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Indian production has grown slowly since the thirties. Brazil, on the other hand, averaging 40,000 tons per annum in the early fifties, exceeded 200,000 tons by 1966. Production in 1970 reached 230,000 tons. Mexico did not exceed 40,000 tons until 1953, but has since reached 150,000 tons in 1970. Chile produced around 18,000 tons annually in the late fifties. Following the installation of new facilities, production is estimated at 38,000 tons in 1970. Spanish production in 1970 was 145,000 tons.

Total output in developing countries rose from 122,000 tons in 1950 to 635,000 tons in 1970, (Spain excluded). The latter figure was about 5 per cent of world production. The combined output of developing countries, excluding Spain, was less than half of Japanese output alone in 1970. The largest producer among developing countries, Brazil, produced less in 1970 than Belgium, the Netherlands, or Australia. Australian production rose from 15,000 tons in 1957 to 209,000 tons in 1963. By 1969, Australia exported 9 per cent of its output. Very little tinplate is exported by developing countries. Brazil is reported to have exported about 1,000 tons in 1969.

Consumption.

The growth in world demand for canned products, especially in the fifties and sixties, has been by far the chief cause of the increase in tinplate consumption from about 3 million tons in 1946 to 12 million tons in 1970. The share of cans, plus

crown caps, is not accurately known, but it is probably about 95 per cent of world consumption. In the U.S., the figure was 96.4 per cent in 1966. The 1968 figure for Japan was 96.3 per cent. There is only a slight variation usually between years. The distribution of consumption by end-use in Chile is as follows: cans 84.4 per cent, crown caps 13.8 per cent, miscellaneous uses 1.8 per cent.

The use of tinplate for containers is split between food cans, beverage cans, and non-food cans. Beverage cans are much more important in the U.S. than elsewhere as a result of the tremendous expansion of the canned beer and soft beverage market in recent years. Out of a total shipment of 145.9 million base boxes in the U.S. in 1968, beer and soft drink metal cans, (including aluminium and tinfree steel cans) accounted for 50.7 million; food cans (including coffee) 69.3 million; pet-food cans 6.2 million; pressure pack cans 4.8 million; and non-food cans 14.9 million. Recent figures for Chile were, as a percentage of total tinplate use, food cans 68.6 per cent; crown caps 13.8 per cent; non-food cans (paints, lubricants, polishes and wa. waxes) 13.8 per cent; unallocated cans 2.2 per cent.

The U.S. is still by far the largest tinplate consumer, absorbing until recently 45 - 50 per cent of total world consumption. There are signs that the U.S. share is falling. In 1970 it was about 42 per cent. Japanese consumption

has more than doubled during the sixties, rising from 371,000 tons in 1960 to an estimated 800,000 tons in 1970. Consumption in the U.K. and E.E.C. has also risen. In the U.K. it was 647,000 tons in 1960 and 910,000 tons in 1970. Corresponding figures for West Germany were 375,000 tons and 810,000 tons; for France 288,000 tons and 460,000 tons. Substantial increases have occurred in the consumption of other industrial countries.

Considerable new capacity is being created in industrial countries, partly to expand output, partly to replace old plant. There is some uncertainty about the future behaviour of U.S. consumption. Per capita consumption has been high compared with that of other industrial countries. Technological change has been affecting the U.S. tinplate market to a greater extent than it has done in other countries. Total U.S. consumption, which tends to fluctuate violently, has had a low rate of growth over the last fifteen years. To a large extent the growth which has occurred has been due to the canned beverage market, in which tinplate is vulnerable to substitution.

The growth of tinplate consumption in the main consuming countries of the developing world is shown in Table 3. It is apparent that experience has differed greatly between countries. During the sixties there has been little change in tinplate consumption in India and Argentina. The same is true of a number

of smaller consuming countries. Several countries, such as Mexico, Venezuela, and Kenya, have achieved very marked increases in consumption. Mexican consumption rose to 177,000 tons in 1970, compared with around 60,000 tons in 1959-60. Kenya, the second largest consumer in Africa, excluding the Republic of South Africa, doubled its consumption during the sixties.

Per capita consumption in most developing countries is far below that of industrial countries. Brazil, the largest consumer among developing countries, has a per capita consumption of about 6 lbs.. This is similar to the consumption level in Mexico and the Philippines. In Belgium and West Germany, which come well below the level of consumption of the U.S., Canada, and the U.K., the figure is around 32 lbs.. India, Pakistan, Indonesia, Nigeria and most smaller African countries consume less than one pound per head. On the other hand, Venezuela has reached the per capita level of some industrial countries. Its consumption is not boosted by an export trade in canned food, which raises the level of consumption in a number of developing countries.

Estimated total consumption by the developing countries of Africa, Latin America, and Asia in 1968 was about 1,450,000 tons. This was 12.5 per cent of world consumption, excluding consumption in the centrally-planned socialist countries. The share of developing countries increased only slightly during the

sixties. Tinplate consumption has been growing so rapidly in some industrial countries that in spite of the large difference in population sizes between developing and developed countries, the share of the former has not risen much in the last decade. In Europe, however, there has been a striking increase in tinplate consumption by Spain, which can be regarded as a developing country by general West European standards. From 46,000 tons in 1960, Spanish consumption rose to about 205,000 tons in 1968, and to an estimated 278,000 tons in 1969. Two other European developing countries, Greece and Portugal, have greatly increased their tinplate consumption during the sixties. Per capita consumption levels in 1968 reached 14.2 lbs. in Spain, and 11.8 lbs in Portugal, compared with 3.9 lbs. and 6.0 lbs. in 1958.

Trade in tinplate

In recent years about 8% per cent of world tinplate production has entered into international trade. Although most industrial countries have their own tinplate facilities, there is still a substantial volume of trade between them. West Germany has imported between 100,000 tons and 120,000 tons annually since 1966, France between 71,000 tons and 81,000 tons, the Netherlands between 33,000 tons and 45,000 tons. The U.K. is usually a small importer, but may import a substantial amount to meet a shortage. Japanese imports have dwindled away during the sixties. None was imported in 1968-70. U.S. imports have risen sharply since the mid-sixties, although at their peak of 272,000 tons in 1969 they were only about 5 per cent of consumption. A high proportion of U.S. imports has come from Japan. This presumably reflects the decline in the competitive position of the U.S. during the sixties.

Substantial changes have occurred in the relative importance of the exporting countries. U.K. exports have more or less stuck at under 400,000 tons for a number of years. The last year they exceeded this level was in 1965. Nevertheless, about one-third of production is usually exported, and the U.K. remains the second or third largest exporter. Japan has been the largest exporter since 1966. Exports doubled in six years, rising from 296,000 tons in 1964 to 600,000 tons in 1970. France shares the second or

third position with the U.K.. West Germany, the Netherlands, and Belgium are large exporters. Each of the E.E.C. countries, except Italy, exports a sizeable tonnage to its E.E.C. partners. U.S. exports are much less than they were in the fifties.

About 40 per cent of world exports of tinplate goes to the developing countries of Asia, Africa, and Latin America. Collectively they imported 55 per cent of their consumption requirements in the late sixties. Since setting up their own production facilities, Chile, Mexico, and Turkey have imported very little tinplate. In certain years, however, Chile has imported a higher proportion of its requirements, but these have been isolated periods. Turkey's imports were running at between 20,000 tons and 40,000 tons in the years 1959 to 1964. Only a few hundred tons have been imported since 1968. Brazil and the Philippines remain sizeable importers, but in both cases the proportion of consumption supplied by imports is much less than it was in the early sixties. Indian imports have fluctuated greatly, with usually a substantial proportion of consumption met from imports. This may change as the new electrolytic line increases production. Argentine has continued to rely on imports for most of its tinplate, since there have been serious difficulties with the electrolytic line which was built some years ago. Argentina's costly experience emphasises the necessity of careful planning in the se setting-up of a developing country's tinplate capacity.[1/] The Argentinian line has a reported capacity of 120,000 tons, but production seems to have been only a few thousand tons per annum.

1/ Details of the Argentinian difficulties are not available.

Chapter 3

Factors affecting tinplate consumption

Living standards

The most obvious and most important determinant of the demand for canned products and consequently for tinplate is the standard of living. As consumers' real income has risen in the advanced countries, they have bought more canned food. With the growth in the number of road vehicles there is an increase in the demand for oils and lubricants which are packaged in cans. Richer societies use more paints. The latest group of canned products consists of the aerosols, which have found an enormous market in the fashion and hygiene conscious high income countries.

In all high-income countries the element of convenience in canned food has become an increasingly important selling point during the last two decades. The U.S. and Canada have led the way in this respect. Now the convenience of canned food has appealed to consumers in Western Europe, Australasia, and Japan.

To some extent consumers in high-income countries turn to canned food out of necessity. With an increase in the proportion of women in paid employment, less time is available for shopping and cooking. Personal service in the home, or in hotels and restaurants, has become scarcer, certainly more expensive, with the result that the preparation of food has also become more expensive. Canned food is prepared under factory conditions in

which high productivity is possible, whereas fresh food tends to be supplied under conditions which, being more labour-intensive, make it often dearer than processed food.

The appeal of canned food in high-income countries has been increased by the very wide range of food products, for which lavish research and development have made canning a safe, practicable and attractive method of preservation. Marketing methods, which may seem expensive but are financially tolerable in high-income countries, stimulate the demand for canned products. It seems likely that a kind of "demonstration effect" has come into operation. As consumption increases and as more people buy canned products, a still wider section of the public is attracted to products which have become popular.

In developing countries there are also signs that higher real incomes are associated with a greater demand for canned products. Countries with a higher per capita real income have a higher per capita consumption of tinplate, most of which, as in advanced countries, goes into tin cans.

Consumer tastes and habits.

In both advanced and developing countries the pattern of consumption has an important effect on tinplate consumption. Tastes and habits differ between countries, and influence the effects of incomes on consumer spending. Per capita tinplate consumption may be lower in some countries than might be expected

from their level of per capita income. Sweden, for example, has a much lower per capita consumption of tinplate than the U.K., but its per capita income is appreciably higher than that of the U.K., and has been so for many years. West Germany's per capita consumption of tinplate is also much less than that of the U.K., while its per capita income is now somewhat higher than that of the U.K. In neither case is the difference explained by an export trade in canned food.

In most developing countries consumers are accustomed to fresh food, which they buy daily. Large parts of the population are still outside the market economy. This means that canned food is not accessible to them, living as they do in rural communities. Consumers adhere to a traditional pattern of consumption in which canned food plays little part. A recent study of U.S. investment in Latin America shows that this has often been the experience of U.S. companies.

Even among that part of the population which is well-off, admittedly a small part of the total consuming public by Western standards, there is not yet a demand for canned food comparable to that of similarly-placed consumers in advanced countries. So far, the taste for the canned product has not been developed; consumers prefer fresh fruit, fresh vegetables, fresh meat. The element of convenience about the canned product has no obvious

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1/ John R. Moore and Frank A. Padovano, U.S. Investment in Latin American Food Processing, Praeger Special Studies in International Economics and Development, New York, 1967.

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PERSPECTIVES FOR TINPLATE CONSUMPTION AND PRODUCTION IN THE DEVELOPING COUNTRIES DURING THE SECOND DEVELOPMENT DECADE 1/

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appeal when labour services are abundant and cheap; hence the purchase and preparation of fresh food is more economically rational than simply opening a can.

The growth of tinplate consumption in Venezuela, however, shows that tastes and habits have been changing considerably in recent years. Venezuela admittedly is an outstanding example and it is a high-income country by the standards of developing countries.

The pattern of consumer spending is likely to be affected by urbanization, which seems to be developing rapidly in many countries. Consumers become more exposed to canned foods, more susceptible to modern marketing techniques. Whether they buy them depends on their incomes and on the relative prices of canned and fresh foods.

The inhibiting effects of tastes and habits do not apply to the same extent to the non-edible can pack. The most striking example is the aerosol can, which has the advantage that it performs functions for which there is no satisfactory substitute. Demand is determined chiefly by income and price. The better-off part of the population is likely to be attracted to the aerosol products, just as consumers have been in richer countries.

Latin American experience suggests that this is happening. Rates of growth of aerosol production appear to have been extremely

high recently in Latin America. In 1967-68 the combined output of Brazil, Mexico, and Argentina is reported to have risen by 28 per cent. In Brazil alone the increase was 30 per cent. The total output of these countries was 55 million units. But this is small compared with an estimated production of 655 million units in western Europe.

Growing industrialization increases the demand for canned products such as paints and oils, but it is difficult to find out the relative importance of these uses of tinplate. In Chile the share of non-food cans is about 14 per cent of total tinplate production. In the U.S., non-food cans, exclusive of aerosols, are about 10 per cent of total metal can shipments, but this includes tinfree steel and aluminium cans.

Research and the market for canned products.

In many developing countries the container market for tinplate may be affected by the lack of research into the packing of local products. In advanced countries the tinplate producers, the can-makers and the canners are continually involved in research and development work which is intended to strengthen the market for canned products. There is close cooperation on technical problems. If a developing country does not carry on similar work, it has to rely on foreign information, which is not always relevant to its particular products. To some extent the obstacles are dealt with by the participation of foreign-owned can-making and canning companies in the local market.

There is a feedback to the tinplate producer from the favourable effect of his technical improvements on the market prospects of the can-making and canning industries. These improvements may mean a cheaper supply of tinplate, or a qualitative change in tinplate which improves the can. An illustration of this was given in a recent paper on the Chilean tinplate market. It was pointed out that the adoption by the tinplate producer of the method of producing tinplate from coldrolled sheets, leading to thinner and better tinplate, helped the consumer by making it easier to open cans.

The supply of raw food for packaging

As far as the use of tinplate for the canning of food is concerned, the market for tinplate is intimately bound up with the state of the agricultural sector of the economy. The agricultural industry must be able to produce foods which are suitable for canning. With meat, for example, much depends on animal husbandry. In general, developing countries lag well behind advanced countries in their animal husbandry. This is particularly true of African countries. The regularity of a meat supply to the canners depends on investment in refrigeration facilities and on a good transport system in rural areas.

