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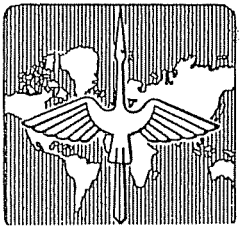

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SOME REFLECTIONS ON THE USES OF SCIENCE AND TECHNOLOGY IN INDONESIA

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INTRODUCTION

The observations contained in this paper are based on a study of the social dimensions and implications of the use of science and technology in Indonesia which I visited in the course of 1975.

The purpose of the paper is not to attempt a full interpretation of the Indonesian situation, but to briefly discuss some basic processes and issues related to the use of science and technology. The views expressed are necessarily partial and tentative and are advanced so as to serve as a starting point for discussion and further analysis.

A HISTORICAL PERSPECTIVE

The present use of science and technology in Indonesian society can only be understood properly if approached in the context of Indonesia's past as a colony of which the economic and social structure was shaped by the metropolis in function of its own interests and economic development.

After its conquest by the Dutch, the peasant economy of Java and subsequently of the other islands of the Archipelago was transformed as the peasant population was subordinated by force (imposition of land taxes, forced handover of produce, forced production of export crops, transfer of land from small-scale peasant ownership to Dutch and other foreign corporations, the development of monocultures) and profound changes were introduced in its social and economic organization. The disintegration of the peasant economy, geared to meet the people's basic needs, was accompanied by the gradual destruction of pre-industrial forms of industry which were an organic part of the self-reliant regional and village economy. The indigenous textile industry suffered from the import of cloth, produced in Holland from imported raw materials from elsewhere.

It must be pointed out that there is a direct connection between the development of the Dutch textile industry (with its wide multiplier effects on the development of Dutch industrialization and technology) and a process of involution of Indonesian industry and the destruction of indigenous forms of technology. A similar process took place in the course of the 19th and first half of the 20th century in other sectors of indigenous production. Agri-

cultural export and mineral extraction industries, both capital-intensive, grew steadily during the colonial period while industries geared to meeting indigenous requirements were largely neglected, to the benefit of Dutch industry in search of a market. The development of indigenous industrialization was further blocked by a variety of restrictive measures, designed to benefit Dutch industrialization.

Thus the dynamics of Indonesian society were qualitatively changed and it was converted from a self-reliant, largely self-sufficient economy, mobilizing and allocating its resources for own needs and requirements, into an externally-directed and outward-induced economy, receiving its major impulses from outside in response to alien requirements.

Since political independence, great changes have taken place in Indonesia, both in its relations with the industrially-advanced countries and in its internal structure. Yet the nature and orientation of the Indonesian present-day economy can only be understood against the underlying dynamics that result from the distorted structure of its social and economic organization, inherited from its colonial past.

CHANGES IN DEVELOPMENT STRATEGY

In the first period after political independence (1950-65), efforts were concentrated on the formation and consolidation of national unity and integration; and from 1957 onwards, after a period of conventional planning, on the creation of conditions for sustained economic development, by 'guided democracy' and state intervention. These two successive attempts both failed to establish the conditions necessary for a process of national self-reliant development. Attempts at land reform to lay the basis for a rise in productivity, increase the food supply and provide the necessary inputs for autonomous industrialization, which were to be supported by the nationalization of major foreign agricultural and mineral corporations, all failed. This was due to a variety of factors, including the opposition by vested interests inside Indonesia, by foreign business and governments, as well as by poor management.

Since 1965 a new strategy has been developed by the new government, whose development strategy was laid down in the 1966 stabilization plan, following the advice of the International Monetary Fund, and in the 1967 law on foreign capital investment. The strategy limits government control over the economy and promotes free entry into the country by foreign capital into all sectors of the economy, under generous conditions and with ample government support. Investment by foreign capital is concentrated in the

extraction and processing of export-oriented raw materials (agricultural and mining) as well as on import-substitution industries.

While the first five-year plan (1969-1974 Repelita I) primarily concentrated on stabilization and maximization of economic growth, the second five-year plan (Repelita II, 1974-1979) proposed to combine economic growth with equity and to take measures and promote activities in production, distribution and consumption that would be conducive to increased employment and a wider distribution of income and welfare through diversifying industrial development, particularly by promoting small-scale industry, and by intensifying support for agricultural and rural development.

A closely connected objective of Repelita II was to ensure a more balanced spatial distribution of industrial activity over Java and the other islands, so as to reduce the over-concentration of industrialization in major urban centers, particularly Jakarta. A third goal was to reduce dependency on imports of foreign capital goods and inputs, to balance the production of consumer goods with that of capital goods, and to increase domestic inputs, both for agriculture and industry.

As a result of pressures generated by the increasingly uneven distribution of opportunities between small-scale indigenous entrepreneurs *(Pribumi)* and the larger Indonesian and foreign entrepreneurs, special measures were taken to provide credit to the former group up to a maximum of $US 12,500 at 12 per cent per annum as investment capital, and $US 12,500 at 15 per cent per annum as working capital. Under this programme $US 70 million were allocated in 1974 and $US 100 million were scheduled for allocation in 1975. The government also prescribed participation by domestic capital through a policy of joint ventures.

CHANGES IN PRODUCTION PATTERNS AND IN LIFE STYLE

Foreign investment in the extraction and process of raw materials is highly capital-intensive. The import-substitution industries which have been initiated since the country was re-opened for foreign investment have also been capital-intensive, and have hardly helped to solve the problem of unemployment, estimated in 1974 by government to affect about one-third of the total labour force. It is characteristic of the first type of investment that it is nearly wholly export-oriented and that its multiplier effect on the rest of the economy is minimal, with the exception of agricultural inputs, particularly fertilizer, the production of which is to expand significantly under Repelita II. The absence of a multiplier effect is also a feature of import-substitution industries which are geared to effective demand, that is to say, the demand of high income

groups of the population.

