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Technical Change and Some British Multinationals in Kenya:
Some Global Considerations.

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Abstract.

IDS Working Paper No. 228 examined the behaviour of the subsidiaries of seven British Multinationals in Kenya with regard to their generation and acquisition of new technology. This Working Paper is complementary to the earlier one insofar as it examines to what extent the behaviour of the Kenyan subsidiaries is explicable in terms of the organisation of the global market in each industry. The global market is thus described, the role of the particular firm situated and an evaluation made of the extent to which this role explains the behaviour of the Kenyan subsidiaries. Some tentative conclusions are offered, but the limitation of sample size is emphasized.

engineering design) were the least capital intensive (measuring only embodied technology).

With regard to the orientation of technical change, only two of the sample were particularly concerned with cost reduction (tea and tea machinery). The two pharmaceutical subsidiaries were predominantly concerned with product technology, and the two capital goods subsidiaries had a common interest in product adaptation (particularly with respect to 'technical adaptation').

None of the sample firms undertook any Basic or Applied research. Only two subsidiaries had a significant expenditure (as a percentage of value added) on Experimental Development and Adaptation (tea machinery and engineering design). Two other subsidiaries (tea production and one of the pharmaceutical firms) had some expenditure in these activities, but in both cases it amounted to less than 1% of value added. One of the important conclusions which emerges from the study is the importance of quality control in stimulating technical change. All of the subsidiaries had some sort of quality control and in almost all cases this expenditure exceeded that on formalised Experimental Development and Adaptation. There were links between quality control and production -, product - and materials - technology, although not all subsidiaries had links in all three spheres of technical change.

Three of the sample (cement and the two capital goods firms) had the autonomy to choose technology without the participation of the parent. By contrast the vehicle assembler and one of the pharmaceutical subsidiaries had little autonomy in this respect. Nominal autonomy aside, only the two capital goods firms had the ability to make full use of the autonomy granted to them by their parents.

With the exception of the tea producer and the cement subsidiary none of the sample made any specific payments for technology to either the parent or non-parent firms. The importance of technology in the relationship of the subsidiaries to the parents is highlighted by the fact that in all cases the property rights over technical change were obtained by the parents. In all cases the parents were also responsible for the registration of patents and brand names in Kenya and elsewhere.

Given the importance of technology in this parent-subsidary relationship, it is to be expected that each of the firms has a system for circulating technical change through the corporate body. The interesting result which emerges is the importance of man - disembodied technological flows through the firm.

Technical Change and British Multinationals in Kenya: Some Global Considerations.

Research has been undertaken on the behaviour of the subsidiaries of seven British multinationals in Kenya to determine their behaviour with regard to the generation and acquisition of new technology⁽¹⁾. The picture which emerged from this study was that in general there was little evidence that the subsidiaries generated either product, material or production technology themselves, although there was obvious variance between the behaviour of different subsidiaries in different sectors. There was also little evidence that technical change resulted from the operations of other enterprises in Kenya or indeed in any other underdeveloped economy.

It is a basic hypothesis of this study that the global operations of the respective multinationals will influence the behaviour of their subsidiaries in Kenya (or indeed any other economy). This is not the first study which has worked from this premise, but the study does address itself to a specific problem in this context which it seems has not yet received adequate detailed attention. This concerns the affect of global operations on the propensity of subsidiaries to generate their own technology. Some limited attention has been given to this problem in research which focusses on the tied purchase of equipment, but these studies generally concern themselves with the problem of monopolisation rather than that of the generation of technology. A further stage of this research (hitherto uncompleted) plans to 'open-up' the problem a little further by examining the behaviour of the subsidiaries of the same multinationals in India.

The presentation of the research will take the following form. First the Kenyan study will be presented in brief. Then each of the sectors (tea production, pharmaceuticals, cement, vehicle assembly, and refrigeration and air-conditioning engineering and design⁽²⁾) will be treated individually. In each case the structure of the global market for that commodity and the competitive position of the firm under investigation will be described. An attempt will then be made to show how the global interests of each firm influences the behaviour of the Kenyan subsidiary, particularly with regard to the generation and acquisition of new technology.

Summary of Results of Kenyan Study.

Seven subsidiaries were included in the sample - one tea producer, two pharmaceutical subsidiaries, one cement producer, a vehicle assembler, one engineering design subsidiary and one tea machinery producer. The subsidiaries varied in the size of their operations, ranging from a turnover of £17.65 m to £470,000 per annum. The cement firm was the most capital intensive and the two capital goods subsidiaries (tea machinery and

at low levels of income, but as per capita income increases beyond a certain level, the consumption of tea tends to remain fairly static. Thus in the late nineteenth century the consumption of tea in the developed countries (particularly Britain) grew rapidly. But by the time that tea production began in earnest in Africa, per capita consumption in Europe began to taper off. The response of the larger tea growing firms with extensive interests in India and Sri Lanka was to try and form a producers cartel (The International Tea Authority). The problem was that at about this time production in Africa had reached exportable quantities. A struggle then took place in Africa. The large international firms who had extensive interests in Asia were anxious to limit acreage in Africa to protect their own heavy investment in Asia. Mean-while the new small-holders, particularly the vociferous European producers in Kenya who had no interests in Asia to protect and who were in a position of perfect competitors (ie no matter how much any one of them produced it would not affect the world price of tea). were in favour of expansion of production.

The end result was that the large companies were able to force a tea agreement on the African colonies⁽³⁾ which lasted through a number of renewals until 1955. At this stage an important switch of policy occurred in the two largest of these international firms. They came to realise that the nationalist pressures in Asia would increasingly lead to the erosion of their strong position in India and Sri Lanka so that it now became in their own interests to encourage increased production in Africa.

(In order to understand the importance of this change in policy we need to know something about the characteristic of a tea-bush. A tea bush takes approximately four years from planting until it produces at about 50% of its optimal output, and a further four years until it is fully mature. It produces at this level for about 50 years after planting and then both yield and quality begin to decline. In addition over the past two decades a new more productive variety of tea bush (vegetative production) has been developed).

The policy of the large tea firms has been to counter the rise of economic nationalism in India and Sri Lanka by 'standing still' in these countries, maintaining existing plantations where possible and taking part in Indian and Sri Lankan tea auctions, and concentrating most of their new investment in Africa. Over 50% of tea bushes in India are more than 50 years old, and unit costs of production in Asia are now some 20-30% higher than those in Africa. In addition the tendency for tea producing firms to move into new products has been concentrated in Africa rather than in Asia.

The international tea industry is dominated by a few large British firms, which is explicable in terms of the fact that Britain alone consumes

Finally, with respect to industrial linkages stimulated by the activities of these subsidiaries in Kenya, there is little evidence of either forward or backward linkages. Where linkages have occurred, they have predominantly involved other multinational firms. The reason for this relative absence of linkages must be found in the undevelopment of the Kenyan industrial sector and the weakness of the local industrial bourgeoisie, particularly African industrialists.

I
Tea

Tea has been an internationally traded commodity since the last quarter of the nineteenth century, and total annual production is now in the region of 1.4 million tons. The overwhelming bulk of this production takes place in South Asia, India and Sri Lanka accounting for about 70% of world output. A further 12% is produced in other parts of Asia, and most of the rest is produced in Africa. Within Africa about half of total production originates in Kenya and Malawi.

The major destabilising factor in the international tea-market over the past century has been the emergence of Africa as a significant producer for export, and the behaviour of the large tea firms cannot be understood in isolation from this fact. At the turn of the century almost all tea consumed in the developed countries originated from Asia. But as the African hinterland was opened up by the colonial powers, tea production expanded. There were two main factors behind this expansion of production. Firstly the colonial powers were anxious to develop export crops in their colonies, both to satisfy the demand of their population and as a contributor to imperial budgets and foreign exchange reserves. This led them to encourage the production of tea by small-holders in some countries, notably Uganda, Tanganyika and Malawi. A second factor encouraging local production was the settlement of some colonies by European farmers who were anxious to find a new lucrative cash-crop in the face of persistent failure.