The market for canned fruit depends on a high standard of fruit cultivation. According to a recent study of the food processing industry in Latin America, "to establish a proper

fruit-processing industry would often pre-suppose considerable long-term investment in new plantings of varieties which possess the required properties for canning".[1] This study refers repeatedly to "lack of quality" and "lack of uniformity in quality". It has been found by subsidiaries of international companies that raw material costs in their canneries are often high compared with those of the companies' home canneries. Raw food supplies may be uncertain and unreliable when free market prices exceed contract prices, since suppliers fail to meet their contractual deliveries. This has an adverse effect on production planning and costing in the canneries, with the result that the price of canned food is higher than it need be.

Production problems of tinplate users

In the can-making plants of developing countries, shorter production runs than in advanced countries tend to raise costs. Generally speaking, the longer the runs and the greater the degree of specialization by type of can, the lower are unit costs. Under-capacity working in the can-making plant also raises unit costs. This is a common phenomenon in developing countries, which can be illustrated from Chilean experience.[2] A considerable number of canners have their own can-making plant. "Taking into account only the 13 automatic lines in the canning sector, the country

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1/ John R. Moore and Frank A. Padovano, op. cit.,

2/ See paper to Santiago seminar by Danilo Vucetich.

has an installed annual capacity of 814 million cans of three sizes, with one-shift operation, but no more than 60 per cent of this capacity is utilized.' As the Chilean study points out, "the problem of under-utilization of equipment and installations for the manufacture of cans has been a source of continuing concern to C.A.F. (the Chilean tinplate producer), and at the present time, various technical and trade union bodies are analyzing the possibilities for concentrating production in one or two specialized enterprises, each with several lines."

Competition between tinplate and substitutes.

The market for tinplate is greatly affected by substitutes for tin cans in advanced countries. Substitution is partly a matter of relative prices for the different container materials or methods of supply, and partly a matter of the ability of substitutes to satisfy certain technical requirements. In the metal can market there is competition between tinplate and aluminium, and more recently between these materials and what is called tinfree steel, a chrome-coated steel. Other substitutes for tinplate are glass, plastics, and paper and board. In the food market, the canned product competes with frozen food.

The main penetration of the metal can market by aluminium has occurred in the U.S., where about 7 per cent of the market was held by aluminium cans in 1960. In 1957 there were no aluminium cans. There are no precise figures for the competition

from plastics, cardboard and composites, but plastics at least seem to have threatened tinplate only in the non-food canning industry. Glass is the oldest competitor with tinplate in the container market. Substitution seems to move backwards and forwards without drastic changes in each material's share, although there may be a tendency more recently for glass to lose ground.

Tinplate has been suffering from the competition of deep-freezing in the fish market. Canned fish production has been contracting in most countries because of competition from frozen fish. Deep-freezing has also penetrated the vegetable and meat market. But it is worth emphasising, from the point of view of developing countries, that while frozen food has the advantage of easier and cheaper preparation processes, its storage is more expensive than that of canned food since it requires refrigerated premises. The low incomes of most consumers in developing countries rules out refrigerators, hence the frozen food threat to the home market for canned food is not important.

In spite of competition between the different packaging materials, the growth of the overall market has enabled each material to obtain larger sales, although its share may have fallen. Tinplate may be threatened by aluminium, but aluminium is threatened by plastics and tinfree steel. Each material competes with several others. The size and range of the market

has allowed an increase in the volume of tinplate consumption. Only in the U.S. is there evidence that the market for tinplate has begun to contract, but competition in the U.S. is particularly intense, innovation in the packaging industry is very important, and tinfree steel seems to be making large inroads into the tinplate market. Since tinfree steel is a substitute output for the tinplate producer, the substitutes which concern him as a threat to his business are the others we have mentioned.

The manufacturers of cans, being primarily concerned with serving the packaging market profitably, may produce tinplate, aluminium, or tinfree steel cans, plastic containers, and paper and board containers. They may also produce composite containers. It is a question of the most profitable material and the one which is best suited for the market. The largest companies are multi-material users, carrying on research into the various materials for packaging, developing combinations of materials which combine the merits of each. The tinplate producer, therefore, must exploit the advantages of tinplate in competition with materials produced by the other industries. This involves producing thinner tinplate by reducing the thickness of the steel base, or improving the protective coating on the steel. In the extreme case it has meant switching from the tin coating to a chrome coating. The implications of the technological changes will be discussed in the next chapter.

In developing countries the competition between materials is much less acute than in advanced countries, but it is evident to some extent in Latin American countries such as Chile, Brazil, Venezuela and Argentina. Information, however, about the packaging industry is very incomplete. Many statistics do not distinguish between canned products and other forms of packaged products. Tinplate tends to benefit from the fact that it is a well-established and well-tried container material with a reputation for reliability, for safety in transport and for long-run storage capability. The last point is particularly relevant to developing countries where the shelf life of canned foods is longer than in richer countries. Tinplate is also attractive to developing countries with an export trade in canned food for these reasons. In many cases the production facilities of the packaging industry in developing countries are not adaptable to materials other than tinplate. This can, of course, be changed with new investment, but experience must also be acquired in handling substitute materials.

The conclusion regarding substitutes seems to be that tinplate is not seriously threatened in developing countries. The overall growth of the market in countries where per capita consumption of canned products, or of packaged products in general, is still low, leaves scope for a large expansion of the tinplate market.

Canned food exports

In a number of developing countries the consumption of tinplate is considerably influenced by the export trade in canned food. How large a proportion of the tinplate consumed in these countries is exported in the form of canned food is difficult to determine. Export statistics often do not give sufficient detail. The weight of the can varies from product to product. Using the available data on canned fruit, meat and fish, which account for most exports of canned food from developing countries, we can estimate roughly the amount of tinplate exported in the cans by assuming that the average weight of tinplate per can is about one-fifth of the gross weight. This is appropriate to the normal food can sold for domestic consumption.

As a rough estimate, the Ivory Coast exports about 85-90 per cent of its tinplate consumption in the form of canned fruit. This is probably the extreme case. Morocco exported about 60-70 per cent of its tinplate in the sixties. The corresponding rough estimates for other countries are as follows: Taiwan, 50-60 per cent; Jamaica, 30-40 per cent; Kenya, 25-30 per cent; Argentina, 15-20 per cent; Philippines, 10-15 per cent. In Mexico the percentage is low, around 5-7 per cent. In Chile it is even lower, and in Venezuela it is probably zero, the entire consumption of tinplate being destined for the home market.

The export proportion may be affected by demand or supply changes. It depends on the demand for canned food imports in importing countries, which tends to fluctuate, and where there is strong competition, and also on the supply situation, which may be seriously affected in some years by a bad crop, a poor fish catch, or a drought-stricken cattle population.

Some developing countries have been particularly successful in building up an export trade in canned food. Taiwan's exports of canned pineapple increased from an average of 27,000 tons in 1956-60 to about 86,000 tons in 1965-66. Ivory Coast's exports of canned fruit rose dramaticallyfrom an average of only 2,600 tons in 1956-60 to 18,800 tons in 1966. The growth of Malaysia's exports of canned pineapple have been slower, but the increase of 30,000 tons between 1956-60 and 1966 was second only to the increase in Taiwan's exports.

World exports of canned fruit approximately doubled between 1956-60 and 1965-66. The share of developing countries was about the same in the two periods. Thus in spite of difficulties, the developing countries managed to hold their ground in this important and highly competitive food market.

Tables 8 to 10 show the shares of developing countries in the canned fruit imports of the U.K., West Germany, and France. In 1966-67 developing countries had about one-seventh of U.K. imports, roughly the same share as in the fifties. In West Germany their share varied between one-sixth and one-seventh between 1960 and 1966. In France, a much smaller importer

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than either the U.K. or West Germany, the share of developing countries is much higher, but there were signs of a fall between the early and later sixties. In the chief importing countries as a whole, the share of developing countries is about one-quarter, most of it being canned pineapple from Malaysia, Taiwan, Philippines Ivory Coast and Mexico.

World trade in canned meat grew by about 50 per cent between 1958-59 and 1967-68. The six developing countries in Table 8 , the leading exporters among developing countries, did not as a whole increase their share. The largest exporter, Argentina, had a particularly chequered history. The newest exporters, Kenya and Tanzania, did not maintain their earlier growth rates. Most of the increase in canned meat exports has been in Denmark and the Netherlands.

On the import side there are only three large markets, the U.K., West Germany, and the U.S.. British imports have been more or less static for years, although domestic production of canned meat has been rising. West German and U.S. imports have risen sharply since the fifties. There have been increases in imports into Canada, Belgium, the Netherlands, and Sweden, but their total imports in 1968 were only about 25,000 tons, a little over half of West Germany's imports.

Exports of canned fish from developing countries are a

relatively small part of their total canned food trade, but they are of great importance to Morocco. Exports have fluctuated considerably for both supply and demand reasons. Apart from the sharp growth in Peru's exports in the fifties, there has been no marked upward trend comparable to that of canned fruit exports from developing countries. Changes in the world fish market, notably the frozen fish trade, have clouded the prospects for canned fish exports.

Determinants of canned food exports.

The export trade in canned food of developing countries depends on a number of factors. On the supply side, we could stress the efficiency of agriculture to which we have referred earlier in this chapter. Costs tend to be high in the can-making and canning plants of some developing countries. Imported capital equipment may be expensive because of import duties and high interest rates. Tinplate costs seem to be higher than in advanced countries. Import duties raise the cost of imported tinplate. The can-maker using home-produced tinplate may find that the quality is lower and more variable than in imported tinplate.

On the demand side, the foreign demand for developing countries' exports of canned food is influenced by the following factors: tariff and non-tariff obstacles; preferential treatment

or the lack of it in some importing countries; competition from domestic suppliers in importing countries; the import and export policies of the centrally-planned socialist countries.

Although tariffs may be an important obstacle to developing countries, especially for the cheaper types of canned food, non-tariff obstacles are probably more important. Canned meat, fruit, fish, vegetables, are subject to very stringent health regulations in the major importing countries. Unless a developing country can satisfy these regulations it has no chance of breaking into the U.K. or West German or U.S. markets. Developing countries which aim to exploit potential export markets for canned food must raise their standards of cultivation, animal husbandry, and inspection of canning factories to levels which are beyond those customary on the home market. This is a lengthy process with a delayed pay-off.

Subsidiaries of large international companies find it easier than nationally-owned firms to deal with the complicated regulations of importing countries. The large companies are well-established with brand names in leading importing countries. These brand names give the consumer a guarantee of quality. Brand consciousness is less important in the catering size can market, but price competitiveness is more important there.

Preferential treatment helps a number of developing countries

which export canned food. This can be seen in U.K. imports from Commonwealth countries and in French imports from Ivory Coast, Morocco, and Martinique. Malaysian - U.K. trade in canned pineapple, however, shows that preferential treatment is of diminishing value when a market ceases to grow. Malaysia has been forced to look elsewhere for expanding markets, which have been found in the U.S., Canada, West Germany, and even in some developing countries, such as Aden.

The question of discriminating treatment for the manufactured exports of developing countries has been under discussion for several years. Arguments for discrimination are well-known. So far, discrimination has favoured certain developing countries. The arrangements between the E.E.C. and some associated countries have accentuated the problem of the developing countries which are outside any preferential system. The favoured solution is preferential treatment for developing countries in general by advanced countries. This would increase the competition between the developing countries, but make it somewhat easier for them to compete with advanced countries. As far as canned food is concerned, the decisive factor would be the ability to match the high standards of the canned food market in advanced countries. The developing countries which have gained from preferential treatment have satisfied these standards. Having done so, they benefit from a lower tariff, but it must be stressed that it is

extremely difficult to compete with the highly efficient suppliers in advanced countries.

However important the canned food trade may be for a few developing countries, the main use of tinplate in developing countries as a whole is the production of cans for the domestic consumption of canned products. No developing country in Latin America, Asia, or Africa, with an export trade in canned food, comes anywhere near the level of canned food exports from South Africa, which exported at least 250,000 tons in 1967. None yet equals the canned food exports of a developing country in Europe, namely Portugal, which is reported to have exported 135,000 tons of canned fish and tomatoes in 1966.

Apart from the export trade, therefore, the main influence on the production of cans in developing countries is the level of income. The distribution of income is of some significance, but there is little information which could be used for assessing future consumption of tinplate. There is also little information about the prices of canned food and its substitutes. In the experience of Chile, the price ratio between canned food and fresh food is an important factor in fluctuations in the demand for tinplate, since the prices of agricultural products are subject to sudden changes depending on the supply position and on government policy towards agriculture. It might be expected that uncertainty about the competitive position of canned food would also affect its long-term prospects as well its short-term prospects.

Of the other factors which may be assumed to affect future prospects of tinplate consumption only the growth of population could usefully be brought within any quantitative assessment of the market. It would be impossible to determine the effect of an improved supply of home-produced electrolytic tinplate beyond the judgment that consumption would probably increase to some extent because of the removal of an import constraint. Detailed studies of particular markets would be required to measure the effect of an increased supply of foods suitable for canning.

Chapter 4

The Development of Tinplate Technology

Electrolytic and hot-dip tinplate

There are two methods of producing tinplate. The first is by the hot-dip method, the second by the electrolytic method. Hot-dip production uses the older process. Steel strip from a hot-rolling mill, after being reduced to the desired thickness in the cold-reduction mill, and passed through various preparatory processes, is cut into sheets and fed mechanically into a bath of molten tin, from which it emerges with a tin coating. This coating is evened by passing through rollers, but it cannot be made perfectly smooth.

Until the 1939-45 war the hot-dipping of steel sheet to make tinplate was the only method, although a large amount of research work in Europe and America already offered the possibility of an alternative before the war. As recently as 1960, hot-dip tinplate still made up over 50 per cent of the output of Italy, the Netherlands, and West Germany, and over one-third of the output of the U.K. and Japan. In the U.S., which began to switch to electrolytic tinplate during the 1939-45 war, the production of hot-dip tinplate had fallen to only about 7 per cent

of total production by 1980. There was still a sizeable output of 564,000 tons of hot-dip tinplate in the U.S. in 1960, a tonnage about 10 per cent greater than West Germany's total output in the same year.

