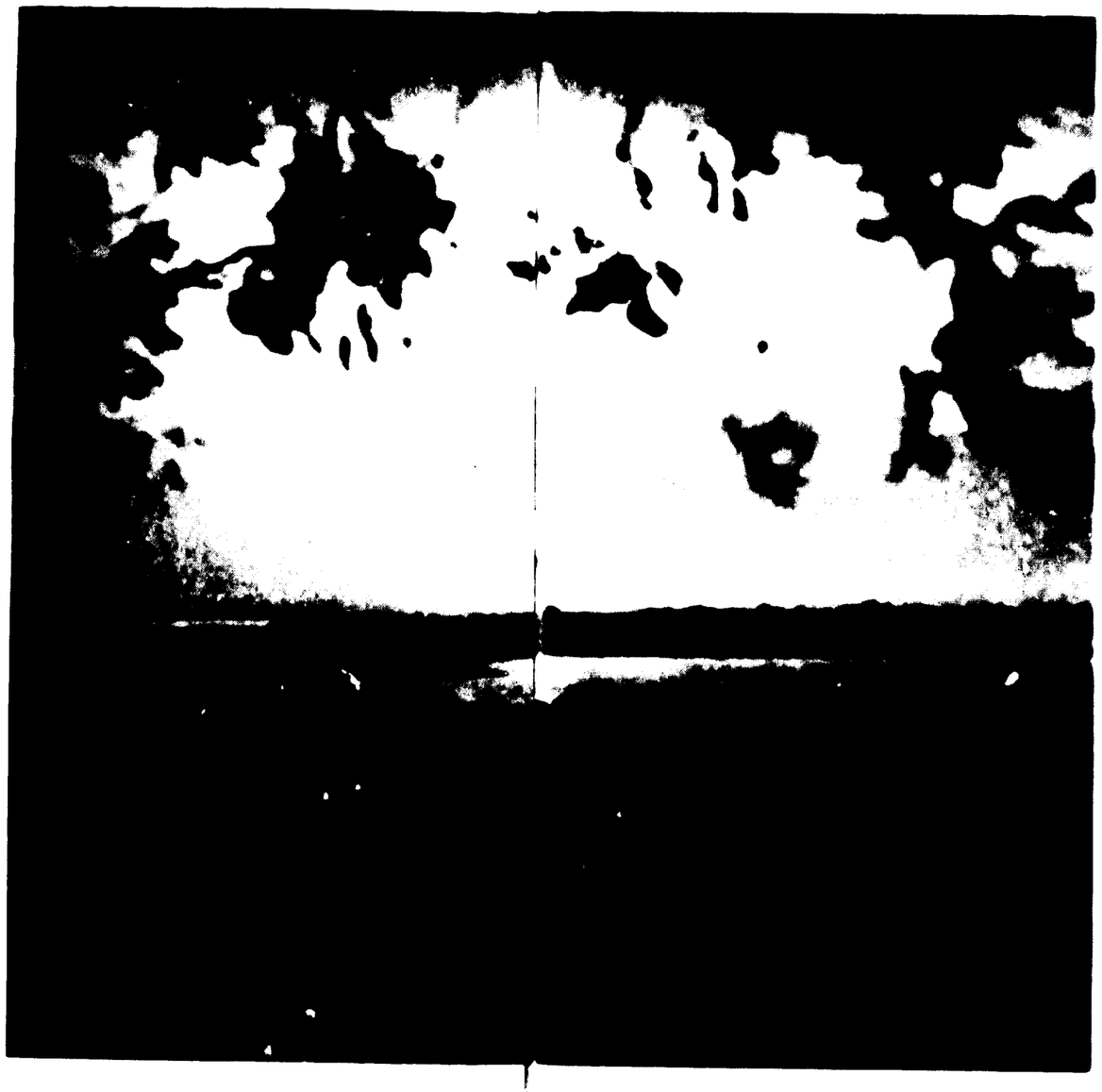
- A detailed survey of the Polish wool-using industry was carried out. The project involved visits to all major firms in the country. Detailed recommendations were made for the future development of the Polish wool-using industry.

USSR

- A team of consultants carried out a detailed investigation into the total reconstruction and complete layout of a very large spinning mill. ■

SELF-HELP: IRELAND'S RECIPE FOR DEVELOPMENT

M. J. Killeen and J. B. Swan



The industrialization programme of the Government of Ireland is administered by the Industrial Development Authority. The ultimative objective of the Authority is the improvement of the economic and social welfare of all Irish men, women and children who live, or would like to live, in Ireland. The level of a country's standard of living depends on economic production: the betterment of that standard depends on economic growth.

The three sectors of the Irish economy—agriculture, industry and public services—contribute to the national income. All of these sectors are interdependent: the growth of each depends on the demand from the others, and from abroad. At the present stage in the country's development, industry is the primary and principal generator of growth in employment: agricultural employment is declining and employment in public services is substantially affected by the level of demand from industry.

The country's ability to provide employment opportunities at home for all its people by the 1980s depends directly and indirectly on the establishment of new industries and the expansion of existing ones in the country. The level of real incomes in the future will depend very largely on the success of these measures. At present, average incomes in Ireland are only about half those in other member countries of the European Economic Community (EEC). Furthermore, average incomes in the more prosperous regions of Ireland are substantially higher than those in the less well-off areas: incomes in the eastern region are 60 per cent higher than those in the west.

The Industrial Development Authority itself does not establish or control industries. Its task is to promote the rapid build-up of the industrial sector by providing guidance, encouragement and financial inducements and assistance both to Irish industry and to overseas manufacturing firms willing to invest in Ireland. In appropriate cases, it participates in new projects by equity investment.

Industrial development in Ireland is a complex activity involving, directly, private and public enterprises (e.g. industrialists, banks, insurance companies) and, indirectly, many State, semi-State, and other bodies (e.g. the Department of Posts and Telegraphs, the national transport system, the Electricity Supply Board, gas companies, the National Building Institute, the Institute for Industrial Research and Standards, and the Irish Export Board). The Industrial Development Authority plays an important role as co-ordinator of the industrial development-related activities of all these companies and agencies.

Industrial development is a team effort. If it is to be fully effective, it is essential that all those engaged in it be agreed on the final objectives and work together for their achievement.

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Since 1960, 723 new manufacturing plants, involving a total capital investment of £279.4 million and 63,891 jobs at full production, have been established in Ireland. Overseas companies set up 496 of these plants, representing a total investment of £217,750,000 and 48,455 jobs, the remaining 227 were established by Irish interests. The following table shows investment in these industrial projects, by principal source countries:

Country	*Amount invested (million pounds)*	*Number of projects*
United Kingdom of Great Britain and Northern Ireland	42	183
United Sates of America	84	131
Germany, Federal Republic of	16	91
Netherlands	36	21
Ireland	57	227
Others*	40	70

*Including Austeria, Belgium, Denmark, France, Italy, Japan, South Africa, Sweden and Switzerland.

The new industrial development had a dramatic impact on the Irish economy throughout the 1960s. It was the main contributor to the rapid increase in the Gross National Product, which achieved a volume increase of 48 per cent over the decade, or an average annual rate of growth of 4 per cent in real terms. The average annual rate of growth in the industrial sector for the period was 7 per cent and was one of the highest recorded in Europe.

The expansion in industrial output was strongly reflected in industrial exports from Ireland, which rose from £83.8 million ($201 million) in 1960 to £394.3 million ($1,025.2 million) in 1971, an increase in real volume of over 240 per cent. In 1970, industrial exports accounted for 54 per cent of total merchandise exports, and for the first time exceeded agricultural exports in value.

The new industries produce a wide range of products, including engineering goods, electronics and electrical equipment, pharmaceuticals and chemicals, textiles, foodstuffs, metal and plastic goods.

The author: *J. B. Swan is Executive Director of the Industrial Development Authority, Ireland.*

With Industrial Development Authority assistance, a new plant goes up at Killarney in County Kerry.

This satisfactory performance has produced significant changes in the distribution of the Irish work force. Employment in the agricultural sector dropped from 36.1 per cent of the total work force in 1961 to 26.3 per cent in 1971. The percentage employed in industry, however, increased from 24.4 to 30.7 per cent over the same period, while the percentage in public services rose from 39.5 to 43.4 per cent.