The international tea industry has always been concentrated amongst a few large producers based in Britain. Concentration increased over the years until the emergence of independence in many colonies began to threaten this concentration by encouraging small scale production (especially in Africa) and nationalisation (especially in Asia). The increasing concentration of the industry over the years, followed by the recent emergence of nationalist pressures in the producing countries helps to explain the behaviour of these firms, particularly in regard to their attitude towards increased production in Africa.

In order to understand this behaviour some description of the market for tea is necessary. The income elasticity for tea is particularly high

distribution (many of the Asian estates record nett losses every year), this pattern is clearly rational. Thus for example, while its subsidiaries only produce about 1% of Sri Lanka's tea, the firm is responsible for exporting over one-third of the country's output.

It is the largest of four firms which dominate the British and European market and accounts for over 40% of the British market. This reflects the growth of the firm over the years since 20 years ago its share was just over 20% of the British market. It is heavily involved in product differentiation and in the UK alone it markets 6 different brands of packet tea and 5 different brands of tea bags.

However in spite of its clearly dominant position in the global tea market (or perhaps because of this dominance), this firm has made a policy decision to decrease its dependence on tea. Within the last decade it has therefore merged with a large British based meat-packing firm, and within the producing countries the firm is embarking on a long run plan to move into other agricultural-based intermediate products. Three reasons explain this shift of policy. In the first place the world market is hardly growing at all (although this may now change with the new high prices for its close substitute, coffee), and while that of underdeveloped countries is growing a little faster (particularly in India) it is nevertheless an unspectacular overall growth rate. Secondly it is hard to differentiate tea as a product - tea is tea is tea - so that the firm is vulnerable to competition from others, particularly to a firm with lower overhead costs. Some attempt has been made to move into instant tea, (see later) but hopes are not high in regard to its future potential. Finally, it is recognised that tea production is a relatively simple procedure and their production facilities are increasingly prone to takeover as nationalist pressures mount in underdeveloped countries. Hence their move into distribution and their quest for alternative products.

An illustration of the importance of production in Africa to the firm is shown by the share of profits and sales contributed by subsidiaries in Africa, Asia and the UK and Ireland (table 1). It can be clearly seen that African subsidiaries produce a disproportionate share of the firms profits and that, if anything this share has grown in recent years.

Table 1
Share of Africa, Asia and UK in Group sales and Profits

	S A L E S				P R O F I T S			
	1970		1974		1970		1974	
	£'000	%	£'000	%	£'000	%	£'000	%
U.K AND IRELAND	112,439	40.2	179,570	39.7	3,531	53.1	2,541	27.1
ASIA	73,233	26.2	87,526	19.4	1,043	15.7	1,302	13.9
AFRICA	31,484	11.3	48,711	10.8	1,416	21.3	3,241	34.6
TOTAL	279,888	100	451,893	100	6,655	100	9,388	100

Source: Annual Reports.

about 40% of world production, underdeveloped countries take just under this figure and the rest is split amongst other countries, many of which are ex-colonies of Britain. These large firms are vertically integrated. For example, the largest producer (as opposed to marketer) of tea in the world has its headquarters in Scotland, controls 10 estates in India and Pakistan, 5 in Sri Lanka and 25,000 acres in Kenya. It has subsidiaries producing plywood tea and rubber chests; pulp for the manufacture of paper; printing of paper and boxes; produces insecticides and fertilisers; and is linked to 20 shipping firms and shipping claims agents in 10 countries and 8 insurance companies in 5 countries.

One particularly important characteristic of this vertical integration is the participation of these firms as tea purchasers and auctioneers. Primary auctions are held in producing countries and transactions take place between producers and buyers. These are followed by secondary auctions in London between these buyers, and blenders and retailers. Legislation in producing countries is designed to ensure that a 'perfect market' is in operation, but since the same firms are involved as sellers and producers in primary markets and in secondary markets, there is clearly extensive scope for price manipulation. For example, between 1961 and 1972 the average annual auction price per kilo of Sri Lankan tea in London was between £0.45-50, while the Colombo price was in the region of £0.26 (ie Rs 4.25-39), which suggests a considerable mark-up. In addition when India increased its export duties on tea in the mid -1960's, and Sri Lanka imposed a moratorium on profits, freight and insurance prices increased dramatically while local prices were depressed.

To sum-up, then, the international market is characterised by the geographical concentration of production and the concentration of marketing and production in a few large firms based in Britain. Their interests/production in Africa have changed dramatically over the years and this had had an influence over their policy towards the introduction of new technology in Kenya. The tea industry appears to be one where there exists abundant opportunity for the manipulation of prices and there is some evidence that the firms have taken advantage of this opportunity.

The Position of the Sample Firm in the Global Market.

The firm in this study is the dominant marketer of tea in the world and is directly involved in the distribution of about a quarter of the world's tea crop and indirectly controls the distribution of a further 15%. Its tea interests are widespread, with estates in all the major producing countries. In addition it is an agent for 29 independent estates in Sri Lanka, most of the independent producers in Kenya and over 50 large estates in India. Since, as we have seen, the real profits arise in

The Effect of Global Operations on Generation and Acquisition of Technology by the Kenyan Subsidiary.

We have seen that the global operations of this firm suggest that three dominant factors will affect the behaviour of the Kenyan subsidiary. These are that (i) Kenya is particularly important producing country for the firm and that much of the firm's new investment over the years will have been concentrated in Kenya. (ii) the operation of the Kenyan subsidiary reflects the Group's desire to lessen its dependence on tea, and (iii) the Kenyan subsidiary reflects the general move from production into distribution. Each of these factors influence the behaviour of the Kenyan subsidiary in the generation and acquisition of new technology.

Before the effect which these global factors have (on the situation of technical change in the firm) is described, it is necessary to make explicit the expectation that it is in the nature of agricultural based industries that much of their research and development is tied of necessity to the producing country. It is partly a geographical accident that tea production overwhelmingly takes place in underdeveloped countries and it is thus likely that at least some R & D is done at source. This is in fact largely confirmed by the study - almost all of the new technology used in the growing of tea originates in producing countries, such as optimal fertiliser patterns, new techniques of growing, the use of shade-trees etc. On the other hand the position changes in relation to processing equipment, and the more complex the technology involved, the greater the tendency to situate the R & D in a developed countries. This is partly because of the back-up services required, partly a consequence of the disposition of research workers, and partly one of the more important ways the parent ensures that it maintains control over the new technology.

This pattern is clearly reflected in the behaviour of this firm. Simple processing equipment is fabricated (ie from imported motors, steel etc) in Kenya (by another firm in the Kenyan study) and some is manufactured in India and Sri Lanka. But the most important development in processing technology in recent years - the development of instant tea was entirely situated in Britain in the developmental stages. Once the technology had been developed, a plant was set-up in Kenya, but even then the trial runs and commissioning were the responsibility of the parent corporation. The participation of the Kenyan subsidiary has been limited to the operation of the plant once it has been commissioned.

The development of this instant tea technology raises another important point about the behaviour of this firm. Their R & D unit was set-up in direct response to the challenge of producing an acceptable instant tea technology. Now that the challenge has been met the firm has disbanded its R & D unit. This is seen by the firm as the abandonment of R & D and as marking a significant change in corporate policy. That this is the

case is not entirely clear for the formal abandonment of R & D was associated with the complete reorganisation of its Technical Services Unit. One of the functions of this new unit has been to solve problems which arise in various subsidiaries and it has absorbed much of the former R & D staff. Rather than an abandonment of R & D, it seems to mark a turning point in that there is little further scope for large technical breakthroughs of the sort which require concentrated R & D inputs and attention has now to be given to smaller, more incremental change.