The type of technology used is determined partly by the kind of goods produced. Consumer goods, produced by foreign investors and corporations looking for a high level of profitability, and catered for by high income consumers, tend to be capital-intensive, apart from being import-intensive and implying a limited utilization of local resources. A pronounced inequality in the distribution of income such as is characteristic of Indonesia - there is evidence that the uneven distribution of income is increasing, following a growing concentration of productive assets both in industry and agriculture - not only reflects but also causes the existence of unemployment. A more equal distribution of income would lead to a different pattern of effective demand by which the production of goods would be geared primarily to satisfying the basic needs of the population as a whole. Such a structure of demand, which would optimize the use of local resources, be of low import content, and lead to expanded working opportunities and spread of income, would reduce the need for reliance on foreign aid and capital import. While it might open the way to self-reliant national developments, however, it is not likely to be compatible with foreign and national vested interests which, interested in maximizing their profits, understandably orient production to those groups which in the short run enable them to satisfy this objective.

It may therefore be argued that 'modern' sector producers are inherently interested in an unequal distribution of income. The same interest characterizes 'modern' sector consumers who seek goods which they could not acquire if they had lower incomes, and if production were geared to the needs of the people as a whole, produced by 'traditional' indigenous producers with indigenous technology. It is argued that the 'modern' sector as it is identified with economic growth and 'social progress' (suggesting a break with economic and social stagnation) is likely to receive major support by government, which tends to support the values and lifestyles of modern higher-income consumers.

This is manifest in government's highly unequal treatment of the 'formal' sector (foreign investment with associated national capital) versus the 'informal' sector as evidenced by a multiplicity of forms of favoured treatment (exchange rates, import licenses, tax facilities, access to services, subsidies, infrastructure).

The Indonesian government is officially committed to give high priority to the pursuit of equity, income distribution and employment in Repelita II. It is suggested that a balanced policy of growth and equity cannot result from introducing new elements to the hitherto pursued strategy. On the contrary, the strategy is in need of fundamental changes in view of the dynamics of the modern sec-

tor which can only be re-oriented by consciously-planned intervention and control. This observation is inspired by the view that, if present tendencies will continue, the result will be increased inequality and the exclusion of large segments of the population from socially-productive work.

THE EFFECTS OF MODERNIZATION ON INDIGENOUS INDUSTRY

The expansion of modern industry under free market conditions is linked with the disintegration and disappearance of traditional home and local industry. Changing patterns of consumption not only occur and are shaped by modern industry in the urban centers but also in the rural areas, where higher income groups are emerging in the villages as a result of uneven agricultural modernization.

The disintegration of those traditional home and local industries which managed to survive the destructive effects of the Dutch colonial period, is evident in numerous branches of industrial and pre-industrial activity such as food, beverages, and tobacco; texiles; construction; shoes (e.g. substitution of wooden sandals); container production (water pots and buckets); earthenware; packing materials; furniture; leatherware; small capital goods production (agricultural tools); looms; ropemaking; wood processing, and many other home and local industries.

New styles of more expensive clothing (creasefree) demand new capital-intensive imported equipment and the import of raw materials. The production of tobacco with more 'sophisticated' perfume also requires imported equipment. Traditionally popular drinks are substituted by 'modern' drinks and Coca Cola has reached the most remote villages. Higher income groups in the villages are 'seduced' to 'join' civilization and to use Blue Band margarine, Delfia oil and Lifeboy Soap.

Such products drain away local savings and take away potential productive capital from the villages to increase the profits of large corporations, at the expense of local resource mobilization, labour utilization and income generation and local investment. Local container production is being replaced by plastic containers, imported or produced in cities and towns.

The same applies to other productive activities. Thus, rural-based small industry is substituted by urban-based industry, and agricultural and industrial productive activities are divorced from each other. Rural areas become increasingly dependent on the urban centers. The activities of intermediaries grow, terms of trade increasingly work against the mass of the rural population, who are obliged

to leave the rural areas to join the marginal population in the urban areas. Their productive potential which was under-utilized in the countryside, will be more wasted in the urban centers due to the nature of the growth that is taking place there.

Certain village industries (handicrafts, e.g. batik, silver), try to adapt to the changes in effective demand, and change to production for high income groups in urban centers. For example, the production of batik which is gaining popularity among high income women as an expression of Indonesian identity combined with elegance. More demand comes from the tourist clientele.

Such a shift towards a new clientele, however, is often accompanied by increasing intervention of middlemen on whom producers depend both for inputs and for marketing. This is likely to reduce the rewards for their work and may turn them into wage labourers, only nominally retaining ownership over their productive assets and control over working conditions. Their operations often disintegrate, however, as they are substituted by more modern and larger urban-based units of production, operating on credit from businessmen or banks in the urban centers or from the Jakarta metropolis. Another example is the village rotan industry: efforts have been undertaken to cater for new markets thanks to the improvement of quality and adaptation of design. Exhibitions have been organized and fine products are on sale in some of the expensive hotels in Djakarta.

DISINTEGRATION OF LOCAL INDUSTRY AND THE CHANGING STRUCTURE OF AGRICULTURE

The disintegration of home and local industry is not only generated by the incapacity of low productivity 'pre-industrial' home and local handicrafts and small-scale industry to compete with more productive, more efficient urban modern industry or imported goods. It is also closely related to the profound changes that are taking place in the structure and pattern of agricultural production.

Under the Suharto government, serious efforts have been undertaken to increase agricultural productivity. Government support has been especially concentrated on rice production, hoping to achieve self-sufficiency in order to reduce imports of basic foodstuffs, and to meet the demand of a rapidly growing city population. Government strategy has favoured the 'top' third, larger farmers who operate 38% of the farms (in Java) and 80% of all farm land.[1] Thanks to the introduction of high-yielding varieties, coupled to a package programme for inputs, the government has managed to raise productivity, but as yet Indonesia has to continue to rely on sizeable rice imports. The

small farmers (the second third) and the landless (the other third) are highly dependent on these larger farmers to whom they have to relate as clients to patrons. Inequality in income is a direct result of inequality with regard to land.[2]

The process of growth and modernization in agriculture is having serious effects on income distribution and labour utilization. There is evidence that inequality in income between larger and medium-sized landowners, and the small landowners, share-croppers and landless labourers who form the bulk of the population in rural Java, has been rising. While the real income of the first group as a rule has increased significantly, that of the second group has tended to remain unchanged or to deteriorate.[3] Poverty makes people far more vulnerable.[4]

The introduction of technological innovations is reported to shake the foundations of village life and to decisively undermine the various traditions of income sharing that characterized village life before the full penetration of the market economy, with its inherent pressure for profit maximization and cost minimization sought by the modernizing producers. These problems arise particularly from changes in rice harvesting and processing methods.

