OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

D01669

Industrialization of the Coconut in the Philippines

By Canuto G. Manuel, Commissioner,
National Institute of Science and Technology

The coconut, often called "the tree of life", is truly useful from its roots to its leaves. The National Institute of Science and Technology (NIST) in the Philippines has carried out a series of research projects aimed at utilizing several parts of the coconut tree which were formerly wasted. Two projects had particularly successful results.

Chemical pulping of coconut leaves

The Philippines is one of the major coconut-producing countries in the world. Statistics from 1960 indicated that there were already 167 109 000 fruit-bearing trees planted over 91 427 acres throughout the country.

The industrial potential of the coconut was enhanced by the recent discovery that its dried fallen brown leaves and those about to fall can be utilized for pulp and paper manufacture. Studies have also shown that an average of twenty-four leaves fall per year, at a rate of approximately two per month. An insignificant number of them are used by the farmers as fuel, but most are left to rot on the plantation. The utilization of these leaves not only provides additional income to those engaged in coconut production, but also represents an important technological achievement.

A recent survey of a 43 000-acre coconut plantation in Quezon Province in eastern Luzon showed that approximately 315 metric tons of coconut leaves could be gathered daily. If the pulp yield, as earlier laboratory studies have shown, is 35 per cent of the weight of the leaves harvested or gathered, then it could be expected that about 110 tons of pulp could be produced daily from the 315 tons of leaves.

With financial assistance from the National Science Development Board, the Industrial Research Centre of NIST undertook in 1964 to scientifically investigate fallen leaves—as well as those about to fall—and other fibrous parts of the coconut tree as potential sources of paper pulp materials. A team composed of two chemists, two chemical engineers, a mechanical engineer and a technician were assigned to the project.

Research has been divided into the following phases: (*a*) extensive chemical analysis of the whole leaf, i.e., the leaf blade, midrib and petiole; (*b*) studies and chemical testing of resulting pulp to determine the most suitable digestion methods and conditions for producing different qualities of pulp, ranging from coarse to bleachable grades; (*c*) pilot plant studies on the economic feasibility and product quality for the commercial manufacture of pulps; and (*d*) profitability studies, engineering development and equipment design for commercial production.

Present status of research. Although no study has previously been made on the pulp potential and pulp quality of coconut leaves, some analytical studies have been undertaken on the calcium, magnesium and potassium content of the leaves, which were mainly directed to determining the rate of absorption of plant nutrients in the cultivation of the coconut trees.

To date, the whole leaf--leaf blade, midrib and petiole—is being analysed for (*a*) moisture content; (*b*) solubility in ether, alcohol-benzol, hot water, hot water after extraction with alcohol-benzol, cold water and dilute alkali; (*c*) total cellulose content including lignin, pentosan and (*d*) ash content. This analytical phase of the research project is being undertaken by the chemical research laboratory of NIST. Preliminary results show that the cellulose content of the whole coconut leaf is 32.25 per cent; leaf blade, 29.90 per cent and petiole, 31.98 per cent. The data on this phase, however, are being rechecked and evaluated.

Equipment. To aid researchers in their quality control studies, a small rotary digester was designed by the engineering research and development laboratory of NIST and manufactured locally. The rotating autoclave consists of a steam-jacketed cylindrical digester body, with provisions for direct steaming, and a frame with an electric motor drive. The digester rotates at 2 rpm and is equipped with pressure gauge, thermometer and safety valve.

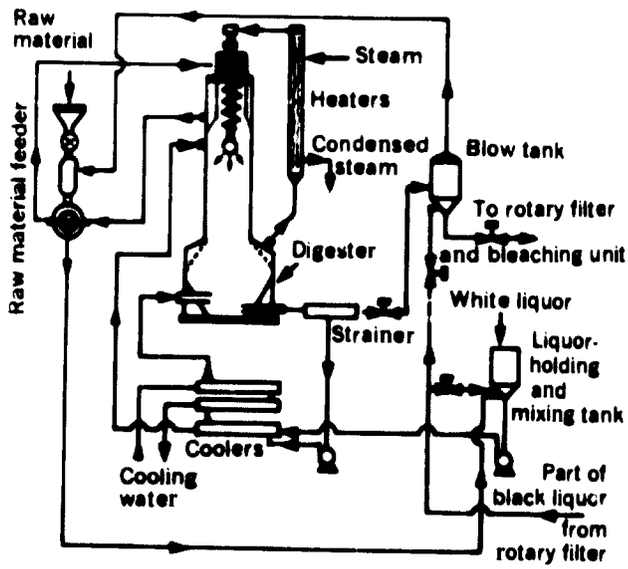
Of special interest to plup and paper researchers and manufacturers is the design of a versatile and flexible screw-type digester (capacity 1 kg./hr. of unbleached pulp and 3.125 kg./hr. of raw material). Patterned after the KAMYR pulping equipment presently being used in the United States and other industrialized countries, the design provides for a two-stage low-power process involving treatment with a relatively strong alkaline agent of very finely chipped or crushed materials, and subsequent defibering by chemical action.

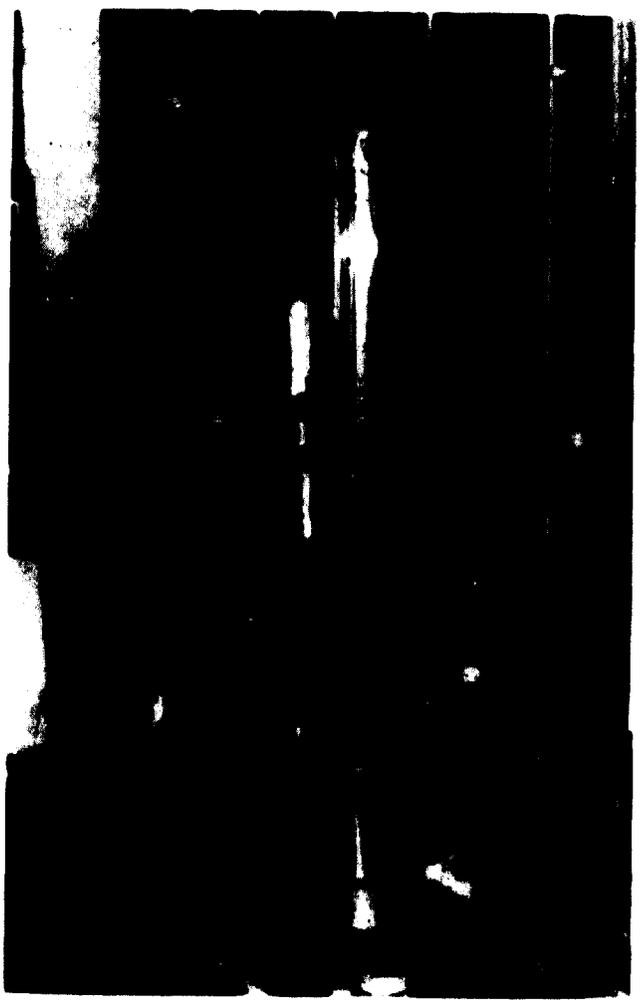
This continuous pulp digester unit is being constructed at the Industrial Research Centre engineering shop and is nearly 80 per cent completed. The setup for this process is illustrated in the flow sheet.