Aside from this new, more complex instant tea technology, most of the technical change which does take place occurs in underdeveloped countries. As we have seen the firm's global interests dictate that future expansion should take place in Africa rather than in Asia. Therefore much of the new production technology which has been developed has taken place in Kenya, even if the technology itself has been generated in Asia. For example, the firm has concentrated the planting of high yielding vegetative production tea bushes in Kenya. In the sphere of materials technology, much of the technical change in the firm has occurred originally in Kenya - the development of new insecticides were pioneered in conjunction with multinational agro-chemical subsidiaries in Kenya and then transferred to Asia.

But it is in the sphere of product technology that most of the new technology has been introduced. As we have seen long-run corporate policy has been to move out of reliance on tea to new, agricultural-based intermediate products. The Kenyan subsidiary has pioneered the development of the cinchona tree (processed in Europe to manufacture quinine to send back to Kenya as a malaria palliative!) as well as that of tara bark (used in the manufacture of tannin). Both have required some developmental work (e.g. the use of a computer to design optimal cultivating patterns). Another sign of the importance of Africa (and Kenya in particular) for this firm was the decision to situate the new instant tea plant in Kenya, rather than in another country.

Two cautionary points need to be made in conclusion. The first is that in spite of the rather specific nature of this industry leading to the situation of some R & D in an underdeveloped economy, care should be taken not to overestimate the significance of this phenomenon. The total annual expenditure on all forms of R & D by this firm was about £35,000, (0.92% of value added and 0.002% of turnover) and the R & D which has taken place has been of an insignificant nature. Where technical change has been more complex in nature, it has been developed in Britain and parent has made sure it has maintained exclusive control over the technology. The second point is that the importance of the Kenyan subsidiary to the firm should not lead to the conclusion that no technical change at all takes place in Asia. Here an important point emerges. The Indian subsidiary has been restricted in the repatriation of dividends and as a consequence the Indian subsidiary has been characterised by a large degree of liquidity. This

money has been used in part to fund the generation of new technology. To a limited extent it has led to the innovation of new production technology in that high yielding varieties have been planted in marginal lands (as the parent thought it politically unwise to hold unutilised land) and new tea-picking techniques have been developed and transmitted to other subsidiaries. It has also led to some detailed research on product technology, and the Indian subsidiary has undertaken some original investigation into the properties of oleo-resins (which comprise the flavouring agents of certain spices). The stage has not been reached yet where this product technology can be implemented, but when it does it will be of interest to see in which subsidiary the innovation takes place.

II

PHARMECEUTICALS

So much has been written on the global pharmaceutical industry that there is some danger of stating what has become the obvious. Nevertheless it is perhaps the best example of an industry which cannot be understood outside of the global context. It exhibits most of the characteristics of truly multinational enterprise. For example its size, estimated to be over £10,600m by the mid 1980's (compared to the value of current production of just over £100m for the tea industry - at London auction prices). It is characterised by multinational production facilities - 80% of Hoffman-La Roche's production (the world's largest producer) takes place in foreign subsidiaries. And perhaps, most strikingly, the industry seems to be characterised by higher levels of transfer pricing than any other industry.

The most important characteristic of the industry is the phenomenon of product differentiation allied to large inputs of R & D. There are roughly 500 listed illnesses on the WHO register, and about 150 of these occur quite frequently. Although this would appear to allow for a large number of formulations, this hardly in itself explains the number of drugs annually introduced into an existing total of over 500,000- the US Food and Drugs Administration alone estimates that it annually receives applications for the approval of over 3,400 new formulations. The generation of these product formulations is dependent upon large inputs of R & D and generally takes the following form. Thousands of drug combinations are screened in an attempt to discover a hitherto unknown formulation which has some beneficial affect on the body without harmful side-effects. Most of these combinations are variants on existing formulations, and as the years go by without a major new breakthrough (as in the case of antibiotics) the screening process becomes less productive, and hence more costly. For example, one of the pharmaceutical firms in this study holds the patent on an effective anti-

rheumatic drug. But in order to 'discover' it, it first screened 13,620 other therapeutic compounds.

Another prominent feature of the pharmaceutical industry are the elements of monopoly which exist. There are numerous firms in this sector, and one estimate is that no single firm controls more than 7% of total production. But this overall picture of diversity masks extensive pockets of monopoly, with most large firms holding monopoly positions in the production of a specific drug family (for example the firm in this study has a monopoly on the anti-rheumatic drug which alone accounts for 60% of its ethical drug sales).

R & D in this industry is therefore an important element in each firm's quest for areas of monopoly. However, given the relatively limited number of illnesses in relation to the total number of drugs, much of this R & D goes into development of existing breakthroughs rather than into basic research. One estimate is that about 85% of all R & D in the industry goes into development and only 15% into research.⁵

The multinational characteristics of the industry are reflected in the performance of R & D. Unlike some industries where R & D is confined to the country of the parent, most of the larger multinational pharmaceutical firms perform R & D in a number of countries. To what extent this includes underdeveloped economies (in spite of the cheapness of their research staff in relation to that of developed countries), is doubtful, although there is some evidence of R & D being undertaken in India and Latin America.

One final relevant characteristic of the industry is that some of the larger firms are beginning to diversify their activities, in spite of the fact that profit rates in the pharmaceutical industry are relatively high. Partly this is because these large profits, coupled with extensive transfer pricing and increasing resistance to the practice of molecular manipulation have made governments increasingly prone to regulate their activities (as with the recent action of the British government towards Hoffman La Roche). It is also partly a reflection of the fact that there is some evidence that some new breakthroughs in the industry are likely to weaken their competitive position (for example the suggestion that new drug delivery systems which are capable of delivering drugs to particular areas of the body are likely to lead to a drop in the overall consumption of drugs). The response of the pharmaceutical firms has been to move into allied fields, such as cosmetics, medical equipment etc.

The position of the underdeveloped countries in the global market is characteristically weak. With over 70% of the world's population (and presumably a disproportionate share of its illnesses) the underdeveloped countries account for only about 14% of world consumption of pharmaceuticals. The monopolistic position held by the multinational pharmaceutical firms is intensified in these countries - for example it is estimated that in 1969 multinational subsidiaries controlled nearly 80% of the Brazilian market, 65% of the Argentinian market, 65% of the Indian market and nearly 100% of the Kenyan market. The structure of product differentiation and the emphasis on marketing are replicated in these countries.

The Position of the Sample Firms in the Global Market.

Two pharmaceutical subsidiaries were included in the Kenyan study, referred to here as B and C. In terms of total turnover C is bigger than B (£414m in 1974 compared to £259m). Yet in terms of production of pharmaceuticals, B is bigger and was estimated to be the 18th largest producer of pharmaceuticals in the world in 1971 and the largest single British producer. In 1972 C was reckoned to be the 57th largest firm in the UK (measured by capital employed), while B was estimated to be the 66th largest (1971). By global standards in the industry, then, these are relatively small companies and this is true even in terms of aggregate size in relation to all British companies. But they do figure very prominently amongst British based pharmaceutical firms. A short history of each of these firms will help to set them in context.

B began in 1904 as a producer of baby foods. It grew steadily over the years until the 1950's. At this stage a hectic 15 years programme of merger and acquisition of competitors took place (in line with the general trend in British industry at this time) until B established itself as the dominant firm in the UK industry. It penetrated international markets sooner than its British competitors and now has an established range of overseas operations. There are 48 worldwide subsidiaries of which 15 are in the UK, 14 in other developed countries and 19 in underdeveloped countries. Forty three of these are wholly owned subsidiaries and at least 75% of equity is held in the other five. It is predominantly a producer of pharmaceuticals 90% of its profits come from ethical pharmaceuticals. B is Europe's largest producer of bulk fermentation products and it is amongst the World's largest producers of anti-biotics and corticosteroids. Overseas sales comprised over 60% of total turnover in 1974.