The displacement of hot-dip tinplate has been spread over many years, beginning in 1942 with the construction of several electrolytic lines in the U.S.. By 1970 hot-dip tinplate had been reduced to under 5 per cent of world production. In the E.E.C. and the U.K. it was 6 per cent and 5 per cent respectively of production. In the U.S. it had dwindled to less than 1 per cent by 1967, the latest year for which a figure is quoted in the International Tin Council's Statistical Bulletin. The fall in U.K. production of hot-dip tinplate during the last few years has left Japan the largest producer. Production in 1968 was 154,000 tons compared with over 200,000 tons in 1964-64. Half of the 1968 output in Japan was exported.

In developing countries there has also been a marked trend away from hot-dip production. Brazil had switched completely to electrolytic production by 1968. A high proportion of Chile's output is expected to be electrolytic in the near future. Turkey and the Philippines produce only electrolytic tinplate. Electrolytic lines have been built recently, are under construction, or are planned, in Colombia, Peru, Argentina, Venezuela,

Malaysia, and Egypt. Argentina, Taiwan, and Thailand have a small amount of hot-dip capacity. India produced only hot-dip tinplate until recently, but now has an electrolytic line in operation. Mexico still has some hot-dip output, but figures are not available.

The electrolytic process, by which a continuous steel strip receives an electro-deposition of tin while passing at high speed (which can be varied) through a solution of stannous salts, has largely replaced the hot-dip process for a number of reasons. The hot-dip process uses much more tin to coat a ton or a given area of steel. The thickness of the tin coating can be up to six times greater than with the electrolytic process. It has been estimated that the average tin coating of electrolytic tinplate is about 11 grams per square metre, compared with about 25 grams for hot-dip tinplate. The thickness of the coating on hot-dip tinplate cannot be controlled as it can be on electrolytic tinplate. With an electrolytic line it is possible to vary the tin deposition. Tinplate can be produced with a tin coating on only one side. Further, the hot-dip process has the disadvantage that the coating is not as even as it is with the electrolytic.

Although a much thinner coating means a higher risk of corrosion as the result of scratching or penetration of the coating by the canned product, lacquering reduces the corrosion risk to that of hot-dip tinplate for most products. Lacquering, of course, is an additional process which the can requires, but

the gain from a thinner tin coating and other advantages still generally give the edge to electrolytic tinplate.

Continuous tinning of the steel strip has speeded up the production of tinplate with the electrolytic process. It has also been possible to produce electrolytic tinplate in coil form instead of cut lengths. These coils can weigh up to ten tons, but they can be handled more conveniently than the traditional sheets of tinplate. It is important to stress, however, that electrolytic tinplate needs particular care in handling because the thinnessof the tin coating makes it more vulnerable to damage in transit.

Although hot-dip tinplate is now only a small proportion of world output of tinplate, it is still useful for highly corrosive canned products, especially if the state of the market is such that a long storage life is required. In developing countries, the shop turnover of canned food is less than in industrial countries.

Methods of Electrolytic Tinplate Production.

A decision to instal an electrolytic line involves a choice of one of the three types of tinning lines: the vertical acid line, or Ferrostan type; the horizontal acid line, or halogen type; and the alkaline line. The vertical acid line is the most commonly used in Europe, and accounts for about two-

APPENDIX

TABLES

FIGURES

thirds of world production. The fundamental research work was done in Germany, but a number of discoveries were brought together by U.S. Steel, which, in cooperation with Loewy Engineering Company, applied electro-tinning to full-width steel strip in a continuous process at high speed. The halogen line also uses an acid electrolyte, but its method is not the same as the Ferrostan acid line.

Each process has some technological and economic advantages and disadvantages compared with the other, but the prevalence of vertical acid lines suggests that it is believed to have the edge on the others. The lines in India, Brazil, Chile, and Spain are Ferrostan lines.

Until recent years, the minimum installed capacity for the economic operation of halogen lines was 250,000 tons, compared with a minimum of 100,000 tons for a vertical acid line. During the sixties a halogen line with a capacity of 40,000 tons and several vertical acid lines of 30,000 tons were operated successfully. But estimated capacities of lines recently constructed, under construction, or planned, seem to be around 50,000 to 150,000 tons.

With both the vertical acid and horizontal acid lines, the steel strip must be thoroughly cleaned before tinning. With the alkaline line, the electrolyte acts as a cleaning agent, which

simplifies the preliminary treatment of the steel strip. A vertical line provides better control over the tin coating at the edges of the steel strip than does a horizontal line. It also gives better plating efficiencies than the alkaline process. It has a high flexibility of operation, which can be satisfactorily achieved at speeds of between 400 and 600 feet per minute (equal to outputs of 40,000 -150,000 tons). The horizontal line is believed to be the most economical for the production of differentially-coated tinplate. The alkaline line, theelectrolyte of which is not acid, does not corrode mild steel, which makes the construction materials for the line cheaper.

Opinions differ on the relative merits of the three lines. It is worth noting the opinion of a Mexican tinplate expert, justifying Mexico's choice of a vertical acid line.[1] This authority favoured the flexibility of operating speed of such a line, which could be operated initially at low capacities. He also believed that it had relatively low operating costs, was easier to operate than other processes, and gave fewer problems with the electrolyte. The choice of an electrolytic line should be carefully considered with foreign advisers who have extensive knowledge of tinplate technology, and are aware of the problems of developing countries.

Information about the Ferrostan lines in several developing countries was given in papers presented to the Santiago

1. See paper to Santiago seminar by Jose Costaldi Yurioho.

seminar. The Indian line has a rated capacity of 150,000 tons. It is a standard Ferrostan line of U.S.Steel patent, consisting of the normal alkaline cleaning, electro-pickling, coating, resistance-melting and chemical treatment followed by a Trion Oiler. Various modifications, such as additional rectifier capacity, were necessary after the line was commissioned. There were difficulties over spare parts and chemicals, partly due to the shortage of foreign exchange. The dependence of developing countries on imports of foreign components, and their great distance from foreign suppliers can be a problem. This clearly points to an adequate supply of spare parts at the plant in order to reduce the risk of costly interruptions in production.

Discussions on this and other lines in developing countries led to a general conclusion at the Santiago seminar that the turn-key method of installing tinplate facilities in developing countries was to be avoided, if possible, although it seemed a straightforward way of setting up a plant in a developing country which was relying heavily on foreign consultants, foreign equipment, and probably foreign money.

The arguments against the turn-key method were as follows: the use of local knowledge and resources economise on foreign expenditure; opportunities are available to make changes in d design and layout of a plant to suit local conditions; local personnel will find it easier to operate a plant in the building of which they have participated.

Recent Innovations: Double-reduced tinplate.

There have been two major innovations in the steel industry affecting tinplate in the sixties. The first was double-reduced tinplate; the second was the replacement of the tin coating by a chrome coating, the so-called tinfree steel, the result of many years' research and development.

So far, neither innovation has been introduced into a developing country. Brazil has plans to produce double-reduced (DR) tinplate to meet the demand for thinner gauges. The planned third Ferrosten line in Brazil can be changed to a tinfree steel (TFS) line.

The development of DR tinplate has been a response to competition from aluminium. The tin coating is not affected, but the steel base is much thinner. Tinplate gauges have been falling for many years in response to the can-makers' desire for the thinnest tinplate possible. DR tinplate represents a sharp advance in this process, with the result that the weight of a given area of tinplate has been greatly reduced. In the U.S., which was the first to produce DR tinplate, it is defined as tinplate with a weight of 60 lbs or less per base box, compared with an average of about 90 lbs per base box of conventional tinplate. In the U.K., before the adoption of DR tinplate, the average gauge sold was reduced from 0.0106 in. in 1955 to 0.0097 in. in 1966. The lowest gauge in the U.K. until

recently was 0.0066 in. used increasingly in the expanding canned beverage market. The use of DR tinplate would allow a reduction in the gauge to 0.006 in.. In the U.K., DR tinplate would be cheaper to make than conventional tinplate only if the gauge were below 0.007 in,. As the gauge is increased, DR tinplate becomes progressively more expensive and hence uncompetitive with conventional tinplate. As a British expert has pointed out, "Gauge reduction will become of paramount importance in the economics of substitution at heavier gauges".[1] If it were possible to make DR gauges above 0.0066 in. viable, and users adapted their processes to them, DR tinplate would penetrate both the beverage and the food markets.

The technique of making DR tinplate is described as follows in a recent "British Steel" article.[2] "In the conventional process steel is rolled to its final thickness, annealed, temper-rolled, and tinned. In the double-reduction process, the steel is rolled, to an intermediate thickness, annealed, and then, instead of temper-rolling, (2 per cent reduction), it is rolled to a substantially lower final gauge (double reduced), and tinned." The article goes on, "The product, branded as DR tinplate, is not fully annealed, and is consequently stronger than conventional tinplate. Thus we have a process which is not only a cheaper way of making thin tinplate but as a bonus gives a stronger material. And because it is stronger, it encourages

1. 'Breakthrough in the Tinplate Business', J.A.Cockburn. British Steel Quarterly Review, March 1969.

2. J.A.Cockburn, op. cit. The section on D.R.tinplate in this chapter relies heavily on Mr. Cockburn's succinct account in the article referred to above.

the can-maker to make use of thinner material than he could previously consider. The can-maker's incentive to use DR tinplate is the opportunity of reducing his tinplate costs, and it is only fair to add that he must be prepared to make changes in his own techniques to gain the greatest benefit. This is because DR tinplate is stronger, springier, and more directional than conventional tinplate and it must be allowed for by modifications in can-making technique."

Currently, DR tinplate is used for beverage cans. It is most suitable for cylindrical can bodies. In developing countries, where the beverage can market is very small, DR tinplate is premature, but Brazil apparently has a large enough market to justify production. Apart from the need for a large enough number of high-income consumers, it is a question of taste for canned beverages. This has developed more slowly in Europe than in North America. As far as the canned food market is concerned, there is a technical problem for DR tinplate. Whereas in the beverage can the carbonation pressure helps to support the can, in the food can there is a vacuum, which has the reverse effect on the can.

Tinfree Steel.

TFS has been developed chiefly in Japan and the U.S., but all the major steel producers in the advanced countries are carrying out research into it. So much work is being done in

the field of TFS material that only a short-term report can be given of the situation, which will change as fresh results emerge from the various research and development programmes. The following analysis is based on a paper presented by Dr Gerd Haeusler to the Santiago seminar.

TFS may be defined as a chromium-plated black-plate, which is the end-product of a steel strip led in coil form through cleaning baths and surface-treatment baths, from which it emerges with a surface coating of varying composition of metallic and oxide chromium and phosphates, depending on the process. It may be referred to as CCO (Chromium-Chromium Oxide) TFS, or as CPT (Chromium-Phosphate-treatment) TFS.

Depending on quality and method of production, TFS has an appearance which may be blue-grey, shiny grey, brown grey, or silvery grey. The surface appearance depends on the roughness of the steel strip, and on the varying amount of metallic and oxidic chromium as well as the presence of phosphates. The surface thickness is much thinner than that of electrolytic tinplate. The chromium coating is only one-tenth of the thickness of the coating on electrolytic tinplate with the smallest coating weight of 0.25 lbs per base box. To be a successful product TFS must satisfy the usual essential requirements for tinplate, namely, optimum resistance to corrosion, the minimum number of pores, ease of shaping mechanically, very good lacquer adhesion, and optimum efficiency in production. It must look attractive

to the consumer.

A key element in producing TFS is knowledge of the way in which the relative amounts of chromium oxides and chromium metal vary with the bath composition. Another important point is whether the chromium deposition comes from alkaline or acidic solutions. Corrosion tests have shown that the corrosion resistance of TFS depends essentially on the amount of chromium oxide in the coating, the relationship between corrosion resistance and chromium oxide content being directly linear. Since other properties such as lacquer adhesion decrease with an excessive oxide layer, it is necessary to find an optimum from the point of view of the different requirements.

TFS is very vulnerable to scratching. In contrast to the surface resistance of tinplate, any scratch on the TFS surface finish will make the area affected sensitive to rust or corrosion. Tin coatings or aluminium provide an "active protection against corrosion" because they "co-react" in the process of corrosion as sacrificial anodes. TFS coatings, on the other hand, give only a "passive protection" against corrosion. The vulnerability of TFS to scratching and subsequent corrosion points to the prime importance of careful handling.

Chromium-plated materials have a better adhesion for the types of lacquer used in the packaging industry than is usually the case with tinplate. But it should be pointed out that lacquer adhesion is considerably reduced by fingerprints on the plain TFS surface as the result of the manual feeding of sheets into coating and printing machines. This problem would be overcome by fully-automatic equipment. Because of the excellent adhesion properties of TFS, normal lacquers without deep-drawing qualities may be used on TFS plate for the manufacture of deep-drawn containers. Cans of identical specifications made of tinplate and TFS plate proved that tinplate cans had greater porosity and lacquer removal in the areas which had been subjected to mechanical stress. Excellent lacquer adhesion of TFS was one of the reasons for its application to crown corks, since lacquer adhesion is of prime importance for this product.

Considerable attention has been devoted to coating systems which will give as attractive an appearance as possible to TFS, which lacks the bright surface appearance of tinplate. More printing may be required on TFS in order to achieve the same effect as on tinplate. On the other hand, TFS has an advantage in that it is suitable for much higher lacquer baking temperatures. The melting point of tin (232 C) limits the baking

temperature, with the result that relatively long baking times of 10 to 12 minutes are needed for polymerizing lacquers. With TFS, provided adequate equipment is available, the baking of coatings may be done in a much shorter time at temperatures of around 350° C.

Conventional body manufacturing processes by soldering cannot be applied to chromium-plated materials. It has been necessary to adapt alternative methods already used in the packaging industry - welding, gluing, lock-seaming and cementing with side-seam cements - to the characteristics of TFS. The problems involved in welding by conventional methods have not yet been satisfactorily solved for commercial production. Welding is practicable if the chromium/chromium oxide layer at the relevant point is removed, but this raises difficulties by the loss of the protective function of the original surface finish on the can. It is necessary, therefore, to find an efficient coverage for the sensitive side seam.

Product Compatibility of Finest Steel.

