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TECHNOLOGY POLICIES IN EGYPT: SCIENTISTS, TECHNOCRATS AND PUBLIC POLICY

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* The opinions expressed in this document are those of the author and do not necessarily reflect the views of the United Nations Economic Commission for Western Asia.

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Scientists, Technocrats and Public Policy

Nazih N. M. Ayubi

As is the case in most developing countries, technology policies in Egypt are subject to a number of formidable difficulties. The main problem is, of course, a historical one and cannot be blamed entirely on the technocrats. In the West, today's technology (both in material and social fields) rests on a base of three hundred years of development, initiated intellectually by the Renaissance and socially by the Industrial Revolution and the transition from feudalism to capitalism. The situation is of course different in Egypt, as a less-advanced society whose development has not only had a much shorter period of time but which was also for the most part 'imported' and transplanted into the society by an elite with a European-type education.

To bridge that technological gap which separates them from advanced countries, the underdeveloped countries attempt different paths, especially as far as research and development are concerned. Countries like India and Egypt, for example, try more or less to copy the style of scientific development followed in advanced countries. But here the problem is that while research and development budgets in industrial nations are approaching very nearly 3 percent of GNP, Third World countries are struggling to achieve a mere 0.3 percent of their far more slender GNP. Nor is this tiny proportion necessarily being spent according to a comprehensive plan that would coordinate different research activities and link them to production purposes on a national level. Given the level of poverty and stagnation in developing societies this model is therefore bound to keep scientific research at a sub-threshold level, spread too thinly over too many fields and too many institutions, and unless efforts and manpower are concentrated into a smaller number of priority areas, a difficult taks for any society that is "labouring under the dead hand of tradition, precedent and power groups",(1) the model is unlikely to be efficacious either.

Japan may be the only country to have succeeded in initiating such concentrated efforts in what was (and probably still is) essentially a pre-scientific culture. She achieved this by choosing to harness industrial science and technology for her basic goal of rapid economic growth, and by concentrating on the industries that would be potentially successful in the prevailing conditions of population density and limited resources, such as her electronics industry.(2) Strong government support allowed research to be conducted by the government itself, by industry and, to a lesser extent, in the universities. Meanwhile the powerful coordinating agency for science and technology attached to the Prime Minister's office has remained highly conscious of the economic benefits to be derived from science, and indeed some 73 percent of all research and development budgets in Japan go towards economic-motivated research.(3)

At the other end of the spectrum is the Chinese model where a breakdown of the old 'non-scientific' aspects of the culture seems to permit science to grow extremely quickly. Through experimentation in new fields and the deliberate attempt to teach science to the masses, the dangers of 'bureaucratization' are avoided, with the equating of 'socialist man' with 'scientific man'. More particularly the Cultural Revolution set China new goals by emphasizing the 'popular scientific man' (as against the development of an elite scientist) within new political and social goals for the whole society, rather than simply multiplying production. This stressing of the creation of a mass scientific culture led, during Mao's rule, to close foccussing on China's own problems, on 'self-reliance' in technology and production rather than dependence on foreign expertise, and to the creation of cheap products and harmonized (traditional with modern) techniques of production.(4) It is this type of approach which, incidentally, may well offer the greatest gain to an underdeveloped society, both economically and socially, although "it is almost certainly unfavourable except in a post-revolutionary situation."(5)

Unable for historical and organizational reasons to adopt something like the Japanese model and unable or unwilling for political and ideological reasons to adopt a model similar to the Chinese, Egypt remains overwhelmed by a number of constraints and contradictions in her technology policies. There is a reasonable network of institutions involved in science and technology research and planning, but the funds allocated to these activities are too small, and their distribution is so dependent on considerations of 'bureaucratic politics' among the various groups of scientists and technocrats, that a most rational and socially responsive order of priorities in research and development is unable to predominate.

For social and political reasons, the technocratic community is large and fast-growing; it is socially distinguished and bureaucratically spread. However only a relatively small group within the larger technocratic community is directly involved in research and development activities and the efforts of the members of this small group are further constrained, among other things, by the shortage of research assistants, of technical facilities, and of appropriate award systems. Nor are the technocrats able to function effectively on the 'economic' level, given the shortages in intermediary technical personnel and the lack of a general 'scientific culture' in the society, and other related problems.

On the level of the society at large, and in spite of the rhetoric of the sixties and early seventies concerning 'science and technology' as the guiding concepts for all social and political activities in the state, the technocrats -- though not entirely without influence -- did not manage to play in policy-making a role that was in any way commensurate with their numerical strength or with their assumed socio-political distinction. But they themselves are not entirely blameless. They remain generally conventional in their perspectives, and are rather inclined to confuse modernization with Westernization and to opt for high technology and for capital-intensive solutions for technical and social problems.

The purpose of this essay is to consider some of the issues and problems that surround the formulation and implementation of technology policies in Egypt. It will first survey the principal institutions involved in the area of scientific research and technology planning, and the main policies formulated and carried out by them in recent years. It will then examine the technocratic community in Egypt: its size, its growth and its characteristics, and will briefly consider the role of this technocratic community in policy-making, especially in the technical areas. Then a final section will touch upon some of the wider socio-political implications of the role of technology in a developing society such as Egypt.

THE INSTITUTIONAL FRAMEWORK

The main organization responsible for technology research and policy in Egypt today is the Academy for Scientific Research and Technology (ASRT), which was established in 1971 to replace the Ministry of Scientific Research (an intermittently appearing body), and to incorporate the major institutes involved in technology policies, including in particular the National Research Centre. The declared goal of the Academy is to support scientific research and the application of modern technology in all areas included in the country's programme of economic and social development, and to draw up and coordinate scientific and technological policies on the national level.

More specifically the Academy is responsible for designing the programmes related to research projects that aim at solving national problems, promoting new technological activities, and financing and following up such programmes in all research centres, whether or not they are affiliated to the Academy. It is also expected to encourage education in the fields of science and technology and to help promote scientific publications and scientific activities, as well as to help ministries and departments in establishing specialized research centres such as the Institute of Petroleum Research, the Institute of Radiology, the Institute of Metallurgy ...and so forth.

The Academy is also very much involved in conducting research for various ministries, organizations and companies. Following a conference of its Council in 1974, it concluded about 140 research contracts with various institutions, spanning the following five broad areas: (i) research projects related to housing, public utilities and rural construction; (ii) projects related to the problems of loss and waste in agricultural crops, including research on the fight against agricultural pests; (iii) projects related to the eradication of certain endemic diseases such as bilharzia and tuberculosis; (iv) research projects aiming at the development of the country's natural resources, especially in the area of mineral, hydraulic and energy resources; and (v) projects related to the development of animal and fish wealth.