The principal components of the screw-type digester are the digester tower, liquor beaters and coolers, raw material feed assembly, black liquor and white liquor pneumatic pumping tanks, and a pulp blow tank with strainer. Regulators are provided to adjust and control the rate of feed, travel and pressure in the digester, and the liquor delivery rate. External electric heaters raise the temperature of the circulating liquor inside the digester up to 350° F. Prior to discharge from the digester, coolers and heat exchangers lower the temperature of the pulp and its black liquor to 150° F.

The flow sheet also illustrates the continuous movement of materials to and from the digester tower. Movement of liquors is by controlled compressed air requiring an outside supply of 200 psig (pound per square inch gauge) at 5 cfm (cubic feet per minute).

Process flow-sheet of a continuous pulp digester unit





Fractional distillation of coconut fatty acid esters into component fractions, one of the research projects of NIST.

The screw-type digester can be employed to process any type of fibrous material producing a variety of grades of pulp under varying conditions—pulp which can replace higher priced ground-wood pulp or chemical fibre.[1]

Coconut water vinegar

Vinegar can be produced by combining yeast with starchy and sugary materials, such as banana, pineapple, orange or coconut water, which results in their subsequent acetic fermentation.

By determining the suitability of sugar-enriched coconut water for vinegar manufacture, the Biological Research Centre of NIST found a means of limiting the bulk waste product of the country's copra industry.

Selected strains of *saccaromyces* and acetic acid bacteria were used for the alcoholic and subsequent acetous fermentation. Conversion of the sugar into alcohol requires four to seven days. Transformation of the alcohol, including ripening of the vinegar product for the development of sweet aroma and flavour, takes four to six weeks. Enrichment of coconut water with 15 per cent sugar yields quality vinegar containing 6 per cent acetic acid.

Coconut water vinegar for use as a culinary and table condiment or a component in pickling may now be prepared by housewives and produced on a commercial scale in cottages in rural areas where coconuts are abundant.

The simple procedure developed by NIST for vinegar making is as follows:

Materials. Coconut water, sugar, Fleischmann's dry yeast pellets or wine yeast, mother vinegar,[2] demijohns or any suitable receptacle.

Alcoholic fermentation. Dissolve 1.5 kilogrammes of sugar in enough coconut water to make 10 litres of solution. Pasteurize by heating at 65°C for twenty minutes, cool and add 3½ tea-spoons of Fleischmann's yeast or inoculate with wine yeast. Cover the container with a piece of clean cheese-cloth which was previously boiled in water for at least twenty minutes. Allow the sugar solution to ferment from four to seven days or until no more bubbles of carbon dioxide are formed. Strain the liquid through a clean cheese-cloth to remove the yeast and other solid materials. Pasteurize the alcoholic liquid and allow to cool.

Acetic acid fermentation. Using the alcoholic solution prepared in accordance with the above procedure, add two litres of mother vinegar. Set aside undisturbed for one month or until maximum sourness or acidity is obtained.

For the development of the desirable aroma and flavour, allow the vinegar to age in barrels or earthen jars which are filled to capacity. Filter the vinegar and pasteurize to kill micro-organisms before bottling the product. If a clear vinegar is desired, clarify it by stirring with well-beaten white of two eggs and heating it until coagulation of the egg white takes place. The clear vinegar is obtained by filtration.

If it is developed into a home industry, vinegar production provides a profitable means of utilizing coconuts and thus increases economic prospects in rural areas.

---

[1] *Researchers:* Josefa Pesigán and Eduardo Serra.

[2] Wine yeast and mother vinegar may be obtained from the Biological Research Centre, National Institute of Science and Technology at 10 Philippine pesos per culture.

Research and Development Network in Czechoslovakia

The State Commission for Development and Co-ordination of Science and Technology

A general note on research and development

There is no generally accepted definition of "research and development". The entire process extends from the acquisition of basic scientific knowledge to its application in production, embracing the first idea and its final realization. It can be divided into any number of phases, but the division between these phases is hypothetical since they are always interconnected and sometimes merge.

The first phase is represented by fundamental research, aiming at new discoveries and at a deeper understanding of natural and evolutionary processes of society and human knowledge.

The second phase is applied research, where knowledge obtained through fundamental research is developed in a more concrete form, and methods are sought for its best application in society and more particularly in production.

The third phase is development, which translates results obtained in applied research into new products, techniques, processes and materials for producers operating under specific conditions.

General organization

The Research and Development Network (RDN) in Czechoslovakia, including the staff and financial management, is centrally directed, all of which is outlined in the national plan of development of science and technology.

The statutory basis of this unified system of research and development is Act No. 55 of 9 July 1963.

This Act clearly defines the scope of RDN, the manner of establishment of its functional units, the termination of phases of activities and other foreseeable organizational measures and changes.

The State Commission for Development and Co-ordination of Science and Technology acts as the central directing and co-ordinating Government agency. This Commission issues new regulations under the above-mentioned Act and, in general, directs and guides the development of the entire network. In addition it has the task of elaborating long-term policies of technical and economic development, which in turn serve as a basis for devising long-term national development plans.

The supreme agency in the field of fundamental research is the Czechoslovak Academy of Sciences (CSAS). In addition to its own research activities conducted by its various institutes, CSAS is also responsible for the methodological development of science in Czechoslovakia. The direction and development of science and technology in the different branches of the economy, however, is under the direct responsibility of the appropriate ministry and the central Government agency.

In 1964, as part of the over-all State plan, a system of funding science and technology was created to better provide for both the staff and material needs of RDN. The funds are listed as independent items in the respective sections of the State development plan and, as far as financial means are concerned, in the respective part of the State budget. These funds are earmarked to meet the expenses incurred in solving scientific and technological tasks at all levels, from central Government departments down to individual works. This State plan for financing RDN is compiled and presented to the Government by the Commission, which in turn allocates appropriate amounts to respective Government departments.

RDN consists at present of over 1 850 establishments, about 20 per cent of which have State budgetary support, with the rest operating as an integral part of industrial organizations. Plans have now been formulated to gradually concentrate industrial establishments into larger units.

RDN: A reflection of the national economy

Taking a national cross-section, the structure of RDN corresponds to the general structure of the national economy.

The most recent statistical surveys of the Network, done in 1962, indicate that two thirds of all employees were in industry, principally in machine building, which attracted 45 per cent of the total esearch and development capacity of the country (see *Table 1*).

Table 1. Structure of the Research and Development Network according to main sectors in 1962 (Thousands of employees)

Sector	CSSR*	Percentage of the total
Science	10.6	9.7
Industry	72.4	66.5
Building construction	3.7	3.4
Transportation & communications	1.5	1.4
Agriculture	11.4	10.5
Health services	5.6	5.1
Other	3.7	3.4
Total:	108.9	100.0

* Czechoslovak Socialist Republic.

Research and development network in industry

The share of the total operational cost of RDN, allotted to the individual sectors of industry, is shown below (see *Table 2*).

Table 2. Distribution of the total operational cost of RDN in industry in 1962

Sector		Percentage
Electricity and heat generation		1.5
Fuels and products from coal and oil		3.0
Ferrous metallurgy (including mining)		4.4
Non-ferrous metallurgy (including mining)		1.3
Machine-building & metal-working industries		68.9
Machine building	34.5	
Electrical engineering	15.2	
Transport equipment	11.6	
Precision instruments & optics	6.0	
Steel structures & metal products	1.6	
Chemical, rubber & asbestos industries		11.0
Wood-working industry		1.8
Pulp and paper industry		0.5
Glass and fine ceramics industry		2.2
Textile industry		1.8
Clothing industry		0.2
Leather, foot-wear & fur industry		1.2
Printing		0.4
Food industry		1.0
Building materials industry		0.8
Total:		100.0

Machine-building and metal-working industries had by far the major share of the research and development resources. Of this amount 50 per cent served machine building and 23 per cent electrical engineering.

