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Imperialism and Science

SCIENCE, said Mao, is the crystallization of knowledge developed through man's struggle for production. Throughout history people have developed science by collecting, systematizing, analysing and generalizing their struggles for increased production.[1] But increasingly, and especially from the seventeenth century onwards, the word 'science'[2] and the expression 'scientific knowledge' have come to be reserved for that body of knowledge and skills whose development is associated with the names of Copernicus, Galileo, Newton, Boyle, Harvey, Faraday, Darwin. Einstein, Heisenberg, Bohr and Rutherford. When one thinks of science, one thinks of steam engines, electricity, atom bombs, computers, sputniks and genetic engineering. This science has developed along with the rise of capitalism. In fact the title 'science' has been exclusively reserved for that knowledge and those skills which can be systematized and incorporated into the academic culture of the ruling capitalist class.[3] All other knowledge and skills that belonged to the popular culture, and which have accumulated over centuries of careful and selective observations and practice, have been denigrated and labelled unscientific. Third world countries came into contact with this science through imperialist expansion, plunder and colonization. With the establishment of imperial hegemony over the third world by the end of the nineteenth century,

popular local knowledge and skills suffered an eclipse. They were declared unscientific and denied encouragement and support of any kind by the imperialist rulers. Even after gaining formal independence the rulers in the third world continue to follow the imperialist in denying state patronage to local popular knowledge and skills. Thus allopathy, which relies heavily on synthetic drugs, is considered scientific, is taught in universities, is practised in government hospitals and receives research grants from the state. On the other hand, plant medicine, which relies on vast stores of knowledge accumulated over centuries of observation and practice is declared unscientific and is condemned by the medical profession. It does not command government support for research and development. Numerous other examples can be given from the popular practice of agriculture, animal husbandry and weather forecasting. Thus in the third world it is only capitalist science which receives state support, and is taught and researched in universities, laboratories and other establishments. The title of science in the third world is reserved for that knowledge and those skills which can be incorporated and integrated into the capitalist relations of production, and which is of value and use to the world capitalist system.

According to Scheffler: "A fundamental feature of science is its ideal of objectivity, an ideal that subjects all scientific statements to the test of impartial criteria, recognising no authority of persons in the realm of cognition."[4] Sharing the same viewpoint J Monod, the French biologist and Nobel laureate, writes: "Science rests upon a strictly objective approach to the analysis and interpretation of the universe, including Man himself and the human societies. Science ignores and must ignore value judgements."[5] But this commonly held view has come to be increasingly challenged, even by bourgeois philosophers of science. In 1962 Thomas Kuhn launched his controversial attack on the conventional wisdom, popularized in the writings of Popper, that science progresses cumulatively towards an ever greater understanding of physical reality, step by step, guided by logic and the appeal to a theory-independent empirical basis. Kuhn divides science into two types: normal science and revolutionary science. Normal science consists of the articulation of the paradigm[6] to which the scientific community is committed. "Scientific revolutions are non-cumulative episodes in which an older paradigm is replaced in whole or in part by an incompatible new one."[7] As subjective, personal and partisan considerations play a decisive role in the acceptance of a new paradigm, science can hardly be said to be an objective, neutral and value-free activity. In fact the metaphysical position of the scientist affects the form that scientific theories take — they are 'regulative principles' which reflect a view of nature.

In western Europe, ever since the seventeenth century, the central paradigm of science has been provided by the *mechanical philosophy*. In the seventeenth century it achieved a clearcut victory over its rival