Studies report an increase in various parts of Java of a technique called *tebasan* under which owners, in order to free themselves from the traditional obligation to share the harvest with a large group of villagers who were hitherto allowed to participate in the harvest, sell it shortly before it is reaped to a middleman called the *penebas*. This penebas has no social obligations and can bypass those customarily entitled to a share in the harvest, and contracts a limited number of wage labourers from outside the village. The small finger knife *(ani-ani)* is replaced by a sickle, and 1 ha. of rice can be harvested by 20 people in two days instead of by 100 people in three or four days. Shares received by the wage-labourers will be higher than those of the harvesters under the traditional system, but total expenditures (wage fund) are significantly less, hence the owner's profit greatly increases. The possibility of increased profits induces owners and those controlling village lands (the village officials) to try to control more land through leasing or sharecropping.[5] Thus, landlessness tends to grow.

Another far-reaching change is the introduction of the imported rice huller and the substitution of hand-pounding (mostly by women) by mechanical hulling.[6] A team of the Agro-Economic Survey at Bogor has estimated that the total loss in Java as a result of this change is of the order of $50 million p.a. (120 million women/days of wage-labour or wages for one million women every day for four months p.a.). It is reported that in 1969 85% of the paddy was still hand-pounded with a mortar and pestle.[7] Such a major technologic-

al change has serious effects and re-shapes income distribution in favour of the relatively larger farmers and the ricemill operators, at the expense of the small cultivators, landless, small tenants and owners who have lost a major source of work and income. A change in the pattern of income distribution in more densely populated areas is also likely to be reflected in the reduction of the share of the harvest that the sharecropper receives.

Although the government has undertaken various major public works programmes at the Desa, Kabupaten and provincial levels, which provide work and wages, these do not compensate for the loss resulting from innovations in production and harvesting techniques. No in-depth evaluation studies have as yet been undertaken on the results of these programmes. The short-run effects of the Kabupaten programme are claimed to be significant in terms of employment creation and enhanced capacity for local planning,[8] but they unavoidably make the peasant population, paid in cash by the contractors, more dependent on market and exchange relations and on prices for basic necessities over which they have no control and which are likely to rise. Also, an undue share of the funds may end up in the hands of local contractors and brokers. There is a growing body of evidence that, in the absence of broad-based growth of production and of a reduction in inequalities in rural areas, an increase in demand for food-grains may merely bring about a rise in prices; consequently, the real incomes of the landless labourers and small peasants (owners/sharecroppers) may remain the same or even decline. It appears that for public works programmes to be beneficial to the poor, several conditions need to be met: that these works should help to build up productive assets and to increase the amount of essential consumer goods; that there exists a fairly effective public distribution system to secure an even distribution of basic needs, goods and services, eliminating the all-pervasive influence of the middlemen; and that ways are developed to permit the poor to save by preferential access to assets.[9] In the final analysis, the effect of public works cannot be dissociated from the need to effect profound changes in the distribution of power and assets in the community and society at large. An expansion of the wage-earning population by itself opens up little perspective; rather, it tends to increase opportunities for heightened exploitation of the small people in rural areas by landowners, usurers, middlemen and merchants operating from the towns and cities. All this serves to point out that national self-sufficiency (if it were achieved), increased productivity, and meeting the requirements of urban consumption, may well go together with the impoverishment of a substantial part of the rural population.

Given the nature of the economy, it is in a way 'natur-

al' that government services concerned with the increase of productivity should address themselves to that part of the rural population which possesses the minimum resource-endowment to take advantage of the package of inputs offered. It is also understandable that marginal farmers, not to speak of landless labourers, are not likely to try to make full use of the services offered as their resource endowment does not permit them to make a proper use of them, and they are likely to attempt to secure first the maintenance and improvement of the family's livelihood before responding to the government's call to co-operate.

This would presuppose a radical shift away from their dependence on the middlemen who continue to reap disproportionate benefits. In short, for the majority of the rural population to participate on beneficial terms in modernization, far-reaching inclusive changes are necessary in the over-all social and institutional organization of production and distribution.

Technological changes, accompanying changes in production patterns, include the introduction of trawlers. These have had a serious effect on the incomes of thousands of fishermen in the coastal villages of north Java, who have lost an important supplementary source of livelihood. The only way in which this could be prevented would be to organize the fishermen and to enable them to become joint owners of such trawlers, rather than to let them be used by joint ventures of foreign enterprise and national entrepreneurs from outside the fishing villages.[10] These entrepreneurs as a rule come from towns or cities where they are able to obtain easy and cheap credit in view of their privileged access to government support and to the banks.

The growth of uneven income distribution (which also in the villages tends to accompany an increase in the concentration of resources and access to inputs to mobilize those resources) is bound to affect village industry negatively and the possibility of its organic connection with agriculture. The market within the village becomes too small and, with the transfer of industry to the urban centres, the higher income village groups become the clientele of the urban-based industries (consumer goods, capital goods, inputs). At the same time they provide their products for city and town-based processing.