A vast amount of research has been carried on, and continues, into the compatibility of TFS and the products of the packaging industry. In all cases of food packaging, the overriding considerations are the stringent food regulations in the interests of public hygiene. The results of tests which have been carried out may be summarised as follows.

Chapter 1

Introduction

Tinplate is one of the most sophisticated products of modern industry. Its manufacture is usually one of the last stages of development of a country's steel industry. Most tinplate is used for tin cans, in which are packed a very wide range of edible and non-edible products. The tin can itself is an advanced, if apparently simple, manufactured product.

The use of tinplate for canning dates from the early nineteenth century. Prior to the discoveries which made canning possible, tinplate was used for a number of industrial products in which steel required the protection of a tin coating. The range of products for which tinplate is used, other than for cans, is extremely wide, since many new uses have been developed over the years. Examples are automobile oil and air filters, gas meters, ashtrays, thermos flasks, biscuit tins, flashlamps, and decorated waste baskets.

The technology of tinplate production has changed enormously as the result of both major and minor innovations. Originally it was a slow process. Steel sheets were dipped in a bath of tin and out by hand. In the early nineteenth century an operator could shear 25 base boxes a day. (A base box is a standard unit of measurement in tinplate production, being 112 sheets 14in. by 20in., with an area of 31,360 sq. in.) The speed of shearing was raised by

1. Meat products. TFS cans (two-piece, drum cans, coated on both sides) are suitable for the packaging of meat, with no serious corrosion during storage. With spiced products, however, damaged coatings must be eliminated to avoid contact between the product and iron.

2. Fruit. Because of its different electrochemical performance, TFS behaves differently from tinplate in contact with acidic products. In the present state of technology, TFS cannot be used safely unless an adequate inside coating provides a reliable coverage against the product. The normal roller coating does not generally provide a film on the steel base free from pores and scratches. Tests have shown that in all cases of corrosion in TFS cans, damage to the coating from the conversion of the plate into cans has been found to be the cause of corrosion.

3. Fish. TFS cans have proved practicable for some fish products, such as tuna fish and herring. But if the fish product is aggressive, TFS can only be used if the inside coating is adapted to the product, and pores and scratches in the coating film are avoided during drawing. Semi-preserved fish products which contain a large proportion of acetic acid, citric acid, or salt and preservatives, cannot yet be packed in TFS cans because of the low resistance of TFS to high acid, corrosive products.

4. Beer and beverages. The biggest gains by TFS during the last two or three years have been in the beer and soft drink market. If the cans are either welded of lap-glued, tinplate is not necessary for the whole can. The bottom end is made of TFS, the top end of aluminium. The aluminium top performs two functions: it makes for easy opening and it offers anodiaicprotection against potential iron pickup from the other can materials. Comparatively acidic carbonated beverages may be packed in TFS products. The reason for this compatibility of TFS with an acidic product is that the beverage cans are spray-coated, which covers practically all pores, and they are not sterilised. Potential corrosive reactions may be expected chiefly with higher temperatures.

5. Other foods. TFS is compatible with dry products like coffee and biscuits, provided there is an adequate inside coating.

6. Non-edible products. With these products, the constraints imposed by food regulations are absent. In general, it may be said that TFS is an alternative to tinplate if the cans may be produced on existing equipment. If the manufacturing process avoids scratching, TFS may be used even in the plain condition for such products as oil, lubricants, and solvent-based paints. If cans with welded bodies are required, the protective surface finish must be removed and then the area must be protected against corrosion by atmospheric influences outside and by the

product inside the can. As far as water-based paints and varnishes which are highly alkaline are concerned, TFS is superior to tinplate because it avoids the possible reaction with the tin surface leading to lacquer removal. TFS should not be used for acidic products such as paint remover. It is widely used for battery shells. It is likely that TFS will become important for the manufacture of aerosol cans.

Some Economic Aspects of Tinfree Steel.

Ultimately, the extent to which TFS encroaches on the tinplate market will depend on economic considerations. It may be assumed that the material accounts for 50 to 80 per cent of the selling price of the container, depending on the container specification. The material cost is of course higher for an unprinted unlacquered container than for one treated outside and inside with multi-print and special lacquers.

It is difficult to make valid comparisons between TFS and tinplate since the cost position varies from country to country. TFS is produced on installations similar to those for the production of electrolytic tinplate, and electrolytic lines can be converted to TFS production. The preliminary treatment - degreasing, cleaning, and pickling - are essentially the same for TFS and tinplate. The difference begins with the depositing process on the surface coating. Baths of different composition are used, based on chromic acid or alkali chromates. An important

cost factor is the amount of current needed for the process whereby the chromium compounds are separated. The current-efficiency of chromium plating, especially for the larger coating thicknesses, is considerably lower than that for tinning. Differences in energy consumption and in line speed, which may have to be reduced with chromium plating because of low current efficiency, are important factors to be taken into account in assessing relative costs. From the customer's point of view, lacquering costs are an important consideration in comparing TFS and tinplate, especially in an additional lacquering process is required with TFS. This depends on the use. The general view seems to be that the economics of TFS are still complicated, but it is expected to make headway against tinplate, irrespective of the movement of relative costs. The technical advantages of TFS are a guarantee that it will be exploited as a rival to tinplate, and to aluminium. But it is not yet to be regarded as a uniform substitute for tinplate. Its product capability needs much further study before it reaches this position. Since there are different kinds of TFS material, countries which do not have their own production facilities and which import TFS will probably need supplies of differing specifications. These will have to be tested individually with regard to the lacquers to be used and the products to be packed.

The impact of technological change on developing countries.

The first electrolytic lines in developing countries were installed in Brazil and Mexico during the mid-fifties. Both countries already had experience of hot-dip production, but new techniques had to be mastered in order to make a success of electrolytic production. Brazilian experience of its first electrolytic line has been described by J.B.Araujo in the following terms:"The start-up of the complex electrolytic coating line was not easy, but as the equipment problems were solved, it became obvious that the quality requirements for the steel strip to be coated by electrolytic process were far more demanding than the quality requirements for the sheets which were hot-dip coated. Defects such as box annealing oxides, rust, slivers, scale and roll marks which were covered by the hot-dip process could not be tolerated in strip for electrolytic coating." [1] Araujo states that the quality of Brazil's electrolytic tinplate was gradually raised by improvements in equipment, operation, and quality control through the entire process sequence of hot rolling, continuous pickling, cold reduction, cleaning, annealing, temper rolling and electrolytic coating.

Great importance must be attached to quality control in tinplate production. This should be clear from the fact that most tinplate is used to pack foodstuffs. The steel base is

1. See paper to the Santiago seminar by João Batista Araujo.

separated from the contents of the can, which may be highly corrosive, by only a minutely thin coating of tin covered by lacquer. As Araujo has pointed out, the hot-dip process allowed much greater latitude for imperfections in the steel base than did the electrolytic process. Moreover, since the tin coating was thicker, there was less risk of damage which would penetrate the tin to the steel base. In order to obtain the benefits of electrolytic production, a greater degree of skill and care was required from the labour force.

It has been necessary to pay great attention to manpower training in preparing to undertake the production of electrolytic tinplate in developing countries. Indian experience has shown that this should be done well in advance of the commissioning of a plant, and that the personnel chosen for training should already have acquired some practical industrial experience. The mistake was made of sending personnel fresh from college for training on hot-dip facilities, prior to the commissioning of similar facilities in India. Lack of previous experience showed up in the time it took to bring them to a reasonable pitch of efficiency. This mistake was avoided when the first electrolytic line was commissioned. Even so, there was for a time a high rate of rejects at certain stages of production, which the foreign commissioning team attributed to lack of experience among workers.

It is often difficult in developing countries to match the quality control standards in tinplate production which are customary in industrial countries. Apart from the need to train the quality control staff in the best techniques, it is essential to install the philosophy of high industrial standards into the labour force generally. This is clearly important with an advanced technology like electrolytic tinplate production. Such a technology also requires adequate investment in equipment and other facilities for metallurgical and quality control staff.

At the recent Santiago seminar there was considerable discussion of the problems of switching from a lower to a higher technology in tinplate production. These arose when electrolytic capacity replaced hot-dip capacity. In Chile the steel company mounted a carefully-prepared promotion campaign before launching its first electrolytic tinplate on the market. Customers had been used to tinplate with a thicker tin coating and were somewhat apprehensive about the technical problems which they would have to master before they could use electrolytic tinplate successfully. Their can-making and canning machinery, and their methods of handling tinplate were adapted to handling hot-dip tinplate. It was necessary to supply them with information about the lacquers and lacquering processes which were appropriate to electrolytic tinplate.

The tinplate producer took responsibility for the campaign, which included practical canning tests for small-scale canners lacking the equipment to carry out the tests themselves. Customers were given guidance on the types of tin coating, with or without protective varnishing, for different canned products. They were also advised about the handling of electrolytic tinplate and of containers made from it. A fuller account of the programme is given in the paper by D. Vucetich.

A similar campaign was organised in Spain to prepare the way for the output of the country's first electrolytic line. It was considered essential to obtain a quality of tinplate similar to that already available to the user from European exporters. Before the final tests on the new line, a quantity of prepared sheet was sent to the U.K. and West Germany for electrolytic tinning. The result was a complete overhaul of the company's operating practices for pickling, rolling, degreasing and tempering its steel strip, in order to obtain a better steel base for subsequent tinning.

The difficulties which developing countries have often encountered in setting up new industries or in introducing new technologies from more advanced countries have sometimes led critics to argue that they try to push their industrial development too fast. This view has produced the rejoinder that it

is equally a mistake for developing countries to take on techniques which are becoming dated, since this will merely perpetuate their technological backwardness. The debate is relevant to policy-making affecting tinplate.

The steel base for tinplate is the product of a strip mill which produces other flat steel products such as galvanized sheets. Many developing countries have the home demand for a home steel industry, including a strip mill. If they can produce flat steel products, there is a case for using part of their output to produce tinplate, which will diversify demand, and possibly make demand more stable. It is necessary, of course, to bear in mind that the competing demands for steel strip from the mill have to be balanced.

As far as the choice between hot-dip and electrolytic tinplate is concerned, there appears to be little interest in building new hot-dip units, although there is not yet absolute unanimity that only electrolytic capacity should be installed. Discussions at the Santiago seminar led to the view being expressed that countries with an annual consumption of less than 20,000 tons might be justified in starting off with the smaller capital investment involved in hot-dip capacity. Opponents of this kind of investment were very strongly critical. They emphasised that since an electrolytic line involved quite a

technology quite different from that of hot-dip production, it was a mistake to start off with the latter, particularly as the replacement of hot-dip by electrolytic capacity had gone so far in most countries, developed or developing. In their view it was better to begin with a method of production which had proved its superiority by its general acceptance. The various technical points have been mentioned earlier in this chapter.

There is certainly still a market for hot-dip tinplate, as the production figures of advanced countries show. Although it is now only a small proportion of world tinplate production, a proportion which is still falling, the combined hot-dip production of the E.E.C., the U.K., and Australia in 1970 was still the sizeable figure of 265,000 tons. How much hot-dip tinplate is imported by developing countries cannot be determined from the available data. How much individual countries need depends on the nature of their food pack. Developing countries with a tinplate consumption of less than 20,000 tons can certainly avoid a large capital investment by installing hot-dip units, but unless this low level of consumption is expected to increase quite quickly, it is debatable whether any tinplate capacity at that stage is justified. The view at the Santiago seminar was that a consumption of under 10,000 tons was too low for any domestic production. Both Turkey and the Philippines had

of cans. The can-makers, therefore, are involved in technological changes. Research by the canning industry has led to a wide range of products which could be safely and economically packed in cans.

The growing popularity of canned food and other canned products in the present century has led to a widespread increase in tinplate consumption and production. The tin can has become an ubiquitous product in all industrial countries. Food may be safely transported and stored for long periods. Food cans recovered from Scott's Antarctic expedition of 1911 were opened in the Tin Research Institute, London, in 1957, and found to contain food in an excellent state of preservation. For the ordinary consumer, the food can has meant a great improvement in the standard of living. In fact it may well be said that "tinplate widened the world for living in the same sense that wood, skins, pottery, metals, glass, and other raw materials had done".[1]

Since tinplate and the tin can are such common products of the industrial countries, it is to be expected that demand for them will grow in the developing countries. As elsewhere, their use will mean an advance in food hygiene and storage. The growth of industry in these countries will require more cans for lubricants, oils, and paints. Other uses of tinplate will expand, although as in the industrial countries, they will be small compared with with the requirements of the can-makers.

1/ E.S.Hedges, "Tin in Social and Economic History", London, 1964. P. 161.

considerably exceeded a consumption of 80,000 tons when they began producing tinplate. Turkey's imports in 1964 were about 40,000 tons, the Philippines' imports in 1961 were 60,000 tons. The most recent producer, Colombia, had been importing over 25,000 tons every year, except one, since 1959. Chile, however, started as a producer, admittedly during a period when there were steel shortages after the war, at a consumption of only 10,000 tons.

The question naturally arises in a contemporary discussion of tinplate technology, of the relevance of DR tinplate and T/S for the steel industry of developing countries. Both innovations have come on the scene at the time when many developing countries are building or thinking of building an electrolytic line. Both are a response to the highly-competitive situation among packaging materials in advanced countries. This situation is not reproduced in developing countries, certainly to anything like the same extent, but the cheaper they can make metal cans the better for their can-makers and canners.

Much depends on the structure of a developing country's can pack, since T/S has not yet been confirmed as compatible with some products. While its economics remain uncertain, even in advanced countries, this is another reason for not taking it up quickly. It is possible to convert an electrolytic line to

produce TFS if it becomes economically worthwhile. There is no question of writing off an option by committing resources to an electrolytic line.

Apart from the limited size of the beverage can market in developing countries, there are technological reasons for caution in taking up the production of DR tinplate. It requires changes in the can-maker's methods of production since it needs new techniques. It may also create problems for the tinplate producer since it is technologically more advanced than conventional tinplate.