The unprecedented rate of industrial development in Ireland during the 1960s was the result of conscious planning by the Government. The initial impetus for the development was provided by the Government's programme for economic expansion, which established general growth targets for the national economy and specific targets for the industrial sectors. As part of this programme, the Government introduced incentive schemes designed *(a)* to encourage and assist domestic industry to expand, diversify and raise its efficiency to meet free-trade conditions, and *(b)* to encourage foreign industry to establish manufacturing plants in Ireland.

The objective of the Government's industrialization policy was twofold: to provide greater job opportunities for Irish workers and thereby lessen involuntary emigration; and to raise general living standards in the country. In the mid-1950s, 50,000 persons a year were emigrating: a chronic haemorrhage from a population of just under 3 million. In addition, Ireland was experiencing the drift of workers from agricultural occupations a movement that was also taking place in most other European countries. The Government realised that the fundamental cure for these economic and social ills was to provide jobs at home for Irish workers. These could only be provided in the industrial sector.

Production of tufted carpet yarns at Newbridge, County Kildare. Overseas interests are British, Indian and Belgian.

Accordingly, the Industrial Development Authority, a State-sponsored organization with national responsibility for industrial development, was established. The main objectives of the Authority are:

- To encourage overseas industrialists to establish export-oriented manufacturing plants in Ireland;
- To assist home industry to expand, diversify and improve its efficiency.

The Industrial Development Authority achieves these objectives with the aid of a unique package of incentives which go further than those of any other country in encouraging export industries and in attracting private capital for this purpose.

This article is primarily concerned with explaining the objectives, priorities, and activities that make up the Industrial Development Authority's programme for the attraction of new industry. The programme will have a significant impact on the industrial and economic performance of Ireland in future years. Before taking a forward look at new industrial development, however, it is necessary to review briefly the fundamental economic rationale of the form of industrial development that has evolved in Ireland and the impact it has had on the industrial sector.

The economic rationale

Up to the end of the 1950s the position of the Irish economy was characterised by:

- Relatively plentiful national resources to finance both infrastructure and direct industrial investment;
- A growing surplus of labour accruing from natural increase in the labour force and decline in agricultural employment, resulting in a high level of emigration;
- A low momentum of growth in industry. Since the bulk of Irish industry had been established in an era when even highly developed countries pursued protectionist policies, it was directed almost exclusively at meeting domestic market requirements. The scope for further development of this kind had become extremely limited.

In this situation it was necessary to devise a strategy for achieving a rapid and sustained increase in the volume of export-oriented industry and for the channelling of underutilized resources of labour and capital into export-generating projects. It was recognized that, for existing industry, a move from operating in a virtually closed market economy to competing on international markets, while offering considerable long-term growth prospects, would pose a challenge in the short term. It would call for substantial changes in the structure of industry, in the fields of marketing, product development and management, and would require heavy investment in manufacturing facilities. A wide-ranging programme of incentives and support services was developed with the object of encouraging existing industry to move into export activities. This programme included tax relief for profits from exports, grants towards expenditure on modernization and re-equipment of manufacturing facilities, industrial grants towards capital costs of new export-oriented projects, and a strengthening of the resources of a number of State bodies providing services for industry, including the Irish Export Board, the Institute for Industrial Research and Standards, and the Irish Management Institute.

It was obvious, however, that if the desired expansion in export-oriented industry and in industrial employment was to be secured quickly, it was necessary to supplement the potentialities of existing industry by attracting from abroad new, export-based industry. The Industrial Development Authority was not alone in this view, as similar conclusions were reached in a number of other Western European countries (e.g. Belgium, Italy, the Netherlands and the United Kingdom of Great Britain and Northern Ireland) where programmes for the attraction of new industry from abroad were also being launched.

Tax relief from export profits

The most important of the Irish incentives is the tax relief from export profits. New manufacturing companies establishing plants in Ireland enjoy 15 consecutive years of complete exemption from taxes on profits earned on export sales, and a sliding scale of relief for each additional year up to 1990, when the relief ceases. Sales by Irish companies to their parent companies or other associated companies abroad are regarded as

Operators at work in a mechanical handling equipment plant at Galway.

export sales and qualify for export tax relief. The benefit of this relief to an industrialist is very substantial.

There is also free movement of capital from Ireland. A company, once it has received exchange control approval from the Irish Central Bank (which is normally granted automatically on the establishment of a company), is guaranteed free international transfer of dividends and profits from its Irish investment, in any currency. Capital and appreciation of capital may also be repatriated in full. There is no capital gains tax in Ireland.

Ireland has double-taxation agreements, providing for the avoidance or mitigation of double taxation, with Austria, Canada, Cyprus, Denmark, Finland, France, the Federal Republic of Germany, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom of Great Britain and Northern Ireland and the United States of America. Agreements with Belgium, Italy, Luxembourg and Zambia have been signed and await ratification, while agreements with Japan and several other countries are at an advanced stage of negotiation. These agreements provide for full or partial exemption from taxation in the recipient country on profits (which are already tax exempt in Ireland) received from an Irish company.

Capital grants

The second major financial incentive available to manufacturers setting up plants in Ireland is the comprehensive range of non-repayable cash grants. The most important of these are the grants which the Industrial Development Authority provides towards the cost of fixed assets. For grant purposes, fixed assets comprise sites, site development, buildings and machinery. Grant levels for medium-sized projects are determined as a percentage of fixed asset investment. They can be as high as 50 per cent in certain areas of the country. Grants for capital-intensive projects are related to the number of workers employed in the project and range up to a maximum of £5,000 per worker, depending on location.

In selecting new industry and determining grant levels, the Industrial Development Authority rates projects on their benefit to the national economy against the following criteria:

- High market growth rate of the product;
- Long-term stability in terms of there being small danger of technological obsolescence;
- High "added value" when the full impact of the project on national income is taken into account;
- High degree of exportability in terms of physical ease of transport, storage and tariff rates;
- Low capital requirement per job created; or where the requirement is high, good potential for linkage or spin-off benefit.

Training grants

The Authority also provides grants towards the cost of specific training programmes for workers for new industrial projects. Such costs include the following:

- The wages, travelling and subsistence expenses of the workers being trained, whether in Ireland or at parent companies abroad;
- The salaries, travel and subsistence expenses of training personnel;
- Management training expenses;
- The cost of hiring training consultants, where necessary.

The establishment of overseas-sponsored industries in Ireland has introduced skills and technologies to a work force that is educated and adaptable to new techniques. The State-sponsored Industrial Training Authority operates training centres throughout the country and provides training courses to meet the specialized requirements of specific industries.

Ready-built factories

On its industrial estates at Galway and Waterford (and at Shannon in association with the Shannon Free Airport Development Company), the Industrial Development Authority provides fully serviced ready-built factories for purchase or renting. Ready-built standard-type factories are also available from the Authority at many other centres throughout the country. Where factories are leased, the capital grants are applied to reduce the rentals. The Authority will also build and lease specially designed factories to meet the requirements of particularly attractive projects.

Apart from the factory facilities provided by the Industrial Development Authority, there are many privately operated industrial estates in Ireland. Fully serviced sites are also available in most towns.

Research and development

The Authority also operates a grants scheme for research and development projects, based on a maximum of 50 per cent (or £15,000, whichever is the lower) of the cost of each project. It has established an industrial research park just outside Dublin where firms may establish units to conduct research on new processes and product development with the aid of the grant scheme.

Opposite: *Technician operates machinery at an industrial fasteners and tooling factory, Galway.*

Apart from the exceptional financial benefits which Ireland offers to establishing manufacturers, it has many other attractions as an industrial location. It has a reserve of educated, adaptable, English-speaking workers who can be readily trained to perform any industrial task. Its location between the United States of America and continental Europe makes it an ideal base for trade both with expanding American markets and with the large and lucrative markets of the European Economic Community (EEC).