Inasfar as the remaining village industry and agriculture do not serve in practice to improve the real income of the villagers at large, the perspective of an over-all uplift of rural conditions remains limited. A first condition for that would be to promote the mobilization and organization of the bulk of the village population around an improved livelihood. But this would require that they first of all share access to the resources available in the com-

munity. This indicates the urgent need for the land reform that was prepared by the Basic Agrarian Act of 1960 and blocked by vested rural interests in 1965, and whose modest achievements were undone with the support of the new government. The need for land reform has since been wholly ignored as if it were an 'untouchable issue'. Yet pressures for it are bound to grow in force since productivity increase does not solve the problems of the poor but, on the contrary, helps to aggravate them. Development continues to require a political breakthrough which in turn will enable the far more gradual economic process.[11] A rural uplift also requires reconsidering the use of the land needed for the production of industrial crops - land taken away from the villagers during the colonial period or on which they, retaining nominal ownership, were forced to plant cashcrops under onerous conditions which tend to persist. It is reported that in East Java, for instance, as much as 30% of the land is required by government edict to be devoted to sugarcane which the government purchases at fixed low prices.[12] Broad access by the rural masses to available resources in the rural communities would help to release their large potential of under-utilized or hitherto withheld productive potential and induce a wide range of activities of capital formation. After pooling the now highly-fragmented land and introducing more rational use of water supply, modern methods of agriculture could become more general. Food supplies could be increased and diversified; industrial crops could be expanded as a complement to foodcrops; and conditions could be established for integrated local self-reliant development. Agriculture would then serve as the foundation for development (food, inputs for industry) and industry as the leading sector (production of capital goods to raise the productivity of agriculture and industry, and the processing of agricultural products and consumer goods for the population at large). The step-by-step organization of mutual aid teams, production co-operatives and larger units for the all-round integrated pooling and management of resources would create conditions for a way out of the present serious underutilization of people and mismanagement of resources.[13] A study of past experience suggests, however, that under conditions of serious inequality in the distribution of assets, particularly land, a co-operative undertaking is always bound to serve minority interests. Total village income may well increase, but the gains of growth go largely to the privileged minority.[14] Without co-operative organization, only a small fraction of the rural people can be reached, but such organization requires self-mobilization, which is precisely what the government has consistently been unwilling to accept.[15] A radical change in orientation by the government is thus necessary.

ENTREPRENEURIAL INITIATIVE AND 'RESISTANCE TO CHANGE'

In 1974 the government initiated a substantive programme of support to small-scale indigenous entrepreneurs. During the first year of the programme, 23 per cent of loans disbursed were for manufacturing, 15 per cent for agriculture and the balance for trading, transport and small hotels.

The rather disproportionate investment in activities that are not directly productive or even partly parasitic should be no surprise, nor that some loans are misused and spent on consumptive items. Short-term easy profits and rapid turnover are characteristic of trading activities. Investment by small-scale entrepreneurs in productive activities is fraught with risk and insecurity under uneven opportunities of many kinds. Those who are not accustomed to operate in a monpolistically-controlled market with rapid price fluctuations and changing conditions can be expected to be cautious and to avoid indebtedness which may make them lose the little they have. 'Resistance to change' should not be attributed to certain inherent characteristics. This is a racialist approach, suggesting that foreign entrepreneurs have superior qualities to indigenous ones. It is suggested that, in order to understand the relative reticence of people to act as 'entrepreneurs', it is not useful to look for personal characteristics, but rather to examine the contextual conditions which make people unwilling to take innovative action. A recent survey of small-scale industries in Indonesia undertaken in connection with a request for World Bank support, revealed that there are nevertheless some small-scale entrepreneurs who demonstrate a high degree of initiative, inventiveness and resourcefulness, both in terms of local resource-mobilization and organization. They are, however, often at the mercy of unscrupulous credit-suppliers, middlemen and merchants.

Banks are also not geared to 'development banking' and to helping small people with credits, much less to helping them in organization and management. From the point of view of commercial banking, such involvement is of little interest. A proposed scheme to train banking officials to gear themselves to this new type of activity may be of some help, but will not solve the constraints on innovative creative action and organization in a 'free' and risky environment, which encourages speculative activity by the stronger entrepreneurs. There is evidence that monopolistic firms, operating with brand images, tend to favour capital-intensive over labour-intensive equipment.[16] Price is not a primary consideration, as they have relative independence to set its level. Another consideration for the use of capital-intensive equipment is that it helps to avoid 'trouble' with labour. Inasfar as the government has curtailed action by independent labour unions so as to attract

foreign investors, the pressure for a switch in production techniques disappears. Southeast Asian countries, however, are relative latecomers in the light-industry export strategy based on the exploitation of cheap labour, which formed the basis for rapid growth of Hong Kong and Singapore, and Taiwan and South Korea. If wages continue to rise in those countries, a move by the multinationals to areas of even cheaper labour, such as Indonesia, is likely.[17] To point to Korea, however, as a possible example for Indonesia to follow, would not seem very appropriate.[18] Like Taiwan, Korea has undergone a unique process of transformation over the last quarter-century. In the case of Taiwan, a land reform became necessary for a government which came in from outside, in order to create a basis for its legitimacy and stability. Thus it had to do what it had not been willing to do for so long on the mainland, and as a result of which it lost power. In South Korea land reform also became a necessity in view of the radical reform introduced in the North, and in order to demobilize the militant peasant organizations that pressed for reform. The reform was preceded by the appropriation of Japanese holdings and prior sales by landlords to tenants and smallholders, in view of the threat of a possible takeover. Only after these land reforms did industrialization start. The joint group-farming approaches that have been developed in Taiwan and are now being tried in South Korea, will hardly serve for Southeast Asia; they are intended primarily to meet the scarcity of labour in the rural areas as a result of which mechanization has become a necessity. In Indonesia the effects of mechanization without the prior transformation of production relations, tend to have seriously destabilizing effects, which only can be contained by tightening the control over the rural poor.

According to the preparatory survey on small entrepreneurs mentioned above, major problems include the excessive collateral which borrowers have to put up and the high fees for a variety of licenses. Such conditions are discriminatory when compared to the treatment of larger entrepreneurs, and form part of the favoured treatment of the 'formal' over the 'informal' sector. They permit, in as far as they do not limit, the expansion of larger industries which can obtain inputs at low cost (components, services, inputs).

The uneven access to government support and facilities is a manifestation of the relative position of power of those who seek access. Thus, the larger producers are organized in associations by branch of industry and are the 'natural' partners of government on questions regarding relations between government, the banks, and the private sector.