Chapter 5

The Economics of Tinplate Production

Capital costs

The estimated capacities of the electrolytic lines in operation, under construction or planned throughout the world range from about 40,000 tons to 250,000 tons. Typical lines have a capacity of around 100,000 tons to 150,000 tons. Generally they are flexible and can be successfully operated at well below their top capacity. A line may be designed initially for, say, a capacity of 40,000 tons, but there will be provision in the plan for raising its capacity, as was done in Mexico when it planned its first vertical acid line. For a line of such a capacity, going up to around 100,000 tons, the cost of the equipment would have been about U.S.$ 5 millions in 1970. This figure excludes many other cost items such as the cost of laying on an electricity and water supply, laying the foundations for and erecting buildings, and installing the equipment. These costs may be roughly estimated as equal to half the cost of the equipment. Much of them would probably be incurred in local currency, whereas the cost of the equipment for the line would involve foreign currency expenditure. Some developing countries could provide part at least of the auxiliary equipment. Additional expenditure would have to be allowed for in providing facilities for preparing the steel before tinning and for shearing the tinplate. These costs would also involve foreign currency.

Illustrations of capital expenditure on several electrolytic lines are given below. Comparisons between these lines can be only rough because the cost data do not refer to precisely the same items of expenditure.

For the first Spanish line, a Ferrostan line, with a rated capacity of 100,000 tons, a breakdown of capital costs was given in a paper to the Santiago seminar. Excluding costs for construction work, patents, technical assistance, and an electricity supply, the line cost U.S.$ 5 million.

Allocation of costs for first Spanish electrolytic line.

	Percentages
Civil engineering work	4
Non-electrical equipment	48
Electrical equipment	30
Assembly of non-electrical equipment	5
Assembly of electrical equipment	5
Auxiliary and laboratory equipment	3
Project engineering studies	2
Miscellaneous	3
Total	100

For the second Spanish line the figure quoted is US$ 20 million. This line will have a capacity of 150,000 tons. The cost includes a two-stand temper rolling mill, a preparation line, a tinning line, and some modifications to existing equipment.

The total cost of Chile's first electrolytic line, also a Ferrostan line, was US$10.5 million. This line has a capacity of up to 120,000 tons. Potential output per hour for different coating thicknesses is as follows: 1 lb coating - 10 tons; 3/4 lb coating - 13.5 tons; 1/2 lb coating - 18 tons; 1/4 lb coating - 25 tons. For differential coating, say, 1/4 lb-1/2 lb coatings, the line's capacity would be rated according to the heavier coating.[1/]

The first Venezuelan line, due to be built in the early seventies, is estimated to cost about US$11 million, inclusive of the cost of related facilities. Reported capacity is about 108,000 tons. Import expenditure associated with the line is put at US$8 million, to be incurred for the following items: a coil preparation line, an electrolytic and chrome plating line, supervision of installation and start-up, plus some unspecified items. A figure of US$11 million is also quoted for the planned third Brazilian line. A recent estimate for the latest UK line, still under construction, is US$17 million, including expenditure on related facilities. All these estimates are considerably influenced by differences in local labour costs.

1/ Data on Chile in this chapter supplied by William Bray, UNIDO Field Expert, and John Charles McCullagh, UNIDO Special Fund Project Manager.

A hot-dip unit is a much less costly installation. The equipment of a small unit would cost about U.S.$ 200,000,, for which, plus the cost of related services, it would be possible to produce at least 5,000 tons per annum. The relative merits of the two methods of production have been discussed in the preceding chapter.

Labour requirements.

The experience of the U.K. and Chile will show the differences in the labour requirements of hot-dip and electrolytic production. In 1939, when U.K. production was entirely hot-dip tinplate, a labour force of about 25,000 was needed for an output of 929,000 tons. In 1970 a labour force of about 3,250 produced 1,250,000 tons, of which 94 per cent was electrolytic, and the rest hot-dip tinplate. To put it another way, tinplate output per man in 1939 was 37 tons, in 1970 384 tons, a more than tenfold increase in labour productivity. Capital cost of the equipment,of course, was much greater with such an increase in labour productivity. Details of the position in Chile are as follows; for a monthly rate of output of electrolytic tinplate amounting to 2,800 tons, the work force per shift is one general foreman (day shift only), one turn foreman, 12 operators (including 2 tin bar casters and 2 scannor operators 3 men in the metallurgy department (2 in the laboratory and one on the line). By contrast, if the 5 hot-dip machines were in operation

and producing about 2,000 tons a month, the work force per shift would be one foreman, 20 operators, 2 tractor drivers, 18 sorters (all personnel in the sorting room are women who inspect both the hot-dip and the electrolytic tinplate).

Operating Costs.

Operating costs on Chile's electrolytic line have been stated to be as follows:

	U.S.$ per ton
Cost of producing material to entry of line	208.64
" " " " " exit from line	294.53
" " production on shear line	5.76
" " producing tinplate from raw material to finished product ready for shipment	315.64

A comparison of this cost with the average value of U.K. tinplate exports in the first four months of 1971 shows that Chile is at a considerable disadvantage. The figure for the U.K. was about U.S.$ 240 per ton. These results can be regarded only as a rough comparison, but it seems to be clear that the small-scale producer cannot match the costs of the large steel producers in the industrial countries. Some idea of comparative prices in the industrial countries is given in the following table. These prices, quoted from a British Steel Corporation statement in "Tin International", are for a Standard Area of Tinplate (SAT) of 100,000 sq. in., excluding delivery costs, and relate to orders of 25 tons for

hot-dip tinplate and of 50 tons for electrolytic. From these figures it will be seen that hot-dip tinplate costs about 20 - 30 per cent more than electrolytic in industrial countries. The U.K. was easily the cheapest country for hot-dip tinplate and slightly the cheapest for electrolytic.

	£ sterling per SAT[1]	
	hot-dip 28"x20"x0.0118"	electrolytic 28"x23"x0.0099"
U.K.	14.754	11.913
U.S.A.	19.731	14.150
West Germany	17.700	13.532
Belgium	17.608	14.321
France	16.069	12.051
Italy	15.743	13.583
Netherlands	15.914	12.369

1. Reported in "Tin International", October, 1970.

According to the cost data of the Chilean line, the cost of the material supplied to the line is about two-thirds of the ex-factory cost of tinplate. The latter cost may be reduced by cutting the gauge of the steel strip, the cost on the electrolytic line by reducing the thickness of the tin coating. Some countries produce more tinplate in the higher coating ranges than others simply

because a higher proportion of their can pack consists of products which need the protection of a thicker tin coating.

There are certainly big differences in the tin percentages by weight of tinplate between countries. To some extent these differences are due to thinner steel gauges in some countries than in others. In the former a given quantity of tin will cover a larger quantity of tinplate. Brazil has the lowest percentage, 0.44 per cent in 1968. In the U.S. it was 0.52 per cent. Before Chile commissioned its electrolytic line the tin percentage was 1.3 per cent. This figure will fall sharply as the proportion of electrolytic tinplate in total output rises. It has been falling elsewhere for many years. Currently, approximately 90 per cent of Chile's output is 1 lb coating.

The tin cost per ton of tinplate can vary considerably as the result of fluctuations in the price of tin. In the U.K. it is roughly 10 - 11 per cent of the cost of electrolytic tinplate. If the cost of the steel base is excluded, the tin cost rises to about one-third of production cost on the line. The incentive to reduce the tin coating reflects the steel producer's desire to give the can-maker and canner a cheaper container material, without affecting the efficiency and attractiveness of the material. Fluctuations in the price of tin and uncertainties about the long-run supply of tin have also been important factors in the reduction of the tin coating.

The difference in price between hot-dip and electrolytic tinplate means an important saving to the can-maker. According to G.

Habenicht, the tinplate cost may be as high as 80 per cent of the cost of the can. For typical cans produced in the U.S. the tinplate cost, according to J.R.McKie, is about 72 per cent of the can cost.[1] For non-food cans the ratio is somewhat lower than it is for food cans. Naturally the ratio of the tinplate cost to the cost of the canned product is much less, but however small it would not be regarded as insignificant by the canner. McKie's figures, referring to the wholesale price of the canned product, were 20 per cent for tomatoes, 20 per cent for corn, and 10 per cent for peas. With canned fruit, which is a higher value product, the cost of the tinplate is a smaller proportion of the cost of the canned product. All these ratios are further reduced by using the retail price of the canned product. According to some recent British data, the tinplate cost is about 10 per cent of the retail price of aerosols, but only 2 -3 per cent of the cost of tobacco and paint cans. After a thorough study of the U.S. market McKie comes to the conclusion that " the price of tinplate is a vital factor for the market levels that lie between it and the consumer". This is the general view in industrial tinplate producing countries.

The steel producer is naturally anxious to protect the tinplate market from encroachment by other forms of packaging. This means protecting the market for steel, whatever may be the coating. In a highly competitive situation such as prevails between steel producer, can-maker, and canner in the U.S., the steel

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1. J.R.McKie, Tin Cans and Tinplate.

The object of this study is to examine the development of the market for tinplate in the developing countries, its prospects in these countries during the seventies, the factors which are likely to influence consumption and production, and the problems involved in the introduction of advanced and changing technologies in developing countries. The study relies partly on the papers and proceedings of the Santiago seminar on tinplate production in developing countries.[1]

1/ "Tinplate production in developing countries", Report of the Seminar held in Santiago, Chile, 9-13 November, 1970. This Report contains a full list of the papers presented to the Seminar.

producer has been under strong pressure to cut production costs. Apart from using less tin and reducing the gauge of the steel strip, the producer can make savings if there is greater standardisation of tinplate and can sizes. This depends on the customer, the can-maker and the canner. Experience in India and Spain has shown that the benefits of electrolytic lines cannot be fully realised if they are required to supply too diversified a market. Some Indian tinplate fabricators are reported to have created problems for the tinplate producer by their use of different types of equipment obtained from different countries. This has led them to insist on being supplied with a large number of tinplate sizes, with the result that the tinplate producer has run into problems of production planning. In Spain too the can-makers and canners are reported to have caused difficulties for their supplier by insufficient standardisation. The tinplate producer suffers from short production runs, diversification of output, and low plant utilisation.

To some extent these difficulties arise from differences between the organization of tinplate manufacture and that of can-making and canning. Tinplate production is a part of the steel industry, which is carried on by large organisations, large relatively to other business units in developing countries. Customers are scattered, and, unless subsidiaries of large international companies, liable to be inefficient and technically backward, requiring modernisation of plant and layout, as well as improved managerial skills. In Spain, for example, the short duration

of work in the canning seasons reduced the incentive for modernization. In the fifties and early sixties, however, there was a large increase in the demand for cans which stimulated modernization of the can-making and canning industries, and also led to some closures of can-making parts of canning factories.

In most developing countries there is likely to be a problem of transport costs for tinplate producer and his customers. The size of the tinplate market is not usually sufficient to absorb the output of more than one or two electrolytic lines. Since tinplate often has to be carried long distances by road or rail on an inadequate transport system, there is a risk of damage to the tin coating. Electrolytic tinplate is particularly vulnerable to scratching in transit. This is also true of TFS.

It is also worth emphasising a point which attracted attention at the Santiago seminar, namely, the importance of an adequate supply of spares. This obviously involves locking up capital in equipment, but experience has shown that it is essential to the smooth operation of a plant. Developing countries are usually far from the countries which supply the equipment for a line. They are short of foreign currency and it is never easy to squeeze out funds for spares at short notice from government departments. Commenting on the disastrous experience of some Indian plants, the chairman of the Indian Iron and Steel Company recently pointed out that "the very best maintenance engineers would not be able to maintain

a plant properly if essential spares, accessories, and implements were not made available to them in proper time".[1/]

1/ Statement in annual report for 1970.

Chapter 6

Prospects for the Second Development Decade

Consumption prospects

Between 1955 and 1965 the trend rates of growth of tinplate consumption among a group of the chief developing countries ranged from 2.7 per cent to 20.9 per cent. One developing country, Argentina, was actually on a downward trend, but if the export use of tinplate is excluded by the rough calculation already mentioned, there was some growth of consumption for purely domestic purposes. Apart from Argentina, in every developing country listed in Table the increase in consumption was greater than the increase in per capita G.D.P. Levels of per capita consumption in 1967 varied from 0.5 lbs. to 17.6 lbs. Excluding Venezuela, the country at the top of the scale had a per capita consumption about twenty times greater than that of the country at the bottom of the scale.

Some rates of growth were so high between 1955 and 1965 that it is difficult to envisage their continuance throughout the present decade. Certainly they were not maintained up to 1970 in Taiwan, the Philippines, Peru, and Venezuela. In each of these countries the level of consumption at the end of the sixties was well below what would have been expected on the basis of the previous trend. The opposite is true of Brazil and India, each of which had a relatively low rate of growth of consumption between 1955 and 1965.

Several countries gave forecasts of their consumption to the Santiago seminar. Chile estimated about 65,000 tons by 1975-76, compared with an average of 34,000 tons in 1966 - 70. An estimate for Mexico was 270,000 tons by the mid-seventies, compared with 170,000 tons in 1970. Brazil's future expansion programme included a fourth electrolytic line to meet an undated future consumption of 600,000 tons. For a country with a per capita G.N.P. of only U.S.$240 in 1966 and only a small export trade in canned food, Brazil's per capita tinplate consumption was relatively high in 1967. A number of countries with per capita incomes of around U.S.$ 200-300 have reached the 2 to 3 lb. level. Chile and Mexico, which are considerably higher up the income scale, have a substantially higher per capita tinplate consumption than Colombia, Peru, or Turkey. At the bottom of the scale are the poorest countries, including India, Pakistan, Indonesia, and a large number of smaller countries, which have a per capita consumption of less than 1 lb., or certainly not much above that level.

As a rough guide for policy-making, it might be useful to take these levels of per capita G.N.P. and tinplate consumption for diferent developing countries rather than rates of growth in each case, assuming that canned goods are likely to become a universal consumer good and a typical object of expenditure like, say, the

transistor radio. Among the Latin American countries listed in Table differences in G.N.P. per head were found to explain 75 per cent of the differences in per capita tinplate consumption. Broadly speaking, countries moving up from one income level to another might expect that their demand for tinplate would approximate to that of countries already on the higher income level. This implies that countries like Colombia, Peru, and Turkey, might reach the 6 lbs per head level once they reached the U.S.$ 500 level of per capita G.N.P. In fact, Mexico had a per capita tinplate consumption of about 3.5 lbs. in the mid-fifties when its per capita G.N.P. was at the level reached by Colombia and Peru in the mid-sixties. Countries much lower down the income scale, like Thailand, might increase their tinplate consumption to the level reached by Colombia and Peru. In each case a country's experience would be affected by factors other than money incomes.