Recources and deficits

The use of incentives non-repayable cash grants and export profits tax relief to attract new industries from abroad is sometimes equated with the incurring of a national "cost" in some sense. From the standpoint of the economy as a whole, the notion of "cost" implies the benefits that are sacrificed through directing investment resources into one channel rather than another. Hence, a system by which national capital resources—in the form of Industrial Development Authority financial incentives are allocated to new industries so as to ensure their location in Ireland, rather than elsewhere, constitutes a national "cost" to the extent that these resources could be used more beneficially in some other way to promote economic growth. However, as noted above, the position in the Irish economy has traditionally been one in which the momentum of growth in the existing base of industry has fallen far short of what national capital resources could finance or what employment needs required. The notion of the "cost" of new industrial development is, therefore, misconceived. The attraction of external industry to Ireland is essentially aimed at finding sources of enterprise to utilize national resources of capital and labour in industrial expansion that otherwise would not materialize. The attraction of the necessary enterprise involves the deployment of capital resources on an incentive basis, i.e., to increase the profitability of specific industrial projects in relation to what they might earn if located in some other country.

The total annual volume of financing deployed by Irish State-sponsored agencies, including the Industrial Development Authority, in industrial development is approximately the same as the total annual yield in income and corporate profits tax on existing businesses. This fact naturally prompts the questions: Why give back in financial aids to industry what is taken away from them in taxation? Would it not be better to leave these resources to be reinvested directly in industrial expansion? These questions miss the very relevant point that the resources are directed in the form of financial incentives and support services to those firms—many of them foreign firms—that are most likely to have the potential for long-term growth and for the generation of increased exports and employment. A similar process of redeployment of resources forms part of corporate development in large businesses.

What has been said so far merely establishes the broad economic rationale of the Industrial Development Authority's programme for new industrial development. In essence, the Irish economy has a surplus of primary industrial resources of capital and labour and a deficit of industrial enterprise and knowledge. The latter must, therefore, be imported, with the aid of financial incentives. The question arises, however, as to what priorities for attracting external industry should guide the deployment of financial incentives. It is important to stress that the Authority's product policy is to search out industrial projects that yield a high national economic benefit in relation to the investment involved.

A ranking of projects on this basis does not necessarily correspond to a ranking on the basis of commercial profitability. New industrial projects are rated on the following major indicators of economic benefit:

- High growth rate of the product in international markets;
- Stability, in terms of small probability of technological obsolescence;
- High national value added through the use of native raw materials or locally manufactured products;
- Low capital intensity, or, if it is high, substantial possibilities of linkage or spin-off benefit from the project.

Quantified versions of these indicators provide the framework through which the Industrial Development Authority's project selection process is conducted in its initial stages. A project having a high rating on all of these criteria does not neeessarily have a higher commercial profitability than one with low ratings on all of the criteria. However, the project with high ratings would obviously attract larger incentive per unit of investment since it would deliver higher national economic benefit. For example, an export-based project involving a product that is at the growth stage of a long-life cycle, and that uses Irish raw materials, would attract a higher level of incentive than an export-based project with a low skill content and using imported materials—even though both projects might have the same prospective rate of return on capital employed.

It follows from this discrimination on grounds of economic benefit that it is incorrect to regard the Industrial Development Authority's financial incentives solely as a means of generating projects in which to utilize national resources of capital and labour. Incentives are also the vehicle for the promotion of a product policy for industrial growth. Variations in the rate of incentives to new industrial projects are a key method by which the over-all pattern of new industrial

Operator at work on a milling machine at Killarney, County Kerry.

expansion is made to conform with national development needs, such as a high male content in new job creation, stability and permanence of employment, and the use of local raw materials.

One of the persistent doubts expressed about the use of financial incentives to attract new industries concerns the permanence of these industries. It is often thought that, when the benefits of grant assistance and export profits tax relief are exhausted, the industries will tend to move elsewhere. The probability of this happening depends essentially on the selection effort, which is initially devoted to attracting new industries. In general, new export-based industries become more permanently rooted in their locations according as *(a)* they develop local resources of skill and management not easily substitutable in alternative locations, and *(b)* they reinvest and expand within the economy.

New industrial development since 1960

Table 1 shows the extent of new industrial development assisted by the Industrial Development Authority since 1960. The impact of this development is most closely reflected in the growth and diversification of manufacturing export sales over the period, since virtually all of the development consisted of the establishment of highly export-oriented industries. In contrast to the pattern of manufacturing activity in 1960, which was heavily dependent on food processing, textiles, clothing and footwear, these new industries were concentrated in the product areas of engineering goods, electronics and electrical equipment, pharmaceutical and chemical products, and plastic products.

TABLE 1. NEW INDUSTRIES AND MAJOR EXPANSIONS ASSISTED BY THE INDUSTRIAL DEVELOPMENT AUTHORITY, 1960–1972

Sources	*Number of projects*	*Total capital investment (million pounds)*	*Employment at full production*
Irish	227	57.65	15,436
Overseas	496	217.75	48,455
Total	723	275.40	63,891

View of the shop floor level at a company in Waterford producing laboratory balances.

As table 2 shows, in summary form, the growth of manufacturing export sales since 1960 was accompanied by a marked shift in their industrial pattern towards the broad product areas of metal goods and chemicals. This pattern of growth is expected to continue.

TABLE 2 BROAD PRODUCT PATTERN OF MANUFACTURING EXPORTS, 1960 AND 1971
(Percentage of total value)

Product	*1960*	*1971*
Food processing, beverages, tobacco	62.5	49.4
Textiles, clothing, footwear	11.0	13.8
Chemicals and metal products	9.6	19.0
Other products	16.9	17.8
Total	100.0	100.0
(Value, million pounds)	(83.8)	(394.3)

In retrospect, the 1960s represented what was inevitably the pilot stage in the programme to attract new industries to the economy, even though the programme in those years accounted for much of the expansion and diversification of the manufacturing sector. The scope for selection of new industries upon which to exercise financial incentives in line with development priorities was much less than it is now, or will be in the future. Inevitably, it took time to build up Ireland's reputation abroad as a base for manufacturing industry. Furthermore, with continuing uncertainty in European trading relations, it was not possible as it is now—to promote Ireland as a part of the European free market economy, particularly among United States industrial companies in Europe.

It is necessary to stress that joint ventures (less than 10 per cent of new industrial projects established in the 1960s were joint ventures between existing and new industries), are possible only where industrial companies in different countries can match complementary strengths to their mutual benefit. For example, a country with a certain developed product technology may be attracted to a company in another country, or

Technician sets up unit at a machine and tool company at Ballina, County Mayo.

part of the world having manufacturing facilities and established market access and knowledge. The scope for joint ventures is limited, therefore, where these kinds of complementary strengths are lacking. During the 1960s, when existing industry in Ireland was primarily concerned with changing from production for a potential home market to operating in international competitive markets, the scope for joint ventures was severely restricted. Existing industry has now considerably more experience of export operations, and in the coming years is likely to acquire more new technologies and new products through joint ventures and licensing agreements.

A feature of a significant number of the industries established in the 1960s has been their development from branch production units of external companies into units that conduct their own marketing and research and development activities. This movement is partially reflected in the fact that 20 per cent of the total investment committed during the 1960s represented expansion of manufacturing facilities by firms already supported under the Industrial Development Authority programme. A number of expansion projects recently approved relate to firms that were set up in the early 1960s and for which the benefits of export profits tax relief will be exhausted in the course of a few years. The recently introduced programme of grant support for research and development activities should increase the potential for firms to widen their activities and expand.

Future development of new industry

A large proportion of the expansion needs of industry during the coming decade will continue to be met by the attraction of new industries from abroad. The Industrial Development Authority's programme of attracting external industrial investment for the 1970s comprises the following elements:

- Researching the pool of investment possibilities arising in the industrial countries making up the developed international economy, i.e. for practical purposes North America, Western Europe, and Japan;
- Selection of the product areas, projects and industrial companies which best meet the criteria for economic benefit already mentioned;
- Identification within these selected groups of the projects and industrial companies which have the greatest potential for conversion into actual projects in Ireland;
- Implementation abroad of general promotional campaigns and direct marketing activities aimed at specific industrial companies.

Research and selection of industrial projects and companies provides a portfolio of investment possibilities to which the Industrial Development Authority can apply its marketing activities. In this way, it is possible to influence the expanding industrial structure in accordance with development priorities. Rather than the foreign industrialist choosing Ireland as a location, which leaves the Authority with little or no control over the pattern of new industrial development, the Authority chooses the foreign industrialist. It then approaches his company directly with a specific investment proposal. Success in this effort depends on arranging that the proportion of desirable "candidate" industrial projects in the total portfolio of investment possibilities is kept to a maximum on a continuing basis.