Small-scale entrepreneurs, and the home and handicrafts industry, are highly unorganized. This reflects their fragmented nature of production, which is bound to affect their perspectives, perceptions and attitudes. A change in these is dependent upon changes in the social organization of production from small-scale and atomized to larger-scale production that integrates isolated units and would permit the use of improved and more productive forms of technology. Co-operative forms of production, however, require conditions of relative homogeneity and equality and cannot flourish under 'free' market conditions which induce monopolization and oligopolization by concentrated control over resources and inputs. The situation may be compared with that of small and poor peasants who are too easily qualified as 'resistant to change', apathetic and lacking entrepreneurial initiative. Their apparent resistance to change and innovative action is a rational measure of self-projection in facing an environment which does not allow them to pursue their vital interests. If they were able to pursue those interests they would probably show plenty of initiative. Resistance should therefore not be seen as in the minds of small-scale entrepreneurs or peasants but among the privileged who resist their participation in the control of , or access to, resources.

Training programmes to inculcate what has been called 'achievement motivation' and to help people to acquire features that are characteristic of the 'western' entrepreneur, without being linked to changes in the structural and institutional conditions, are unlikely to meet expectations. They are based on the assumption that people's behaviour can be altered without changing the environment in which they live and work.

A different approach is that of working closely with the people in analyzing problems from an overall perspective, helping them to understand their own conditions and the constraints with which they are faced, reviewing with them their resources and helping them to organize themselves around the mobilization of those resources. This involves a group approach and contrasts sharply with that which focuses on the individual entrepreneur. A group approach inevitably touches upon major political issues connected with the use and distribution of resources and income, and can only flourish in an environment which views the change of structural conditions and social relations as an essential dimension of the development process. Its promotion requires politically-conscious and socially-committed cadres.

EDUCATION AND RESEARCH

Great efforts have been undertaken by the Indonesian govern-

ment to modernize the educational system and to organize it in such a way that it can respond more adequately to the requirements of the future. A distinction has to be made, however, between quantitative growth and qualitative transformation.

Educational facilities have been greatly expanded at all levels. There has been a fast growth of primary schools in the rural areas, of vocational and technical schools. A number of experiments are underway to develop a new type of school that is better geared to concrete local problems, resources and potentialities. Some experiments attempt to link the learning process to a study of community conditions and needs and the identification of ways with which they can be matched to resources.

Education is not an independent variable; it reflects in its set-up, scope and outcome the structure and orientation of the society of which it is part. If it is reported that in some areas the number of school facilities increases but school attendance declines, this may well reflect a growing dysfunctionality of the school for a number of parents. For the poor, literacy and other elements of education may be of little interest. Also, for their children to learn 'how to match resources with prevailing needs', when they have hardly any resources and are denied access to them, is not likely to draw their interest. For those families which do have resources, however, schooling is vital in order to mobilize their resources in the most advantageous way. They see the acquisition of culture, science and skills as crucial for raising their social and economic conditions. It is not surprising therefore, that higher education shows a proportionately high percentage of children of parents with resources. This is further encouraged by fee requirements which discriminate against children of low-income families. In such a way an educational system tends to reproduce, maintain and even intensify class and income divisions in the society in which it supposedly functions as an instrument to promote equal opportunities.

An expansion of technical and vocational schools is planned to meet the growing manpower requirements of the modern sector. A major problem with such schools has been the non-combination of theory and practice, as a result of which industries have started their own training courses. The development of technical and vocational schools, however, appears to have little organic relation to a policy of developing industries in the 'informal' sector, whether urban or rural-based.

Giving all middle schools a half-study/half-work focus would obviate the need for special professional schools at that level, while linking education more closely with the development of the community. Such a focus would require a

de-emphasis of the primacy accorded to the modern sector, however, and the hierarchical split between 'higher' education and training for skills that this sector relies upon. Generalization of scientific and technological education and training should only be seen in a context that links education and training more organically with the requirements for self-reliant development of resources by communities. Such an approach, however, would require a far more egalitarian social structure and a less pronounced variance in needs and aspiration.

Indonesia is endowed with a multiplicity of research institutes, most of which existed before the more recent expansion of the modern sector. They play a minor role in the development of technology for investment by foreign investment or through joint ventures, as such technology is acquired from abroad, mostly purchased at high cost in a market characterized by highly monopolistic conditions.

It has been observed that intellectual property laws do not function to protect against abuse but to promote the owners' interests.[19]

Thus, to speak of transfer of technology is misleading as many patents are monopolistic by nature; any price may be charged while they always remain the property of the lessor or investor. The choice of technology is usually linked to the source of finance and credit, and high costs are charged for services rendered.[20] The introduction of technology, which in fact is non-transfered if it serves solely for using the resource-endowment of a particular country for own profit, precludes any research towards developing an indigenous technology. Research institutes which do work on the development of technology are likely to gear their work to the requirements of the foreign-dominated modern sector. This domination is not eliminated but rather facilitated by a joint venture policy, as joint ventures increase security for foreign capital and ease their penetration and expansion, control not being located in control over 'physical' capital but increasingly over knowhow.

Some research institutes, however, 'go against the stream' and engage in work to support the development of the indigenous informal sector, not relying on foreign capital and expertise. The outcome of their work is very much dependent on the degree to which the government is willing to regulate production, either by excluding foreign and/or national modern enterprise in certain branches or by planning cooperation in these lines of production with local indigenous industry, allocating specific responsibilities to each in the production process.

As styles of operation, patterns and rhythms of production of the formal and informal sectors are quite dif-

ferent, motivation to make the second successful is not likely to be high in an environment in which primary consideration is given to growth, profit and efficiency in terms of productivity and cost to the individual enterprise.

There is little opportunity for the informal sector to play a role where pressure for modernization requires high speed, high productivity (e.g. the construction of a modern city core). Such projects have to rely on imported equipment. Calculations indicate that home industries can produce 50 million bricks p.a. with 2,200 workers. A recently installed brick-factory in Jakarta can produce 450 million bricks with 130 workers in the same period.

Reliance on the improved organization and modernization of existing industries would have implied postponement of implementation, or another set of priorities, leading to a modified allocation of resources and support to groups which at present do not have the leverage to secure government support.