C has a completely different background. The firm originally began as a chain of chemists which expanded rapidly over the years. Despite attempts to diversify into pharmaceutical production and international operations, it is still predominantly a UK-based retail marketing group. It operates

about 1,400 chemist shops in the UK and over 80% of sales are made-up of non-pharmaceutical products. There are 21 worldwide subsidiaries, 10 of which are in the UK, 6 in other developed countries and 5 in underdeveloped countries. All but 5 of these are wholly-owned. C has moved into international operations much more recently than B, and despite rapid growth of international operations they still comprised only about 5% of total sales (although, reportedly of a much higher share of profits) in 1974. The move into pharmaceutical production has also been a recent phenomenon and has been founded on the success of the anti-rheumatic drug mentioned earlier. Since only five years remain before the patent on this drug expires, much depends on the current programme of R & D if C is to remain as a successful pharmaceutical firm. It should be noted that the operations of the Kenyan subsidiary are distinctly different from those of the parent, since there is no retailing outlet in Kenya and much of the subsidiary's output is made-up of non-prescription pharmaceutical products.

In the early 1970's C made an attempt to take-over B. It was a rather complicated picture which was characterised by some observers as an attempt by C to get into the 'big-time' as a pharmaceutical producer. The outcome was that the UK Monopolies Commission vetoed the take-over largely on the grounds that it would have had a deleterious affect on the performance of R & D. The effect on international operations would perhaps have been less deleterious as B was strong in markets where C was weak and vice versa.

The distribution of global sales for the two firms is shown in table 2 and table 3

Table 2

B: Global Sales in 1974		
	£ m	%
UK	100.7	38.9
Europe	67.9	26.3
Asia	40.8	15.8
The America	22.1	8.6
Africa	15.6	6.0
Australia	11.5	4.4
Total	258.6	100

Source: Annual Reports.

Table 3

C: Global Sales in 1974		
	£ m	%
Africa and New East	6	1.5
Australia	5.5	1.3
Asia	6.8	1.6
America	1.6	0.4
Europe (UK)	394.1	95.2
Total	414	100

Source: Annual Reports

The Effect of Global Operations on the Generation and Acquisition of Technology by the Kenyan Subsidiaries.

The Kenyan subsidiaries of these two firms are small by comparison with other overseas subsidiaries. B is a 'tariff jumper' in the sense that local production both anticipated and followed the introduction of tariffs after independence as a way of consolidating its market position in Kenya which had been developed prior to independence. The presence of C in Kenya reflects the decision by the parent in the late '60's to increase international operations. Rather than establish a new subsidiary the firm chose to take over the only existing locally-owned pharmaceutical enterprise in Kenya which, conveniently, produced much the same range of products as C viz some pharmaceuticals and some cosmetics. In addition baby products have now been added to the subsidiary's portfolio of products.

The behaviour of these two subsidiaries clearly reflects the global organisation of the market. Since there are reputed to be significant economies of scale in the production of pharmaceuticals, the Kenyan subsidiaries make no attempt whatsoever to produce these locally. Their local production is confined almost entirely (with the one exception of B's production of baby foods) to mixing, pill-making and packaging. These activities are not characterised by significant scale-economies, and anyway they make up only a small proportion of value added in the final product. The production technology used by these firms is therefore rather simple and a range of equipment (producing at varying rates of output) is readily available on the world market.

Small as these needs may be with regard to production technology, there is an identifiable difference in the policy of these two subsidiaries in the generation and acquisition of new technology. B procures all its production technology from Europe - although it is consulted by the Technical Services Division of the parent, the ultimate choice and purchase is undertaken by the parent. C appears to have much more autonomy in the acquisition of production technology and this is reflected in the fact that since the take-over in 1970, approximately 20% of its production technology has been locally manufactured. To some extent the subsidiary has itself been involved in the generation of new techniques in consultation with local suppliers. Care should be taken however not to overestimate the significance of these local purchases, since the production technology has been relatively simple (eg tin-fillers), and local production has largely consisted of making up a suitable machine from imported components, albeit to a local design.

Changes in material technology have predominantly been embodied in imported inputs and the two subsidiaries have had little involvement in these changes. The one exception to this concerns packaging materials and here, too, C has been more active in the generation of locally designed and produced inputs. It has made a decision to purchase all of

its packaging inputs from local producers in order to cut inventories and reduce lead-times between order and delivery. In consultation with local producers (notably the subsidiary of a Canadian/British multinational) changes have been made in the nature of packaging materials produced. The interesting point here is that it is frequently argued that subsidiaries of product differentiating multinationals replicate parent product-choices entirely so that, for example, a Coca Cola is a Coca Cola wherever one goes. In the case of C this policy, particularly in regard to packaging used in product differentiating strategies, has to some extent been forsaken in the interest of using local inputs. This as we can see, does have a limited affect on the generation of new material technology.

We have observed earlier that product technology is the most important sphere of technical change for the pharmaceutical industry. This pattern is clearly evident in the behaviour of these two subsidiaries. New products have been innovated, product-differentiation techniques are used and existing products are adapted. Both product innovation and differentiation follow the pattern of the parents and little new product technology is required by either of these two subsidiaries in this regard. But for both 'technology is required by either of these two subsidiaries in this regard. But for both 'technical' (eg climatic) and other reasons, existing products do have to be adapted to suit local conditions. Here too, a difference occurs in the behaviour of the two subsidiaries. B relies completely on the parent for reformulation - a consultant is sent out by the parent to make the necessary changes, and the new product is then tested by the parent to see if the quality is acceptable. C has much more autonomy. It undertakes the reformulation itself and then sends the new product to the parent to see whether it satisfies the requirements of quality.

Thus the two subsidiaries do differ significantly in the degree of autonomy which they have from their respective parents. This clearly affects their behaviour with regard to the generations and acquisition of technology. C is involved in the local generation of materials, product and production technology, and B appears not to be. With regard to the acquisition of new technology, C also appears to have more autonomy to unbundle and diversify its purchases from that of the parent.

The question of interest to us is to what extent the differential behaviour of these two subsidiaries is explicable in terms of the role which their parents play in the global pharmaceutical industry. It is believed that there are three explanatory factors here. The first is that B is primarily a pharmaceutical manufacturer and has extensive investment in the production of some inputs. It also has presumably over the years developed relationships with machinery producers which it can manipulate to its own advantage in the purchase of machinery. By contrast C has

predominantly been a marketing enterprise with few production facilities of its own and little opportunity to develop these close relationships with machinery suppliers. There is therefore much more advantage to be gained for B if it is able to route the purchases by its subsidiary through its own centralised production and marketing operations.

The second explanatory factor concerns the experience which each of the firms has had in the sphere of international operations. B, as we have seen, is a long established international operator, while C is a relative newcomer. Now there are clearly benefits to be gained (up to a certain point, anyway) in firm strategies which emphasize global maximisation, rather than local profit centres. The problem for the new entrant, however, is that these benefits follow years of experience in the manipulation of subsidiaries to satisfy global interests. C, being a relative newcomer, is at a distinct disadvantage in this sphere and this is reflected in the relative autonomy which it accords to its subsidiary.

There is a third explanatory factor which is offered in contradiction of the second factor discussed above. It may be that there are advantages to be gained by the firm if subsidiaries are allowed to adapt to the local environment, as in the case of C whose locally generated production technology reflects local factor proportions more accurately than imported techniques, and where inventory costs are lowered by the purchase of locally generated materials technology. The explanation may be that it is the nature of organisational behaviour that the newer, and more eager, an entrant may be to global operations or a local market, the more flexibility it exhibits in regard to adapting to local conditions.