Priority areas

The Industrial Development Authority, through experience and research, has identified the products, projects and industries that best meet the criteria of economic benefit already mentioned. Some of these priority areas are listed below:

Priority areas for new industries

Food

Nutritional and health products
Processed meat products
Delicatessen products

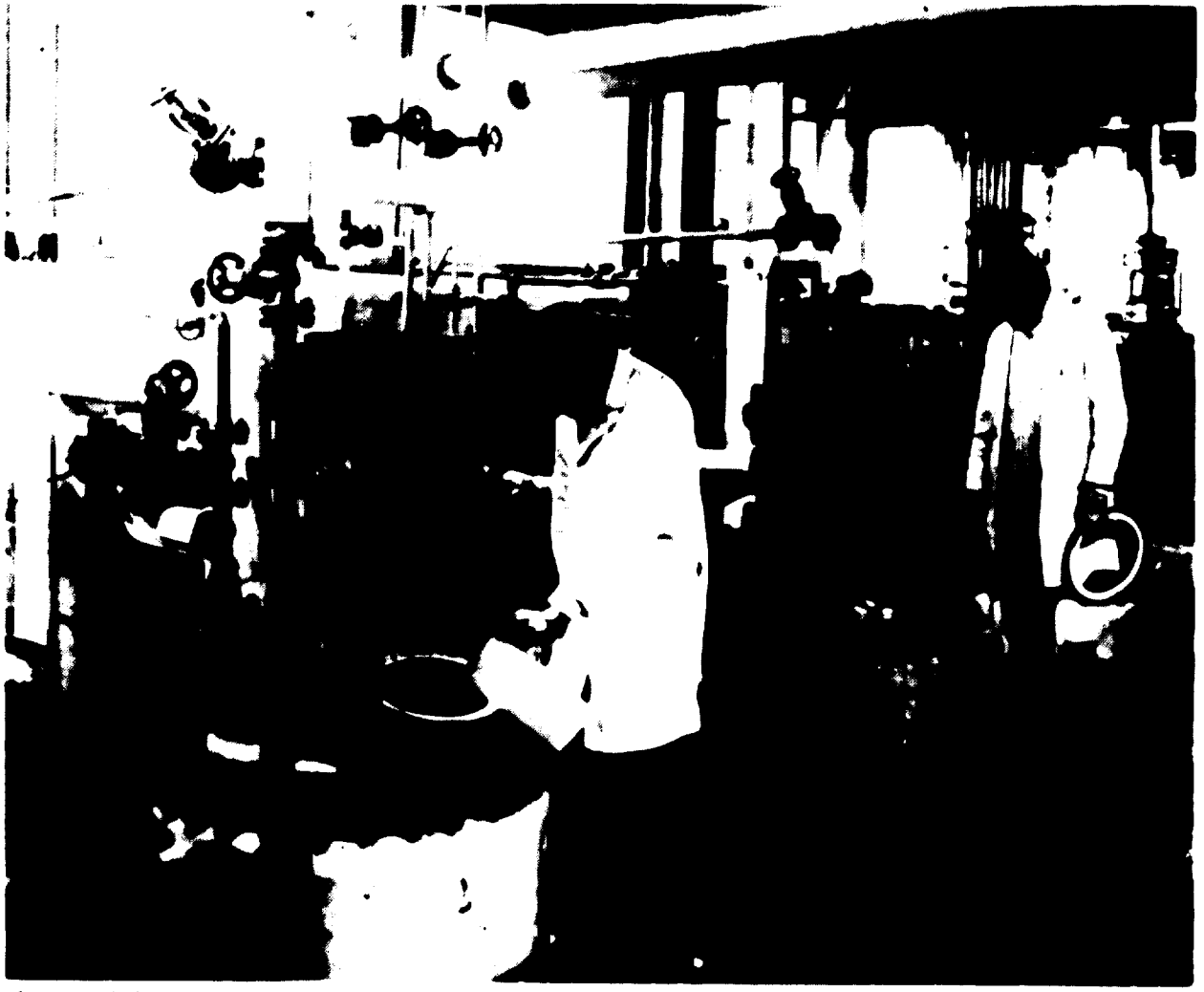
Instrumentation

Electronic navigational aids
Medical, surgical, ophthalmic instruments
Laboratory and scientific measuring equipment
Hand power tools
Video equipment
Process control equipment
Computer peripheral equipment

Engineering and electronics

Environmental control equipment
Office equipment
Commercial and institutional food-service equipment
Supermarket and retail accounting equipment
Automobile parts and accessories
Security devices
Mechanical and hydraulic handling equipment

Opposite: ***Employee at a chemical corporation at Ringaskiddy, County Cork, stitches up a bag before shipment.***



Pharmaceutical company (with American interests) at Swords, County Dublin. Production started in 1964.

Other products

Industrial ceramics and refractories
Adhesives
Bonded fabrics
Sports and leisure equipment
Pleasure boats
Educational and teaching products

Research into priority industrial sectors is only the beginning of a complex process of identification and selection of new industrial investment possibilities. From industrial sectors, the process leads to industrial companies which are established as leaders in the various priority product areas. These companies are researched and rated on the following indicators of interest to the Industrial Development Authority

- Commercial soundness, as measured by general growth and profitability record;
- Growth potential, as indicated by the company's present strategic position for market growth and its possible effectiveness in exploiting this position;
- Production-capacity pressures in the company;
- Ability of the company to fund new investments;
- Pressures in the company towards locational mobility;
- Historical policy of the company in responding to advantages of new locations for investment.

The sifting of industrial companies on these criteria is a long and laborious process. A recent search in a certain product area started with 21,000 companies, was reduced to 3,325 after elimination of companies employing less than 100 employees, and yielded 1,235 candidate companies after screening on the above criteria.

International marketing

The emergence of candidate companies from the research and selection process provides the basis for international marketing activities by the Industrial Development Authority. The focal element in these activities is direct approaches to selected companies with specific proposals for location of their investments in Ireland. Such proposals are in effect "intercepting" on-going investment planning in candidate companies, since each company has been selected with an eye to the pressure which its growth performance is putting on existing production capacity and which may be leading the company to new decisions on new locations for its activities. This is a vital outcome of the selection effort, namely, the channelling of the Industrial Development Authority's scarce marketing resources to where investment planning by industrial companies is at critical stages and, therefore, where the benefits of locating new investment projects in Ireland are likely to be most relevant and attractive.

The Industrial Development Authority's marketing presentations to industrial companies typically cover three areas of interest:

- The physical environment and services for industry in Ireland;
- The general economic and monetary factors affecting industrial investment in Ireland;
- Industrial Development Authority financial incentives and their incorporation in a financial model of a general or specific investment proposition.

The country's main selling point is that, in relation to most other European industrial locations, it has plentiful supplies of trainable labour, an effective training system embracing the Industrial Training Authority, regional technical colleges and local vocational schools, infrastructure, and transport and communication services. With growing congestion in other industries, these advantages of themselves give Ireland an increasing competitive edge as a base for European industry.

It is important to emphasize to overseas industrialists that Ireland is a very strong monetary region in relation to many other countries, and that there is totally free transfer of capital and profits in all foreign currencies between Ireland and elsewhere.

It can be said that the combination of Industrial Development Authority incentives and Ireland's membership of the European Economic Community (EEC) puts industrial companies in Ireland at a unique advantage as producers for European markets.

Joining the EEC

Ireland became a member of the EEC on 1 January 1973. The country's negotiators with the Commission for the European Communities, however, agreed to a special protocol which recognized Ireland as a developing region within the Community. The protocol recognized in particular that the application of the Articles of the Rome Treaty, which deal with State aids, "must take account of the objectives of economic expansion and the raising of the standard of living of the population".

Ireland has been allowed to continue to operate the Anglo-Irish Free Trade Agreement, which gives Irish industrial exports duty-free access to the United Kingdom market of 55 million persons. The combination of the Industrial Development Authority incentives and EEC membership will therefore give manufacturers in Ireland a unique advantage as producers for the European markets. It will provide non-European countries with an attractive manufacturing location in Europe. It will provide EEC companies with a base from which they can export back into the EEC, duty free and tax-free, while at the same time taking advantage of the surplus labour situation in Ireland.