Aristotelian, magical animistic, alchemical, hermiticist and other images of nature—for this philosophy alone offered the prospect of, and served to legitimate, human (read rising capitalist class) control of and power over the natural world. It was the mechanical philosophy alone that declared the entire universe to be in principle raw material for the benefit of *homo faber* (read capitalist class). Conversely, it was the mechanical philosophy's image of nature that capitalist relations of production in turn reinforced—and eventually established—as the only rational image of nature. This mechanical philosophy has remained unaltered in its essence, although its form has changed with time. It is the basis of present day 'physicalist reductionism' which attempts to 'explain' all phenomena, whether physical, biological or human and social, in terms of physics and chemistry, that is to reduce all phenomena to their 'basic' physical properties in terms of the properties of the 'ultimate' constituents of matter, the so-called elementary particles. All phenomena which do not fit into the physical-reductionist scheme are regarded as unnecessary irritants, which scientists could do without. Thus J Monod writes: "We might say, the existence of a living being (an organism with sentience, perception, cognition, consciousness) is a constant challenge and a menace to the postulate of objectivity"—a line of reasoning which would make living beings a challenge and a menace to the development of science.[8] This science, then, with its objectivity and rationality, both represents and reflects the point of view of the ruling capitalist class which regards the natural world as consisting of raw material, in part immensely complex raw material (namely working-class men and women) but raw material nonetheless, to be used in production for its own benefit.

Science is now firmly and overwhelmingly integrated into the capitalist relations of production. Practically all science is now done under capitalist state patronage or in the laboratories run by big capitalist firms. Most science is goal oriented, being geared to two broad areas of social existence: *production and social control*. Production science is science for profit, science for the accumulation of capital, and is concerned with developing industrial capacity, exploiting new materials and increasing profitability. Social control science takes two forms: it concerns itself with either defence against potential external enemies, or the development of techniques for the pacification, manipulation and control of the indigenous population. If one examines the annual 'science budgets' of Britain or the United States, one finds that between 75 and 90 percent of the annual total comes under these two heads (77 percent in Britain in 1974-75, 80 percent in the US in the fiscal year 1975).[9] A recent book, *The Technology of Political Control*, documents the development of the science of control in great detail.[10] It is industrialized, militarized and bureaucratized science which is being developed and practised in the advanced capitalist countries, and it is this science

which third world countries are being encouraged to adopt.

Social Function of the Scientist

Scientists are projected as egalitarian, tolerant, open minded, predisposed to collaborate across intimidating social barriers, emotionally detached and supremely rational. Not only is their community a model of international cooperation, but also of internal political organization.[11] This image of scientists as competent experts, who are politically neutral, helps the ruling class to institute new forms of oppression and exploitation (or old forms under new conditions), and to make them acceptable in the name of science and under the authority of scientists. William Shockley, 1956 Nobel Prize winner, co-inventor of the transistor, now uses his expertise (in transistor physics!) to further the cause of modern genetic racism in the US. The Pentagon was able to obtain the services of forty-seven of the most eminent American scientists, including five Nobel laureates in physics (E P Wigner, M Gellmann, C Townes, L Alvarez and D Glaser) to work for the Institute of Defence Analysis (IDA). They were organized in the Jason division.[12] Every summer (from 1960 onwards) they met to devise methods to wound, mutilate or kill the maximum number of civilians without employing strategic and tactical nuclear weapons. The committee finally came up with the 'electronic battlefield' which consists of night-vision systems, accoustical detectors, emitters and receivers linked with computers located far away from the battlefield which could trigger bombing raids with laser guided bombs, pellet bombs and defolients. This electronic battlefield was deployed extensively in Indo-China to mutilate, maim and kill.

Science and Industrialization

The movement of capitalism and science are related; though much too intimately for that relationship to be expressed in simple terms of cause and effect. It can, however, be said that at the beginning of the period the economic factor was dominant. It was the conditions of the rise of capitalism that made that of experimental science possible and necessary. Towards the end of the period the reverse effect was beginning to be felt. The practical successes of science were already contributing to the next great technical advance—the Industrial Revolution.[13]

Behind our Industrial Revolution there lies this concentration on the colonial and 'underdeveloped' markets overseas, the successful battle to deny them to anyone else...Our industrial economy grew out of our commerce, and especially our commerce with the underdeveloped world...[14]

In the early period of the Industrial Revolution most of the inventions and devices were not the result of conscious application of

science, but were the work of people engaged in struggles for improvements in production techniques. But this situation changed drastically in the last decades of the nineteenth century.