The chemical industries, including rubber and asbestos, claimed second place. Basic chemical production represented two thirds of resources, and pharmaceuticals about one fifth.

The ratio of research and development in industry varies according to the nature of technological development in the particular branch (see *Table 3*).

Table 3. Structure of RDN according to the phases of the research and development process[a] (Percentage distribution of employees in 1962)

	Total	Research units[b]	Development units[b]	Pilot plants	Standards	TEI[c]	Other
Fuel	100.0	25.0	46.0	12.5	1.5	3.0	12.0
Power	100.0	7.0	55.0	8.5	1.5	17.0	11.0
Metallurgy	100.0	31.0	48.0	2.5	1.5	3.0	14.0
Chemistry	100.0	36.0	47.0	8.0	0.5	2.5	6.0
Machine building	100.0	9.0	71.0	5.0	2.0	2.0	11.0
Consumer goods industries	100.0	15.0	66.0	4.5	0.5	2.0	12.0
Food industries	100.0	30.0	57.0	—	1.0	4.0	8.0

[a] Refers to the entire RDN, including both independent and integrated R&D establishments.
[b] Only R&D establishments financed by the industry concerned are considered in this table.
[c] TEI = Technical and economic information.

In the fuel, metallurgical, chemical, consumer goods and food industries, where technical advance is of the greatest importance, the share of research was considerably larger than in machine building, where most of the activity is directed to developing new machines, equipment and instruments. By this definition, the power industry should logically belong to the first group. The data for the power industry, however, appear distorted because research and development in this branch are primarily concentrated in independent organizations, with only about 13 per cent being done by the industry itself. Since the total number of workers engaged in research and development in this industry is limited, even a small change in the structure has a great influence on the ratio per worker.

Training of scientific workers

On the basis of the State plan, scientific training and education in Czechoslovakia is controlled by different central Government departments under the guidance of the CSAS, in conjunction with the Ministry of Education and Culture.

Of the entire number of workers in RDN during this survey, those engaged strictly in technical work and thus considered experts totalled more than 58 000, or an average of 52 per cent. Of this number approximately 37 per cent had university degrees and 51 per cent had completed a secondary level technical education.

Approximately one fifth of the group with a university education specializes in science. The distribution of these "scientific workers" throughout the national economy is shown below (see *Table 4*).

Table 4. Distribution of scientific workers in the national economy in 1962

	Total	Percentage	Doctor of Science	Candidate of Science
CSSR	8 186	100.0	494	5 174
Science	5 729	70.6	415	3 555
Industry	934	11.5	14	581
Construction	48	0.6	2	37
Transport & communications	35	0.4	4	21
Agriculture	359	4.4	15	279
Health service	487	6.0	28	367
Other	517	6.5	16	334

By the end of 1963 more than 8 500 people were undergoing scientific training, with the number preparing for the degree of Candidate of Science having increased by 140 per cent over a three-year period. It is expected that between 1963 and 1970 the number of graduates in science will be tripled. Most post-graduate students undertake studies in connexion with the work they are already doing in planned research.

Committee for the Advancement of RDN

In order to effectively channel national scientific and technical development efforts, a Committee for the Advancement of RDN has been recently adjoined to the Commission.

This Committee evaluates proposals for structural and organizational change, questions on location of research and development institutes, creation of branch co-ordinating bodies, annual and long-term plans for financing science and technology, and proposals for training scientific workers. In addition, its opinion is sought on other matters pertaining to the extension or improvement of RDN, including upgrading the qualifications of its workers.

Research Projects

Guatemala: Pulp and Paper Production from Agricultural Wastes

The Central American Research Institute for Industry (ICAITI), Guatemala City

Although there are extensive forests in Central America and some of the coniferous areas have already been marked for exploitation by the pulp and paper industry, the area still imports some $US 34 million of paper and paper products annually. Paper mills currently in operation are not sufficient to meet the demand, and ICAITI therefore thought it worth while to investigate the possibilities of utilizing agricultural wastes for the production of pulp and paper, thereby also increasing the economic value of present crops.

Special pulp and paper technology laboratories, equipped with apparatus for production and testing, are experimenting with the following agricultural wastes: cotton stalks, cotton waste, sugar cane waste, kenaf thread-spinning waste, coffee pulp and bean husks, citronella waste, banana stalks, castor bean stalks and corn-stalks.

Preliminary production of pulp, paper and cardboard, using all of the above waste products, has already been accomplished. The process used in each case is as follows:

(*a*) The waste material is first cut into small pieces;
(*b*) This is subjected to alkaline digestion;
(*c*) The fibres thus prepared are subsequently washed with hot water in troughs until neutralization is achieved;
(*d*) Then follows a controlled beating of the fibres in a Jokro mill;
(*e*) Homogenization is achieved *via* suspension of the fibres in water;
(*f*) An aliquot that will give a circular sheet of paper 19 cm. in diameter and the desired dry weight is taken from the suspension and made into sheets in the sheet-forming apparatus;
(*g*) The sheets are dried and then "temperized" for at least twenty-four hours at 18° C and at 56 per cent relative humidity.

This preparation procedure is then followed by physical, tensile, tearing and bursting strength tests on at least ten sample sheets.

Experiments are also being conducted with corn-stalks, the last on the list of agricultural waste products.

When these are completed, further experiments are planned, in which two or more raw materials will be combined in order to produce paper and cardboard of high quality.

The successful development of pulp, paper and cardboard production from such agricultural wastes will not only reduce the outflow of currency by cutting down on paper imports, but will increase earnings for the farmers who produce the raw materials for this new industry.

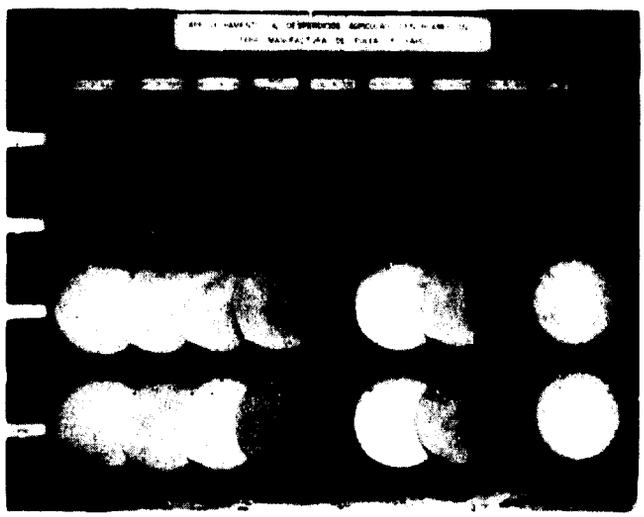
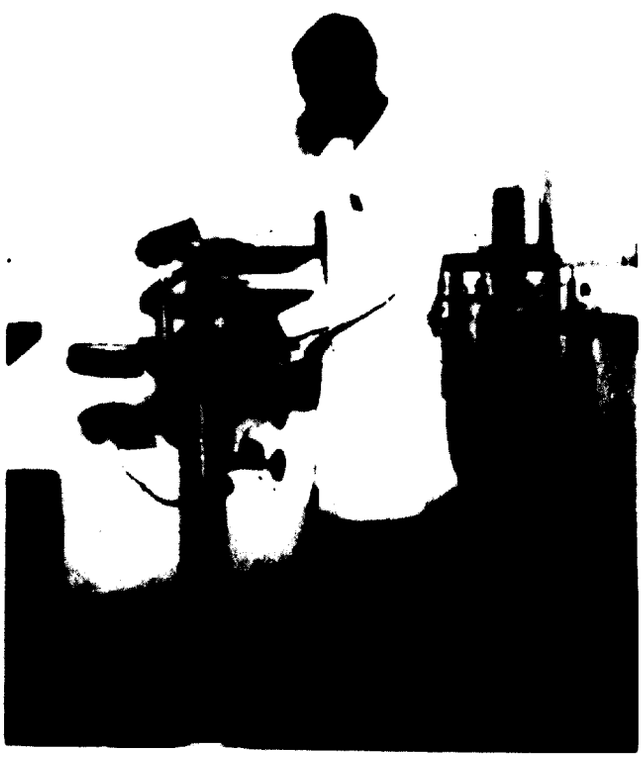