Though offering very attractive incentives, the Authority's international marketing activities must face substantial and intensifying competition from other countries in Europe. Most countries within the enlarged EEC will be competing for new industrial projects to be located in their less-developed regions, although a "ceiling" has been placed by the EEC on grant incentives to industries in the general regions of the Community.

Despite increasing competition, the research, planning and executive effort that is devoted to new industrial development by the Industrial Development Authority should put Ireland in a strong position to attract the kinds of new industries that best suit the country's development needs. Provided the general international and domestic economic climate does not deteriorate, there is every likelihood that, as a member of the enlarged EEC, Ireland will make rapid progress towards meeting these needs. ●

Evaluation of Electrical Measuring Instruments in India

The electrical measuring instrument industry in India is composed of many small companies which lack design, development, environmental testing, and tooling facilities. To assist in overcoming these handicaps, the United Nations Industrial Development Organization (UNIDO), the United Nations Development Programme (UNDP) and the Indian Government founded the Institute for Design of Electrical Measuring Instruments late in 1968. Pending the construction of a new, permanent building, it had temporary quarters in the Small Industries Service Institute, in the Saki Naka section of Bombay.

Plans were made immediately for the establishment of design training courses, the installation of machine tool facilities, and the establishment of laboratory standards for electrical measurements; and orders for equipment were placed.

Commencing with the instrument industry, information was obtained on individual companies and their needs. Lectures were given and consultation made available on instruments and problems of instrumentation.

Today, the Institute has a fine instrument calibration and testing laboratory; machine tools are being used to build tools and prototypes; and it has an almost full complement of technical experts, Indian counterpart staff, and administrative personnel.

Technical information published by the Institute's experts shows much concentrated effort and discernment in the subject-matter covered.

A group of trainees in instrument design are attending 18-month, full-time lecture courses at the Institute. They are also participating in design work for projects sponsored by instrument manufacturers. The trainees, all technical college graduates, are given a small stipend during their training period.

During the course of a lecture tour organized recently by the Institute, in the Bombay, Hyderabad, Madras, and Ambala areas, where most of the instrument manufacturing is concentrated, 27 illustrated lectures on instrument principles and the various phases of design were attended by instrument manufacturers and experts, as well as trainees.

Lectures on instrument taut-band suspension were given prominence, and the very active question-and-answer periods that followed the lectures gave evidence of the intense local interest in this subject. Although it has met with wide acceptance in the United States of America and Europe, taut-band suspension is a relatively new concept in India and much information is needed regarding it. Previously, electrical instrument moving systems rotated in polished pivot and jewel bearings and required spiral control springs to provide a counter torque. In the new design, the moving system is supported by two flat metal bands under tension. These bands also provide a controlling torque and electrical connexion to a moving coil. Pivots, jewels, springs, and spirals are eliminated and, as they are free from friction, the instruments operate with greater sensitivity and measure lower current values. The advantages of such a system can be seen quite readily but since the bands are very fine (one half to two thirds the diameter of a human hair) great care must be exercised in designing the instrument. When properly designed, however, it will withstand very heavy impact and vibration.

The building of the permanent headquarters of the Institute is proceeding slowly, but work on the foundations has at least been started. ■

The author: *R. M. Rowell, an instrument consultant, was Project Manager and Chief Adviser to the Institute for Design of Electrical Measuring Instruments during its first year of operation. He has also served as consultant to the Institute.*

Opposite: *Temporary quarters of the Institute for Design of Electrical Measuring Instruments at the Small Industries Services Institute building in Bombay.*

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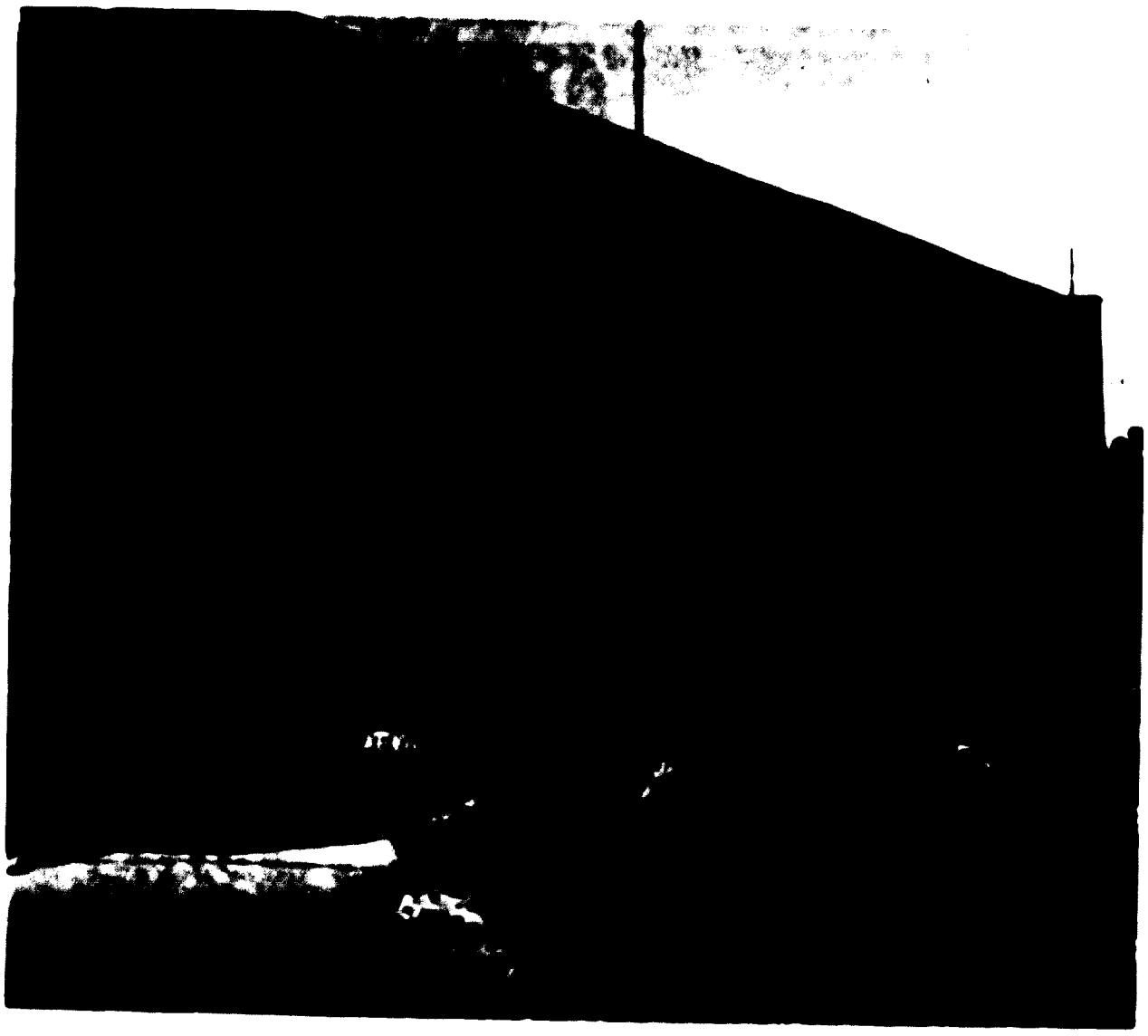

New Processes and Products

Protective gas furnaces developed for brass-annealing process.

New pollution-free brass-annealing process

In contrast to copper, steel and other metals, brass is still annealed by the recrystallization process. This leads to surface oxidation, which has to be removed by subsequent pickling. The pickling, in turn, results in losses of copper and zinc, the two elements used in the production of brass, and in the contamination of considerable volumes of water.

All this has now been changed by an industrial furnace producer in Austria who has designed an annealing process that uses protective gas instead of air and thus avoids surface oxidation. The new technique is suitable for various semi-finished brass goods, such as drawn wire, cold-rolled strip, and drawn tubes in bundled form. The protective-gas furnaces (illustrated above) can be fired by either electric current or gas. An important advantage of the new process is the low cost:

it is claimed that the cost of a bright-annealing plant for brass products is only half that of a conventional unit using pickling equipment.

Patents for the new process are pending.

EBNER-Industrieofenbau, Josef Ebner, P O. Box 345, A 4021 Linz, Austria.