Braverman describes this beautifully:

> Science is the last—and after labour the most important—social property to be turned into an adjunct of capital. The story of its conversion from the province of amateurs, 'philosophers', tinkerers and seekers of knowledge to its present highly organised and lavishly financed state is largely the story of its incorporation into the capitalist firm and subsidiary organisations. At first science costs the capitalist nothing, since he merely exploits the accumulated knowledge of the physical sciences, but later the capitalist systematically organises and harnesses science, paying for scientific education, research, laboratories, etc., out of the huge surplus social product which either belongs to him or which the capitalist class as a whole controls in the form of tax revenue. A formerly relatively free-floating social endeavour is integrated into production and the market.[15]

From being a 'generalized social product incidental to production' science became 'capitalist property at the very centre of production.'

The old epoch of industry gave way to the new during the last decades of the nineteenth century chiefly as a result of advances in four fields: electricity, steel, coal, petroleum and the internal combustion engine. Scientific research along theoretical lines played a sufficiently important role in these areas to demonstrate to the capitalist class, and especially to the giant corporate entities then coming into being, its importance as a means of furthering the accumulation of capital. This was true particularly of the electrical industry which was entirely the product of nineteenth century science, and the chemical industry based upon the synthetic products of coal and oil. German capitalists, latecomers in the industrialization of Europe, were the first to incorporate science into industry from the middle of the nineteenth century onward, Their model was to be followed by the rest of the capitalist world and by the end of the nineteenth century scientific industrial research was firmly established. The corporate research laboratories of the United States of America coincided more or less with the era of monopoly capitalism.

The era in which science was beginning to be incorporated into capitalist production overlaps considerably with the rise of modern imperialism. In the period 1876 to 1914 six European capitalist nations increased their colonial possessions by about twenty-five million square kilometres; an area which is one and a half times the area of these six countries put together. In 1876 three countries (Germany, the US and Japan) had no colonies of their own. By 1914 these three countries, together with France, which had hardly any colonies in 1876, had a

colonial empire stretching over an area of more than fourteen million square kilometres.[16] The impetus for this imperial expansion was the need to divide the entire globe into captive markets and to capture sources of raw materials for rapidly rising industrial production, made possible by new scientific discoveries.

In the nineteenth century Britain was the largest imperialist power. Her colonial empire was spread over the five seas. In order to establish and maintain British naval and imperial hegemony through a global network of harbours, the sciences of meteorology, oceanography and naval astronomy were developed. Similarly, the agricultural and mineral sciences were developed greatly to exploit the agricultural and mineral resources of the colonies. From the eighteenth century onwards there had been a large scale expansion of plantation industries in the colonies. New plants and crops were introduced into entirely different surroundings. New soil conditions, new pests, new weather conditions and their mutual relationships were from the very beginning studied scientifically.

The Rise of Imperialism

By the middle of the nineteenth century, the exploitation of the colonies entered a second phase. In addition to the exploitation by the mercantile and industrial capital of the colonial powers, the colonies were subjected to exploitation by finance capital as well. A large number of companies dealing with the transport, mining and plantation industries began to invest in the colonies. In India the largest and economically the most profitable investments, in railways, shipping and tea plantations, grew very rapidly after the 1870s, necessitating the development of scientific and technical expertise. The colonial government therefore encouraged the development of scientific and technical education, and research institutions were established on a considerable scale. By the end of the nineteenth century there were 170 colleges affiliated to five universities at Calcutta, Madras, Bombay, Lahore and Delhi. These included several medical and engineering colleges. The colonial government also established ten scientific services in India (the Meteorological Reporter, the Inspector General of the Civil Veterinary Department, the Director of the Botanical Survey of India, the Reporter on Economic Products, the Inspector General of Agriculture, the Director General of Archaeology, the Chief Inspector of Mines, the Surveyor General, the Inspector General of Forests and the Director of the Geological Survey).[17] In addition, two agencies were exclusively created in British India (the Indian Advisory Committee (IAC) of the British Royal Society and the Board of Scientific Advice of the Government of India) for the specific purpose of using 'science, including medical science to explore and exploit the geography and natural resources of the colonies in general and the Indian sub-continent in

particular, for the benefit of British commerce.[18]