Institutes whose scientific work backs the development of native local industry are looked upon as engaging in a wasteful, futile exercise, i.e. they are likely to 'only repeat without adequate capacity work which has already been done in more advanced parts of the world'. Such views are not uncommon. When voiced by foreigners they reflect unfounded superiority, or if expressed by nationals, an inferiority complex and the absence of a spirit of self-reliance. The desire to initiate modernization is clearly related to the pursuit of a conspicuous life style.

An organic linkage of research to the development of technology in response to the needs of the country, requires it to be rooted in the environment and supported by a political commitment which gives primacy to the practice of self-reliance. It is incompatible with a policy which relies mainly on foreign capital and technology as the source of national development.

The creative involvement of people, both in the nation at large and in the local communities, in an effort to seek imaginative answers to problems through scientific analysis and to combine their findings with the fund of knowledge and technology from outside, presupposes forms of social and economic organization which enhance their motivation and mobilize their potential. This cannot take place without progressive de-monopolization of control over resources.

A major question is how to link universities more closely to the needs of the country and to train students in such a way that practice in the field will inspire their theoretical work which should focus on the solution of concrete problems and meeting the needs of the majority. It has been suggested that study in all disciplines should be made more relevant by making students more sensitive to

basic issues such as equity and the structural dimension of development.[21] Perhaps greater scope should be created for students to concretely express and convert into practice their thirst for social justice. In 1972, the Ministry of Education initiated a programme for students to work three to six months in the villages. In 1975, several thousands of students from 29 of the 41 state universities participated in this study/service scheme. Unquestionably this provides them with a major opportunity to understand village life and the problems and needs of the population, and they may, if committed, engage in a highly useful learning process.

Whether the scheme will serve to transform them in their personal being and give a social and service orientation to their lives after graduation is doubtful in view of the highly stratified society of which they are part - a society which reserves for them a place within the privileged higher income groups and induces them to develop a lifestyle or aspirations to secure it. This may prevent them from sharing the concerns of the people. A more organic relationship between university and society would require a combined study/work approach as a basic feature of the entire learning process. This, in turn, would presuppose the development of a society which organizes education in first instance around improving the livelihood of the people and closely organizes academic and scientific study around these concerns.[22]

There would seem to be a profound contradiction between a policy which tends to equate development with the growth of the modern sector and marginalizes a large part of the population, and the study/service scheme described above. Inasfar as the scheme helps students to realize this contradiction and enhances their political and social consciousness and concern, the scheme could be of great value, although perhaps unintentionally.

Another programme that links university training to the villages is that of the Indonesian Board of Volunteer Service which organizes schemes whereby Indonesian graduates can serve for up to two years as volunteers and generalist community development workers. The Volunteer Service (Butsi) which enjoys dedicated leadership, was started in 1963; the number of volunteers increased steadily from 30 in 1969 to more than 1,500 in 1975 when it was planned to raise the number to 4,000. Volunteers are placed in groups of five, one in each of a string of contiguous villages. They work as auxiliaries to extension services at the Kecamatan (Subdistrict) level in such fields as agriculture, animal husbandry, health and welfare, and are expected to help the villagers in solving their economic and social problems and to co-operate with them in projects such as erosion control, re-afforestation, improvement of cultivation techniques, irrigation, co-operative organization.

Unquestionably, the Volunteer Service provides interested graduates not only with work, but also with a fine opportunity for an educative experience. If they genuinely identify with the problems which the poor villagers have to face, theirs can be a valuable experience. They will inevitably face the fact, however, that attempts to deal effectively with prevailing problems (land shortage, low level of capitalization, low productivity, non-cooperation, the disintegration of local industry, usury and exorbitant interest rates, indebtedness, little care for the environment, erosion, de-forestation, malnutrition, poor health) are invariably connected with the need for profound changes in the social and power structures inside the village community and in relations between the villages and society at large. The need to come to grips with 'the fundamental causes of maldistribution, among which foremost the concentration of productive wealth, including ownership and control of land' is abstractly recognized. To suggest that this requires the creation of a suitable institutional and political 'framework',[23] however, implies that the problem is perceived as something external to the social and production relations which shape power, wealth and poverty. As if the rich and poor face the same problems.

The volunteers may also learn that changes can not take place unless the people are allowed and encouraged to mobilize and organize themselves to challenge the prevailing power-structure and to secure conditions for protecting and promoting their livelihood. The development of political and social consciousness and action in this direction however, is incompatible with a government policy with equates development with modernization and which considers it necessary to politically demobilize democratic peasant and worker organizations so as to facilitate the process of growth and modernization and to secure the continuation of a privileged existence to the elites, both in and outside the village.[24]

A significant process of technological change is taking place in the villages, in production, harvesting, processing and marketing. This manifests the increasing penetration of the market economy into the villages, with as a consequence a tendency for concentration of power and productive assets and a popularization of the income and social structure.

Inasfar as people, including volunteers, want to associate with the diffusion of technology so as to promote a more even spread of its benefits, they have to associate with the promotion of social and political transformation that is likely to be resisted by a minority which reaps the fruits of growth and uneven development.

The above is not intended to denigrate the usefulness

of the volunteer service but to try to place it in perspective. It is suggested that its usefulness depends on the degree to which it serves to associate the volunteers with the promotion of social and institutional change so as to ensure that technological progress will serve the purpose of development. Indonesia has more than 60,000 villages, which leaves much scope for expansion of the volunteer service. Its real usefulness and the scope for creative action by the volunteers will continue to depend on the possibilities for village people to achieve democratic control over their resources and to use them for the benefit of all.

The study of science and technology is fundamental to any educational institute to promote in young people the capacity to understand and to learn how to work with the forces of nature and to contribute to the development of productive forces. It is just as urgent or even more urgent, however, that the nature of social forces operating in society should become an integral part of the study so that students acquire some insight into how people can control their conditions.