The prospects for tinplate consumption in the developing countries with a substantial export trade in canned food naturally depend on the growth of world imports, and on the success they have in maintaining or increasing their share of trade. Between 1958 and 1966 imports of canned fruit into the main importing countries as a whole seem to have grown at the rate of 8 per cent per annum. Meat imports into the main importing countries, excluding the U.K. whose imports were more or less static, grew at 7 per cent per annum. These were high rates of growth, considerably influenced by low initial starting points in several countries. It is doubtful whether they could

be maintained. Moreover, there is growing competition, especially in the canned fruit trade, which may make it difficult for some developing countries to hold on to their share of the market. It is possible that there could be good growth prospects for new canned foods from developing countries, provided supply problems could be overcome and adequate marketing strategies used. But it seems unlikely that large volumes of trade could be built up before the end of the decade.

An increase in tinplate consumption in developing countries will have to be accompanied by investment in can-making, canning, agriculture, animal husbandry, and fishing. As experience has shown, it may be necessary to replace existing facilities for can-making and canning, as well as to increase capacity. However, individual investments in can-making and canning plant are much less costly than they are in electrolytic lines. One electrolytic line may be sufficient to meet a developing country's tinplate needs for years, and clearly involves a major investment decision.

The necessary investment in agriculture and other sources of raw food may be very slow to produce results. An increase in the supply of raw food suitable for canning may need major improvements in animal husbandry, or changes in methods of cultivation, or heavy investment in irrigation. But the long-term advantages are likely to be great for both producers and consumers. An important part in the expansion of Spanish tinplate consumption during the sixties was

played by the increase in the area under irrigation, by the modernization of the fishing fleet, and by improvements in the quality of raw food delivered to the canneries. These developments paved the way for an expansion in the demand for cans and contributed to the rise in incomes in the extractive sector. Many developing countries, however, would have to start from a much weaker position technically than Spain in developing their sources of raw food supply. They could not expect quick results. Their producers of raw food would be working for a very different market, which would necessarily require high and consistent standards of product. An important part would have to be played by technical advisory services which take time to build up to an adequate size.

Production prospects.

Table 11 lists the electrolytic lines in operation, under construction, or planned in developing countries, with some estimates of their capacity. Apart from these lines, a number are reported to be under consideration, how serious is uncertain, in another seven developing countries, Morocco, Zambia, Iran, Ethiopa, Pakistan, Uruguay, and Indonesia.

Widespread additions to existing capacity have either been made recently or are under construction in industrial countries, West Germany, Belgium, the U.K., Canada, Japan, South Africa, and Australia, and in four developing countries of Europe, Greece, Spain, Portugal, and Yugoslavia. The Soviet Union, Bulgaria, and Hungary are also reported to be building or planning to build electrolytic lines. There are no reported plans to build new lines in the U.S., where several lines have been or are being converted to tinfree steel production.

Total existing capacity of developing countries in Latin America, Asia, and Africa is about one million tons of electrolytic tinplate. Hot-dip capacity is probably about 200,000 tons. The electrolytic lines under construction or planned, for which estimates of capacity are available, add another 460,000 tons. No hot-dip capacity is reported to be under construction.

Assuming that domestic production is likely to be higher-cost than imported tinplate, a number of developing countries with their

own capacity will inevitably switch to higher-cost sources of supply during the seventies for part at least of their consumption. This will apply particularly to countries which have their first experience of tinplate production. The higher cost of domestic tinplate must be set against the saving on foreign exchange and the long-term gain from the experience acquired by the labour force in learning a modern technology. Whether the cost of tinplate can be reduced depends to a large extent on the efficiency of steel production.

The question of manpower training is crucial. Developing countries which set up their own tinplate facilities acquire the equipment and the technology of an advanced industry. They start off with a plant which is more modern than that of some of their foreign competitors whose equipment will span a number of years, depending on their rate of investment. But whatever advantage there is in having modern equipment depends essentially on the skill of the labour force, including all grades of labour from the least skilled to top management. The number of workers involved on an electrolytic line is comparatively small, since this is a highly capital-intensive method of production. The expenditure required to give them the fullest training, including foreign training and the employment of foreign experts, would be modest compared with the capital cost of a line and related facilities.

Chapter 2

Tinplate Production, Consumption and Trade

Production.

Tinplate production has increased from 900,000 tons at the beginning of this century to over 13,000,000 tons in 1970. The peak pre-1939 output was 4,140,000 tons in 1937. Before the world slump, there was a peak of 5,090,000 tons in 1929. During the slump, tinplate production fell appreciably less than production in other parts of the steel industry. In the sharp 1958 depression, there was a big fall in U.S. and U.K. production, but in the rest of the world production continued to expand.

Until well in the present century, by far the greater part of world tinplate production was in the U.S. and U.K.. In fact, the U.K. dominated the industry until the 1890's, when the American industry grew up under the protection of the McKinley tariff. On the eve of the world slump in the thirties, only 13 per cent of world output came from other countries. Production fell heavily outside the U.S. during the 1939-1945 war. Since most tinplate is used for the production of consumer goods, and since there were competing uses for steel, the tinplate section of the steel industry did not have a high priority in war-torn countries during the forties. In 1950 the share of the two leading countries in world production was about the same as in 1929. With U.K. production still well below its pre-war peak, the U.S. share was as high as 75 per cent.

Some developing countries with small markets may saddle themselves with considerable spare capacity if they invest in electrolytic lines during the seventies. It is not unreasonable to have this spare capacity since there is a good case for allowing for future demand. An electrolytic line can be expected to have a long life. Lines which were built in the U.S. during the war are still in operation. The question is whether it is desirable for a developing country to look up capital in an electrolytic line rather than to invest in some other project. The answer to this will depend on the competing demands for capital in individual developing countries.

Prima facie, it might appear sensible for developing countries which are interested in economic cooperation to encourage imports of tinplate from a developing country with which they are associated. This would enable the tinplate producer to reach the rated capacity more quickly, assuming that there was no shortage of steel scrip. Such a proposal is easier to contemplate in theory than to implement in practice. Potential customers in developing countries may well prefer to import tinplate from an industrial country, which can supply tinplate of a higher quality as well as at a lower price. In fact, if given the choice, some customers may prefer imported tinplate to tinplate produced by a local firm. While the government of a developing country can keep out low-cost imported tinplate to protect the domestic producer, it is at some cost to the user. This reinforces the need for the efficient use of expensive capital equipment.

Chapter 7

Recommendations.

Consumption

The growth of tinplate consumption in developing countries depends to a large extent, on the supply side, on the availability of raw foods of the right quality for canning. This implies much more investment in the industries producing these foods, such as meat, fish, fruit, milk, and vegetables, in reliable and cheap methods of delivering them to the canning factories, and in facilities for marketing the canned products.

Much more research is needed to deal with the practical problems of canning in developing countries. The tinplate producer, as part of the steel industry, operating on a larger scale than the users of tinplate, has an important part to play in helping the can-maker and canner with their technical problems. This is a common feature of industrial countries. It needs to be imitated in developing countries. The experience of Chile, Brazil, and Spain in recent years could be used by other developing countries.

Developing countries need to acquire and to undertake themselves the professional market research which will supply much-needed information about price elasticities of demand, design standards, packaging styles, consumer preferences, and competition from other materials in the packaging market. This information is extremely important for export markets in canned food. It can also play a leading part in developing the home market.

Export prospects for canned food from developing countries depend on the ability to meet the high standards of quality, presentation of the product, etc., which are customary in the advanced importing countries. Proposals by the latter to give preferential treatment to developing countries generally, will not give good results for canned food unless the above-mentioned conditions can be satisfied. A number of developing countries have already done so, with important benefits for their export trade.

Developing countries should avoid investment in many scattered canning plants operating at a very low percentage of their capacity. At the same time it should be recognised that these plants must be close to their raw food supply. The experience of other developing countries in reconciling these requirements should be studied by a developing country which wishes to increase its canning capacity.

Developing countries should not be deterred from investing in tinplate capacity by the threat of competition from substitute materials in the packaging industry. The overall packaging market has sufficient potential to absorb an increased supply of tinplate. The extent to which substitutes for tinplate are used depends on the nature of the products to be packed and on relative prices. Before using TFS, developing countries should examine its product compatibility for the products in which they are interested.

In planning industrial development the governments of developing countries should recognise the value of the canning industry as a stimulus to higher standards in food production and as a means of removing obstacles to commercial food production in areas best suited to it. The use of tinplate enables the preservation of large quantities of food in easily transportable form.

Production

There is not unanimity that developing countries with small volumes of tinplate consumption should opt at first for electrolytic tinplate production, but the very widespread replacement of hot-dip by electrolytic capacity implies that developing countries would be following an established pattern if they chose an electrolytic line. Expert technical advice should be sought and a thorough assessment of present and future market requirements made before reaching a decision. This should also be done before deciding on the type of line to be installed, since a capital investment of ten or eleven million dollars is a common expenditure on electrolytic lines by developing countries. A recent example of a line installed by a country with a population of nine millions and a current rate of consumption of about 30 - 35,000 tons is Chile's first electrolytic line. Its ultimate capacity is about 120,000 tons.

A decision to instal tinplate facilities should take account of the fact that the strip mill, which will supply the steel for tinplate production, will be required to supply other flat steel products. The interests of customers for these products must also be considered.

Quality control is essential in the production of tinplate. Quality control should apply to the steel base and to the subsequent processes which convert the tinplate in to tin cans and provide the commodities for packing in these cans. If developing countries are to produce satisfactory electrolytic tinplate, they must be able to supply steel of the required quality.

Developing countries should not stint the physical resources for test facilities at an electrolytic line. It is a mistake to economise in this respect when investing millions of dollars in a line.

Tinplate production requires particular attention to the training of the labour force, including quality control staff. Developing countries should be prepared to seek the best foreign consultants for training their labour force, especially key personnel. The latter should also have opportunities to keep in touch with new developments in tinplate production abroad and if appropriate to study production methods in more advanced domestic plants.

Developing countries with electrolytic capacity will use it

more economically if they can reduce the number of tinplate and can sizes. Greater standardisation involves cooperation between tinplate producer, can-maker, and canner. If necessary, the tinplate producer should take the initiative. On standardisation, as on other matters affecting tinplate production, it would be logical for developing countries to consult each other in order to tap the growing fund of experience in developing countries which have been producing tinplate for some time. This would supplement the knowledge obtained from the advanced tinplate producing countries.

Developing countries should ensure that sufficient provision is made for spare parts, since interruptions to production can be extremely costly when deliveries must be obtained from a distant supplier in a foreign country, and difficulties over foreign currency may delay the order of replacements.

A P P E N D I X

Table 1

Tinplate production in developing countries of Latin America and Asia. 1950-1970. '000 long tons.

	Brazil	Mexico	Chile	India	Philippines	Turkey	Total
1950	37	11	6	68	-	-	122
1951	44	12	12	70	-	-	138
1952	41	18	16	67	-	-	136
1953	40	19	15	57	-	-	131
1954	41	24	18	66	-	-	149
1955	38	25	18	70	-	-	151
1956	87	29	20	72	-	-	208
1957	71	33	16	65	-	-	185
1958	78	51	16	58	-	-	203
1959	88	59	17	68	-	-	232
1960	94	57	14	79	-	-	244
1961	128	68	17	86	-	-	299
1962	137	74	26	93	1	-	331
1963	158	96	29	99	5	-	387
1964	143	84	26	105	31	-	389
1965	168	113	20	89	39	13	442
1966	168	106	33	79	50	27	463
1967	203	127	36	78	46	44	534
1968	206	151	27	90	48	44	566
1969	224	156	30	94	44	47	595
1970	230	153	36	115	36	41	611

Source: W.Robertson. Report on World Tin Position, I.T.C.,1965; I.T.C. Statistical Yearbooks and Monthly Statistical Bulletins.

1. Excludes a small volume of output recently in Argentina, Colombia, and Thailand; 1968, Argentina 2,400 tons, Colombia 21,000 tons.

Table 2

Electrolytic tinplate production in developed countries

(percentage of total production)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
U.S.A.	93.1	95.1	96.3	96.5	97.1	97.9	99.1	99.4	-	-	-
Canada	92.8	94.8	94.9	95.0	95.0	95.0	96.1	100.0	-	-	-
U.K.	63.5	72.3	77.7	79.4	81.0	86.3	88.2	89.0	90.9	92.3	94.8
West Germany	45.2	55.8	62.2	68.5	73.1	74.9	80.0	84.8	87.1	90.2	92.5
France	50.5	58.5	65.8	71.3	74.0	79.0	85.0	87.5	91.7	93.0	94.9
Italy	34.8	44.2	48.8	51.1	59.2	73.7	81.6	88.0	92.4	94.6	95.6
Netherlands	49.3	57.2	64.7	70.3	82.7	82.5	83.7	85.8	88.0	90.5	91.5
Belgium-Lux.	65.8	70.7	79.0	81.0	83.7	85.2	90.0	90.0	90.0	95.0	95.0
Japan	59.3	71.3	62.0	69.0	71.4	75.4	80.5	-	87.7	-	-
Australia	-	-	-	62.0	72.7	80.6	84.7	87.6	92.7	95.0	90.0
South Africa	-	-	-	-	-	-	-	-	86.3	-	-

Source: International Tin Council Statistical Yearbooks.