A colonial official has commented that the huge empire of Britain was kept together 'in part by concession, in part by force, and in part by the constant intervention of new scientific forces to deal with the growing difficulties of imperial rule.'[19]

Science for Underdevelopment

Today it is the local education system which sorts out and selects the best brains to be given the necessary basic training. Indeed, third world countries have received a large amount of aid, in the form of equipment, finance, technical assistance and training programmes, to enable them to set up sophisticated training and research institutes in the sciences. Advisers from the advanced capitalist countries ensure that the standards of research and teaching are equivalent to those of the metropolitan institutions. The best students are then brought over to the advanced capitalist countries for further training in highly-specialized fields; after which, of course, they seem over-qualified for their own little underdeveloped countries. In 1970 there were more than 100,000 foreign students in the USA, 50,000 in West Germany, and about the same number in France, from the third world. Various capitalist countries offered more than 100,000 scholarships to students from the third world.

Many of those who return to their native countries become frustrated through the lack of the institutional facilities for higher research they had become accustomed to during their stay abroad. As a result they return to the advanced capitalist countries. Those who remain introduce and reinforce an elitist, hierarchical and expert science which perpetuates and reproduces the same exploitative system as before.

Take the case of India. In 1947 there were eighteen universities with about 300,000 students. In addition there were a number of well-established institutes undertaking research in agriculture, medicine, geology, mining, and so on. India also possessed a number of institutions such as the Indian Council of Agricultural Research (ICAR); the Indian Science Congress (1914), the Indian Academy of Sciences (1934), the Indian Institute of Sciences (1935) and the Indian Council o Scientific and Industrial Research (CSIR) founded in 1942.

In the twenty-five years following independence, over seventy new universities and research laboratories have been established. The number of students has shot up to nearly three million. Nine institutes of technology have been set up, modelled upon the Massachusetts Institute of Technology. In addition specialized research institutes, like the Forest Research Institute, Tata Institute of Fundamental Research, Atomic Energy Establishment, Indian Cancer Institute, national laboratories and central research institutes, have been established to undertake research on food, drugs and technology. In 1973 Indian universities awarded more than 1,803 Ph Ds 35,000 M Scs and 80,000 B Scs in

various branches of science.[20] India has been spending 2.6 percent of her GNP, and more than 23 percent of all public expenditure, on education. In 1972 India spent more than 200,000 million rupees on research and development. In 1973 about 1,174,300 scientists and engineers were working in India, of whom 96,954 were engaged in research and development. The expenditure on education has increased from 6,104 million in 1965 to 13,575 million in 1973.[21] Indian science has certainly developed, and is impressive by any standards. Indian scientists have been awarded Nobel prizes and their articles are published by practically every scientific journal in the capitalist world; they have successfully exploded an atomic device and they have sent a satellite into the sky. Every year several local, regional and international conferences, congresses and symposia are held in India. Indian scientists are found all over the world in the most prestigious universities and research institutes.

Distribution of Benefits

But who has benefited from all this expenditure and development. Has it reduced poverty, malnutrition, disease and unemployment in the country? Let us look at the statistics. In a recent study Romesh Diwan shows that "the percentage of rural people below the minimum standard of living has significantly gone up from 38 percent of the total population in 1960-61 to 54 percent in 1968-69".[22] And yet, according to a spokesman of the Congress Party, which ruled India from 1947 until its defeat in 1977, "there has been more scientific progress and achievements in India during the last ten years 1965-75 than perhaps in the previous century".[23] Whom did this progress benefit? According to Sau this period also saw a phenomenal rise in the fortunes of Indian big business.[24] He finds that medium and large public limited companies had more than doubled their assets in the eight years, 1967-68 to 1974-75. The bigger companies did even better. The total assets of twenty celebrated big business houses (Birlas, Tatas, Mafatlals and so on increased from Rs 20,800 million to Rs 35,150 million in six years (1966-67-1972-73), and then to Rs 51,100 million by 1975-76, that is an increase of Rs 15,950 million in just three years. The profits of medium and large companies rose from Rs 6,600 million to Rs 16, 800 million in eight years (1966-67—1974-75) a compound growth rate of 11.33 percent for gross profit. The twenty big business houses increased their gross profit in three years (1972-73—1975-76) by a stupendous 57.8 percent, from Rs 3,800 million to Rs 6,000 million! The biggest two, Tatas and Birlas, registered the maximum increase. Tatas increased its assets from Rs 3,650 million in 1963-64 to Rs 9,746 million! in 1975-76; Birlas from Rs, 2,829 million to Rs 10,646 million during the same period. Throughout the whole of this period wages remained more or less stagnant.