Given that to some extent the explanatory reasons offered above are contradictory (i.e. in the costs and benefits of subsidiary autonomy), it is not clear where the answer lies. There is seldom any virtue in compromise, but in this particular case it does appear that all of these factors explain various aspects of the behaviour of these two subsidiaries. Generation of technology locally is both an advantage and a disadvantage to C. The real question arises with regard to the direction of future policy by the firm. Given the costs and benefits of autonomy, will future decisions be reflected in increased, or less autonomy by this subsidiary?

III

Cement

Cement has been produced on a commercial scale since the beginning of the twentieth century and is now a universal building material. Because of the ubiquity of raw materials used to manufacture cement, it is now produced in almost every country. There is still significant global trade in the commodity (about 30m tons a year), but most countries are developing

their industries to attain self-sufficiency.

Between the two world wars, European and American producers operated cartels which determined export shares. However after the second world war the trend for most countries was to establish their own cement plants and these cartels^{were} undermined. The majority of cement plants in the world are now wholly-owned by national capital, and where this is not the case, the trend is towards excluding foreign equity in these enterprises, particularly in underdeveloped countries.

There are, as a consequence, few multinationals operating in this sector. The largest producer is probably a French firm, which is followed in size by the British firm (involved in this study) and then a Swiss Firm. At a smaller scale (in terms of total output, home and abroad) are three American multinationals.

To some extent the pattern of enforced divesting is explained by the lack of vertical integration in the industry. With few minor exceptions, production of cement is entirely divorced from the manufacture of cement plant. Ten firms dominate the production of cement plant and two of these - one German and one Danish firm - account for about half of the world's output. For many years the technology for cement production has been relatively stable. Basically there are two different methods of manufacturing the commodity, the wet process and the dry process. The wet process is most applicable to raw materials with a naturally high water content. It is technically the simplest method and involves grinding the raw materials with water and feeding it into the kiln after which it emerges as clinker. In the case of the dry process, the raw materials are ground without water. This latter process utilises exhaust gases to dry the raw materials in the grinding process and thus leads to a marked reduction in unit energy costs. This has become an obvious asset in recent years.

Although these technologies have been relatively stable over the years, as have the market shares of machinery suppliers, the picture has begun to change recently for a number of reasons. Firstly the change in energy prices has affected the relative costs of the wet and dry processes.⁶ Secondly a number of these suppliers, notably the smaller Japanese firms, have recently^{made} a series of breakthroughs in terms of kiln size, heat and pollution saving innovations and automation and quality control. The result has been that in both periods - initially the relatively stable earlier stage, and then in the changing recent period - the market has been characterised by a relatively competitive oligopoly.

In the face of this divorce of cement production from machinery production and the relatively competitive market for machinery manufacture, the cement producers have been able to develop a role for themselves as consultants and management - contractors. For the existence of this oligopoly

in machinery manufacture has meant that the price of particular pieces of equipment results from a bargaining process. The capital cost of plant, measured in terms of dollars per ton of annual capacity, has been known to vary between \$50 and \$200. To the extent that the larger producers have knowledge and experience of purchase of cement plant they are able to 'sell themselves' to new producers in terms of obtaining the lowest quotations for machinery.

There are other features which encourage the growth of consultancy services. The production of cement is relatively capital intensive and for some underdeveloped countries, particularly those in Africa, it is a relatively complex process. The costs of inefficient utilisation can therefore be high and this has been an important factor in persuading a number of underdeveloped countries, notably in Africa, South America and recently in Iran and the Middle East, to accept management contracts and hire consultant firms. One additional factor is that quality control is an important element in the manufacture of cement and many firms (such as the subsidiary in this study) do not have the capacity to undertake all of these tests themselves. They therefore need to link themselves to larger producers in order to undertake adequate quality control testing.

In recent years there has been a renewed emergence of marketing cartels amongst the larger producing firms.

For example, the British firm in this sample has formed a joint company with the Swiss multinational mentioned above to serve the countries in the Arabian Gulf from their jointly owned plant in Kenya. Clinker is produced in the plant on the Kenyan coast and this is bulk-shipped to countries in the Gulf for grinding into the final product.

The Position of the Sample Firm in the Global Market.

The firm in this study produced a total of 27.5m tons of cement in 1973, making it the second biggest cement producer in the world. The share of overseas deliveries (i.e. UK exports and production by overseas subsidiaries) has grown markedly over the years and now comprises over 50% of total deliveries. There are twelve principal subsidiaries (i.e. where it holds more than 50% of equity), of which nine are in developed countries. In addition there are another fourteen associate companies (i.e. where it holds more than 20% and less than 50% of equity), of which seven are in developed countries. Finally there are two further companies (one in Kenya and one in Spain) in which less than 20% of equity is held.

There are three factors which broadly explain the behaviour of this firm in the global market. The first concerns the problems it faces in the home market. The growth of the British economy has fluctuated notably over the past three decades, and the construction sector has felt these

fluctuations particularly severely. This unstable market has also shown little tendency to grow. Production by this firm for the home market has in fact remained fairly static and between 1965 and 1971 there was hardly any sign of growth at all. In addition the British Government reacted to serve inflation in recent years by introducing price controls on ordinary portland cement.

The reaction of the firm to these problems in the home market has been twofold. Firstly it has countered price controls on ordinary portland cement by leading in the field of product innovation. A number of new type of cement which have specific uses (such as the newly developed glass-reinforced concrete) and which are exempt from price control in the UK, have been developed. Secondly it has attempted to increase its penetration of foreign markets and the share of foreign deliveries has increased markedly from 2.5% in 1945 to 22.8% in 1960 to 53% in 1973. Sales to these markets have predictably been more profitable and this is shown in table 4.

Table 4

Share of Home and Foreign Sales and Profits in Group Performance

	% share of turnover		% share of profit	
	1973	1974	1973	1974
U K	72.1	71.7	55.4	43.4
Total over- sease	28	28.3	34.6	56.6
African	14.6	25.4	21.3	51.1
Australasian	13.0	2.5	13	3.3

Source: Company Report 1974. Difference between 1973 and 1974 for Australasia is largely a result of loss of majority equity in one Australasian firm.

The second factor which has influenced the global behaviour of this firm has been the tendency to enforced divestment in foreign (particularly underdeveloped) countries. According the company has "had to modify and adjust its policy towards overseas investment seeking to maintain a strong influence on those companies in which it had invested in the past and seeking to maximise control over new investment".⁽⁷⁾ The consultancy division was set up in 1969 to market the group's technological knowhow in this context. "The Consultancy Service works closely with the Overseas contacts, and feeding them back information on potential opportunities for investment". The firm maintains that since the group "does not manufacture plant or machinery for the cement industry, it therefore has no vested interest in the selection of plant. It offers a complete range of services, from preliminary economic financial and geological investi-

gations through to planning and designing new plant, commissioning and erection and full management and technical assistance including negotiations with machinery suppliers and sources of finance, and selection and training of staff".

In 1974 the firm announced its biggest consultancy contract so far, worth £1.5m with a joint Moroccan/Algerian government plant. It will be responsible for the design, engineering and supervision of construction together with the training of manpower to run the plant on completion. It is also active in South America, Qatar, Zambia, Iran and Kenya. A new consultancy partnership has been established with the Swiss firm to serve the Middle East exclusively and it is negotiating with its Mexican partner to set up a consultancy unit to serve Central and South America and the Caribbean.

The third factor which has affected its global operations has been its link with the Swiss firm to serve the Arabian Gulf export market from the Kenyan subsidiary. Since this intimately affects our discussion on the behaviour of the Kenyan subsidiary in question we shall turn to this later.