Some of these projects are already advanced, not only at the research level but also in practice, through their results having been utilized in production. Fish farming, for example, has achieved reasonable success in several northern lakes (with the productivity of the feddan rising to

1200 tons of fish), and there is further experimentation taking place in cooperation with the Institute for Oceanography and Fisheries on the potential of fish farming in rice fields, and feasibility studies comparing the returns of land reclamation for agriculture with the returns of fish farming in marginal lands. Another important area in which some advance has also been reached is in research on the extremely urgent problem of finding alternatives to the use of Nile mud for the manufacture of building bricks. This research was done in conjunction with the Institute of Building Research and the Faculty of Engineering of Cairo University, and fifteen areas have been specified in which desert clays suitable for brickmaking were found to exist in 'economic' quantities. Recommendations for a short- as well as for a long-term plan for the utilization of this clay have been presented to the Ministries of Housing and Reconstruction, Industry, Local Government, and other agencies involved in related activities.

It is useful at this point to look at the decision-making machinery within the Academy itself. The highest decision-making organ is the Academy Council, but there are also about a dozen other 'sectoral' councils responsible for the following areas: industrial research, horticultural research, animal and fish husbandry research, applied physics and electronics research, research in basic science, in radiology, and in social science, ecological research, petroleum and mineral research, transport research, and research related to land and water resources and to energy. It should be emphasized that in its present organizational context, the Academy is not simply a research organization but is more of a 'parent' organization to which the following institutions belong: the National Research Centre, the Nuclear Energy Authority, the Institute of Oceanography and Fisheries, the Meteorological Institute and the National Standards Institute. Affiliated to the Academy is also a number of supporting institutions such as the Scientific Equipment Centre, the National Centre for Scientific Documentation, Information and Publication, and the Science Museum. Some universities also have scientific research centres, as do a number of ministries (for example the Ministry of Agriculture, the Ministry of Health ...etc.).

Most of this institutional framework for scientific research and technology was developed in the fifties and sixties, mainly as part of the revolutionary government's drive for 'rationalization' and 'scientism' in national policies. The nucleus for this network was the National Research Centre (NRC), although it had had a sort of predecessor known as the Fuad I National Research Council that was established in 1948. The NRC was set up in 1955, and included sectors that dealt with chemistry and bio-chemistry, agricultural and biological research, engineering, petroleum and minerals, physics, medical and pharmeceutical research, and industrial chemicals research. The NRC and most other scientific and technological centres normally encompass several divisions, branches and affiliated units which constitute an impressive listing.(6)

Since its establishment, the NRC, which is stil the largest multi-purpose research institute in Egypt, has tended for a variety of reasons to favour research of a pure, academic nature. In the early seventies, however, attempts were made to establish strong links between research pursuits and national development requirements. From 1975 on, priority was to be given to research in five specific areas: food and agriculture; health and environment; natural resources; energy; and technology transfer.[7] This shift was indeed in line with the general policy orientations which had just been developed by the Academy in its first general conference held in January 1974, and according to which research and technology were to be closely related to national developmental needs.

The Academy sponsors other activities, which include twelve scientific reviews published by the National Centre for Scientific Documentation, Information and Publication. It also sponsors scientific conferences, visits, and exhibitions, and other activities that involve cooperation with foreign and international institutions. For example, research projects related to scientific policies are being conducted with UNESCO, research related to remote sensing technologies with the United States, research related to petroleum with France, research related to the protection of sea shores with the UN, research related to endemic diseases with the Federal Republic of Germany, and research related to earthquake detection with the Soviet Union and Japan. There are also exchanges of scientific and technological data with the German Democratic Republic and with a number of other countries.

As is often the case, the reality concerning scientific and technological policies is far less impressive than what is suggested by the institutional framework. One problem in the area of technology policy is related to the multiplicity of organizations involved in scientific and technological research, and to the lack of coordination among their activities. Some universities, of course, have their own research facilities, and even though they tend to be run on very meagre budgets, the problem is made worse by the fact thay they often do not relate their research to the real needs of production bodies; nor do they cooperate with other institutes and organizations to avoid repetition and duplication.[8] The same also applies to a number of ministries (such as the Ministry of Agriculture or the Ministry of Health) and a number of public organizations (such as the General Organization for Spinning and Weaving), which have their own research units.

As for the main national body responsible for scientific research and policy, its organizational life remains characterized by uncertainty and instability, for sometimes it is merely a scientific research centre, and sometimes it is an academy for science and technology; sometimes it is turned into a ministry by itself, and sometimes it is merged into the Ministry of Higher Education (now the Ministry of Education). Nor is there a clear conception of the relationship between such bodies on the one hand, and the National Council for Education and Scientific Research (one of the higher specialized councils affiliated to the Presidency) which started its activities in 1974, on the other.[9]

Another important problem representing probably the most constraining factor is that of finance. The share of scientific research in Egypt until the end of the sixties was a mere 0.1 percent of GNP, which had to be spread too thinly over too many fields and amongst too many institutions.[10] As a result, for example, all research related to food had a total budget of no more than LE600,000 by 1977, research related to agricultural loss and pesticides had no more than LE300,000, research for health and environment purposes LE900,000, research for construction and building purposes had LE150,000, and research related to transportation problems had LE50,000. All areas of scientific research were allocated only LE7.6 million in 1978, including a mere LE2.5 million for all projects of the Academy, although this was considered a great improvement over previous years since it was double the expenditure on scientific research as it existed in the 1977 budget.(11) Even so, the funds allocated to the whole sector of scientific and technological research are in fact lower than the budgets of some individual research centres in the advanced societies. For example, in 1971/72 the budget allocation for scientific research for that year was LE3,482,000, of which LE2,420,000 was actually spent. This represented under 6 percent of the total allocations of the whole educational sector (including schools, universities, research, youth affairs...etc.), and in fact was smaller than the allocation and expenditure for any single one of Egypt's three main universities and only marginally higher than that of the regional university of Asyut.(12)

The Five Year Development Plan for 1978 to 1982 envisaged the following expenditure on scientific research (Table I). Since the avaerage total annual expenditure for all sectors of the economy during the years of the Plan is LE2,327,000 this means that scientific research will acquire no more than 0.45 percent of the total budgetary allocation every year. The planners

TABLE I

PROJECTED EXPENDITURE ON SCIENTIFIC RESEARCH
1978-1982 (in LE million)

1978	1979	1980	1981	1982	Total 1978/1982	Annual Average 1978/1982
7.7	9.9	11.0	12.0	12.0	52.6	10.5

SOURCE: Ministry of Planning (Egypt), The Five Year Plan 1978-1982, Vol.I (Cairo, August 1977), pp. 74-5.

are themselves aware that this is a very modest allocation and that great care will have therefore to be given to identifying the appropriate priorities for its utilization. It is thus maintained that

> ...The five-year plan lays stress on the expectation of research contracts signed by the Academy of Scientific Research and Technology and different research departments and centres to solve national and sectoral problems, especially in relation to agriculture and industry; and to study the peaceful utilization of atomic energy. Other projects have to do with the development and exploitation of Sinai.
>
> In view of the almost infinite possibilities of scientific research, LE52.6 million is a small allocation for this sector. More is clearly needed for immediate purposes of bringing about increased productivity in industry, electricity and agriculture. Foreign finance should be investigated as a possible source, particularly since the foreign [currency] component on these projects is relatively high.