Figure I. Pulp, paper and cardboard samples prepared at ICAITI from region's agricultural and industrial wastes.

Figure II. A technician at the ICAITI laboratory performs the pulp and paper strength test.



Guatemala: Protein-Rich Flour

Institute of Nutrition for Central America and Panama, Guatemala City

Approximately ten years ago, INCAP launched a research programme to find a way of supplementing the protein intake in staple diets of regions where animal protein is not only scarce, but so expensive as to be beyond the economic reach of large segments of the population.

After a careful study of the problems of protein malnutrition, the Institute concluded that high-quality cotton-seed meal, combined with a cereal, is one of the cheapest and most satisfactory sources for obtaining quality protein.

"Incaparina" is the name INCAP has given to vegetable mixtures containing 25 per cent or more protein, which makes them comparable in protein value to that derived from animal sources. In addition, these mixtures have been proved by laboratory tests to be suitable for the diet of young children.

The most effective and economical mixtures developed for Central America are Formulas 9, 14 and 15, the composition of which is shown in the following table:

Basic formulas for use in the manufacture of Incaparina

Ingredients	Formulas: g/100 g.		
	#9	#14	#15
Maize meal[a]	58	58	58
Cotton-seed meal	38		19
Soy-bean meal		38	19
Torula yeast	3	3	3
$CaCO_3$	1	1	1
Vitamin A (I.U.)	4 500	4 500	4 500

[a] Maize meal may be partly or wholly replaced by meal made from rice, gama grass, barley, oats or other suitable cereals.

These formulas indicate that the proportion of the principal sources of protein, here cotton-seed and soy-bean meal, may be varied.

"Incaparina" has the appearance and consistency of finely ground floor. It is easy to prepare at home in the form of "atole", a hot beverage popular with the inhabitants of many Latin American countries. The product can also be incorporated into other foods, such as soups, puddings and biscuits.

"Incaparina" is manufactured and distributed only by licensed commercial organizations in accordance with certain basic rules laid down by the Council of INCAP. These require that samples be periodically analysed by the Institute or by a scientific body previously designated for the purpose; and that the firm contribute part of the cost of such analyses and agree to undertake further research to improve the product.

Figure I. Testing biological changes resulting from INCAPARINA feeding.

"Incaparina" is now produced and marketed not only in the five Central American countries and Panama, but in Brazil, Colombia, Peru and Venezuela as well.

A booklet entitled *Incaparina*, published by the Institute, gives detailed information about the development of the project, formulas, ingredients, the manufacturing process and marketing.

Nicaragua: Plans to Study the Effect of Radiation in the Preservation of Bananas

Encouraged by recent experiments in Costa Rica, Puerto Rico and Guatemala, in which radiation has been successfully used in the preservation of tropical fruits, INFONAC (the National Development Institute of Nicaragua) now plans its own research project which will investigate the possible application of radiation in retarding the ripening process of various types of bananas grown in Nicaragua.

The "Atoms in Action" exhibit, sponsored by the United States Atomic Energy Agency, is expected to open soon in Nicaragua, and several of its scientists have agreed to co-operate with researchers from the National Autonomous University of Nicaragua in helping INFONAC carry out the project.

In addition, the exhibit has offered to lend its Cobalt-60 unit, which has a nominal activity of 5 000 curies, to be used as a source of radiation.

Similar experiments in this specific area are reported to have successfuly retarded the ripening of bananas for periods of up to twenty days.

New Zealand: Research Studies in Ceramics

The New Zealand Pottery and Ceramics Research Association, Wellington, New Zealand

The Department of Scientific and Industrial Research of New Zealand makes annual grants for research in universities and allied institutions, societies and associations to encourage development in subjects which are frequently outside the regular programme of research and scientific services of the Department itself.

These departmentally approved grants, which in 1965-1966 totalled £NZ 431 052,[1] provided in some cases approximately half of the total funds available to certain institutions.

The New Zealand Pottery and Ceramics Research Association is one such group having benefited from a grant-in-aid for new research. Examples of the projects undertaken by this group follow.

Moisture stress and plastic strength

The concept of moisture stress, introduced five years ago in ceramics, has proved to be of great value as a unifying principle. Besides being the force responsible for water movement through clay bodies, moisture stress has proved to be directly related to the plastic strength of bodies. Thus, for the first time the possibility has emerged of depicting, by means of a set of parameters fundamental to the material, the behaviour of unfired bodies during drying.

Methods of obtaining these parameters are being developed, and so far both permeability and plastic strength have been satisfactorily measured. There is a useful mathematical analogy between the problem of shrinkage during drying and the thermal stress in fired articles on cooling. For the latter, theoretical mathematical solutions are available, and a considerable volume of work in the thermal stress field has been accumulated. Thus any problem solved in the thermal stress case has a counterpart in the case of clay drying, for which a solution is immediately available once the relevant parameters of the clay have been measured.

Apart from the long-term aim of this work, it has been found that moisture stress ideas help to explain some of the practical difficulties that arise and give a guide to empirical lines of attack in factory problems.

Ceramic technology of halloysite

The traditional clay mineral used in ceramic manufacture is kaolinite, but the distribution of this in New Zealand is limited, and manufacturers have to utilize the abundant supplies of halloysitic clays. The understanding of why and how ceramic bodies containing halloysite differ from those containing kaolinite is therefore essential to the most economic use of New Zealand clay resources.

Early work was aimed at preparing bodies with the amount of halloysite as a controlled variable and comparing the ceramic properties with those of kaolinite bodies. Further work showed that results would be of limited value unless the halloysite mineral used was completely defined.

It was therefore necessary to investigate the types of halloysite which occur and their properties as clay minerals. One aspect of this work concerns the ability of halloysite to exist in two forms—the hydrated form and a form similar to kaolinite. X-ray diffraction and weight loss techniques have been used to study the dehydration at room temperatures of certain halloysite samples, since this transition considerably affects the behaviour on drying of ceramic bodies containing halloysite.

[1] The New Zealand pound is equivalent to approximately $US 2.80.