The Effect of Global Operations on the Generation and Acquisition of Technology by the Kenyan Subsidiary

There are two cement producing firms in Kenya. One is centred in the interior of the country near the capital city, Nairobi, and is the oldest plant, with an annual capacity of 250,000 tons. It was set-up initially by local-capital to grind imported clinker in the 1930's and was taken-over in the 1950's by two British firms - one of which was the firm in this study. In the latter 1960's, its British partner sold its share to the Swiss multinational, but this change was associated with enforced participation by the Kenyan Government - who now own over 50% of the equity capital (the two multinational now only hold 14% each of the equity). The plant produces for the local market only and, officially, not for export. (In fact some of the output is reported to be smuggled into Uganda). The British firm holds a Technical Services Agreement with this subsidiary and as part of this agreement, it provides technical manpower, assists in the process of quality control by analysis of samples in the parent company, assists in the purchase of machinery and is available for consultation should any problems arise. The Swiss partner is 'not active' and merely holds equity.

The second plant in Kenya is situated on the coast and produces predominantly for export. Of its 1.25m tons annual production, 250,000 tons will go to the local market and the rest is for export to the Arabian Gulf in the form of clinker. Each of the multinational partners (i.e. the

firm in the study and its Swiss partner) holds 40% of the equity and in this case the Swiss firm holds the management contract for the firm the terms of which are unfortunately not known.

The research was concentrated on the generation and acquisition of technology in the Nairobi subsidiary since the focus was on the British multinational and it was active, through the Technical Services Agreement, in this plant. However clearly the behaviour of the one subsidiary cannot be considered in isolation, particularly as there is obviously a closely harmonised strategy in the behaviour of these two firms.

The strategy is concentrated on the behaviour of the exporting subsidiary. Partly this is because of the need to control the export market to the Arabian Gulf and partly (it is suspected, although no evidence is as yet available) because this export market offers plentiful opportunity for transfer pricing. The main function of the holding in the Nairobi plant is therefore firstly, as a source of funding for the Consultancy Unit and secondly, as a way of controlling a potentially disruptive factor with regard to the lucrative export market to the Gulf. As a consequence the expansion of capacity has been confined to the export plant which is currently expanding capacity from 0.75m tons to 1.25m tons. The Nairobi plant has seen no expansion of capacity since the existing plant was established in the late 1950's. There are also no plans to expand output in this plant, in spite of the shortage of cement on the home market. (8)

The contribution of the parent in the sphere of production technology is thus limited since there is little prospect of new capacity being added to the plant. It provides disembodied managerial and technical inputs as specified by the Technical Services Agreement, and is heavily involved in the quality control procedure in analysing some intermediates in Britain. The main contribution in new production technology is with regard to the savings of energy costs since the increase in prices in 1973. The plant is of the wet-process type which means that it is a particularly important problem for the firm due to high unit energy costs. Since the parent currently operates a number of similar plants in other parts of the world, the Kenyan subsidiary is awaiting the results of research into this problem which will be passed on to the Kenyan subsidiary when available. No information exists as to whether this will be provided in terms of the existing agreement or as part of a new package

There is some evidence that the link to the British parent has had negative effects on the introduction of new production technology. In the 1950's, the Nairobi plant was grinding imported clinker and wished to introduce a kiln to manufacture clinker itself. The British parent is

reputed to have used its cross-holding of equity to block the introduction of this kiln for a number of years.⁽⁹⁾

As we have seen product technology has become of considerable importance in the cement industry, with a number of special types of cement and available. The Nairobi plant produces only ordinary portland cement and the production of specialised derivatives (such as cement used in the lining of oil bore-holes) has been confined to the export plant. Materials technology is of no great importance in this industry and there is thus little participation by the parent in this regard.

In summary, control by the parent in this subsidiary is predominantly exercised through the management contract, rather than through the (small) equity holding. The importance of this control is manifested with regard to the performance of the second, export-oriented subsidiary at the coast. A second less-important aspect of the participation in the Nairobi plant, is that it provides the opportunity for participation by the Consultancy Service Division in the face of forced divestment. Both aspects are clearly explicable in terms of the global operations of the firm.

IV

Vehicle Assembly.

The development of the motor industry over the past seventy five years is a familiar story which needs no detailed repetition. The industry is now of significant size in many developed economies⁽¹⁰⁾ and of growing importance in many underdeveloped economies.

Technical change has been of considerable importance in the growth of the industry. In the sphere of production technology, the main changes have concerned the scale economies which result from the utilisation of mass production techniques. This has led to the increased division of labour in the plant and increased mechanisation.

Changes in production technology have also occurred in the industry, as all product ranges are heavily differentiated in a product conscious market. For the consumer, price and product variation are indissoluble, so much so that in a marketing sense, each particular vehicle may sell to a restricted market. The share of this market is however very sensitive to both changes in unit cost and in product characteristics, so considerable resources go into changes in product technology.

Changes in material technology have also been of importance to the industry. But unlike production and product technology, these changes in material technology have predominantly been carried through/component suppliers to the vehicle manufacturing companies. This has important implications for the vehicle industry and there is some evidence that

vehicle manufacturers who do not buy-in large quantities of components tend to lag in the product technology which results from the utilisation of these components.⁽¹¹⁾

The first half of the century saw the domination of car production internationally by the American firms. In post war years, however, European and Japanese firms have shown striking growth in the output of motor vehicles in a period which has seen the increased interpenetration of markets by producers. Not only has this led to the rapid growth of exports, but increasingly to the practice of manufacturing abroad. To what extent this pattern of location of production is durable is unclear. There have been signs recently that (in the mould of the product cycle) some component producers are locating themselves in low-wage economies, and also that low-wage economies (and Eastern Europe) are themselves building the capability for the mass-production of motor vehicles.⁽¹²⁾ Yet at present underdeveloped countries are insignificant both in terms of the scale of production and the scale of the market for motor vehicles.

The production of commercial vehicles (which together with four-wheel drive vehicles are the subject of this study) has followed a slightly different pattern. Until very recent years commercial vehicle markets in developed countries have been dominated by national producers. But change is imminent with a number of American firms building plants in Europe and intra-European cross penetration of markets increasing. Another difference between the car and commercial vehicle production has been the relative absence of large scale production in this sector, particularly with regard to the heavier vehicles.

The market for four-wheel drive vehicles has features of both car and commercial vehicle markets. Like the latter, the scale of production is relatively small, but since these smaller vehicles use many components developed for motor cars, scale economies do arise in the production of some inputs (e.g. engines). Unlike either the car or commercial vehicle markets, there are relatively few producers on the market - the American firms produce largely for the domestic market, while the sole Japanese and British firms produce primarily for the export market.

The Position of the Sample Firm in the Global Market.

The firm in question is the only British owned car manufacturing firm. There are forty-eight worldwide subsidiaries, twenty two of which are in Britain and eight in underdeveloped countries. All but three of the underdeveloped country subsidiaries are wholly owned. The distribution of global sales is shown in table 5. The firm has recently been taken-over by the British government and has been the subject of much discussion

as to its future viability which is in question given the existing organisation of scattered small scale plants.

Tabel 5
Global Sales in 1975

	£ m	%
UK	843	52.9
North America	133	8.3
Europe	275	17.2
Africa	117	7.3
Australasia	107	6.7
India and Pakistan	40	2.5
S and C America	39	2.5
Far East	21	1.3
Other	20	1.3
Total	1595	100

Introduction of commercial vehicles is less concentrated than that of cars and there exist a number of small producers in operation in Britain. Presumably this reflects the fact that scale economies are less important and that the use of bought-in components is more widespread in the production of commercial vehicles.