The Bandung Institute of Technology is undoubtedly the most important centre in Indonesia in this field. Founded by the Dutch colonial government in 1928, its training has from its inception been geared to meeting the requirements of the modern sector. Younger sister-institutes in other cities in Indonesia can in no way cope with the fast growing demand from that sector.

In 1973 a Development Technology Centre was created within the Institute. This was a turning point, reflecting the desire to move away from the one-sided subordinate role of the Institute to the private sector, at the expense of service to the people at large. There is evidence that a one-sided training of engineers to work with 'advanced' equipment pre-disposes them to favour such equipment, irrespective of economic and social cost-benefit considerations. The establishment of the Centre reflected the great concern felt by some of its staff to promote the search for adapted forms of technology that would improve and expand production in agriculture and industry by relatively inexpensive methods, requiring only modest capital lay-out, promoting the use of local resources, creating scope for labour utilization; in short, creating scope for self-reliant development.

The Centre's programme is inspired by a group of young professionals organized as an interdisciplinary team; the focus of their orientation is clearly of a pioneering nature. The first phase of their activity has been principally to sensitize their own Institute and other centres. Some work is being done at the Institute to develop new techniques (e.g. low cost windmills, the use of solar en-

ergy, low cost housing). Also, the productivity of blacksmiths and small workshops in rural areas and urban areas is being surveyed.

A proposal for technical co-operation with a Dutch university on the development of appropriate rural technology has been submitted to the Dutch government. This would enable the Centre to start a technology service in a neighbouring area. It seems a wise decision not to expand its activities too rapidly; more reflection is needed and ideas are still in the process of maturation.

On the other hand, ideas need to be tested in down-to-earth involvement with the village people and small urban entrepreneurs and the variety of problems which they encounter in the development of suitable technology. The question is not one of 'transfer and application of technology from outside' but the linking and use of technology to forms of economic and social organization which enhance productivity, opportunities for socially productive work, motivation, and a fair distribution of income.

While the Centre was clearly born out of concern with the marginalizing effects of the modernization process, in attempting to find practical answers it cannot bypass facing the political and institutional questions and dynamics which shape the direction and use of science and technology. Either it will be allowed, under the pressure of increasing contradictions, to develop an integrated approach, or it will have to limit itself to technological experimentation, dissociating itself from helping to shape a society in which not only growth but equity must be realized in accordance with the guiding principle of government policy. Pressures to achieve a balance between the two are mounting as a result of increasing control over science and technology and of the rapid increase of population. The latter may well be imputed to the growing necessity among the poor masses to offset their increasingly precarious livelihoods by a growth in labour capacity, as growing poverty requires a family to earn less with more labour.[25] The function of reproduction as a condition for production is thus intensified.[26]

GLOBAL DEVELOPMENT STRATEGY AND THE USE OF SCIENCE AND TECHNOLOGY

Throughout this paper major emphasis has been placed on the need to strengthen local small industry. This in no way implies a position against modern capital-intensive large production units as such. For a country to rely exclusively or mainly on small-scale production would condemn it to stagnation and poverty, in view of the low productivity that usually characterizes such industry. On the other hand, to rely mainly on rapid expansion of modern industry at the

expense of small-scale industry obliges a country to make excessive use of foreign investment and aid. High growth may occur, but its benefits are likely to serve mainly foreign investors and only a small fraction of national producers. It is bound to increase reliance on imported raw materials, intermediate goods and foreign know-how, and is likely to cause an increasingly distorted pattern of resource use and a growing under-utilization of the immense productive and creative potential of the mass of the people who are excluded from the possibility to earn a reasonable living.

This is not a plea for autarchy, but genuine national development implies that a nation has full control over its own resources and the capacity to adapt external pressures and interests to its own internal domestic requirements. In this sense technological independence, which requires profound changes in the as yet unequal terms of the 'interdependence' between the industrially advanced and the third world countries, is inseparable from the pursuit of political, economic, social and cultural independence.

If it is postulated that national development requires the simultaneous development of large, middle and small-scale industry and also the use of modern and traditional technology, this is linked to several assumptions:

- the development of an organic relationship between, and the mutual support of, agriculture and industry - agriculture providing inputs for industry and industry providing inputs for agriculture so as to raise its level of productivity;
- the mutual support of modern and large and traditional small-scale industry. The latter can be gradually improved, thanks to the creativity of the local people and the support of more advanced production units. Similar units can co-operate with the larger, e.g. production of inputs, components;
- a balanced development between urban centres and rural areas and regions in which the integrated development of rural areas and particularly of agriculture and industry (e.g. the development of processing industries, small capital goods, consumer goods responding to basic necessities) has a high place.

The question inevitably arises whether the use of science and technology can be planned at all. Our thesis is that science and technology do not stand by themselves, but

that their use and development is a dimension of the wider planning of societal transformation.[27]

Such planning is made urgently necessary by the very nature of the scientific and technological revolution, the great benefits which that potentially carries for the well-being and welfare of all, the rising contradictions between the needs of the masses in Third World countries and the actual benefits accruing to privileged minorities, both in industrialized and in Third World countries.

These assumptions imply the rejection of the thesis that concentration and centralization of control and the use of science and technology on an ever-increasing scale are part of an 'inherent' law of industrialization. It is submitted that it is more correct to consider such processes of concentration and centralization as consequences of the dynamics of a mode of production which requires maximization of profit and, at a more advanced stage, the maintenance and promotion of high levels of profitability, in response to pressures generated by a specific type of economic and social organization and concomitant motivation.

Another way of approaching the question is to ask whether evolving patterns of technology are the consequence of invariable, purely technological, 'compulsions' or whether technological linkages are historically, politically and socially shaped. If it is assumed that all sectors of industry have their fixed recipes, in the main determined by technology and prescribing input co-efficient matrixes derived from input-output tables in the industrially-advanced countries, and that these represent a complete cookbook which any Third World country has to follow if it wishes to develop, then countries may be qualified as underdeveloped inasfar as they do not imitate the industrially-advanced countries, and as developed inasfar as they base their production pattern on the latter's experiences. The second position would exclude any choice and originality or flexibility of Third World countries in pursuing a path adapted to their own needs.