> ...Priority is given to short-run vocational training, to increase the work efficiency of skilled and semi-skilled workers for the various sectors, especially in housing, manufacturing and public utilities. LE6 million are allocated for training programmes which represent a human investment.(13)

It can be seen from this that there is a growing awareness that the relatively modest sources available for scientific research should be spent with greater care according to clear priority systems and in close co-ordination with other fields relating to technology policies such as vocational training and educational development in general. But in reality the task is far from being easy.

Yet another problem is related to shortages in scientific personnel. According to the general secretary for scientific research at the National Specialized Councils, scientific researchers in the country number about 22,000 and they are expected to be nearly 70,000 by the year 2000. Most officials believe that this is still a small number, given in particular the continuing 'brain drain' -- in the order of thousands -- from among these scientists.(14) Official figures indicate, very conservatively, that there are at least 2,000 'scientists' who left the country with the definite intention of migrating and at least 2,500 others who left to work temporarily in Arab countries and international organizations.

The supporting community of research assistants and laboratory technicians, who are about 5,000 in number, is considered to be incredibly small numerically, and it is believed that 45,000 are needed urgently for an effective research capability in the country at large. In the NRC, for example, which has a staff of 3,000, including about 1,500 individuals actually involved in research, there existed an estimated shortage of at least 500 research assistants by the end of the seventies.

The problems of finance and personnel often combine, to produce unhealthy practices such as petty squabbling among scientific researchers over joining certain research contracts (for industry, agriculture...etc.) that involve extra payment for research teams, as well as quite a few other aspects of 'piastre'-motivated bureaucratic politics.

Such problems of jurisdiction, finance and personnel very often lead to a rate of implementation that falls well below the specified goals and which frequently fails even to fulfil the requirements of the signed research contracts. At the beginning of the seventies, for example, ten scientific commissions were established to promote cooperation between the NRC and the various production sectors. A unit for the marketing of research was also established within the Centre in 1975 to promote the Centre's research with business and industry and to gain research contracts in the fields considered vital by government departments and production bodies. Nearly a hundred such contracts were signed with the Centre in the following years, and a special bureau was also created to conclude research contracts with foreign and international institutions. However, the Administrative Control Authority reported in 1977 that until then, for example, none of five research contracts intended for the study of cotton pests had been fulfilled by the NRC and only one out of four research contracts on desert soils had been completed by the Desert Institute (and even that one was three years late). In some other cases the contract is completed by the producing of a research document, but the latter is neither applied nor put into practice.[15] So, for example, out of four research contracts with the Misr Company for Spinning and Weaving, the results of one were applied but discontinued because of side effects, and three were not applied at all, which does pose some questions as to the relevance of such pieces of research.

Having examined, among other things, the problems of personnel directly involved in science and technology research, let us now turn to a consideration of the broader technocratic community in the society at large.

THE TECHNOCRATIC COMMUNITY

A quarter of a century after the revolution of 1952 -- i.e. in 1977 -- Egypt had some 656,000 university and college graduates, of whom about one tenth were scientists and engineers (that is about 1,650 scientists and technologists per hundred thousand of the population).[16] Of these only about 12,000 personnel (i.e. 30 per hundred thousand of the population) were involved in various research and development activities. This in fact means that graduates had more than doubled in number during the first seven years of President Sadat's rule. Some 80,000 new graduates are produced every year, which means that the country has had at least three quarters of a million graduates by the end of the seventies.

There are now, in addition, over half a million students who are enrolled in universities and in higher institutes. Although the number of students in 'scientific' subjects is growing at a higher rate than that of students of the humanities snd social studies, the absolute number of the first group remains smaller than that of the second group, so that in 1977 the totla number of university students was 450,000 of which 274,000 were pursuing social studies and 179,000 were taking natural and applied sciences. In the same year, university graduates in the humanities amounted to 40,000 while university graduates in sciences amounted to 24,000 (total 64,000). In the technical higher institutes in 1977, 21,000 students were involved in commercial (business) studies and 11,000 in industrial (engineering) studies. Graduates from the same institutes in the same year were 5,000 in business training and 3,000 in industrial training (total 8,000). It is also interesting to observe that the highest rate of growth within the category of 'sciences' and within that of 'humanities' was always among the most 'technical' sector within each of these categories so that the highest rate of growth within the humanities was in 'business' studies and the highest rate of growth within the sciences was in 'engineering' studies.[17]

With regard to trained technicians, one has to look at figures for the various types of secondary education. Here we find that the country in 1977 had some 800,000 secondary students (compared to 4 million primary and 1,400,000 preparatory pupils). Fortunately about half the secondary school pupils were engaged in some kind of 'technical' study. As for secondary school leavers in 1977, there were 121,000 who completed 'general' secondary education (with 38,000 emphasizing arts and 83,000 emphasizing 'sciences') and 111,000 who completed 'technical' education; of these, 68,000 were trained in business, 31,000 in industry and 12,000 in agriculture.[18]

It appears from this that there is more of a balance in the specializations within secondary education, which represents quite a reasonable development. In fact there were, by the end of the seventies, around half a million students enrolled in preparatory and secondary technical schools all over the country which is, again, a very good sign, since the economy's needs for technicians are still very high indeed.[19] One reason for this is the fact that the newly-introduced 'intermediary technical education' (i.e. above secondary and below university level) remains very disproportionate to the country's needs, and far less popular with students than conventional university or college education. Thus in 1977, for example, intermediary technical institutes admitted 27,000 students (in industrial, commercial, agricultural and health branches), while universities and higher institutes admitted 86,000 for the same year.

The need for technicians has indeed always been the most pressing of all occupational needs of the economy. It was estimated, for example, in the early seventies (as shown in Table II) that if the percentage of 'specialists' would have needed to double or treble between their level represented in the 1960 Census and their required level by 1985, then the percentage of technicians would have had to grow by four or five times to reach the required level by 1985.

TABLE II

PROJECTED NEEDS OF VARIOUS OCCUPATIONAL CATEGORIES

	% in 1960 Census	% 1985 (1st altern.)	% 1985 (2nd altern.)	% 1985 (3rd altern.)
Managers	0.844	1.3	1.5	1.6
Specialists	1.354	3.7	4.0	4.4
Technicians	2.098	11.0	12.0	13.0
Auxiliary	8.441	9.0	8.5	8.5
Skilled Workers	11.141	24.0	24.5	25.0
Semi-skilled Workers	37.928	25.0	24.5	24.5
Unskilled Workers	38.192	26.0	25.0	23.0
TOTAL	100	100	100	100

SOURCE: Institute of National Planning, Takhtit al-quwa al-camila...[Manpower Planning in Egypt], (Cairo: INP., 1971), p. 124.

By 1976 the imbalances in the manpower structure had not all been corrected (as Table III illustrates). Although the percentage of 'specialists' (which, it should be noted, is quite a loose category) had grown more or less within reason, the percentage for technicians remained far too low and, conversely, the percentage of managers had grown out of proportion.

