

in the corneal epithelium would probably be noticed by the sufferer before it could be seen by an examining ophthalmologist.

It seems advisable for exposure to these amines to be minimized. In our opinion, the attention of workers exposed to this hazard should be firmly drawn to the type of haze that heralds the reversible stage of the condition.

We should like to thank Dr. M. D. Kipling, H.M. Medical Inspector of Factories, Birmingham, for bringing this problem to our attention, and Dr. W. T. Jones for providing samples of the amines used.

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## The Future of an Occupational Health Unit in Khartoum University, The Sudan

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A brief geographical and economic review of the Sudan has been attempted. Occupational health problems of the present and future have been outlined. The potential and intended functions of an occupational health unit are defined. The importance of teaching, surveying industry, and research is stressed.

The Sudan is a zone of steppe extending west of the River Nile to rise in the extreme west as volcanic hills of Jebel Marra, 5,000 to 6,000 feet high, and to form the Red Sea Hills in the east which are part of the Rift Valley and link up with the Ethiopian Highlands.

The climate differs in each region. In the Red Sea Hills the winter is wet and the humidity high. In the northern region desert conditions prevail; there are two seasons only—hot, dry summers and cold, dry winters. The southern part is a region of tropical forests which has a long wet season from March to November. The central region, which includes Khartoum, has a sub-tropical, continental type of climate with four seasonal changes, and the temperature varies throughout the year between 50° and 105°F.

The climate influences the type of vegetation and agricultural crops. Of the 600 million acres, 120 million are suitable for agriculture and another 80 million for stock-raising; however, only 15 million acres are under cultivation.

In 1951 the Sudan was divided into nine provinces each with its own elected council. The provinces are further divided into districts, each having a rural district council or a town council.

### Population

The Sudan is inhabited by approximately 13 million people. The birth rate is 48 per 1,000 and the death rate 20 per 1,000. Thus the population is increasing yearly by 2.8% and is expected to reach 25 million in 1990. The expectation of life is 40 to 50 years. As the birth rate is high and the expectation of life is short, the population pyramid is quite steep, as expected in a developing country (Table I).

Ethnologically the Sudanese are a product of Hamites and Negro people—the result of the Arab invasion of Nubia from the north in the seventh century. The Arabs are predominant, Arabic being the language of the 10 million people of the north.

Only 15% of the population live in towns; the remainder is a rural population whose chief occupation is agriculture. Illiteracy is high.

### Economics and Manpower

In the last 10-year plan the economic growth was estimated at between 7% and 8%, which is fair for a developing country provided it can keep pace with the population growth. The average income is low but varies greatly for persons in different occupations.

TABLE I  
POPULATION PYRAMID IN THE SUDAN BASED ON 1956 CENSUS

Age Group	Approx. Number	Percentage
0-14	6,000,000	46
15-29	3,500,000	27
30-44	2,000,000	15
45-74	1,000,000	8
75+	500,000	4
Total	13,000,000	100

The economically active part of the population is nearly 45% (as estimated by the Ministry of Labour), but, of this, 25% are below the age of 15 years. The percentage between 15 and 25 years who are economically active is high at 85% in males, as is to be expected in any developing country. Due to the population pyramid and the fact that women are not employed, the ratio of dependants on those who are economically active is nearly 2 to 1, resulting in a reduction of income and a lowering of the standard of living.

It is difficult to give a detailed description of occupational groups, but generally manpower in the Sudan can be classified under three main headings (Table II).

TABLE II  
PERCENT DISTRIBUTION BY ECONOMIC SECTORS OF MANPOWER IN THE SUDAN AND SELECTED OTHER COUNTRIES\*

Country (both sexes)	Primary (%)	Secondary (%)	Tertiary (%)
Sudan, 1956	86	4	10
India, 1951	71	10	19
U.A.R., 1951	54	5	41
U.K., 1951	9	44	47

\*Percentages corrected to round figures.

**Primary Sector** This includes activities which are mainly concerned with the direct exploitation of natural resources whether renewable or not. They include agriculture, animal husbandry, forestry, fishing, mining, and quarrying.