TABLE 3

APPARENT TINPLATE CONSUMPTION IN MAIN CONSUMING COUNTRIES
LATIN AMERICA, ASIA, AND AFRICA, 1953-1970 000 long tons

	Argentina	Mexico	Brazil	Venezuela	Chile	Philippines	India	Turkey	Taiwan	Morocco	Kenya	Nigeria
1953	51	35	103	14	15	21	78	38	-	15	5.5	-
1954	64	34	153	15	18	15	73	27	-	15	3	4
1955	106	45	108	14	18	29	110	20	-	13	6	2
1956	114	58	180	14	20	25	132	17	8	16	7	3
1957	137	49	178	34	16	39	93	16	8	20	5	3
1958	67	54	111	20	18	30	96	10	9	17	4.5	3
1959	91	60	145	41	18	44	130	24	12	14	5	3
1960	88	59	178	48	16	58	164	25	14	21	6	2
1961	86	75	168	45	23	68	133	23	22	25	7.5	4
1962	87	81	171	64	30	44	133	27	28	23	9	9
1963	93	102	222	53	30	62	146	30	21	24	9	9
1964	113	90	183	63	27	73	158	40	44	19	10	8
1965	105	118	180	65	24	77	116	32	43	18	10	15
1966	95	100	205	70	35	86	105	35	46	20	11	10
1967	100	120	230	70	37	86	140	48	48	28	11	13
1968	110	140	237	75	28	88	150	46	24	22	15	11
1969	98	160	244	62	32	80	126	48	44	28	14	13
1970	97	177	281	73	38	80	164	49	54	21	17	12

Source: International Tin Council Statistical Yearbooks and Monthly Bulletins.

Table 4

Tinplate exports from principal countries, 1964-1970

000 metric tons.

	U.S.A.[1]	U.K.	France	West Germany	Belgium	Neths.	Japan	Italy	Australia
1964	314.8	392.3	393.0	141.7	152.8	102.5	295.6	36.0	39.0
1965	235.4	395.5	309.6	140.7	133.8	99.3	356.5	41.0	34.7
1966	256.3	369.9	339.6	149.6	150.5	119.9	395.3	44.3	37.1
1967	252.2	393.3	354.0	185.0	156.7	144.3	407.3	48.0	28.8
1968	268.3	363.1	333.4	179.5	143.3	133.2	487.4	54.5	14.1
1969	280.3	355.5	375.6	243.7	156.4	220.0	549.2	51.6	24.8
1970	285.9	371.0	402.6	256.9	-	246.1	611.2	32.6	20.1

Source: I.T.C. Monthly Statistical Bulletin.

1. Includes secondary tinplate and decorated tinplate.

Rapid expansion of capacity in other industrial countries has reduced the share of the U.S. and the U.K. By 1970 the U.S. accounted for about 42 per cent of world production and the U.K. for about 11 per cent. Japan became the largest producer in 1970, having increased its output from 110,000 tons in 1953 to 1,400,000 in 1970. Between 1960 and 1970 Japanese production increased fivefold. Other industrial countries have made big, if much less spectacular increases in production in the last decade.

Before 1939, India was the only developing country with tinplate capacity. Apart from the highly industrialised countries, the only other producing country was Spain. India averaged 50,000 tons in the late thirties, Spain reached a pre-war peak output of 35,000 tons in 1939.

During the late forties production began in Brazil, Chile, and Mexico. Turkey and the Philippines followed in the mid-sixties. The most recent producers are Argentina, Colombia, and Thailand. Venezuela, Peru, Egypt, Taiwan, Algeria, and Malaysia are expected to become producers during the seventies. Two less-developed European countries, Greece and Portugal, are reported to have recently commissioned their first tinplate lines. Thus tinplate production, at one time concentrated in a few industrial countries, is spreading widely.

Table 5

Exports of canned meat from leading countries

000 long tons

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Argentina	99.7	61.0	51.6	66.3	56.7	78.4	48.2	36.7	64.1	91.9	83.2
Brazil [1]	8.5	27.4	8.0	13.2	8.8	5.7	7.4	16.5	7.7	4.8	11.6
Paraguay [2]	11.4	16.3	11.8	14.6	13.6	14.5	15.3	18.5	9.9	10.7	11.0
Uruguay	6.5	6.1	7.4	7.5	8.8	9.7	8.2	10.3	4.1	1.9	6.1
Tanzania	2.4	4.6	5.3	6.1	6.8	4.5	5.2	5.0	7.4	5.8	4.0
Kenya [3]	1.1	2.8	2.8	4.0	4.7	4.3	2.6	3.4	4.5	5.2	4.0
Yugoslavia	12.3	17.9	20.8	23.1	20.7	23.4	29.8	35.8	22.9	23.6	19.4
Poland	27.6	31.0	35.2	36.4	36.8	40.4	43.2	47.1	49.7	51.3	50.0
Denmark	64.3	67.2	68.8	74.2	87.0	92.7	94.8	115.7	138.5	133.9	154.6
Netherlands	56.7	58.9	66.1	69.0	65.2	63.8	70.2	73.8	86.3	98.7	102.9
Total	290.5	293.2	248.8	314.4	309.1	337.4	324.9	362.8	394.1	423 8	446.8

Source: Commonwealth Secretariat, London. Reviews of Meat.
1. 1966-68, recorded imports into U.S., West Germany, U.K.
2. 1966-68, recorded imports into U.S., U.K.
3. 1968, recorded imports into U.K.

Table 6

Imports of canned meat into principal importing countries 000 long tons

	UK	West Germany	USA	Canada	Sweden	Netherlands	Italy	Hong Kong	Total[1]
1958	192	22	105	10	-	3	3	2	337 (145)
1959	197	24	96	9	1	2	3	3	335 (138)
1960	188	18	91	6	2	2	5	2	314 (126)
1961	198	20	98	8	3	2	5	2	346 (148)
1962	188	19	106	6	3	3	6	3	334 (146)
1963	170	25	123	7	3	4	10	3	345 (175)
1964	176	34	108	6	4	5	7	7	347 (171)
1965	159	40	132	7	5	5	7	7	362 (203)
1966	164	45	151	9	4	6	8	7	394 (230)
1967	188	48	156	12	-	5	6	10	430 (242)
1968	179	55	172	11	5	6	7	8	443 (264)

Source: Commonwealth Secretariat, London. Reviews of Meat.

[1] Figures in brackets excluding the UK.

TABLE 7.

Imports of canned fruit into principal importing countries

00 long tons

	U.K.	West Germany	France	Belgium	Netherlands	U.S.A.	Soviet Union	Japan	Canada	Switzerland	TOTAL
1958	338	90	29	22	10	33	19	9	55	9	614
1959	306	101	25	22	11	44	21	16	56	8	610
1960	342	115	26	26	17	60	20	18	63	10	697
1961	361	146	27	27	22	65	29	24	65	11	777
1962	407	212	31	25	26	66	29	24	61	13	894
1963	378	199	30	31	28	73	35	30	75	16	895
1964	382	213	41	36	33	85	41	38	74	17	960
1965	371	272	42	38	38	101	28	45	86	20	1041
1966	412	225	53	40	43	107	35	55	91	20	1081
1967	409	222	57	39	41	118	58	49	95	20	1108
1968	433	278	46	35	43	147	71	53	93	23	1222
1969	409	262	62	34	44	145	76	79	99	24	1234

Source: Commonwealth Secretariat, London.
Reviews of Fruit, 1962 and 1968.

Table 8

UK imports of canned fruit[1] from developing countries

000 long tons

	1951-55	1956-60	1960	1961	1962	1963	1964	1965	1966	1967	1968
Malaysia and Singapore	12.2	264.	21.3	23.6	24.4	19.7	18.7	21.5	16.2	22.2	22.8
W.Indies	3.2	3.8	5.0	5.4	6.1	8.7	7.9	10.1	10.3	7.6	7.9
British Honduras	1.3	1.9	1.3	2.1	0.9	1.7	1.8	0.8	3.1	3.5	2.5
Kenya	1.5	3.6	..4	2.5	3.3	3.8	5.2	5.1	3.2	4 .	1.8
Formosa	3.0	3.2	2.5	4.3	2.7	1.2	1.6	1.9	2.8	1.8	6.4
Philippines	-	-	-	0.5	3.3	3.0	3.6	4.8	5.9	7.8	6.0
	21.2	38.9	31.5	40.4	40.7	38.1	38.8	44.2	41.5	47.1	41.7
All countries	149.4	272.0	307.9	321.0	355.6	337.5	340.7	323.9	361.6	347.2	345.1

Source: Commonwealth Secretariat, London. Fruit, 1968 and 1962.

1. Preserved in syrup.

Table 9

West German imports of canned fruit from developing countries

000 long tons

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Malaysia	2.3	2.9	3.6	5.1	3.2	6.8	9.6	8.0	4.8	7.5	4.2
Kenya	0.8	0.5	0.4	1.8	2.2	1.0	0.4	-	0.3	0.1	0.4
Philippines	-	-	-	10.0	8.9	5.7	4.7	6.0	8.2	12.1	6.9
Taiwan	20.1	16.4	15.4	14.3	14.4	16.6	26.1	20.2	20.0	20.9	19.9
Argentina	4.8	1.9	2.7	0.3	2.4	4.4	2.6	0.9	1.0	1.2	2.2
	28.0	21.7	22.1	31.5	31.1	34.5	43.4	35.1	34.3	41.8	33.6
All sources	101.3	114.7	146.2	212.3	198.6	213.4	272.4	225.4	221.9	278.1	262.3

Source: Commonwealth Secretariat, London. Reviews of Fruit.

Table 10

Imports of canned fruit into France from developing countries.

000 long tons

	1961	1962	1963	1964	1965	1966	1967	1968	1969
Kenya	-	-	-	-	-	0.3	-	0.4	-
Martinique	9.5	7.2	7.6	7.6	8.8	8.7	6.4	5.9	9.9
Morocco	10.3	12.1	9.3	15.4	14.7	18.7	15.7	18.1	15.9
Ivory Coast	4.0	4.8	7.6	9.5	10.0	10.8	12.4	12.5	11.8
Tunisia	1.4	2.5	1.4	3.0	1.0	2.1	3.1	2.1	4.1
	25.2	26.6	25.9	35.5	34.5	40.6	37.6	33.0	41.7
Allsources	27.2	31.4	30.3	41.1	41.5	53.0	57.1	45.8	62.4

Source: Commonwealth Secretariat, London. Reviews of Fruit.

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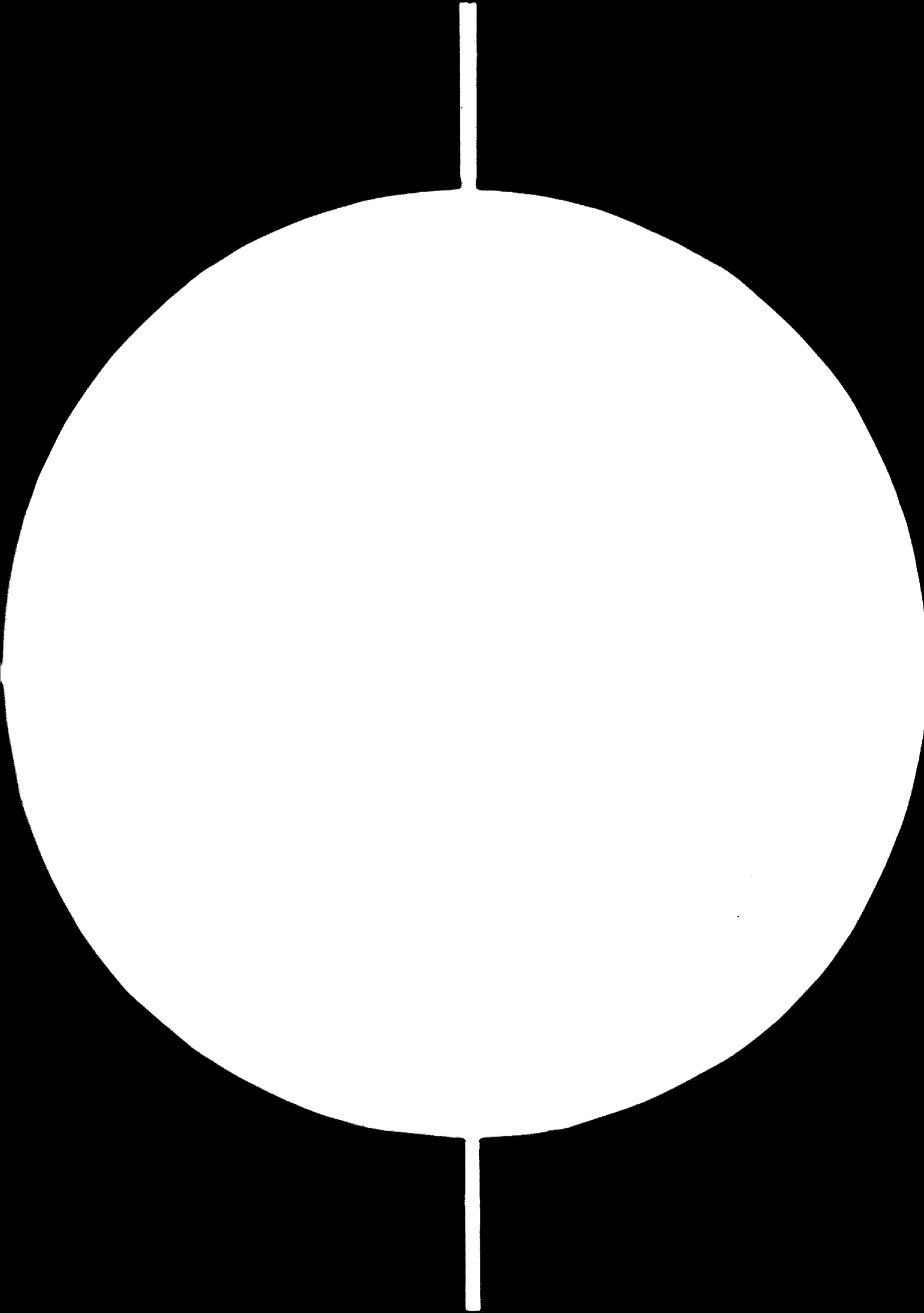


Table 11

Electrolytic tinplate lines in developing countries, in operation, under construction, or planned end-1970. [1]

Country	In operation	Estimated capacity long tons	Under construction	Planned	Estimated capacity long tons
Brazil	2	100,000 140,000		1	150,000
Chile	1	120,000			
Mexico	2			1	
Argentina	1	110,000			
Colombia	1	60,000			
Venezuela			1		120,000
Peru			1		70,000
India	1	150,000			
Philippines	2	50,000 over100,000			
Turkey	1	50,000			
Thailand				1	55,000
Algeria				1	
Malaysia				1	70,000
Egypt			1		

Source: Papers to Santiago seminar on tinplate production in developing countries; reports in Tin International, London.