Nor could the newly-created polytechnics (higher technical colleges) and vocational institutes fill the gap. Having the privileges and prestige of university degrees in mind, most of these colleges struggled at first

TABLE III

MANPOWER STRUCTURE BY OCCUPATIONS
AND SECTORS, 1976
(%)

Occupations \ Sectors	Agriculture	Mining & Petroleum	Industry	Electricity	Construction	Transport & Commun.	Services Commerce & Finance	TOTAL
Managers	0.3	2.1	2.8	4.3	4.6	3.4	8.1	3.6
Higher Posts (Specialists)	0.6	2.9	4.3	9.7	5.0	8.1	9.1	4.5
Middle Posts (Technicians)	0.9	5.2	7.6	9.9	8.9	17.7	11.1	6.4
Auxiliary & Clerical	1.0	4.2	5.0	8.3	8.5	10.6	13.7	6.4
Skilled Workers	2.4	37.0	45.7	36.6	38.6	31.8	28.3	19.8
Unskilled Workers	94.8	48.6	34.6	31.2	39.4	28.4	29.7	59.3
TOTAL	100	100	100	100	100	100	100	100

SOURCE: Ministry of Planning, "Taqdir al-quwa al-^{c}amila wa ihtiyajatiha" [Manpower Requirements...], Memorandum, 1977-78.

to be able to organize four year courses, as in the universities. Their next move was to provoke a debate on the nature of polytechnics, which ended with their view victorious and their transformation into pale copies of universities -- for which function they were, of course, not originally created. The largest assembly of such polytechnics now functions under the name of the University of Helwan, and encompasses within itself the Helwan Institute of Technology, the Matariyya Institute for Technology and Education, the

Institute of Petroleum and Mining in Suez, the Industrial Institute at Port Said, and, in addition, a dozen or so other colleges of commercial, artistic and physical education studies.[20]

If one now asks: where do all these graduates go? then the answer would be: mainly to the 'public bureaucracy' including both the civil service and the public sector. Let us now look at some details.

By the end of the sixties, the public bureaucracy was employing over 153,300 graduates, for example, or about half the graduates that the country had produced. Towards the end of the sixties, too, the overwhelming majority of technocrats in the country was also employed by the public bureaucracy, and in 1968 virtually the entire population of engineers was publicly employed, their distribution being as follows: 34 percent in public companies, 22 percent in ministries, 19 percent in public authorities, 10 percent in public organizations and 7 percent in governorates. In addition, 99.8 percent of all scientists, about 95 percent of all agronomists and 87.6 percent of all physicians were working in the public sector. In contrast only two thirds of the traditionally important law graduates worked for the public bureaucracy, where they constituted no more than 14.5 percent of the total number of employees.[21]

Another aspect to be considered is that of administrative leadership, where the figures show clearly that leadership of the Egyptian bureaucracy is firmly in the hands of economists and engineers. Table IV indicates the distribution in 1967 of 'administrative leaders' from the top of the bureaucratic hierarchy down to the third grade, divided according to homo-

TABLE IV

BUREAUCRATIC LEADERSHIP BY CLASSIFIED QUALIFICATION,1967

Qualifications Group	No. %	Civil Service	Public Sector	Total
Commercial/ Economic	No.	1,586	2,695	4,381
	%	17	31	24
Engineering/ Technical	No.	1,583	2,408	3,991
	%	22	28	17
Educational	No.	1,707	12	1,719
	%	12	-	10
Agricultural	No.	1,022	509	1,031
	%	11	6	9
Medical	No.	732	208	940
	%	8	3	5
Al-Azhar	No.	454	20	474
	%	5	-	3
Military	No.	91	284	375
	%	1	3	2
Other Higher Qualifications	No.	1,785	1,278	3,063
	%	19	15	17
Intermediate Qualific- ations & Nonqualified	No.	292	1,162	1,454
	%	3	14	8
TOTAL	No.	9,252	8,576	17,828
	%	100	100	100

SOURCE: Central Agency for Organization and Administration, Al-^{c}Amilun bi al-mustawayat al-qiyadiyya bi al-hukuma wa al-qita^{c} al-^{c}am [Higher Level Personnel in the Goverment and Public Sector], (Cairo, 1967), pp. 2, 3.

geneous specialization groups based on their academic qualifications. The predominance of economists and engineers is obvious for they constitute nearly half (44 percent) of the administrative leadership.

A significant fact to be observed concerns the supremacy of engineers over economists at the level of top management, especially in the public sector. No less than half the chairmen of boards of directors in the public sector and a quarter of occupiers of the first grade in the civil service, are graduates in engineering and technical subjects. This fact is all the more confirmed by the figures that were produced for 1970, where engineers occupied 49.6 percent of the posts of the 'excellent' grade and 40.4 percent of those of the 'higher' grade in the public sector. Furthermore, engineers are represented on most boards of directors. A semi-official directory in 1973 shows that of some 175 public authorities, organizations and companies involved in the fields of industry, mineral resources, energy, transport, housing and construction, only 33 institutions (12 percent) did not have engineers sitting on their boards of directors.[22]

These educational features also reflect themselves on the personnel structure of the public enterprises which represent the leading economic sector and the main 'business' employer in the country. Table V shows public sector personnel classified by academic specialization, and it is clear from the figures that graduates of commerce (35 percent of all public enterprise personnel with university education) and graduates of engineering (22.5 percent) were the most numerically dominant categories by far, among all university-educated employees in the mid-seventies. They were

TABLE V

PUBLIC SECTOR PERSONNEL BY ACADEMIC SPECIALIZATION, 1975

SPECIALIZATION	Males	Females	Total	%
Medicine	254	37	291	0.6
Dentistry	17	5	22	.04
Veterinary	123	2	125	0.3
Pharmacy	534	265	799	1.7
Science	2193	274	2467	5.0
Engineering	9772	685	10457	22.5
Fine & Applied Art	1294	199	1493	3.0
Agronomy	6024	477	6501	14.0
Commerce	13729	2804	16533	35.0
Economics	50	38	88	0.1
Law	3235	384	3619	7.8
Arts (Humanities)	1487	849	2336	5.0
Education	317	151	468	1.0
Tourism	4	0	4	--
Al-Azhar	89	0	89	0.2
Others	915	261	1176	2.5
TOTAL	40037	6431	46468	100

SOURCE: Institute of National Planning, Hasr wa taqdir al-ihtiyajat min al-ᶜamala... [Manpower Needs in the Public Sector], (Cairo, 1975), p. 99.

also the leading two groups among public enterprise employees with higher diplomas (commerce was 46 percent and engineering 15 percent of all employees); with MA degrees (commerce 20.9 percent and engineering 25 percent); and with PhD degrees (commerce was 7.3 percent and engineering 36.2 percent). It is also interesting to note that science graduates whose general percentage does not exceed 5 percent of all employees with university education, suddenly rise in relative importance to represent 16.9 percent of those with MA degrees, and as much as 20.3 percent of those with PhD degrees, in the public enterprises.(23)

It should be clear from this that Egypt has a relatively large and rapidly growing technocratic community, whose members are mostly employed by the Egyptian public 'establishment'. It is natural therefore, given this situation, to expect that this technocratic community will have an active role to play in the decision-making process in the country.