India: "Built-in Fabric Lubrication"—A New Approach to Enhance Abrasion- and Tear-resistance Properties of Cross-linked Celluloses

By V. B. Chipalkatti, Director, Shri Ram Institute for Industrial Research, New Delhi, India

Tensile and abrasion losses during cross-linking have been the subject of many research projects. A study of cross-linking reactions of esters of 1,3-dichloro-propanol-2 with cellulose suggested a possible new approach to the solution of the problem. It consists in providing "built-in lubrication" during cross-linking—an approach entirely different from temporary measures such as the use of softeners and additives. For this purpose, studies were initiated with compounds having a three-carbon cross-link in which the central carbon atom bore a substituent with gradually increasing chain-length.

Results of cross-linking with acetyl, propionyl and n-butyryl esters of 1,3-dichloro-propanol-2 predict that with increasing chain-length of the substituent group at the central carbon atom, an over-all advantage for the tensile properties could be expected.

It is possible that the long-chain substituent might act as a lubricant by positioning vertically over the surface of the cellulose lamellae or by lying parallel to the cellulose chains. We believe that the former condition would result in improved abrasion resistance, whereas the latter might enhance the tear resistance. In practice, the two effects may be combined, depending on the planarity and other steric effects associated with the cross-linking molecule and on the micellar and lamellar structure of the cellulose undergoing the cross-linking reaction.

The School of Cellulose Research of the Shri Ram Institute for Industrial Research in New Delhi, India, reports significant findings by using lauroyl (C_{12}) and stearoyl (C_{18}) esters of 1,3-dichloro-propanol-2. The properties conferred on the cellulosic fabrics by the latter are far more substantial than by the above-mentioned method.

The treatment of cellulosic fabric with the stearoyl ester of 1,3-dichloro-propanol-2, in the manner indicated hereunder confirms the prediction that built-in lubrication can improve the tear and abrasion resistance of cellulosic fabrics in a permanent manner. Depending on the type of cloth and the conditions of treatment, an improvement of 2 300 per cent abrasion resistance has been obtained. The improvement in tear, however, is only 9 per cent. The fact that it *does* improve and does not reduce in spite of cross-linking is significant.

The cloth used in the study was a casement cotton fabric of 14's count with 54 x 48 ends and picks. The scoured and bleached fabric was padded in a solution of the stearoyl ester of 1,3-dichloro-propanol-2 in carbon tetrachloride, so as to retain 5 per cent of its own weight of the ester after evaporating the solvent. The cloth was then treated in caustic soda of mercerizing strength by padding and keeping it out of contact with air for twenty-four hours. It was then washed, scoured, rewashed and dried. *Table 1* shows typical results.

Table 1

Sample	Impact tear strength (inch-lb.)*	Improvement over alkali control (%)	Flex abrasion cycles (W + F)*	Improvement over alkali control (%)
Original casement fabric	26.7	—	2 665	—
Alkali control	33.4	—	6 050	—
Treated with 5% stearoyl ester of DCP	36.4	9	54 561	900
Treated with 10% stearoyl ester of DCP	34.7	4	78 981	1 316
Treated with 20% stearoyl ester of DCP	34.0	1.2	136 149	2 300

* The samples were extracted with benzene in a Soxhlet for eight hours and conditioned at 65 per cent RH prior to testing for the changes in impact tear strength and flex abrasion resistance.

It was also found that the treated fabric is an excellent base material for wash-and-wear treatment.

Table 2 gives the results obtained when the fabric already treated as indicated above was further treated with 6 per cent of a reactant resin (tetra methylol acetylene diurea) using ammonium nitrate as a catalyst by the conventional pad-dry-cure method.

It is thus evident that this method produces a wash-and-wear effect on cotton, not only without abrasion losses but actually with a five-fold improvement in abrasion resistance, compared to the conventional resin treatment method.

With respect to tear resistance, the new method can give a substantial improvement, even though the tear value is still about 25 per cent lower than the original.

The fact that the new reactant (stearoyl DCP) enhances abrasion resistance in a remarkable manner in spite of cross-linking, adds a new dimension to the knowledge of this topic. Additional research work is needed, however, to correlate the exact role played by short and flexible cross-links on the one hand, and by molecules of small and large bulk on the other.

Table 2. Wash-and-wear properties of fabrics treated with stearoyl DCP followed by conventional resin treatment

Sl. No.	Fabric treatment details	% add-on due to SCIDC treatment	% crease recovery TBL: Dry (% warp + % filling) ±2	% crease recovery TBL: Wet (% warp + % filling) ±2	Impact tear strength, inch-lb., filling	Flex abrasion resistance, no. of cycles, W + F	Wash-and-wear rating
1	Desized (untreated)	—	46.0	28.0	26.7	2 665	1.5
2	Desized, treated with 20% NaOH	0.5 loss	43.5	18.9	33.4	6 050	1.5
3	Desized, treated with 5% stearoyl DCP	1.06	44.3	20.4	36.4	54 561	2.0
4	Desized, treated with 6% TMADU	—	68.2	54.5	14.5	910	4.0
5	Desized, treated with 5% stearoyl DCP, followed by 6% TMADU treatment	—	68.1	58.0	20.25	4 958	3.5 to 4

Impact tear strength: Tested on impact tear tester developed by S.R.I.
Flex abrasion resistance: Tested on BFT Mark IV (A) wear tester, using 2-lb. tension and 4-lb. head load.

Summary of New Product Evolution

The process of new product evolution can be divided into six basic stages, each representing a key activity in the creation of a product.

Exploration: the search for product ideas that meet company objectives.

Screening: a quick examination of product ideas to determine if they should be dropped or if they have enough merit to be studied in more detail.

Business analysis: a thorough examination of the product ideas as a business venture.

Development: the technical task of creating a product that meets the specifications established in the preceding stage.

Testing: this covers the laboratory field and consumer testing required to verify earlier judgements.

Commercialization: the final planning and action required to launch the product with commercial scale manufacturing and sales effort.

Robert F. Sherman
Vice-President, Booz, Allen and Hamilton, Inc.
New York, N.Y.

Private Investment Fund for Guyana

The Guyana Development Corporation has announced the establishment of a Private Investment Fund. The fund has been established jointly by the Guyana and the United States Governments, and will be administered by the Guyana Development Corporation in conjunction with the commercial banks. New or expanding industrial enterprises registered locally may seek assistance ranging from $G 42 500 to $G 425 000.

Australia: Stretch Wool Fabrics

By J. M. Preston,* Commonwealth Scientific and Industrial Research Organization, Division of Textile Industry, Geelong, Australia

Purpose of the development

Wool research at the C.S.I.R.O. Division of Textile Industry was presented with the problem of designing stretch fabrics for form-fitting garments. Such garments must behave like the skin and not become baggy in use. In the act of bending body joints, there is a combination of stretching and translational movement, which requires that the fabric stretch easily and then recover quickly when the joint is straightened.

Stages in development

In the preliminary stage, it was necessary to ascertain the stretch required in a form-fitting garment by measuring shoulders, elbows, knees and seat movements. From the point of view of general appearance, bagginess is most objectionable at the knees; *Figure I* shows the stretch method of measuring at this joint. White threads were tacked on to the garment to form a rectangular lattice. The deformation of the lattice on bending indicated the direction and magnitude of the dimensional changes. It was found by repeated trials that a 30 per cent stretch in the fabric could be considered satisfactory.