**Secondary Sector** This includes activities among which the main purpose is the transformation of primary or partly finished materials into finished or nearly finished products. They include the manufacturing industries of arts and crafts and in addition construction, food processing, and the refinement of raw materials.

**Tertiary Sector** In this group are activities in which the use of materials, whether raw or partly

finished, is mainly incidental. They include services ranging from the humble to the highly specialized, together with commerce, banking, insurance, and entertainment.

### Medical Services and Health Problems

The Under-Secretary in the Ministry of Health is responsible for all health services throughout the Sudan including the training of local medical and health personnel.

As mentioned before, the country is divided into nine provinces, in which the Province Medical Officer of Health (P.M.O.H.) is responsible for the health services. Every province is divided into districts; each district has a hospital and satellite dispensaries. The Medical Inspector in the districts is responsible to the P.M.O.H. for all health problems in his district (see Figure).

The Sudan still depends on medical auxiliaries who represent the front line of this medical service. Although statistics are not well kept the figures below are mainly quoted from the Annual Reports of the Ministry of Health of Sudan.

The average doctor: population ratio is 1:20,000, ranging from 1:1,000 in Khartoum to 1:40,000 in the rural areas. The number of hospital beds is 1.2 per 1,000, ranging from 3.5 per 1,000 in urban areas to 0.8 per 1,000 in certain rural areas. The budget is meagre and the annual expenditure per head on health does not exceed nine shillings. Most is spent on the curative side, while prevention takes only 10%.

**Medical Training** As the Sudan depends mainly on medical auxiliaries, several schools have been developed for their training. The School for Medical Assistants, which runs the dispensaries, was established in 1918; a three-year training is given. The School of Hygiene was established in 1932 to train Public Health Officers; the diploma of the Royal Society of Hygiene is given at the end of three years' training. Other schools have been established for ophthalmic assistants, theatre attendants, laboratory technicians, radiographers, dental mechanics, and dispensers. For women a Midwifery School was established in Omdurman in 1920, followed by a Health Visitors' School. The Nursing College was founded only a few years ago in the late fifties. The School of Medicine started in 1924 and is discussed below.

**Health Problems** Health problems in the Sudan are great and diverse. The infant mortality rate is 93 per 1,000, ranging from 25 per 1,000 in

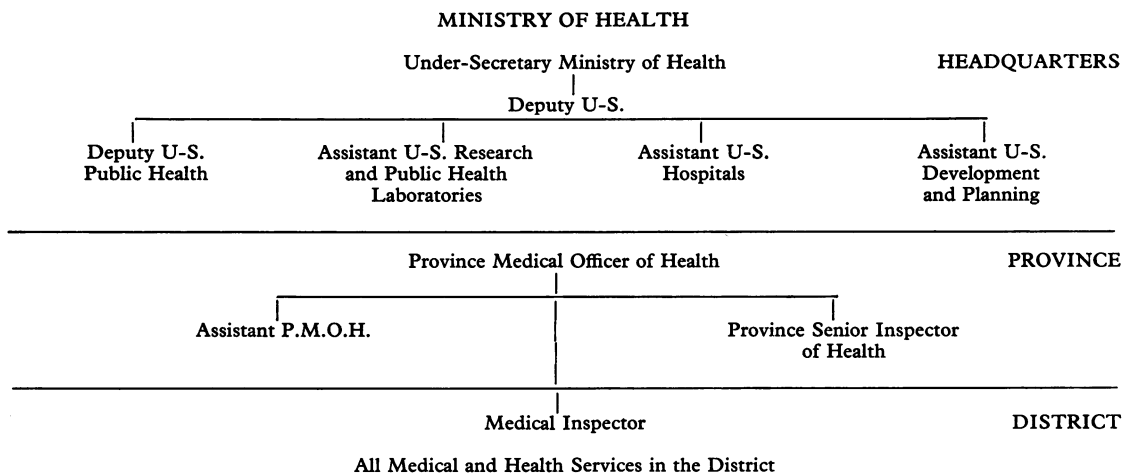


FIGURE. Medical Services in the Sudan

the Khartoum Province to 185 per 1,000 in other areas. The major causes of death are pulmonary tuberculosis and other respiratory diseases, malaria, and enteritis. Among the communicable and endemic diseases, malaria tops the list, being endemic all over the Sudan while bilharzia is endemic in Gezira. Diseases due to poor sanitation are prevalent. Gastro-enteritis is the main cause of death of children, especially when complicated by measles or a secondary respiratory infection.