Bacteria purify metals

A new process for the treatment of spent pickle liquor from iron ore processing plants avoids the problems associated with handling large quantities of precipitated material. It is claimed that a very pure form of iron can be recovered from the regenerated acid. The process is unusual in that it uses the micro-organism *Thiobacillus ferro-oxidans* to oxidize ferrous iron in the spent liquor to ferric salts. Microbial leaching of ore dumps is now practised on a wide scale in Australia.

D. T. Lacy and F. Lawson, Monash University, Clayton, Melbourne, Victoria 3168, Australia.

Latex for roads

Creamed skim latex is most effective for road-making, but field latex may be more suitable for this purpose in the natural-rubber producing countries. Experimental stretches of road surfacing laid with bitumen containing up to 4 per cent field latex have yielded excellent results.

J. J. Fernando and M. Nadarajah, Public Works Dept., Research Institute, Ratmalana, Sri Lanka.

Water pump for developing countries

A hand-operated water pump suitable for manufacture and use in developing countries has been built. Reportedly rugged and easy to maintain, the pump is suitable for either shallow or deep well installation with only minor changes and can be manufactured with a minimum of capital investment. It has design features that discourage pilfering and vandalism.

D. W. Frink and R. D. Fannon, Jr., Battelle Memorial Institute, Columbus Laboratories, 505 King Avenue, Columbus, Obio 43201, United States of America.

Bamboo-reinforced concrete

Rectangular concrete beams reinforced with pre-soaked split bamboo (about 3.5 per cent) are capable of developing over four times the ultimate load-carrying capacity and flexural strength of un-reinforced beams with identical cross sections. The principal problems associated with bamboo reinforcement are volume changes (swelling and shrinking) due to moisture variations, low bond strength, and, possibly, decay. When special precautions are taken in preparing and placing the culms (splitting, pre-soaking, coating etc.), these problems can be minimized.

Helmut G. Geymayer, Assistant Professor of Civil Engineering, Technische Hochschule, Graz, Austria.
Frank B. Cox, Research Civil Engineer, Concrete Division, United States Army Engineers, Waterways Experiment Station, Vicksburg, Mississippi.

Bamboo chipboard

Flat sheets and roofing material for low-cost housing construction have been produced from chips of bamboo. The chips are pulped under steam pressure and treated with a 20-per-cent sodium hydroxide solution and a slurry of cement. The pulp is pressed into shape and allowed to set.

Director, National Building Organization, Regional Housing Centre for ECAFE, Niman Bhawan, Maulana Azad Road, New Delhi, India.

Building blocks

Rice-hull ash has been used in the successful manufacture of hollow cement blocks in a process developed in Iran. Used for composite roof construction, these blocks weighed half as much as normal concrete blocks and could be made for 50–75 per cent of the cost. The required capital investment is reported to be sufficiently low to enable the rice factory owner or any other interested party to undertake block manufacture.

T. Amirsoleymani, Director of Industrial Research, Civil Engineering Laboratory, Institute of Standards and Industrial Research of Iran, Karaj, Iran.

Wood wool

Wood wool is another building product that is suitable for conditions in developing countries. It is made from timber, which is stranded, soaked in a fluid containing cement, and moulded into slabs under slight pressure. The process is based on the availability of cheap, fast-growing timber (often one that has no other uses). A catalogue of suitable timber species and information on binders other than Portland cement has been assembled. The slabs may be used in roofing, partition walls and ceilings.

A. Chittenden, Chief Experimental Officer, Tropical Products Institute, Ministry of Overseas Development, Culham, Abingdon, Berkshire, England.

Boards from straw . . .

Building boards made from waste cereal straw may become competitive with conventional wood-particle boards in both price and quality. A new process developed in Denmark makes both lightweight board for insulating materials and heavy boards strong enough for walls and flooring.

S. Federiksen, Director, Research Institute for Commercial and Industrial Plants, Holbergsvej 10, DK-6000 Kilding, Denmark.

. . . and paper from straw

A process for producing paper from straw has also been developed. Paper samples produced by this process are now undergoing comparative testing with conventional papers.

D. O. Chilcote, School of Agriculture, Oregon State University, Corvallis, Oregon 97331, United States of America.

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Readers requiring more information about products or services mentioned in this column should write direct to the individuals or companies concerned.

UNIDO PROJECTS

Singapore was the venue of a two-week seminar on the Stimulation of Industrial Research in Developing Countries, which took place from 21 November to 2 December 1972. The seminar was organized by the United Nations Industrial Development Organization (UNIDO) in co-operation with the Government of Singapore and the Singapore Institute of Standards and Industrial Research (SISIR). Its main objective was to bring together executives of industrial research organizations, representatives of the business sectors interested in industrial research results, and government officials involved in planning industrial research activities. The participants discussed practical matters relating to industrial research and provided a forum for the exchange of experience among the participating countries.

Five immediate objectives were agreed on:

1. Establishment of an industrial information system to promote industrial research and development activities;
2. Training of senior personnel for research and development management;
3. Training of technical personnel for industrial research and development activities;
4. Strengthening of liaison among organizations engaged in industrial research and development;
5. Creation of appropriate machinery for translation of research and development into industrial practice.

The need for follow-up action was stressed and Governments of the participating countries were urged to promote the implementation of the objectives. UNIDO, in collaboration with other relevant organizations and parties, was also asked to ensure their effective implementation. Securing the support of the United Nations Development Programme (UNDP) and other funding agencies was seen as a major step towards the achievement of the objectives.

Field visits to industrial research and development establishments and industrial enterprises in Singapore and in Kuala Lumpur were conducted during the seminar to acquaint the participants with the situation prevailing in that part of the Far East.

Learning to tap a rubber tree.

Industrial Inquiry Service

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

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

Information on mini steel plants and direct reduction has been requested by an inquirer in Pakistan. The specific questions together with the detailed replies supplied by an engineering and industrial consultant in the United Kingdom of Great Britain and Northern Ireland are given below.

What is an economic size for an integrated mini steel mill?

How small is "mini"? In the decade following the Second World War, an integrated iron and steel works based on blast-furnace iron-making and open-hearth steel-making at about 1 million ingot tons per annum was considered economical. In those days a single blast furnace capable of producing 1,500–2,000 tons/day was considered large. This concept has totally changed: nowadays, single blast furnaces produce 6,000 tons/day, others being built have a capacity of 8,000 tons/day, and projects exist for furnaces with capacities as high as 11,000 tons/day. Similarly, the modern basic oxygen furnace (BOF) can produce 300 tons or more of steel in 40 minutes, compared with an open-hearth (OH) furnace of the same capacity, which required 8 to 9 hours per heat.

Apart from economies of scale arising from such fundamental advances in process units, the economics of steel-making rest upon the ability to assemble high-grade raw materials at the lowest cost at a point close to the markets to be served. Thus, transport cost is a major element. In practice, any decision to construct involves a series of compromises, because rich iron ore and high-grade coking coal are seldom found together; and rich iron ore, in particular, is generally found in remote places. However, with the advent of very large bulk sea carriers, i.e. ships of 100,000 to 150,000 dead weight tons, transport costs have diminished somewhat.

All these factors have assisted the evolution, in the past decade, of very large integrated plants on sites near deep water harbours. The annual capacity of such plants is seldom less than 3 million tons/year and they are usually designed for later expansion up to at least 5 million tons/year. Plants currently projected or under construction are designed for ultimate development to 12 million tons/year, after which level the economies of scale begin to diminish.

A further, most important point in this evolution is the fact that the open-hearth furnace was normally a large consumer of steel scrap. Proportions of scrap to pig iron (cold or liquid) varied according to circumstances, but 85 per cent scrap in the furnace charge was normal. By contrast, the BOF is not a large consumer of scrap. Some scrap (or iron ore or pellets) is necessary in the process for cooling the molten metal and this can vary

from 29 per cent (the average in the United States of America) to about 15 per cent (in at least one plant in Japan). A fair average is 20–25 per cent. In a steel works with a typical over-all yield of 80 per cent liquid steel delivered as finished product, there will normally be 20 per cent scrap circulating within the steel works itself. Thus, the average steel works operating the basic oxygen steel (BOS) process will only have to buy in marginal quantities of scrap.