If it is accepted that major economic parameters for the choice of techniques in market economies are capital accumulation, the structure and patterns of demand of intermediate and final goods, real wage rates, the availability and price of resources and of raw materials, then it must be admitted that these are not purely 'economic' magnitudes but that they are shaped by particular forms of social organization.[28] The view that economic growth is linked to technological recipes with fixed economies-of-scale does not take into account that the process of industrialization has historically been characterized by constant changes of scale and variations in input mix.[29] Various alternatives are open regarding the input mix (e.g. construction, infrastructure, transportation, furniture, clothing, food, land use, agriculture, animal husbandry, the production of steel, fertilizer and cement).[30] If pro-

duction is organized and shaped by the modern sector in a market economy, the trend is likely to be capital-intensive, particularly in the urban areas. When organized and shaped by indigenous local and rural initiative, self-provisioning and self-reliance can play a significant role.

It is necessary to combine the two initiatives so that increased productivity goes together with people being able to realize their creative potential, mobilize local resources, and so participate in making their community and country.

Apart from the vital considerations discussed above for developing a multiplicity of local initiatives in industrial development, there is also a 'technical' argument for the development of small-scale industry. Lower capital intensity, when combined with smaller scale, leads to a shorter gestation period for investment and hence makes it possible to earlier reinvest surplus accruing from investment.[31] The amount of surplus per unit of capital investment may be smaller, but the compound effect could lead to a higher rate of growth.[32]

Such an approach permits a country to avoid recurring to foreign investment, and to finance its basic industries needed to produce the capital goods for raising its productivity in agriculture and industry, by relying at least in part on the compounded value created by agriculture and light industry. This approach requires radical agrarian transformation so that the rural masses engaged in agriculture and small-scale industry receive a fair share in the surplus they produce; this will provide them with the motivation and commitment to work both for their country and for the advancement of their own community and of themselves. Such a policy implies the reversal of an approach which views development as the diffusion and expansion of modernization by the trickle-down effect. Diffusion theory is largely an ideological position which has to serve to justify the privileged treatment of the 'formal society', i.e. big capital. It presupposes an approach which starts from the premise that modernization can be realized by the all-round utilization of national potential through full reliance on people's productive and creative faculties and by the fullest use of national and local resource-endowment. It cannot be realized without the transformation of society towards a more equal distribution of income in resources and of the means with which to mobilize these. But it is not likely that the privileged groups will be willing to give up their positions. The above propositions on possible variations of input mix and combining small, medium and large industries cannot lead to any universally applicable recipes. Each country has to find its own path, starting from and taking into account its resource endowment and distribution,

the size and distribution of its population, and above all, its own historical process and particular stage of development.

Also it has to be emphasized that with changes in production, assuming the development of an organic connection between various kinds of industry, the functions of those industries change (e.g. urban-based capital goods industries would concentrate on larger and more sophisticated equipment, rural industries may take over from urban industry the role of making more simple capital goods and some basic consumer goods). This is part of a continuous planning process of matching production to changing needs and requirements. Planning the use of technology in this sense means that people achieve democratic control over the community's assets and working conditions, in the context of central planning to be rooted in the people's democratic control and participation in society at large.

But internal conditions that will be conducive to the growth of indigenous science and technology cannot at any stage be dissociated from the evolution of the world economy and the control of Third World economies by the dominant industrial nations. The higher the degree of incorporation into the dominant world economy, the more serious will be the effects on the internal economy of a worldwide recession, particularly if the main exports are primary commodities. On the other hand, a temporary break with the world market has historically been a condition for the upswing for local industries making mass consumer goods.[33]

The multiple rise in oil prices means that Indonesia is capable of continuing to rely on imports of goods and services which it otherwise could not so easily do. This rise, coupled with the continued aid from the Indonesia consortium, exempts the Indonesian government for the time being from carrying out basic transformations in the power and income structure which otherwise would be necessary. Meanwhile, production and consumer patterns develop with their associated technological requirements which make it more and more difficult to introduce the necessary changes from above, as vested interests become greater and interest in maintaining the *status quo* grows also.

FINAL CONSIDERATIONS

In this paper I have concentrated on some of the ways in which the use of science and technology in Indonesia is shaped by the internal structure of production. This is part of a worldwide structure of production, and the imbalances within and between sectors and regions, the coexistence of advanced and rudimentary technology, high and

low productivity, reflect Indonesia's dependent position in the framework of worldwide interdependence and the movement of capital. The development of Indonesian society towards self-reliance, and the mobilization of its resources in response to its own domestic requirements of production and consumption, demand a break with conditions of dependency and the implementation of a policy and action programme as was formulated in the International Declaration on the New International Economic Order and its action programme. It should be well-emphasized that inequality in exchange relations does not stand in itself but is a manifestation of the world structure of production, both the economic structure of the industrially-advanced countries and that of the Third World countries that are incorporated in and dependent on that structure. The reason for concentrating in this paper on the internal structure of production is that, if and when fundamental changes occur in the exchange relations, they may take place thanks to the united action by Third World countries as a whole, by regions, and by product groups. The way should then be opened to self-reliant development, but this is not automatically so. It may be prevented by the way national privileged groups have become associated with dominant interest groups on a world scale.

A break with patterns of foreign domination will have no benefits for the people at large unless profound internal changes are also realized, so that authentic national interests can prevail, giving priority to the full mobilization of people's potential and of material resources in function of their own requirements. Support for such an orientation is enshrined in the Pancha Sila, the basic tenets of the Indonesian constitution, proclaiming that development must be rooted in social justice.

Indonesia is blessed with a large population and endowed with a rich variety of resources. This gives it a great perspective if it succeeds in overcoming its external and internal constraints to self-development.

Science and technology for self-development implies not only making use of the existing fund of knowledge (including its application and transfer), but above all, development of people's capacity to identify their problems and to learn how to solve them. This requires the study of material conditions and their instrumentalization (natural sciences and their use for technology), and the study of society and of ways in which to make change serve human advance (social sciences). In this sense the basic function of science is to search for new knowledge and practices. Thus responding more adequately to the people's needs and aspirations.

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