THE TECHNOCRATS AND POLICY MAKING

I have argued elsewhere that, following the 1952 Revolution, Egypt had evolved a basically technical -- as distinct from political -- strategy for development, and that one of the results of this approach was a weakening of the role of the 'political man' and the 'intellectual', and a strengthening of that of the 'organizational man' and the 'technocrat'.(24) The seeds for this 'technocratic doctrine' were actually sown in the National Charter of 1962, the main document of the revolution.(25)

After a dominant 'militocracy' had established its power over the ruins of the power of careerist politicians, the new regime chose to rely on 'managerial modernizers' rather than on 'revolutionary intellectuals', and it was from an early stage that the official doctrine envisaged for the technocrats a prominent role within the 'alliance of working people's forces'. In the quasi- corporatist formula according to which the 'Preparatory Committee of the National Congress of Popular Forces' was elected in 1962, syndicated professionals (then some 173,000 in number) were allocated 225 seats out of the total of 1,500 (i.e. 15 percent). They came next only to peasants (1.6 million) who were allocated 300 seats (20 percent), while the only other group which gained distinct representation without being statistically significant was the university faculty (7,500) who were allocated 105 seats (7 percent). However, from 1967 onwards the influence of the technocratic doctrine becomes particularly evident, especially as the Statement of 30 March 1968 declared 'Science and Technology' as the only possible way towards a modern state in Egypt.[26] The question to be considered in this section concerns the amount of influence that this emerging technocracy really possesses.

One may not be able with justification to speak at any point of 'technocratic rule' in Egypt, yet it looks as though, at least socially, Egypt's sizeable community of some half a million technocrats had nearly 'made it' towards the end of the sixties.[27]

It should be remembered, among other things, that technical professionals, especially engineers, were among the very few groupings and associations in Egypt that could not only maintain their professional integrity but also defend their autonomy and protect their exclusiveness. Since 1967 and the predominance of a 'technocratic' explanation of the defeat in that year, the technocrats have called more loudly in favour of 'men of expertise' and the 'right man in the right place'. They succeeded in occupying more and more of the leading bureaucratic and semi-political positions, and they managed to conduct freer elections in their professional syndicates. They benefitted particularly from the political vacuum created by the decline in the prestige of the military after the defeat in June 1967, and later by the shake-up of the political-security apparatchik in May 1971. The outcome of the 1973 war (especially the regained pride of the military and the business alternative presented by the flow of capital from oil-producing states) may have modified the picture, but the technocrats are unlikely to lose the major part of what they have acquired.

The technocrats have, of course, an indirect but not unimportant influence -- mainly through bureaucratic channels -- on the shaping of general policies in accordance with their class and other biases. The question now concerns the authority which they have in shaping policies directly related to their technical fields. Clement Henry Moore tried to answer this question and concluded that the impact of the professionals on policy-making in these areas was marginal.(28) Speaking more specifically about Egypt's community of over 40,000 engineers, he considers that they influence public policy only slightly by virtue of their technical skill, and quotes the example of the Aswan High Dam and industrialization plans, holding that this observation applies even to much smaller projects. He maintains that whatever influence the engineers possess is derived from their personal connections, not from their technical skills, and indeed claims that the very weakness of political institutions that has facilitated the rise of the technocrats has also minimized their influence unless they become top politicians. "Paradoxically," he argues, "the sphere of effective decision-making shrinks, even as bureaucracy keeps expanding. Technocrats get important jobs in increasing numbers while having even less to do... The very system that promotes them also renders them impotent."(29)

But if it is true that the professional syndicates were never turned into scientific associations where debates on big projects with a technical dimension would be discussed and researched for a long time, it should be remembered that technocrats are not only members of syndicates, but are also officials and managers. It is difficult to prove that all the important projects were not based on any scientific or technical considerations. The nature of Nasir's regime had admittedly made it necessary to deal with things urgently and swiftly, but this had never reduced its desire to make sure that its economic projects such as the Aswan High Dam and industrialization were technically feasible and sound. Projects such as the High Dam were old projects that had been 'researched to death' by different teams of experts under many previous governments. All they lacked was the political will to take a decision and mobilize for their execution. The political leadership that decided to build the Aswan Dam and the Helwan Iron and Steel Complex, or to double national income in ten years, was certainly aware of the criticisms posed, among others, by 'technical conservationists'. A technocrat can be quite narrow-minded by concentration on considerations of perfection and punctuality that overlook considerations of social urgency and political will.

The Aswan High Dam is a useful example. Its basic technical concept, that of the provision of 'century storage', was a feature of the irrigation system conceived for Egypt from the nineteenth century, first by the French and later by British engineers. As Robert Mabro explains, the history of the Dam is characterized by the engineers influencing, and the politicians choosing alternatives.[30] Unlike C.H.Moore he complains that it was the 'economists' who were not significantly involved. The World Bank, which in 1955 had offered to finance the project, made professional assessments of its prospects and so did the Soviets, who undertook later to support it. A number of consultants of various nationalities, including British and Swedish, also advised on various aspects of the undertaking. Yet a gigantic project with the dimensions of the High Dam is bound to raise many arguments for and against its whole concept as well as against its ingredient aspects. There were indeed some Egyptian engineers who criticized the project but many others supported it, and it was the political leadership which took the final decision, one which happened at the time to be supported by the majority of experts -- both local and foreign.

A general point remains to be emphasized here. While the main bulk of technocrats tends to prefer a more slow and calculated appraoch, a certain amount of political will and daring seems necessary for really breakthrough plans and projects, and curiously enough it is this kind of undertaking which gives social eminence and political significance to the technocrats: the very projects that they suspect technically are the ones that promote them socially. It is thus possible to say that Egyptian engineers and technocrats have in a way come to the fore 'in spite of themselves'. Being generally cautious and conservative (by virtue of their purely technical and too specialized training, not to mention their prestigious social positions) the majority of them were inclined to favour a more gradual and piecemeal pattern for industrial and economic development. Their whole 'philosophy' of development was thus very different from that of the political leadership which was markedly influenced by the strategy of the 'big push' and the need for fast and comprehensive development. It is therefore not surprising to find that the technocrats had little influence on the general strategy of development, with its emphasis on heavy industrialization and big projects. As far as technical details of projects were concerned, however, there is no clear evidence that the technocrats did not have their fair say in their technical capacity as consultants and officials, if not necessarily in their political capacity as unionized employees.(31)

But just how much input by scientific institutions has gone into such projects cannot easily be decided. For example the Aswan High Dam went into disfavour with the West as a project owing to Nasir's fiercely independent attitudes. The inclination in most American and many European circles after that had been to belittle the project technically (some even going so far as to suggest that it was so technologically unsound that once erected, it would soon inevitably fall down again), and also, as a supporting line, to imply that the project was basically a political decision that had very little 'scientific' input into it.