The development of prestigious branches of science like nuclear,

particle, solid state and space physics, though of little value to the average Indian, has been of great benefit to the Indian ruling classes. A sophisticated armaments industry has been developed—enabling the ruling class to pursue an expansionist foreign policy. The explosion of an atomic device and the launching of a space satellite in the middle of the 1970s has brought further prestige to the Indian bourgeoisies and helped divert attention from their internal exploitative policies. In short although the development of science in India has not relieved the misery of the average Indian, it has greatly increased the fortunes of the ruling classes (big business, rich landowners and the middle class). It has also provided them with new and more efficient instruments of repression.

But the biggest beneficiaries of all have been the imperialist countries themselves. For, if hitherto third world countries have been the source of raw materials and of unskilled and semi-skilled manpower, today they are also being used as a huge reservoir of cheap scientific labour power. In fact — as we would expect — the closer the links and the greater the 'aid' between a third world country and the metropolis, the greater the drain of scientific and technical manpower. Thus the Philippines, Taiwan, South Korea and Singapore are the largest suppliers (per number of emigrants per thousand of population) of qualified scientific manpower to the US. They are also the largest recipients of US aid (scientific and technical expertise, grants and military assistance). A recent United Nations study has documented the benefits to the US from this inflow of scientists, engineers, physicians and surgeons. The study shows that during the decade 1961-71, over 53,000 scientists, engineers, physicians and surgeons came to the US from the third world. Indeed, during 1965-70, of the net addition to the employment of scientists and engineers in the US more than 20 percent came from abroad, and in recent years these immigrants are coming increasingly from the underdeveloped third world countries. The study further points out that in 1970 alone the amount added to the US national income through the services of immigrant scientists comes to about US $ 3.7 billion. In comparison the figure for the US official development assistance to the third world in the same year was US $ 3.1 billion. It may be interesting to note that the contribution to immigrant scientific manpower is equal to 0.3 percent of the US gross domestic product, nearly 14 percent of total US expenditure on research and development, and about 39 percent of US current expenditure on higher education.[25]

Scientific Agriculture and the Third World

Hunger and insufficient agricultural production are two of the chronic problems facing most of the third world. The advanced capitalist countries have encouraged third world countries to adopt their scientific methods and practices in agriculture. It is claimed that by doing so they could increase their agricultural production considerably.

But before examining the benefits to third world countries of the adoption of scientific agricultural practices, let us look at the consequences of scientific agriculture in one of the earliest capitalist countries, the United Kingdom. In his book *Energy and Food Production*[26], Gerald Leach examines the requirements of food production in societies ranging from the most primitive to modern capitalist industrial states. Leach exposes some of the absurdities of the food production system in Britain. He finds that the application of science does not increase food production per acre, though it does increase productivity per man by the use of agricultural machinery, chemical fertilizers and pesticides. It is extremely wasteful of energy in the form of fossil fuels (used for raw materials for fertilizers, pesticides and as fuel for agricultural machinery). If the third world countries were to use the scientific agricultural practices of advanced capitalist countries like the UK, they would consume their entire yearly energy supply on growing food alone. And if they wanted to use the scientific processing techniques used in the UK, they would also require an amount of energy equal to 40 percent of the entire energy consumption of the whole world. Leach further claims that the *proportion of the work-time spent in feeding the UK population is comparable to that in primitive communities using pre-capitalist science.*

On the face of it, it looks as if the use of scientific methods enables one farmer to feed sixty or more people. But these methods depend on, have allowed, and indeed largely caused, vast social changes—including urbanization and the factory system—which have put large distances between the fields and the mouths in every sense, and greatly swelled the ranks of non-farm workers in food production and distribution. Thus in the UK one worker is able to feed only 14-16 people—a figure which is typical of the middle to upper range for pre-industrial farming, when one counts the working time actually spent in production.