Unlike its European and American counterparts this British firm does not dominate its own, or any other large market. Its share of the home market for commercial vehicles has fallen from 41% in 1966 to about 30% in 1974 - unit production has also fallen by a quarter. Leadership in the light and medium weight markets has been lost to an American firm, although it remains the market leader in the heavier end of the market. Yet as two American firms are in the process of completing plants in Britain to produce these heavier vehicles, there is every likelihood that this dominant position will also be eroded. One of the main reasons for this loss of market share has been the reluctance of this firm to buy in components developed by supplying firms. Although it has purchased some inputs (notably American diesel engines in export models), it has been slow to incorporate the new inputs produced by the component industry (such as the new axles, engines and gearboxes introduced by these firms in the early 1970's). This has not only meant that they have lost the benefit of new, improved inputs, but also that they have been unable to offer the wide range of choice which their counterparts have done.

The one sign that this firm does have some innovative capability has been that it has pioneered the introduction of mass-production techniques in the manufacture of busses, having set-up a new jointly-owned (with a state corporation) plant a few years ago. This is apparently the first time that ^{an} assembly-line has been used in the manufacture of busses, and since early

difficulties have been overcome (in product quality, notably) the plant is running adequately at full-capacity. But it has shown the perennial weakness of this firm in that scale is not large enough to meet demand and this has allowed competitors to obtain a significant share of the home and export markets.

For obvious reasons this firm has been relatively strong in under-developed countries, particularly former British colonies. But here, too, the failings in product design mentioned above have led to the erosion of the firm's market dominance, notably in the larger Australian and South African markets.

The effect of Global Operations on the Generation and Acquisition of Technology by the Kenyan Subsidiary.

The Kenyan subsidiary of this firm assembles commercial vehicles (medium and heavy), busses (the bodywork is locally made) and fourwheel drive vehicles from knocked down kits. Almost all of the inputs are imported, the local content being restricted to batteries, tyres, filters etc. The scale of the operation is small even by European standards (under 3,000 a year) which leaves little opportunity for local manufacture.

The subsidiary dominates the market for heavy vehicles, busses and fourwheel drive vehicles. Yet is the familiar story of lessening dominance over the years as rivals begin to penetrate the Kenyan market. The interest of the parent in the Kenyan subsidiary is as a market for knocked-down kits. It recognises the Governments wish to encourage increased local content and is in the process of constructing a newer, larger plant (about 4,000 units per year) in association with the Government and a local marketing firm. Two other assembly plants are being built in Kenya so this new development is as much of a 'defensive' action as an 'aggressive' attempt to increase market share.

Although scale will be greater in the new plant, local content will still be minimal. It is difficult therefore to talk about technical change in the case of this subsidiary. The production technology in the new plant will be slightly different with the introduction of a mini-assembly line and spot welding. The design of this line and the spot welding equipment was done by the British parent and most of the new equipment required (bar a few simple jigs) will be imported. The subsidiary had no involvement at all in this process. Product technology also follows the pattern of the parent- some changes (e.g. in spring specifications) have been made for the Kenyan market, but these are standard for exports to underdeveloped countries and are automatically included in the knocked down kits. Material technology is the one sphere where the subsidiary has had any involvement, and this has been confined to persuading local

manufacturers to produce products (eg soft-trim) in line with the government's wish to increase local content.

In summary, the operations of this subsidiary reflect the undevelopment of the industrial sector in Kenya and the small size of the local market. This necessitates that vehicles have to be assembled almost entirely from imported knocked-down kits and leaves little scope for locally generated technical change. The structure of global competition has seen the increased penetration of the Kenyan market by rivals and this has to some extent affected the subsidiary by forcing it to build a new, larger plant and in persuading local manufacturers to supply components. There is little evidence that this has led to technical change in component suppliers (for example, locally made batteries are assembled from imported cells and casings).

Refrigeration and Air-Conditioning Engineering and Design.

The industry which is the subject of study is that of air conditioning and refrigeration design and engineering. It caters primarily for industrial users rather than for final consumption and its production is concentrated in larger industrial units, rather than mass-produced house-hold refrigeration and air-conditioning units.

The producing market for these products have become increasingly concentrated over the years particularly with regard to the larger compressors. The largest single market is that of the USA where most of the large firms are situated.⁽¹³⁾ The European market is smaller than that of the USA and, as with other sectors, has shown a tendency towards increased concentration over the years. The number of producers in Europe has halved to about 7 over the last decade and there is every expectation that it will shrink even further over the next few years.

After many years of relatively stable technology, the industry seems to have begun a period of rapid change. For example in the sphere of production technology, new numerically-controlled machine tools have been introduced. They are much more capital intensive than previous equipment, with high acquisition costs (in the order of £0.5m) and much increased productivity - the one introduced by the firm in this study produces a 200hp compressor every 4 hours, while the previous process took 4 days. Product technology too has entered a period of rapid change, notably the switch from reciprocating to screw compressors. The latter have not yet been fully developed but the main advantages should be better reliability and greater flexibility.

It is partly as a result of these changes, requiring fairly large research and development inputs and large investment, that the number of

producers in the industry has begun to contract. Another feature which is allied to this changing technology is the extensive use of cross-licensing practised in the industry - it is estimated that every compressor produced in the world is produced under licences held by no more than ten firms.

What distinguishes this from other sectors is that most of the large producers of equipment also are design contractors, taking on specific projects of design and specifying (and perhaps producing) the equipment which is installed. The balance between design and production varies between different firms - in the case of the British firm in this sample the balance is split evenly between the two activities.

International cross-penetration of exports of equipment seems to be more fully developed than with regard to design. The former is very competitive, particularly in Europe where the rationalisation of production has not yet been completed. The American market has begun to 'open up' to foreign firms particularly in low-temperature refrigeration equipment.

The Position of the Sample Firm in the Global Market.

In 1974 sales external to the group were £45.36m. There are eleven subsidiaries in the group of which two are in underdeveloped countries (one in Brazil and one in Kenya). The division of international sales is shown in table 6.

Table 6

External Sales in 1974		
	£'000	%
UK	23,294	51.4
Africa	10,059	22.2
Australia	4,978	11
Europe	3,852	8.5
Other	3,180	7

Source: Company Report.

The firm has emerged from the merger of three British companies operating in this industry and is currently one of the three largest producers in Europe. They manufacture for sale to other subsidiaries, to rivals and for inclusion into systems which they have designed.

Although the firm is one of the leading innovators in the industry, both in terms of production and product technology, this has depended to a large extent on the licences which it has acquired. For example the newly installed numerically-controlled machine tool is an adaptation of a European machine designed originally for another industry, while the screw compressor is produced under a French licence. This licence

specifies sales to Britain and 'British Trading Partners', while export to other countries is prohibited unless the compressor is part of a larger system designed and produced by the firm. Most large compressors produced by Westinghouse in the USA are under licences to this firm.

The Effect of Global Operations on the Generation and Acquisition of Technology by the Kenyan Subsidiary.

There is little indication that the structure of the global market affects the operations of the Kenyan subsidiary in any way. This is for a number of reasons. The first is that, as with the parent, the Kenyan subsidiary is not only a manufacturing concern. It is largely involved in the design and installation of systems which may or may not include the parent's products. In fact only about 20% of inputs are purchased from the parent which reflects the fact that the subsidiary is more involved with air-conditioning than refrigeration systems (the parent's strong point)

The second reason is that as an industry, design and engineering seems to be tied more to local conditions than most industries in under-developed countries. The main input of the firm is that of skilled design staff, and as an input this is little affected by considerations of global competition. Another feature of this industry is that there are compelling reasons for situating design activities within the country of operation rather than in the parent country, particularly as there are relatively few fixed costs to this design activity (such as expensive plant and equipment)

The third reason for the relative absence of international pressures on this firm is explicable in terms of the historical factors which led to its presence in Kenya. Originally (pre independence) the parent exported its products to a European owned trading firm. As the volume of business grew this trading firm wished to withdraw from the agency to concentrate on other interests and the parent therefore took over the operation and formed a wholly-owned subsidiary to supply refrigeration and air conditioning equipment. Over the years this has grown into a design capacity as well, which is largely autonomous from the parent. The absence of government measures regulating remittances from the subsidiary is probably another contributory factor to the subsidiary's apparent autonomy.