This factor has produced a radical change in the world steel situation. Today, some 40 per cent of the world's steel is being made by the BOS process and the proportion is steadily increasing as OH plants close down. What now happens to the world's quantities of scrap? That circulating in works will be used as explained above, but the large amounts of process scrap, e.g. from sheet press shops, and of capital scrap have to be consumed. It is this factor that has given the great impetus, in quite recent years, to electric arc steel-making, based on scrap as the principal raw material; and without much doubt, this development will continue. The arc furnace used to be the main means of producing alloy and special steels and of relatively small quantities of carbon steel for castings. Now it is an alternative method of bulk common steel production, using the economies of scale inherent in furnaces up to, say, 250 tons or so, with steadily increasing transformer ratings.

The modern hot strip mill can be designed to produce 4.5 million to 6 million tons/year. The smallest version available is capable of producing 1.5 million tons/year. It would not be economical to operate it at a lower output and the quality of product would not be as good as that from the high output mill. A modern plate mill will make 1 million to 3 million tons per year; 3 million to 5 million tons is desirable. It follows that wide, flat steel products fall within the ambit of bulk steel-making and are not really feasible on a small scale. The rest of this answer assumes that the inquirer would produce and sell "non-flats"; reinforcing bars; engineering bars; so-called "merchant products"; light sections; wire rods; narrow strip (up to 12 in. wide), or skelp for tube-making a strictly limited range of products that could be rolled on a single mill, with as much as possible of the investment utilized all of the time.

In this context, it may be seen that by today's standards a 1-million-tons/year plant, which used to be considered large, could now be called a "mini", but this is not what is generally understood by the term. The small blast furnaces employed by a plant of this size are no longer considered economical and while very large electric-arc melting plants may eventually reach this capacity, they have not done so yet. In the United States of America, more than 40 mini-plants have been built within the past 10 years. Of these, 8 have a capacity of 50,000–100,000 tons/year; 17 can produce 100,000–150,000 tons/year; 7 lie between 150,000 and 200,000 tons/year, and 6 produce 300,000–400,000 tons/year each.

What then are the criteria? In roughly comparable situations, iron ore can be converted into steel *via* the BF–BOS route for about $US 8.75 per ton less than the cost of converting scrap into steel *via* the electric-arc route. This figure will vary, of course, with the cost of electricity, quality of iron ore and so on. The BF-BOS steel must, however, be made in bulk at a single location and this inevitably means that the cost advantage will be progressively lost as the finished product is delivered over increasing distances.

Industrial Inquiry Service (continued)

Conversely, it becomes important for the competitive economy of a small electric-arc plant that its owner should not have to incur a cost penalty due to having to transport scrap, his main raw material, over long distances. Proximity to a local market is equally important for the same reason.

Although the economic size of a mini steel plant of the kind described could hardly be less than about 50,000 tons/year, its actual size will depend mainly on the tonnage of scrap estimated to be regularly available within a radius of, say, 200–250 km and upon the estimated size of the market within much the same radius. Many other factors can only be assessed by a feasibility study, e.g. cost and availability of power, quality of scrap and competition for it, cost of collecting and transporting scrap, and infrastructure costs.

What would be the approximate cost?

So much depends upon the type of plant adopted, its location, infrastructure costs and so on, that it is impossible to be precise. Experience suggests that $US 75–100 per annual ton of finished product from scrap to finished bar is a fair figure. This envisages electric-arc steel-making and the use of a small continuous-casting machine, followed by a relatively simple bar mill. The degree of simplicity will affect the cost appreciably. In general, the capital cost per ton of capacity will decline slightly with an increase in size. Perhaps at this stage, $US 100 per annual product ton should be taken as a figure for rough calculation, although it may well be possible to do it for less. Thus, a 100,000 tons/year plant might cost about $US 10 million.

What would be the approximate power requirement?

It is assumed that:

(a) 100,000 tons/year scrap are melted, giving a finished product output of about 80,000 tons/year (80-per-cent yield);

(b) The scrap is melted during off-peak hours, mostly at night, in order to negotiate the most favourable power tariff;

(c) Two furnaces are used, in order that one can be melting (at full power) while the other is refining (at reduced power) or tapping (at very little power). In this way, the maximum demand can be kept relatively low;

(d) Whereas modern high-power furnaces require transformer capacity of about 0.6 MVA per ton of rated furnace capacity, in this typical 100,000 tons/year operation low-power furnaces requiring transformer capacity of about 0.4 MVA per ton would be installed initially.

Thus, a furnace, operating 14 hours per day, 6 days a week, for 50 weeks a year, would give 4,200 available hours a year. An allowance of 15 per cent for downtime (relining, repairs etc.) brings the total to 3,570 hours. Assuming an average tap-to-tap time of 3.5 hours, each 50-ton furnace would produce approximately 50,000 tons/year. Two furnaces, therefore, would melt 100,000 tons/year.

A 50-ton furnace with a transformer capacity of 0.4 MVA per ton will require 20 MVA. It is not, of course, necessary to double this figure when two furnaces are used, because only one of them will be melting at a time. The other will require much less power at the refining and tapping stages. Some allowance must, of course, be made for this factor and

also for the probability that the rolling mill will be operating during part of the day when one furnace is melting. This will depend to some extent on the type of mill installed. Allowances must also be made for the relatively small demand for works services.

A substation capacity of 27.5 MVA would be a reasonable figure to take at this stage for a rough estimate of the power supply in a particular locality. If a furnace operation of more than 14 hours a day is practicable, at reasonable cost, the furnace size can be reduced for a given annual output, with a lower transformer capacity.

Operation for 20 hours a day, 6 days a week, 50 weeks a year with only 10 per cent downtime, gives a total of 5,400 operating hours a year. A 40-ton furnace, averaging 3.5 hours tap-to-tap time, could yield 62,000 tons/year. A 50-ton furnace operating on the same basis could produce 77,000 tons/year.

If, by increasing the transformer rating, the average tap-to-tap time can be reduced to 3 hours, then a 40-ton furnace operating 5,400 hours a year could produce 72,000 tons/year. A 50-ton furnace operating on the same basis could produce 90,000 tons/year.

A 40-ton furnace with a transformer capacity of 0.4 MVA per ton would require a peak supply of 16 MVA or, say, 20 MVA for the whole plant.

In large industrial conurbations backed by extensive grid systems, it may be possible to accommodate 20 to 35 MVA of maximum demand without seriously disrupting the over-all supply pattern. In some areas of developing countries, the position may be quite different, however, and if 20 MVA or so can be accommodated without a major increase in the supply system, it may only be possible for a limited number of off-peak hours per year.

It is usually necessary to balance the cost of relatively low furnace utilization against the cost of power in particular situations, and some compromises have to be accepted. It is advisable, as a first step, to inquire into the cost of providing 27.5 MVA capacity on the one hand, or 20 MVA on the other. The reply will influence the decision on the type and size of plant to install.

Is the process to reduce iron ore by the use of natural gas fully established?

Yes, without a doubt; but it is necessary to distinguish between what is possible and what is economic. There are three important points to consider:

First, direct reduction of iron ore by natural gas is only economic where rich iron ore and cheap natural gas are freely available in proximity to one another. It is possible to produce a similar reducing gas by reforming naphtha, but in most cases this would increase the eventual liquid steel cost by about 12 per cent.

Secondly, the existing natural gas direct reduction plants are relatively small in scale, having capacities ranging from 250,000 to 400,000 tons/year. For engineering reasons, larger individual units are not practicable, so greater output must be achieved by multiplying units. Thus, in contrast to the blast furnace, there is little scope for economies in scale.

Thirdly, whereas the blast furnace delivers liquid iron suitable for BOS steel-making, all the direct reduction plants using gas or solid reductants produce a solid product, usually known as sponge iron, in the form of reduced briquettes. Sponge iron may be 97 per cent metallized, but it is still solid and has to be melted in an electric arc furnace for conversion to steel. The existing plants also use scrap in the arc furnaces, ratios depending mainly on availability and on the cost of scrap relative to sponge; 50:50 seems to be average. ■

Meetings

1974

Eleventh Annual Solid State Physics Conference

Manchester, 2–4 January. The Meetings Officer, Institute of Physics, 47 Belgrave Square, London, SW1X 8QX, England.