Although scientific agricultural practices are of questionable value, even in the UK and the US, still there has been a conscious effort to foster them in the third world. The big American foundations (Ford, Rockefeller and Carnegie), along with the US Department of Agriculture and the US Agency for International Development (USAID), have been responsible for the so-called revolution in agriculture—the Green Revolution—that some third world countries have experienced since the 1960s. In fact the high-yielding varieties of wheat and maize were developed at the International Wheat and Maize Improvement Centre in Mexico, which was set up by the Rockefeller Foundation with American expertise and capital. Similarly, an improved variety of rice was developed at the International Rice Research Institute, set up jointly by the Rockefeller and the Ford Foundations at Manila in 1962. And at these centres were schooled the agronomists and economists who would help 'mould the rural economy into forms compatible with technological change and social stability.' [27]

From 1952 onwards—under a technical collaboration programme with the Indian Council of Agricultural Research and the Ministry of Education—USAID provided the experts,equipment and capital required to set up nine agricultural universities.[28] Six American universities (Ohio, Illinois, Missouri, Kansas, Pennsylvania and Tennessee) collaborated in this project, sending 300 of their staff members to serve in India, and training about a thousand Indians in the agricultural sciences.[29] The programme, which was phased out in 1972-73, introduced capitalist agricultural practices to India in a big way, and vastly increased the use of chemical fertilizers, pesticides, herbicides and agricultural machinery. The class of big landlords and rich peasants who alone could make use of these expensive techniques were able to reduce farm labour and increase their profits greatly. Consequently, inequalities in the Indian rural areas have increased, rural unemployment has risen, but the increase in agricultural yields has not been better than that of the prescientific agricultural era. According to Dasgupta, in the ten-year period 1966-76 "the rate of growth in food production, at 2.5 percent a year was less than the pre - high yielding varieties period with a less advanced technology."[30]

The officials of the agribusiness monopolies, however, acknowledge the role played by the US government in opening up third world markets for them. One executive of a giant fertilizer company told a Congressional Committee:

> I must emphasise that there would be scarcely any investment if it were not for the infrastructure, the education, the training and the support provided by our (US government) aid programme. We certainly would not be in India and very few investors would be in any of the underdeveloped countries were it not for our efforts at economic assistance.[31]

By the 1960s the World Bank entered the field on the premise that what the underdeveloped world needed was agriculture. And what agriculture needed was science. And science could be bought from the firms that sold it—agribusiness firms, multinational corporations—at a price. The World Bank provided the money. In the period 1964-68 it lent $872million to third world agriculture—roughly the same sum that it had loaned in the entire 1948—63 period. Its lending rose again precipitously to US $3.1 billion in 1969-73. And in 1973-74 alone credits amounted to US$956million, plus $294million extended to agricultural industries. McNamara, the Bank's President,promised to commit $7 billion more for agriculture in the third world for the period 1976-80. Lending also rose in relative terms. In 1974-75 agricultural lending was about 40 percent of total lending, as against 15 percent in 1964-68, and 23 percent in 1969-73.[32]

Thus, the massive financing provided by the World Bank and directed towards schemes which facilitate the use of (advanced)

large-scale scientific methods in agriculture, develops a fertile and highly profitable field for agribusiness to operate in and creates a ready-made market for its products. But, as we have seen in the case of India, use of these methods increases unemployment and inequality without increasing the amount of food produced. Moreover, such technologies are wasteful of energy (which most of the third world is deficient in) and increase dependence on the advanced capitalist countries for the very techniques which impoverish third world countries still further. Traditional ways of planting, fertilizing, harvesting and caring for the earth are replaced by the use of expensive imported chemical products. And the use of these products has in turn exhausted and impoverished the soil.[33]

The lesser beneficiaries of the World Bank's largesse are a handful of rich landowners in the third world. But the greater beneficiaries are the makers of farm equipment, fertilizers, insecticides and pesticides. The World Bank might as well have handed over its money to the multinational corporations direct and saved third world countries from further distortions in their economies and further ransoms on their future.