The subsidiary was asked its views as to whether it was likely that some of its competitors may invest in Kenya, and if so what would its reaction be to this extension of international competition. The answer was that there were corporate problems which arose from its dominance of the Kenyan market (there are two other smaller firms in operation)

concerning fluctuations in sales and earnings. Given that the firm holds a large share of the market in Kenya, fluctuations in this share inevitably led to fluctuations in the firm's turnover. To the extent that there are fixed costs in its operation, this has significant implications for profitability. Therefore the subsidiary felt that new entrants into a growing market would be a welcome insofar as this would give some opportunity to even out these fluctuations.

In summary, the Kenyan subsidiary operates with a considerable degree of autonomy from the parent, and is virtually isolated from the implications of changes in the global market. In all probability this isolation and autonomy is general to engineering and design firms in peripheral economies such as Kenya.

Conclusions.

We have concerned ourselves in this paper with the effect of global operations on the generation and acquisition of new technology by subsidiaries of six multinational firms operating in Kenya. An earlier study had established that little new technology had been generated by these subsidiaries or by other firms operating in Kenya. It is difficult to generalise conclusions from the limited sample of case studies.

There are signs that global competition in the pharmaceutical industry is particularly intense and that this had an effect on Kenyan operations. In addition the 'follower' firm in this oligopolistic market showed a greater tendency to adapt to local conditions and this may well be a characteristic of oligopolistic markets in general. The greater adaptative propensity of the subsidiary in question may also be related to the fact that, relatively speaking, it was less vertically integrated than its rival and consequently there were fewer corporate pressures to use parent production technology.

The effect of government policies on the behaviour of subsidiaries is drawn out in the case of the tea subsidiary. Here the relative absence of government pressure in Kenya, contrasted with its strong presence in Asia, has clearly affected the propensity of the parent to generate some of its new technology in Kenya. The behaviour of the vehicle assembling subsidiary is another case where government pressure (or anticipated pressure) has forced some (albeit limited) change in technology on the Kenyan subsidiary. In this case it is the prospect of anticipated government policy, in an internationally competitive sector where penetration of market share by rivals is a great threat, that has affected the subsidiary's behaviour.

The need to control the behaviour of a rival in relation to a lucrative export market characterises the behaviour of the cement firm. It provides key technological inputs to the subsidiary in question and has used this to control the acquisition of new technology by the subsidiary which may erode an established export market. A second feature of great interest comes out in the behaviour of the cement firm. The tendency towards enforced divestment, particularly in underdeveloped economies, has forced the firm to move increasingly out of control through equity to control through management contracts. It is perhaps suggestive of a trend in the operations of many multinationals in future years.

Only one subsidiary showed an almost complete absence of response to global competitive pressures and this was the engineering design subsidiary. Possibly this is a feature of capital goods firms in general for two reasons. Firstly to internationalisation of capital goods industries is a fairly recent phenomenon, and while competitive pressures are beginning to be felt in production of machinery and equipment, they are largely absent in the engineering design sector. This sector is however becoming increasingly subject to pressures of global competition and the global rationalisation of production is occurring at a rapid pace. It may well be therefore that in years to come the Kenyan subsidiaries in this sector too will be subject to global pressures.

The second reason is that it may be that by their nature capital goods industries are forced to adapt to local conditions, since they apply scientific and technological principles to meet the requirements of specific locally-based customers. This, coupled with the relative absence of large fixed inputs of machinery and equipment, makes it more likely that subsidiaries in this sector will show a greater tendency to generate their own technology to suit local conditions.¹⁴

Care should however be taken in interpreting the case studies in this research. In the first place the sample is limited to six firms, which may lead to various biases. The most important of these is that all of the subsidiaries are rather atypical in Kenya in that they operate at high rates of capacity utilisation. Subsidiaries with high rates of excess capacity may show a different tendency with regard to their generation and acquisition of new technology.

The second cautionary point is that the research has of necessity been static in nature. It is not entirely clear how the picture will have changed over time, although at least three potential effects may be noted. The first is that as scale increases the tendency of the subsidiaries to adapt to local conditions (as in the case of one of the pharmaceutical subsidiaries) may decrease as parent technology becomes more suited to the needs of the subsidiary. This 'negative scale' effect may be countered by a 'positive scale effect' that as scale increases there may be

economies in adapting techniques to meet local factor proportions, market tastes and material input availability. The third potential affect is that if anything the global pressures will increase as the rivalry of international capitals increases. This effect is particularly noticeable in the capital goods subsidiaries where the international market is becoming increasingly competitive and the interpenetration of markets increases.

Footnotes

1. Technical Change and the Multinational Corporation: Some British Subsidiaries in Kenya, OECD Development Centre, mimeo, 1975.
2. The study mentioned in footnote 1 also looked at the production of tea machinery. It has not been possible to obtain an adequate overview of the global operations of tea-machinery producers to include the firm in this paper.
3. For an elaboration of the struggle between small and large growers in Kenya, see A History of Foreign Investment in Kenya, N. Swanson, in Readings on the Multinational Corporation in Kenya, R Kaplinsky (ed), forthcoming.
4. S Lall, The International Pharmaceutical Industry and less Developed Countries, Oxford Bulletin of Economics and Statistics Vol 36, No 5 1974.
5. There are a number of factors which explain this concentration on development, rather than basic research. The discovery of a new drug (as opposed to a new formulation of an existing drug) can be an expensive business. In addition to these basic research expenses the necessary clinical trials can take a number of years before the drug can be profitably marketed. Given the high discount rate of these pharmaceutical firms the logic of firm strategy is to concentrate on quick yielding research, notably the characteristic of producing new permutations of existing drugs. There are also reckoned to be high minimum levels of expenditure in basic R & D. One indication of these factors has been that the fairly large Australian firm, Aspro-Nicholas, has closed down its Basic research laboratory in the UK (with an annual expenditure of about £10m) because of the poor return to this sort of research.
6. Unit Variable costs of the wet process are still lower than total (ie fixed plus variable) costs of dry process plants, so there is little evidence of scrapping of wet process plants.
7. All quotes in this paragraph from Company Reports.
8. The expansion of the coastal plant was explained in an advertisement placed by the Nairobi-based firm in the East African Standard in May 1975. The advertisement is interesting in that it addresses itself to the problem of the non-availability of cement in Kenya by considering the strategy of both firms as if they were direct subsidiaries of the same parent. In fact, as we have seen, this is not the case, but it does portray the strategic control exercised by the parent-firms, although they have only a small minority stake in the Nairobi plant.
9. S. Langdon, personal Communication
10. One estimate of its importance was that in the 1960's the motor industry accounted for about 1/3 of all value added in the engineering industries in Western Europe (The Engineering Industries in N America, Europe and Japan, OECD, Paris 1967)
11. The reason why technical change tends to be greater with bought-in components is presumably because of the scale economies which are open to these component suppliers. For example three of Europe's producers have jointly set-up a separate engine plant as the costs of tooling and design were too great for any one of the producers to bear alone, given its limited share of the market.
12. The reported conclusion of a British Government enquiry into the motor industry was that by the year 2,000 the world motor industry would be dominated by production from E Europe and the semi-developed countries. Sunday Telegraph 2/11/75.
13. The largest single firm in the industry, however, is in Japan. It has a particularly large export market, concentrated in Asia.

14. The study in subsidiaries in Kenya (see footnotes 1 and 2) covered another Capital goods firm manufacturing tea machinery. The adaptability of this subsidiary and its autonomy seem to support the observations with regard to the engineering design firm and the Capital goods sector in global.

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