1. Spain has one large and one small electrolytic plant in operation, and another of 150,000 tons capacity under construction. Portugal has recently commissioned an electrolytic line with a reported capacity of 100,000 tons. Greece is also reported to be building an electrolytic plant. Additional capacity is under construction or planned in the centrally- planned economies. A number of developing countries are reported to be thinking of tinplate production but not as yet in any concrete sense.

Table 13

Growth of per capita G.D.P. and total tinplate consumption, 1955-1965. Percentages per annum.

	Per capita G.D.P.	Tinplate consumption.
Argentina	1.5	-0.45
Brazil	1.8	3.92
Chile	1.7	5.27
Mexico	2.5	8.92
Peru	2.4	9.90
Venezuela	2.3	13.17
India	1.3	2.76
Philippines	1.4	10.69
Taiwan	4.6	20.88
Kenya	0.7	7.01
Morocco	0.5	4.66

Source: Estimates of G.D.P. from U.N. World Economic Survey, 1967; data on tinplate consumption from ITC Statistical Yearbooks and Monthly Statistical Bulletins.

Table 13

G.N.P. per capita and apparent tinplate consumption per capita in leading consuming countries of Asia, Latin America, and Africa.

	Per capita G.N.P., 1966	Per capita tinplate consumption, 1967.
	U.S. dollars.	lbs.
Argentina	780	9.9
Brazil	240	0.8
Chile	510	7.9
Colombia	280	3.0
Mexico	470	6.1
Peru	320	2.6
Venezuela	850	17.6
India	90	0.6
Iran	240	2.4
Philippines	160	5.8
Taiwan	230	5.5
Thailand	130	1.4
Turkey	280	3.4
Kenya	90	2.6
Morocco	170	4.5
Nigeria	80	0.5

Source: Estimates for G.N.P. per capita from IDF and IBRD review, Finance and Development, No.1, 1969 ; tinplate consumption from ITC Monthly Statistical Bulletin, and A.La Spada, Patterns of World Tin Consumption 1957-1968, ITC, London.

Figure 1.

Source: Table 12.

Trend rates of growth of per capita G.D.P. and tinplate consumption in leading consuming countries of Asia, Latin America, and Africa.

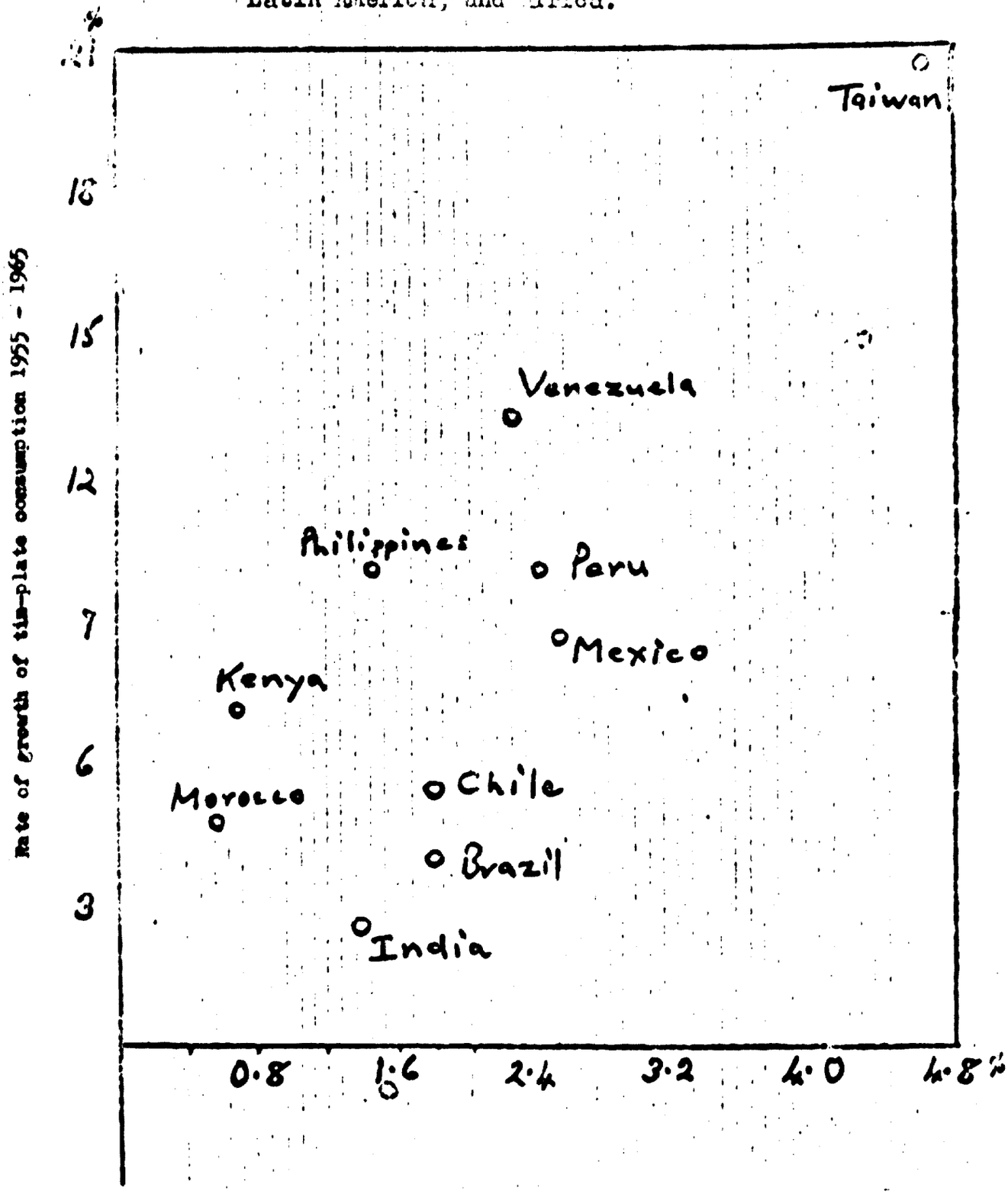
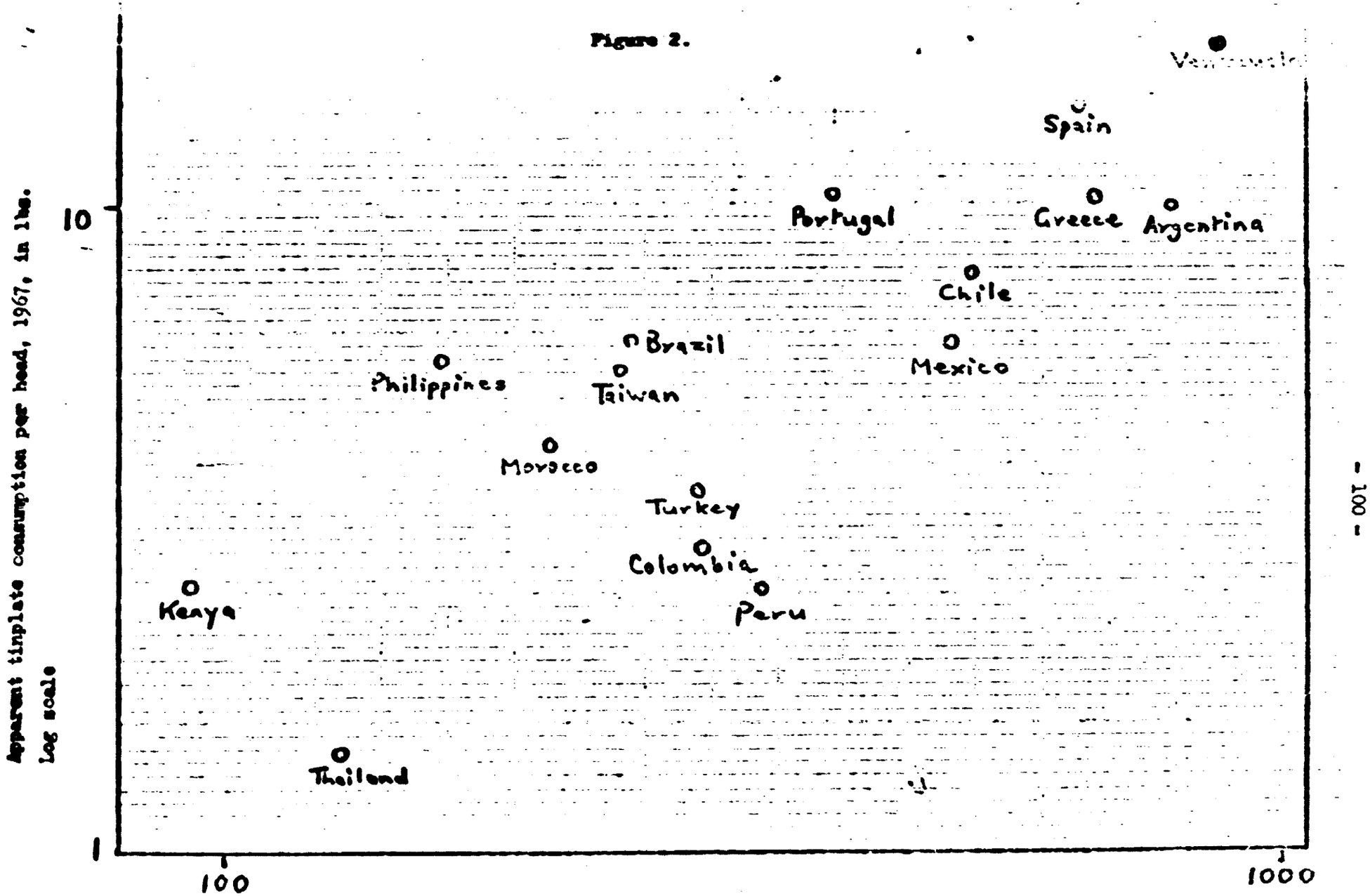


Figure 2.



GNP per head, US dollars, 1966. Log scale

GNP per capita, 1966, and apparent tinplate consumption per capita, 1967, in leading consuming countries of Asia, Latin America and Africa.

Source: Table 13

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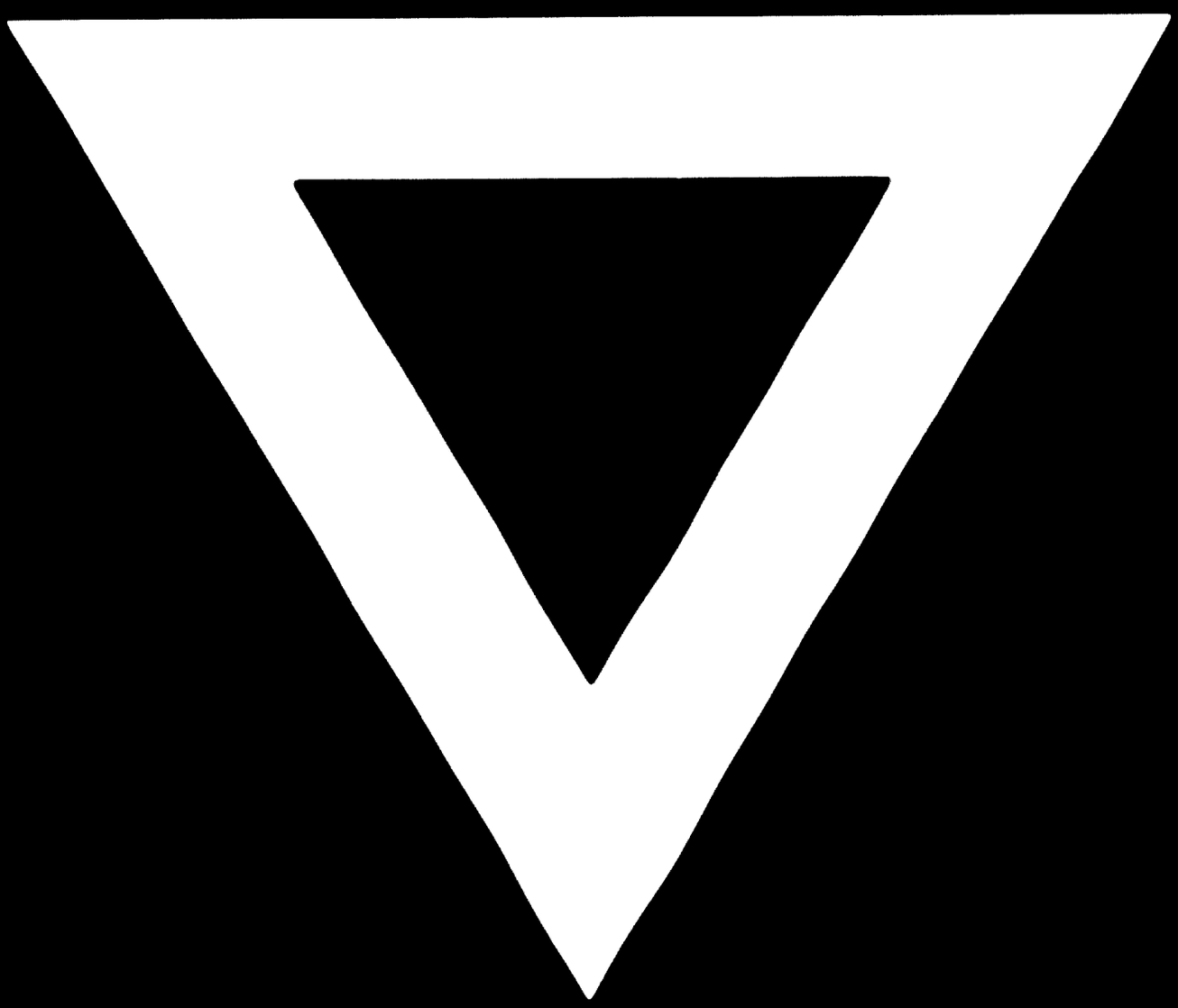

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