Because of the natural high extensibility of wool, it is possible to stretch wool fabrics 30 per cent. Such a demand, however, extends the wool fibres into the yield region, making the elastic recovery inadequate for such garments. This is illustrated by the curve labelled "normal" in *Figure II*. It is seen that a 35 per cent stretch requires a force of 28 kg. on a 5-cm.-wide strip. Furthermore, it can be noted that this stretch occurs mainly in the yield region where the curve bends to the right. As this was unsatisfactory, the possible solution was to obtain stretch by straightening rather than by extending fibres. Wool fibres have a natural crimp, which can be considerably increased by technical processes; when small forces are applied to such fibres, they extend by straightening the crimps. Also the consequent shearing strains in the fibres do not enter the yield regions, and so the fibres recover elastically from the extensions.

An arrangement of bent wool fibres can be produced by increasing the crimp in the yarns; by making bulky yarns using unbalanced singles and folding twists; or by introducing an elastromeric filament.

The bent form of the fibres in the yarns can then be made permanent by a chemical setting treatment. When a stretching force is applied, the crimps straighten and the fabric extends. It can be observed that on stretching there is a displacement of the crossing threads. It is important that these not be too tight or the system will jam on extension.

* Dr. Preston is a staff member of the Division of Textile Industry.

Practical developments

After a large number of yarn and fabric constructions were made, their extensibilities and elastic recoveries were tested, as shown in *Figure III*. An example of the stretch-load curve of one of these can be seen in *Figure II*, where the stretch is 35 per cent under a load of 3 kg. That is, the force to extend the "stretch" fabric 35 per cent is less than one ninth of that for the similar weight "normal" fabric. For smaller extensions, the force required for the "stretch" fabric decreases rapidly and becomes a much smaller fraction of the force required to stretch the normal fabric.

Garments made from the experimental fabrics were worn and, after comparable wearing times, were evaluated.

Specifications have now been drawn up for the preferred fabric construction to enable manufacturing on a commercial basis. The industrial advice on the commercial application of the process in industry is being handled in Australia by the Wool Board and in other countries by the International Wool Secretariat.

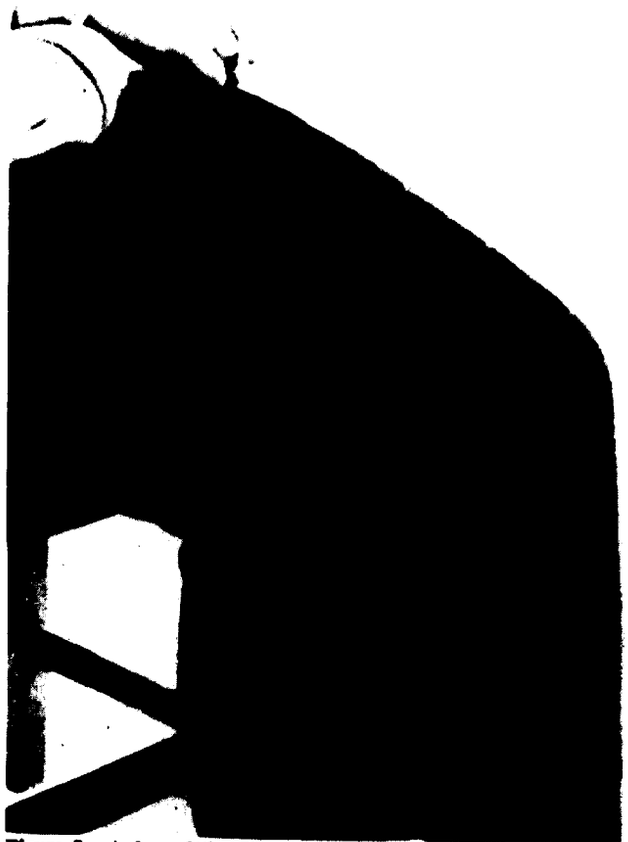
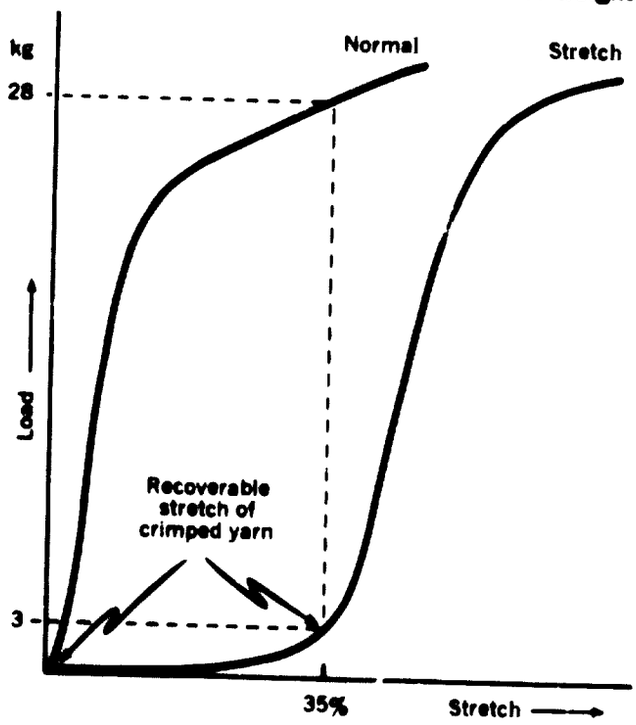


Figure I. A form-fitting "stretch" garment marked with a thread lattice for measurement of dimensional changes on bending.

Figure II Load-extension (or stretch) curves of strips of "normal" and "stretch" fabrics of similar weight



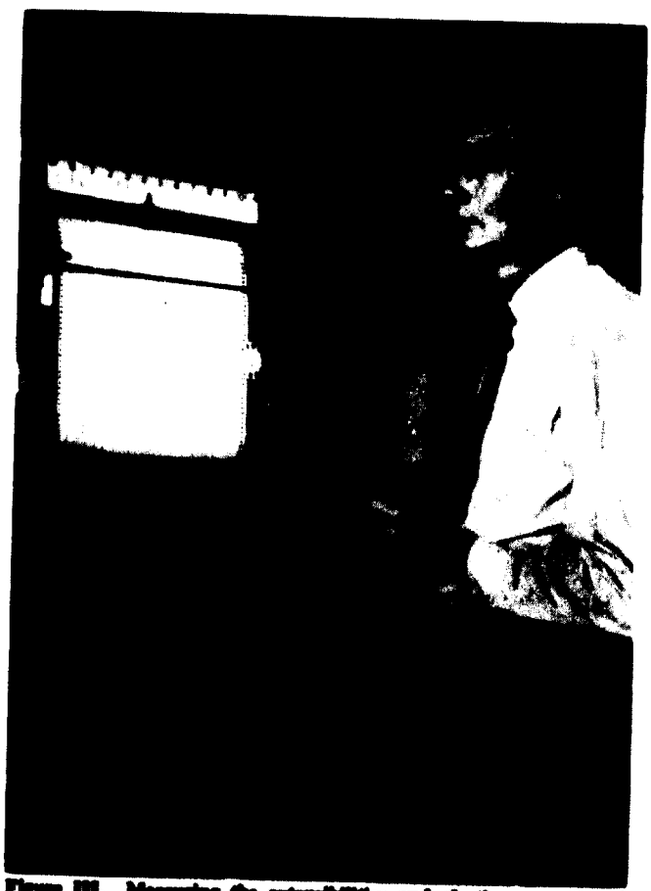


Figure III. Measuring the extensibilities and elastic recoveries of "stretch" fabrics.