The High Dam did indeed become a political issue in Egypt in the seventies, as such an extent that, in a very symbolic way, any favourable view expressed about it was taken to mean that one was a Nasirist, while an unfavourable view was taken to indicate an anti-Nasirist attitude! An accurate measurement of the multiple worth and impact of such a gigantic project over time and in all its technical, economic, environmental and social fields is an extremely difficult task to achieve without very elaborate cost-benefit analysis.[(32)] To judge how much technical expertise has gone into the project is not as difficult, but is by no means an easy task either. It is our view that although the project was not given in advance the type of extensive, feasibility, cost-benefit and impact studies that ideally would have been preferred, the project was not initiated and carried out away from the scientific and technical community in the way that has been suggested by many commentators.

TECHNOLOGY, SOCIETY AND POLITICS

In the meantime, the political leadership remains inclined to favour grandiose technological projects which may or may not actively involve full contributions from the science and technology community in decision-making processes that may be related to them. If the Aswan High Dam was Nasir's 'technological pet', then the Qattara Depression Project seems to be that of

President Sadat. This fits within a very ambitious plan to 'reshape the map of Egypt', that includes land reclamation and food production almost everywhere as well as at least half a dozen large new cities in the desert, a daring scheme which forms part of a long-term strategy for the development of Egypt up to the year 2000.[32]

The Qattara Depression is located in the Western Desert; about 76 kilometres from the sea, with an area of 19,000 square kilometres, 12,000 km^2 of which are more than 60 metres below sea level. The project envisages the cutting of a canal, possibly by controlled nuclear explosions, to join the depression with the Mediterranean Sea, with a view to generating electric power estimated at 57 billion KwH during the first ten years of its functioning. Other possible benefits could include utilizing whatever fish resources might occur in the lake that would form, touristic activities, chemical industries, some agriculture by the lake's shores, and the likelihood of both increased rainfall and easier drilling for petroleum in the region. Total costs of the projects were estimated in 1976 at over LE370 million if nuclear explosion is used and considerably more if other methods are to be utilized.[34] The first stage for implementing the project would involve three years for studies related to feasibility and design and seven years for implementation processes including digging the canal and building the electricity stations.

The project has recently received some renewed political attention but little is published or debated concerning the costs and risks or the possible environmental impact (for example, the effect on the water table) of the scheme.[35] As John Waterbury warned, "The official view of this project, whose side effects, not to mention feasibility, are very poorly understood, is eerily reminiscent of the High Dam at its inception. Sanctification seems but a step away." [36]

But our implied suggestion that more efficient allocation and utilization of resources may be easier to achieve if the technocratic community is included more broadly and more actively in the policy-making process regarding developmental options does not mean that we believe in the absolute wisdom of technocrats. Indeed, if anything, experience shows that Egyptian technocrats tend to be quite 'conventional' in their approach to the problems of development.[37] Their conception tends on the one hand to equate modernization with Westernization, and on the other to concentrate on the material rather than on the social or cultural spheres. Thus their vision of modern Egypt would consist of a Cairo (and the equation here between Cairo and Egypt is significant) bristling with high-rise buildings and bulging with luxury cars, flyovers, monorails, supermarkets and automatic machines, with heavy industry at the outskirts and a great deal of showy or 'demonstrational' technology in evidence.[38] As may be expected, this type of imitative and emulative development may create a veneer of modernity that apes the symptoms of Western affluence, but it does not necessarily bring about the transformation of attitudes and institutions required to promote radical and sustained change.[39]

In the field of management a recent obsession with computers is particularly remarkable. A conference for administrative leaders considered that the use of computers in management was "a basis for the progression of technological advancement".(40) Two well-known experts, after praising the move towards 'technocracy' and 'scientific government' argued that computers were beneficial because they would relieve administrative leaders from many ordinary and repetitive kinds of work, thus enabling them to concentrate on matters of greater importance.(41)

Other experts regretted that Egypt had only a few computer installations and called for an expansion in electronic data processing, chronic deficits in foreign exchange notwithstanding, and criticized 'administrative conservatism' in Egypt and the poorly informed and over-cautious top management who tended to exacerbate the high cost of wastefulness resulting from under-use of existing computer facilities.(42) Even those who could appreciate the magnitude of the financial cost and the variety of organizational and managerial problems that would be involved in expanding computer systems in Egypt were inclined to think that the rewards would far outweigh the costs and difficulties.(43)

Of course there can be no doubt that such modern technologies have the potential to be extremely useful but the more important question is whether they are relevant to the most urgent problems in the society and whether they can be afforded economically and socially. There is a difference between 'technology' on the one hand and 'technicism' on the other (i.e. technology as an ideology), and 'technocracy' (i.e. the rule of experts); the social and material benefits of the latter two can be very suspect. To judge devices purely by their technical merits can be misleading and socially short-sighted, and elaborate and sophisticated techniques may be less needed than those that are both useful and socially appropriate. Egyptian architects, for example, tend to copy blindly the style and techniques of Western architecture, ignoring the merits of their 'vernacular' Arabo-Mediterranean style which is often both functional and attractive (as many Western architects would be the first to agree).[44]

Likewise Egyptian engineers and designers are too busy struggling to catch up with the latest and most sophisticated Western developments to concentrate on producing simple and practical designs for the sort of things that would be most useful in a country like Egypt, such as brick-making instruments, man- and animal-driven carts, effective irrigation devices, low-cost radio and television sets... and so forth.[45] Hasan Fathi, the sensitive Egyptian architect who blended the beauty and functionality of the indigenous architectural styles with the possibility of building 'on the cheap' remains the exception rather than the rule, and his deserted 'new' village in Upper Egypt is, among other things, a sad testimony to the 'bureaucratic' and to some extent to the 'social' resistance that such daring experimentation may have to face.[46]

Egyptian technocrats therefore remain strong proponents of a 'technological doctrine' that revolves around an ideology of science and industrialization, based on the organizational lines that were developed in Western societies and the Soviet Union.[47] While there can be no doubt that this doctrine and the ideology of science and industrialization have brought a number of benefits to Egypt, especially in the field of health and social services, this model has nevertheless also brought problems, including the failure to create a real demand for jobs in keeping with the rapid rise in the size of the workforce, potentially explosive urban unemployment and unrest, a heavy drain on foreign reserves, displacement of traditional labour-intensive techniques and the whole educational infrastructure that surrounds them, and last but not least, a variety of environmental problems. More importantly, it has frequently failed to solve -- indeed has often exacerbated -- the social problems of poverty, malnutrition and the general low standard of living at which it was directly or indirectly aimed. Moreover, the technological model is particularly prone to bureaucratization in the sense of excessive reliance on the government and on formalities and organizations, rather than on individual and community initiative, and on people's participation, and this very often leads to a diminishing sensitivity to the most urgent and vital of social needs.

The sum of these various points is that technology cannot be the panacaea for solving all the problems of a developing country, and that curiously enough technocracy does not necessarily represent the way to 'modernization'. This does not in the least mean that science and technology are not needed in an underdeveloped society, for of course they are needed. But the diffusion of science into society to create a really 'scientific' man is perhaps more important, as is the development of relevant tools, machines and techniques for dealing with the most vital problems. In short, what is required is <u>appropriate</u> technology, including intermediate technology, which is intended to deal in particular with the problems of unemployment and capital scarcity through the use of labour-intensive production techniques that can frequently be developed from local materials and gadgets. In this respect one could say that appropriate technologies were needed not only for exploiting natural resources but also for organizing people.