The Sudan has many public health problems which are exacerbated by the large size of the country. Moreover, the long frontier with eight neighbouring countries coupled with the nomadic habits of a large section of the population, makes the control of these diseases very difficult. However, future planning and the help of international organizations, especially the World Health Organization (W.H.O.), makes the eradication of these diseases feasible. There are certain projects assisted by W.H.O. which must be mentioned. These are the B.C.G. campaigns; a T.B. Pilot Project at Wad Medani which depends on group examination and case finding; a malaria eradication project; the Nursing College; and the Orchocerciasis Pilot Project. High hopes are entertained of the outcome of these schemes.

**The School of Medicine** The School of Medicine started in 1924 with an intake of four students and was affiliated to the University of London. In 1958 the Faculty of Medicine in the University of Khartoum offered its own degree of M.B., B.S. The annual intake has risen gradually

to 60, and the faculty has expanded in all its departments.

**The Department of Public Health** The department was run by an English professor until 1959 when he retired and was succeeded by a Sudanese. There are four lecturers in the department, one of whom is also responsible for the Student Health Service. The department is expanding continuously.

The teaching of public health starts in the second year of the medical course. An average of 150 to 200 hours is devoted to public health, spread over the three years that it is taught; much practical work and field work are given.

The students are also taken on public health tours all over the Sudan during the vacations to help them understand the real health problems of the country. The department has its own laboratory with three laboratory technicians but still lacks a statistician. The relationship of the department to other departments is good, and a close relationship is being created with the Ministry of Health. The Occupational Health Unit, which has been recently created, will be part of the Public Health Department for a long time to come. Undergraduate teaching will be one of the major functions of the Unit. Before discussing the structure and functions of the Unit, it is necessary to consider the industries in the Sudan and those around Khartoum.

#### Industry in the Sudan

Industrial development in the Sudan has followed the pattern seen in the other developing countries

which possess little mineral wealth, namely the processing of agricultural products. Cotton ginning and the manufacture of cotton textiles are well established, the production of vegetable oils from seed pressing is undertaken, and sugar refining is important. Transport is being developed, and railways, roads, and ports are being established while electricity undertakings have grown apace.

Rapid industrialization has been the aim of successive governments and a political slogan of all parties. The general policy has been to distribute the industries equally, but concentration has occurred mainly around Khartoum since it provides the best consumer market. As petroleum has not yet been discovered in the Sudan, the only cheap source of power is hydro-electric schemes. During dam building many disasters have occurred which indicate the need for efficient medical services. So far these have not been planned with sufficient foresight.

The natural resources of the country have not yet been fully exploited. Copper, manganese, mica, gold, and iron are mined on a very small scale. The mechanization of agriculture and proper care of livestock are still in their infancy.

As well as Khartoum, other foci of industry are the Gezira area, where all cotton ginning takes place, the Geneid area, where there are tobacco factories, sugar refineries, cardboard factories, and glass factories, and Atbara where there are railway workshops and the cement industry; in Port Sudan oil refining, oil pressing, and the textile industry are found in addition to the activities of a busy port.

The industries in Khartoum Province are concentrated mainly on the industrial estates in Khartoum North, Omdurman, and Khartoum. According to the classification of occupation adopted above, only 33% in Khartoum are occupied in the primary sector, 30% in the secondary sector, and 37% in the tertiary sector. Although Khartoum Province has one-twentieth of the Sudanese manpower, it contains about one quarter of the men engaged in the secondary and tertiary sectors.

A cross-section of industries is concentrated around Khartoum; the textile industry, employing 5,000 workers; the chemical industry, for example with branches of I.C.I. and Chloride Batteries; paints; oil and soap industries; beer, alcohol, and other distilleries; glass, sweets, and all consumer needs; hundreds of small workshops, foundries, and light engineering. Most of these are privately owned although most of the big factories belong wholly or in large part to the government.