1 See J D Bernal, *Science in History*, 3rd ed London 1965 and J Needham, *Science and Civilisation in China*, Cambridge 1956-65.

2 Science means not only the so-called pure sciences (physics, chemistry, biology), but also applied sciences (agriculture. medicine, engineering).

3 A Gorz, 'On the Class Character of Science and Scientists', H Rose and S Rose (eds) *The Political Economy of Science*, London 1976.

4 I Scheffler, *Science and Subjectivity*, Chicago 1967.

5 Paradigms are the generally accepted fundamental beliefs about a particular phenomenon which describe its nature, explain experimental relations and define further areas of investigation which can proceed without challenging the basic hypotheses.

6 J Monod, 'On the Logical Relationship between Knowledge and Values' in W Fuller (ed) *The Social Impact of Modern Biology*, London 1971.

7 T Kuhn, *The Structure of Scientific Revolutions*, Chicago, 1962.

8 Quoted in B Easlea' *Scientific Knowledge and a Livable World* University of Sussex, December 1975 (unpublished paper).

9 'The Incorporation of Science' in *The Political Economy of Science*, op. cit.

10 C Ackroyd, K Margolis, J Rosenhead and T Shallice, *The Technology af Political Control*, Harmondsworth, 1977.

11 R K Merton, 'The Institutional Imperatives of Science' B Barnes (ed) *Sociology of Science*, Harmondsworth 1977.

12 *Science for the People*, Vol 4 numbers 5 and 6, September-November 1972.

13 J D Bernal, op. cit.

14 E J Hobsbawm, *Industry and Empire*, Harmondsworth 1969.

15 H Braverman, *Labour and Monopoly Capital*, Monthly Review Press, New York 1974.

16 V I Lenin, *Imperialism: The Highest Stage of Capitalism*, Moscow 1967.

17 R M Macleod 'Scientific Advice for British India: Imperial Perception and Administrative Goals 1898-1923,' *Modern Asian Studies*, Vol 9, number 3,1975.

18 G Basalla, 'Science and Government in England, 1800-1870' (quoted in R M Macleod, op.cit.)

19 W S Blunt, quoted in R M Macleod, op.cit.

20 All data from the *Commonwealth University Handbook*, 1976.

21 All data from the *UNESCO YEAR BOOK*, 1976.

22 Romesh Diwan, 'Development, Education and the Poor' *Economic and Political Weekly*, Vol 12 number 5-9 April 1977.

23 Rajni Patel, *The Decade of Scientific Progress*, Bombay, 1976.

24 Ranjit Sau, 'Indian Political Economy' 1967-1977, *Economic and Political Weekly*, Vol 12 number 5-9 April 1977.

25 U N Report number TD/B/Ac 11/25/Rev 1 1975.

26 G Leach, *Energy and Food Production*, London 1975.

27 Harry Cleaver, quoted in S George, *How the Other Half Dies*, Harmondsworth, 1976.

28 These Universities are: Punjab Agricultural University, Ludhiana; Haryana Agricultural University, Hisar; Universily of Udaipur; Agricultural University Pantnagar; M P University of Agriculture, Jabalpur; Orissa University of Agriculture and Technology; Maharashtra University of Agriculture and Technology; Mysore University of Agricultural Sciences, Bangalore.

29 H Read, *Partners with India: Building Agricultural Universities*, Urbana 1974.

30 Biplab Dasgupta 'India's Green Revolution' *Economic and Political Weekly*, Vol 12 numbers 6-8 February 1977.

31 Quoted in S George, op. cit.

32 E Feder 'Capitalism's Last Ditch Effort to Save Underdeveloped Agriculture.' *Journal of Contemporary Asia*, Vol 7 number 1 1977.

33 For example, some side effects of high-yielding varieties which use increased amounts of water and fertilizer have been the devastation caused by water logging salinity and the development of new weeds and pests.