The case for appropriate technology has been argued and discussed in Egypt since the mid-seventies. It has been suggested that technologies adopted by a country like Egypt should be compatible with her natural environment, factors of production, developmental strategy and cultural environment.[48] It is our impression, however, that the majority of the Egyptian technocratic community remains unsympathetic -- or even opposed to -- the concept of appropriate technology. The main argument centres round the need to cope with international competition in the area of sophisticated technology, and around the possible benefits of having leading 'centres of excellence' in the country that might help to pull the institutions behind them towards higher levels of development.[49]

Indeed one of the main justifications offered for the adoption of the 'open door' policy (infitah) in 1974 was Egypt's need for advanced Western technology. One of the conditions used for deciding on projects under the new policy is that "the project should be of such a high level of technology that its products can compete in external markets."[50] And certainly, as the industrial development plan indicates (see Table VI), most joint venture industrial projects are in the area of metallurgical or engineering industries.

In sum, one can say that Egypt possesses a potentially reasonable instit-

TABLE VI

JOINT VENTURE PROJECTS OF THE FIVE YEAR PLAN 1978-1982:
ANNUAL TARGETS WHEN REACHING "FULL CAPACITY"
(Value in LE million)

SECTOR/GROUP	No. of Projects	Total Investment	Value of Production	Value of Exports	Imported Raw & Sub-finished Materials	Net Added Value	LABOUR FORCE	
							Wages	number in 1000's
Food Industries	4	187	77 (17)	28 (3)	13 (3)	99 (6)	5 (1)	6 (2)
Textile Industries	4	74	51 (47)	44 (42)	5 (4)	23 (21)	4 (4)	4 (4)
Chemical Industries	5	101	63 (52)	33 (27)	29 (23)	25 (20)	6 (6)	4 (4)
Metallurgical Industries	7	731	377 (7)	175 (4)	85 (1)	119 (2)	4 (-)*	7 (-)**
Engineering Industries	8	367	667 (498)	124 (85)	268 (198)	171 (126)	39 (37)	26 (23)
Electronic Industries	2	11	35 (24)	9 (7)	12 (10)	15 (9)	2 (2)	1 (1)
TOTAL	30	1471	1270 (645)	413 (168)	412 (239)	392 (184)	60 (50)	48 (34)

* less than LE500 thousand
**less than 500 workers

SOURCE: Public Industrialization Authority, Projects of the Five Year Plan 1978-1982 (part II), (Cairo, 1978), p. 8.

utional network for technology policies, although it suffers from some serious organizational, financial and personnel problems. The country witnessed in the sixties and early seventies a rise, at least in their social prestige, of the technocrats that coincided with the predominance of a doctrine in which the increased technocratization of the system was the way to modernization. However this has not always guaranteed a direct and active role for all the technocratic groups concerned, in the decision-making processes related to the particular policy or project that is at hand. Yet in as much as the technocrats had played a role, they were not always innovative and progressive; very often the 'instrumentality' of the conventional technocrat has limited his capability as a manager or a politician to deal not only with socio-political problems but even with some of the more clearly technical ones. Of late the 'open door' policy has clearly laid a new emphasis on high technology in joint ventures, but some discussion about 'appropriate technology' has also been taking place, albeit somewhat quietly. The new economic policies of the regime will eventually reduce the percentages of technocrats who are directly employed by the government,[51] but this is not likely to reduce people's expectations that the technocrats should always come up with some effective solutions to the country's real problems.

NOTES

1. H. Rose and S. Rose, Science and Society (London: Pelican, 1971), p. 172.

2. Kankuro Kaneshige, "Recent Technological Advances in Japan", in A. Garrett, (ed.), Penguin Technology Survey 1967 (London: Penguin, 1967), pp. 28-30.

3. Rose and Rose, op.cit., pp. 173-176.

4. See on the effects of this policy in the countryside H. Dickinson and T.L.Winnington, "Rural Technology in China", Appropriate Technology Vol. 1, no. 1 (Spring 1974), p. 13. As to whether an advanced industrial society can be built without creating a technocratic elite, this remains to be seen. Cf. C.M.G.Oldham, "China's Developmental Experience: Science and Technology Policies", in Proceedings of the Academy of Political Science Vol. 31, no.1 (March 1973), pp. 80-94.

5. Rose and Rose, op.cit., p. 174.

6. For details see, Arab Republic of Egypt, Al-Kitab al- Sanawi [The 1977 Year Book], (Cairo ,1978), pp. 137-150.

7. Adel A. Sabet, "The Role of Science and Technology Policy in Technological Change in Developing Countries", in A. B. Zahlan, (ed.), Technology Transfer and Change in the Arab World (Oxford: Pergamon, 1978), pp. 36-41.

8. Ahmad ^{c}Adil Rashid, "Fa^{c}aliya aqsam al-bahth al-^{c}ilmi..." [The Effectiveness of Scientific Research Departments in Egyptian Universities], Al-Idara [Management -quarterly], Vol. 11, no.2 (October 1978), pp. 48ff.

9. Cf. Presidency of the Republic (Egypt), Report of the National Council for Education and Scientific Research (in Arabic), annual since 1974.

10. Al-Tuhami ^{c}A. Musa, "Sa^{c}ubat fi tariq al-bahth al-^{c}ilmi" [Obstacles in the Way of Scientific Research], Al-Idara, Vol. 1, no.4 (April 1969), pp. 67-78.

11. Mr Mamduh Salim, the Prime Minister, The Government Statement (in Arabic), delivered to the People's Assembly on 4th December 1977, pp. 64-66.

12. Cf. Ministry of the Treasury, Financial Follow-Up of the Government Budget 1971-72 (in Arabic), (Cairo, 1972), p. 20

13. Ministry of Planning, The Five Year Plan, op.cit., pp. 109-110.

14. The Scientific Research Secretary of the National Research Councils, quoted in Akhbar al-Yaum (21 July 1979), p. 12.

15. Administrative Control Agency, Awjuh al-qusur wa al-khalal...[Shortcomings and Deficiencies in the Administrative State Machinery] Part II, Vol. 1 (Cairo, 1977), pp. 334-340.

16. The size of the engineering community is particularly impressive, and the ratio of Egyptian engineering graduates to the total population was estimated at the beginning of the seventies to be about four times the ratio prevailing in the Arab world in general and in Latin America, twice the ratio for Asia, and over two-thirds of that of Europe, North America and the Soviet Union put together. See Central Agency for Public Mobilization and Statistics (CAPMAS), "The Main Features of the Engineers' Community" (in Arabic), Al-Ta[c]bi'a al-[c]Amma w'al-Ihsa' (July 1968); and "Measurement of Scientific Qualifications and Research" (in Arabic), Al-Ta[c]bi'a al-[c]Amma w'al-Ihsa (January 1971); and Graham Jones, The Role of Science and Technology in Developing Countries (London: Oxford Univ.Press, 1971), p. 143.