**Problems of Industrialization** Rapid industrialization implies radical alterations in any

society with far-reaching effects on all its members. It involves the transformation of a peasant society into a community dependent on factories, and demands migration. Whole communities leave the settled country life to live in or near an industrial town, and the man who is a craftsman in his own right becomes a cog in a machine. These migrant workers may be subjected to insanitary living and factory conditions. They may contract new communicable diseases—thus the incidence of tuberculosis will rise. Accidents will become more frequent and the incidence of tetanus may rise. The agricultural population cannot readily handle the modern machines efficiently nor do they master the new techniques easily. It is not easy for them to adapt to the new factory discipline with fixed hours and mass production methods, and they miss their free and easy rural habits.

The same problems are to be expected in the Sudan as have occurred elsewhere in Africa. Overcrowding of the industrial estates will be a problem; malnutrition and venereal diseases may affect the unmarried and separated. Family ties will be weakened and many social and psychological problems may arise. Moreover, under the slogans of rapid industrialization, shabby, unhealthy factories and workshops may be built. Workers are apt to be exploited and may be asked to handle dangerous materials without the necessary precautions being taken to protect them. How to cope with all these problems and matters is the future task of the occupational health service. In a developing country like the Sudan this will be a part of the work of the public health expert.

**Labour Legislation** Labour legislation in the Sudan consists of two chief categories: that dealing with the conditions of employment, and that governing the formation and registration of trade unions and the regulations of industrial relations. In the first category are the Employers and Employed Persons Ordinance 1948; the Workshops and Factories Ordinance 1949; the Wages Tribunal Ordinance 1952; and the Employment Exchange Ordinance 1955. These ordinances have been borrowed freely from similar laws in Great Britain.

The Labour Department was started in 1947 and consists of the following sections: (1) Labour Inspectorate; (2) Factory Inspectorate; (3) Industrial relations; (4) Training-within-industry; (5) Wages tribunal; (6) Housing of workers; (7) Industrial Standards Board; and (8) Employment bureau.

The Factory Inspectorate section is manned by only six inspectors, none of whom is medically qualified; a medical inspectorate has not yet been

developed. Section 15 of the Workshops and Factories Ordinance 1949 gives power to the Medical Officer of Health to carry out medical inspections of a workshop or factory or employed person as may be necessary.

### Functions of the Unit

A picture has been presented of the current social and economic conditions in the Sudan to try to give an idea of the type of work the Occupational Health Unit should be doing as part of the Department of Public Health. Its possible functions may be summarized as follows:

**Teaching** Undergraduate teaching is important and should be provided for medical students, non-medical (engineering) students, and Public Health Officers in training.

The type of teaching appropriate to each category varies, and it is planned that for medical students the occupational health teaching should be confined to basic and related subjects but should also include visits to factories and demonstrations of clinical cases.

For engineering students, who will be responsible for creating the new environment in which other men work, the teaching should be aimed at preventing occupational hazards by means of planned design before the factory is built, as well as controlling existing hazards.

The Public Health Officers, as agents of the Medical Officer of Health, need to be taught how to inspect a factory so that they may be able to make recommendations on the environment, hygiene (general and personal), and disposal of waste in accordance with the Factories Acts.

**Survey of Industries** The major practical step required at present is to survey the industries: to try to define the size of the various problems, to investigate the health of groups of workers and the conditions under which they work, and to detect and

measure the prevalence and severity of any occupational health hazards. It is planned to carry out this survey as soon as possible. It will entail co-operation between the Ministry of Health, the Ministry of Labour, and the Factory Inspectorate. Students should be of great help in this work.

**Research** A university unit cannot continue to develop if it is not engaged continuously in research. The problems requiring investigation are many and the field is wide open.

**Library** Building a good library and purchasing sound international periodicals is a necessary part of this development.

**Occupational Hygiene Laboratory** Great use should be made of the existing laboratory of the Department of Public Health, which can be developed to include an occupational hygiene unit.

**International Relations** The co-operation and advice of experienced bodies is greatly needed. The aim should be to create closer relations both with the universities on the African continent and with the International Labour Office and W.H.O. through the organizations functioning in the Sudan. The continued advice and help of the Department of Occupational Health and Applied Physiology at the London School of Hygiene and Tropical Medicine is envisaged.

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