New Zealand "Goes Decimal" in July 1967

Mid-July 1967 has been set aside for the official introduction of the decimal currency system in New Zealand. On "D.C. Day" the Banks will issue new decimal coins and notes as legal tender, will honor cheques written only in decimals and will by that date have converted their records and machines to the new system.

Furthermore, from that day the law as set out in Section 6 of the Decimal Currency Act 1964 will require cheques and other money transactions and documents to be made out in decimal currency.

The main task of converting about 75,000 office machines to decimal notation will begin at this time and is expected to take about eighteen months.

The decimal currency system

The system of decimal currency to be introduced is based on a 10s. unit to be called a dollar, divided into 100 minor units called cents, worth six-fifths of a penny (1.2d.).

Pound values are therefore doubled to obtain dollars. A shilling is worth 10 cents, so shilling values stay the same, 5s., for example, being 50 cents, and 17s. being $1.70. The dollar sign is a capital "S" with a single vertical bar ($); while the sign for cents is a small letter "c". Pence are converted to cents by using a simple conversion table, which will be issued by the Decimal Currency Board.

Machine conversion

The biggest single task of the change-over will be the conversion to decimals of an estimated 75 000 £.s.d. adding machines, accounting machines and cash registers, and the replacement of a further 35 000 with new machines. The Government will provide financial assistance to owners of machines, subject to their machines meeting certain age requirements.

Some machines will be converted at Government expense; these are called "Category A" machines, and include adding machines up to twelve years old, cash registers up to fifteen years old, and accounting machines up to nine years old. "Category B" machines are adding machines between twelve and sixteen years old, cash registers between lifteen and twenty years old, and accounting machines between nine and twelve years old. These are considered too old for satisfactory conversion, but the Government will make a cash grant to the owners for loss of their machines' residual life. Owners of older machines ("Category C") will not be eligible for financial assistance.

The banks have priority in the machine change-over, since they will be working on £.s.d. on one bank business day and must be fully converted to decimals by the next–D.C. Day. The 3 500 bank machines cannot all be converted over one long week-end. The banks must employ some combination of alternatives, such as the use of an £.s.d. machine in the pounds sector only; the high row can be quickly and easily converted to a full 0 to 9 decimal row; and the use of decimal loan machines or new decimal machines.

Geological Research Unit for Southern Rhodesia is Planned

At the request of the Government, the Chamber of Mines of Southern Rhodesia is investigating the proposed establishment of a geological research unit in Southern Rhodesia. The project, initiated by the Southern Rhodesian branch of the Geological Society of South Africa, is aimed at boosting the search for new mineral deposits in the country.

Special Resources for Special Needs

Background and Guide to Sweden's Iron and Steel Industry

Swedish Steel Manual—

Presented by Jernkontoret, Swedish Iron Masters' Association

Background

Since Sweden's chief natural assets are her forests, iron ores and waterfalls, the iron and steel industry has an ancient tradition in this country. The range of production today is steadily increasing and includes all steel products—raw materials, semis, finished steels and, to a large extent, manufactured steel products.

Her general economic philosophy as a small country has not been to support a variegated domestic economy, but rather to concentrate efforts on developing her special resources beyond domestic needs. Therefore iron, produced as far back as the 10th century, was one of the earliest export items, and although the metallurgical industry as a whole has undergone radical technical and commercial changes, its guiding principle has still remained "quality for export markets". At the present time her metals sector, which includes iron ore, steel, steel goods and engineering products, represents more than half of her total exports, and about 17 per cent of the world trade in iron ore (including iron content in manufactured goods) is attributable to Sweden.

Growth of the industry

Prior to 1830, Sweden produced about 60 000 tons of iron a year in hundreds of small ironworks. Thereafter, rapid expansion was evident. Swedish iron ore deposits are not only rich in iron, but are well situated in relation to European steel-producing centres. These factors, in conjunction with the liberalization of industrial legislation and a gradual introduction of coke blast furnaces, ingot steel processes and rolling mills, brought about an export figure by 1965 of nearly 25 million metric tons. Further, the small ironworks have been gradually concentrated into increasingly fewer and larger production units, sometimes as a part of a consolidated group of enterprises.

A closer look at growth during the last several decades is even more convincing. Around 1950, the Swedish steel industry was still considered "underdimensioned" in relation to the national economy, consuming up to 50 per cent more steel than it was producing. However, the post-war decision in 1946 for an all-out expansion of the industry bore fruit later in the 1950's, making the growth of steel production more than twice as rapid as that of the gross national product—7.8 and 3.3 per cent respectively *per annum*.

Swedish steel producers plan still further expansion. The rate of growth, which has been approximately 8 per cent *per annum* up to 1966, is expected to decrease somewhat, but the projected rate of investments continues to be high throughout the 1960's. Oxygen processes will increase, and production of flat products will expand.

Scale of production—Steel mills

In the domestic market Swedish firms which produce ordinary grades of steel have certain advantages over larger competitors in western Europe through their more intimate contact with customers and the shorter transport distances. Although size of plants could be considered to offer an advantage to larger countries engaged in the mass production of ordinary grade steels, this factor is less significant in the production of special steels.

Sweden has now more than thirty steel mills. About half of them make solely or principally special steels, some specializing in tool steels, others in stainless steel. Almost 25 per cent of the total Swedish crude steel production is high grade steel. It is well known that in many cases small and medium-sized steel mills are more competitive and better adapted to deal with small and large consignments required by the highly differentiated engineering industry. Thus, the percentage quantity of special steel has been maintained even under a period of rapid growth of the production of ordinary qualities.

Exports

The Swedish steel industry specializes in the export of high quality material. Originally the products consisted mostly of semis, such as wrought iron, Lancashire bars, carbon steel billets and bars, wire rods and hollow drill steel. There has been a successive change, however, to the export of more and more advanced products. Swedish steel has maintained its position on the export market, despite its high cost, owing to high fatigue strength and uniformity of product.

Present exports include also intermediate grades, for which Swedish steel has certain advantages owing to pure raw material. Steel is now exported in practically all existing forms, from billets and hot-rolled steel to cold-worked products of high quality and close tolerances.

The principal exports go to industrial countries of Europe, the United States, Japan and many other countries in Asia, Africa and Latin America. Fair quantities of tools and specialities outside the regular steel programme are also exported by the steel industry. These include specially cemented, carbide-tipped rock drill steels and cemented carbide-tipped tools.

Research in production

The success of the Swedish special steel industry is to a great extent attributable to individual company research, appropriate combinations of furnace types and careful selection of raw materials. Many companies have a comparatively large staff of scientifically trained personnel and

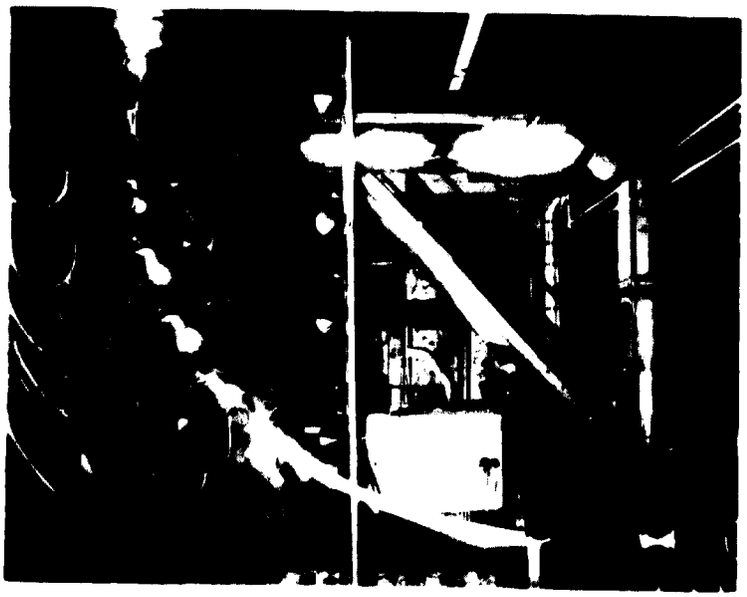


Figure I. A continuous casting plant. While solidifying, the strand is bent by a hydraulic bending device from the perpendicular to the horizontal position; then it passes into a levelling machine.