17. For details see my book, Siyasat al-ta[c]lim... [Education Policy in Egypt], (Cairo: Centre for Political & Strategic Studies, 1978).

18. These and the following figures are all derived from sources of the Ministry of Education and CAPMAS. Particularly important among these sources are, Ministry of Education, Tatawwur al-ta[c]lim al-[c]am... [Development of Public Education], (Cairo, 1972); & Nashrat al-ihsa' al-istiqrari [The Statistical Bulletin], (Cairo, 1977); and CAPMAS, The Statistical Yearbook, various issues.

19. See my article, "Secondary Education: A Link or an End?", Al-Ahram (13 August 1977).

20. Cf. UNESCO and the Arab Republic of Egypt, Vol. 14, nos. 1 & 2 (1976), pp. 29-35.

21. For details see Nazih N. M. Ayubi, Bureaucracy and Politics in Contemporary Egypt (London: Ithaca Press, 1980), Chap. 5.

22. Ibid.

23. Institute for National Planning (INP), Hasr wa taqdir..., op.cit., pp. 99-102.

24. See Ayubi, op.cit., Chaps. 3 & 6.

25. In the Charter, the word 'science' and its derivations recur 49 times, compared to 44 for 'politics' and its offshoots (excluding foreign policy). And while the word ideology is not mentioned at all, 'thought' and its derivatives occur 32 times compared to 38 times for 'organization' and its derivatives.

26. See my article, "Hawl al-^{c}ilm wa al-dawla al-^{c}asriyya" [On Science and and the Politics of Modernization], Al-Majalla (July 1968), pp. 25-29.

27. Medical, engineering, and technological varieties of education remain the most socially prestigious and desirable. In a sample study conducted in six Egyptian governorates towards the end of the seventies, these specializations were ranked as the most desirable by 80.3 percent of the respondents. Economics was given a top ranking by 54.3 percent, and Arts, Humanities and Law were preferred by percentages ranging from 20.1 percent to 43.2 percent. Alexandria University, Al-ta^{c}lim wa al-mujtama^{c} [Education and Society], (Alexandria Univ.Press, 1979), p. 8.

28. Cf. C. Henry Moore, Images of Development: Egyptian Engineers in Search of Industry (Cambridge, Mass.: MIT Press, 1980); "Authoritarian Politics in Unincorporated Society: The Case of Nasser's Egypt", Comparative Politics Vol. 6, no. 2 (January 1974); "Professional Syndicates in Contemporary Egypt: The Containment of the New Middle Class", American Journal of Arabic Studies No. 3 (1974).

29. Moore, "Professional Syndicates...", ibid., pp. 25-26.

30. See for more details and for the assessment of an engineer-economist, Robert Mabro, The Egyptian Economy 1952-1972 (Oxford: Clarendon Press, 1974), pp. 87-106.

31. Nor should one belittle the value of technical influence through personal contacts. Easier access does not stop technical advice from being technical, and such informal lines of communication do exist everywhere. See, for example, C. P. Snow, Science and Government (Cambridge, Mass.: Harvard Univ. Press, 1960).

32. The best studies available to date are, Yusuf A. Shibl, The Aswan High Dam (Beirut: Arab Institute for Research and Publishing, 1971); John Waterbury, Hydropolitics of the Nile Valley (Syracuse, N.Y.: Syracuse Univ. Press, 1979), esp. Chap. 5; Richard E. Benedict, "The High Dam and the Transformation of the Nile" Middle East Journal Vol. 33, no.2, (Spring 1979), pp. 119-144.

33. Cf. Ministry of Planning (Egypt), The Road to the Year 2000 (Cairo, 1978).

34. The Public Authority for the Qattara Depression Project, 1978.

35. President Sadat approved, early in 1981, the new plan for the project, whereby the digging of the canal would be done by conventional -- rather than nuclear -- means by shifting the proposed canal to a shorter route closer to the Nile Delta, just east of ᶜAlamein. A Swedish consulting group joined the German and American teams in conducting some of the feasibility studies and preliminary activities, and work on the first canals is expected to begin in 1983. The total cost of the project is now more realistically estimated at $2 billion. Los Angeles Times (11 March 1981), pp. 4-5.

36. Waterbury, op.cit., pp. 150-151.

37. Not that Egyptian technocrats are particularly unique in this respect. See in general on the technocrats' inclination to favour the status quo Jean Meynaud's classic Technocracy (trans.), (London: Faber and Faber, 1968).

38. See Muhammad Hilmi Murad, "Dawr al-tiknulujiya fi al-tanmiya" [The Role of Technology in Development], L'Egypte Contemporaine Vol. 63, no.349 (July 1972), pp. 5-19.

39. Cf. Peter Donaldson, Worlds Apart: The Economic Gulf Between Nations (Lonodn: Penguin, 1973), pp. 100ff.

40. Administrative Leaders' Conference, Al-Qiyada al-idariyya wa matalib al-marhala al-qadima [Administrative Leadership and the Requirements of the Coming Stage], 6th Session (Cairo, Sept.-Oct., 1967), pp. 541-560.

41. ᶜAbd al-Karim Darwish and Laila Takla, Usul al-idara al-ᶜamma [Essentials of Public Administration], (Cairo: The Anglo-Egyptian, 1972), pp. 188-190 and Chap. 5.

42. See for example M. Farouk el Hithami, "Computers, Management and Development", in Seminar on Development Administration in Egypt (Cairo, The American Univ. in Cairo, January 1972).

43. Cf. Al-Sayyid Nur, "Hiwar maᶜ jabhat rafd al-hasibat" [A Dialogue with the Computers' 'Rejectionist Front'], Al-Ahram al-Iqtisadi No. 532 (15 October 1977), pp. 34-36.

44. See for example Bernard Rudofsky, Architecture Without Architects (London: Academy, 1973).

45. Compare Victor Papanek, Design for the Real World (London: Paladin, 1974).

46. Cf. Hassan Fathy, Architecture for the Poor (Chicago: Chicago Univ. Press, 1973).

47. See on this model David Dickson, Alternative Technology and the Politics of Technical Change (London: Fontana/Collins, 1974), pp. 150ff.

48. See for example Isma[c]il-Sabri [c]Abdallah, "Istratijiyyat al-tiknulujiya" [The Strategy of Technology] in Société Egyptienne d'Economie Politique, Istratijiyyat al-tanmiya fi Misr [Development Strategy in Egypt], (Cairo: Hai'at al-Kitab, 1978), pp. 539-546.

49. See the discussions in ibid., 1978, pp. 551-555.

50. General Authority for Investment and Free Zones (GAIFZ), Report on Investment Projects up to 31 December 1978 (in Arabic), p. 7.

51. Law No. 54 for 1976, for example, has abolished the system of taklif which was legalized in 1956, whereby engineering graduates had to work for the government or the public sector for a number of years following their graduation from Egyptian universities.