International Congress of Artisans and Small Manufacturers

Israel, 13–19 January. Organizing Committee, International Congress of Artisans and Small Manufacturers, P.O. Box 16271, Tel Aviv, Israel.

Technical Association of the Pulp and Paper Industry 1974 Annual Meeting

Miami Beach, Florida, 14–16 January. Mr. W. L. Cullison, Director, Technical Operations, One Dunwoody Park, Atlanta, Georgia 30341, United States of America.

American Society for Testing and Materials Committee Week

New Orleans, Louisiana, 14–18 January. Ms. Joan McFadden, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103, United States of America.

ASCE National Water Recources Engineering Meeting

Los Angeles, California, 21–25 January. Mr. E. Zwoyer, Executive Director, American Society of Civil Engineers, 345 E. 47th Street, New York, N.Y. 10017, United States of America.

Canadian Pulp and Paper Association (Technical Section) Sixtieth Annual Meeting

Montreal, 29 January–1 February. Mr. R. A. Joss, Manager, Technical Section, Canadian Pulp and Paper Association, 2300 Sun Life Building, Montreal 110, Canada.

Canadian Ceramic Society Annual Meeting and Convention

Montreal, 29 January–1 February. Mr. H. L. Taylor, Secretary, Canadian Ceramic Society, 2175 Sheppard Avenue E., Suite 110, Willowdale, Ontario, Canada.

77th National Western Mining Conference and Exhibition

Denver, Colorado, 7–9 February. Mr. D. R. Cole, Manager, Colorado Mining Association, 402 Majestic Building, 209 16th Street, Denver, Colorado 80202, United States of America.

Third International Packaging Exhibition and Technical Conference (Swisspack)

Berne, 12–16 February. Swiss Industries Fair, Postfach 4021, Basel, Switzerland.

Forage Research Industry

Shreveport, Louisiana, 25–27 February. Mr. F. C. Pifer, American Forage and Grassland Council, Box 48, State College, Pennsylvania 16801, United States of America.

American Institute of Mining, Metallurgical and Petroleum Engineers 103rd Annual Meeting

Dallas, Texas, 25–28 February. Mr. A. R. Scott, Conference Manager, American Institute of Mining, Metallurgical and Petroleum Engineers, 345 E. 47th Street, New York, N.Y. 10017, United States of America.

Symposium on Strength of Glass and Glassware

Brighton, 25–27 March. Mr. D. Hawksworth, Society of Glass Technology, Thornton, 20 Hallam Gate Road, Sheffield S10 5BT, England.

International Ferro-alloys Congress (INFACON 74)

Johannesburg, 22–26 April. The Secretary, Organizing Committee, INFACON 74, Private Bag 7, Auckland Park, South Africa.

Sixth Annual Offshore Technology Conference

Houston, Texas, 5–8 May. Mr. S. Houston, Offshore Technology Conference, 6200 N. Central Expressway, Dallas, Texas 75206, United States of America.

Design Engineering Conference and Show

Chicago, Illinois, 6–9 May. Mr. A. B. Conlin, Jr., Director, Technical Departments, American Society of Mechanical Engineers, 345 E. 47th Street, New York, N.Y. 10017, United States of America.

ACS Rubber Division 105th Meeting

Toronto, Canada, 7–10 May. Mr. H. W. Day, E.I. duPont de Nemours & Co., 140 Federal Street, Boston, Massachusetts 02110, United States of America.

Friction, Wear and Lubrication

Slough, 16 May. Meetings Officer, The Institute of Physics, 47 Belgrave Square, London SW1X 8QX, England.

American Society for Quality Control 28th Annual Technical Conference

Boston, Massachusetts, 20–22 May. Mr. R. W. Shearman, Executive Director, American Society for Quality Control, 161 W. Wisconsin Avenue, Milwaukee, Wisconsin 53203, United States of America.

Annual Engineering Conference

Newcastle (Australia), 20–24 May. The Secretary, Institute of Engineers, 157 Gloucester Street, Sydney, Australia.

Eighth International Ceramic Congress

Amsterdam, 27 May–1 June. Vereniging Klei Industrie, Haagweg 139, Rijswijk, Netherlands.

41st International Foundry Congress

Liege, 9–14 June. Association Technique de Fonderie de Belgique, Sint Pietersnieuwstr. 41, 9000 Gent, Belgium.

International Conference on Production Technology

Melbourne, 19–21 August. The Secretary, Institute of Engineers, 157 Gloucester Street, Sydney, Australia.

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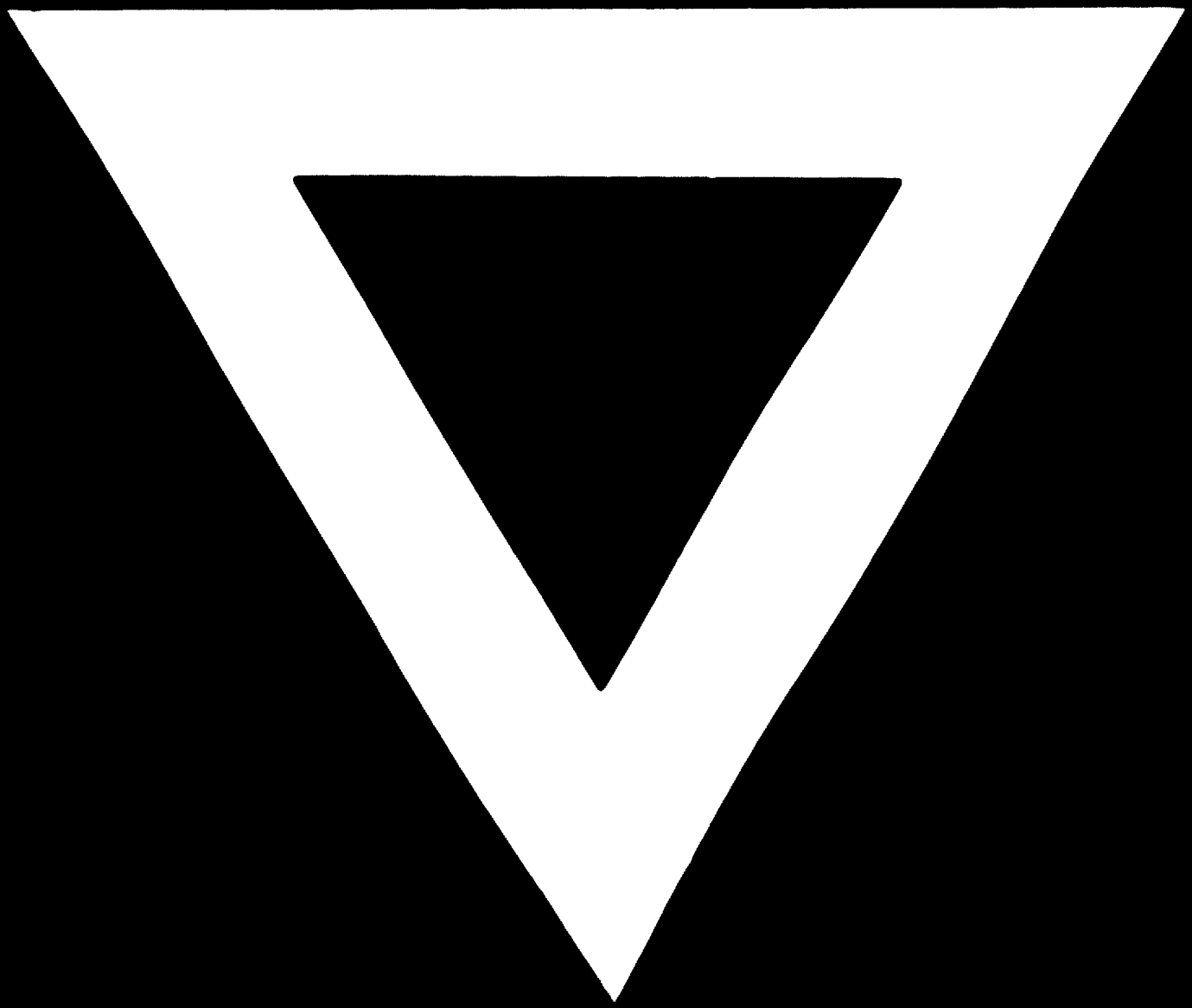

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