Figure II. High-vacuum furnace for the production of extremely pure steel. A worker follows the melting process in the furnace through a window in the control panel.

skilled workers, who can be put on the production of small quantities of specialized and highly priced types of steel.

In addition, the iron and steel industry has not only contributed actively to the development of allied industries, but also to the development and improvement of production methods. Since the introduction of the ingot steel processes, individual contributions of considerable significance have been made by Swedish mining engineers in adapting these processes to Swedish conditions and requirements. The lack of domestic coal supplies and the depletion of forest reserves resulting from the great demands of the pulp industry led to concentration on the problems of fuel economy and the search for a satisfactory substitute for charcoal pig iron, the traditional raw material for Swedish special steel manufacture. Considerable success has been achieved in both areas: fuel consumption has been reduced to a very low level in blast furnaces, and charcoal pig iron has been replaced by sponge iron of extreme purity, made by methods developed in Sweden. Further, research successfully solved the question of desulphurization of coke pig iron, thus providing another welcome addition to the raw material supply for special steels.

The old converter methods, Bessemer and Thomas, are giving way to newer processes, in which liquid pig iron is refined with pure oxygen instead of air. Its advantages include: improved heat economy, higher quality, ability to add large quantities of scrap, and higher yield of steel. Here Sweden has contributed to the advance of manufacturing technique through the Kaldo process, which introduced the rotary vessel lined with basic refractory materials in which tonnage scale oxygen is injected over the bath surface as well as below.

Jernkontoret (Swedish Iron Masters' Association)

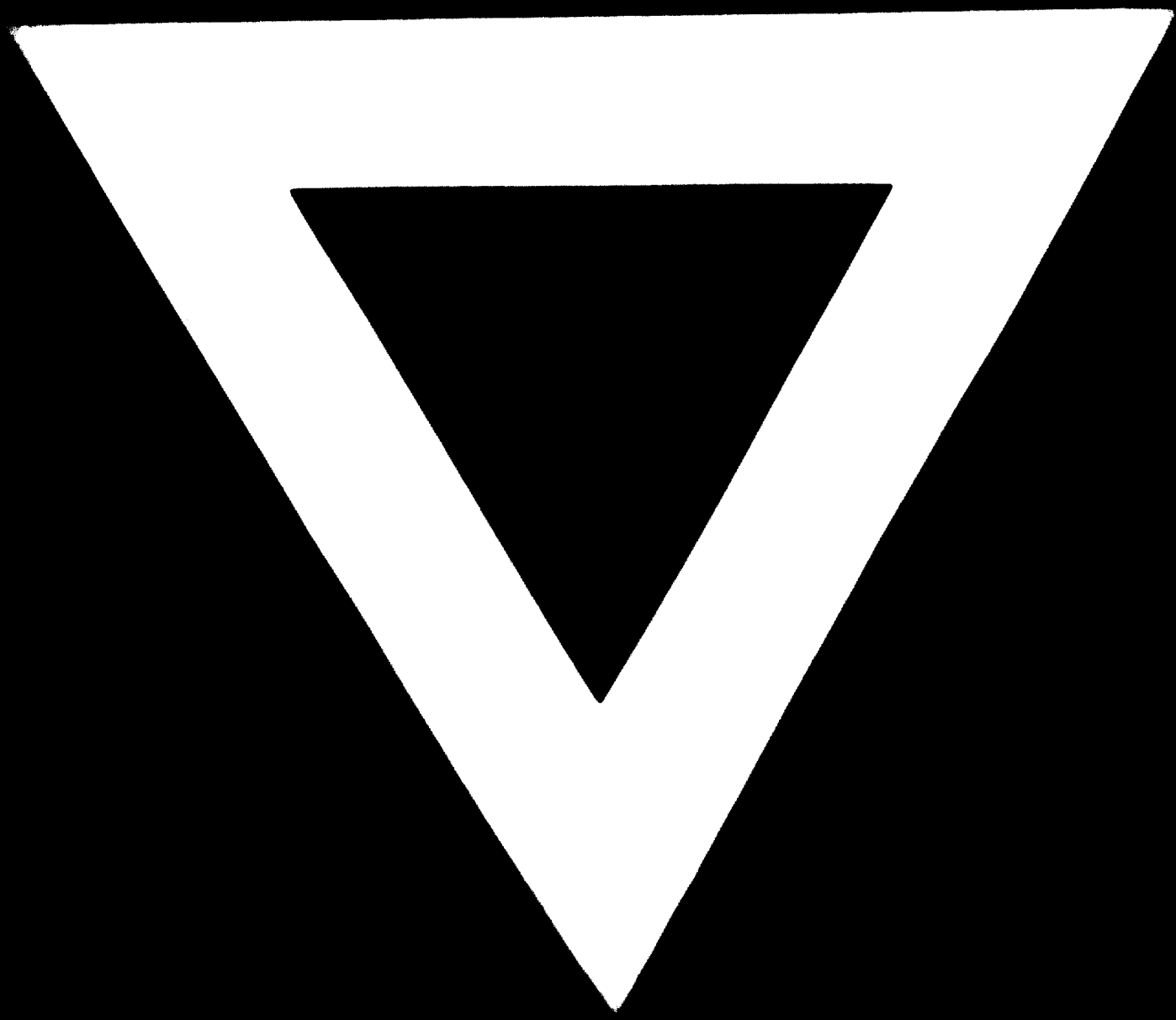
JERNKONTORET, the central organization of the Swedish metallurgical industry, represents the industry in all questions of common interest with the exception of labour relations. Established in 1747 by Royal ordinance, it is entirely owned by the member works and receives no State contributions for its activities. Its staff is frequently asked to submit reports and supply information on questions relating to the industry, and is utilized by the Government in negotiations for trade arrangements with foreign countries, often sending delegates to the steel committees of international organizations such as ECE and OECD.

The aim of JERNKONTORET is not only the financial strengthening of the iron and steel trade, but the encouragement of scientific and technical development of the industry. A research organization along modern lines was established in 1926 and financed by special contributions from the participating works. This research organization works in close co-operation with the Swedish Institute for Metal Research.

In producing the *Swedish Steel Manual*, JERNKONTORET has aimed at increasing the general knowledge of Swedish steel and its other metallurgical products. In addition, the Manual presents comprehensive information on the principal iron and steel companies of Sweden, including their location, history, boards of directors, plants, productive capacities and products. A new edition will be published early in 1967.

In addition, JERNKONTORET has published since 1817 a metallurgical journal *Jernkontorets Annaler*.

(Inquiries for the Manual should be addressed to JERNKONTORET, 6 Kongstradgardsgatan, Stockholm C, Sweden.)



74. 10. 11