PAPER No. 117.

# THE SUDAN PUBLIC WORKS DEPARTMENT.

By D. Macfarlane, Superintending Engineer, P. W. D.

Preliminary notes of general interest—General—The budget—Government residences—Rents—Cotton soil—Roads—Agency for carrying out work—Water supplies—Port Sudan water supply—Sanitation—Personnel—Promotion—Leave—Education—Concluding note on general efficiency of administration.

The following paper is intended to be a brief account of the Sudan Public Works Department in so much as it differs in points of interest from the same department in the Punjab as regards procedure, activities, methods of construction, personnel and other points of interest.

## Preliminary Notes of General Interest.

| | | | |
|---|---|---|---|
| Area of the Sudan .. .. | 1,007,500 | Sq. Miles. | |
| Area of the Punjab .. .. | 99,200 | ,, | |
| Area of the Punjab including Native States | 135,800 | ,, | |
| Population of the Sudan .. .. | 6,469,000 | | |
| Population of the Punjab .. .. | 20,685,000 | | |
| Population of the Punjab including Native States .. .. .. | 25,101,000 | | |
| Population of Khartoum (Capital of the Sudan) .. | 30,800 | | |
| Population of Khartoum North | 14,300 | 123,700 | |
| Population of Omdurman .. | 78,600 | | |
| Population of Lahore .. .. | 281,800 | | |
| Distance from Lahore to Bombay .. | 1,162 | Miles. | |
| Distance from Khartoum to Cairo .. | 1,356 | ,, | |
| Distance from Khartoum to Port Sudan .. | 496 | ,, | |
| Height of Khartoum above sea level .. | 1,250 | Feet. | |

## General.

The Public Works Department, as such, does not include either irrigation or railways.

The Irrigation Department, which has only recently been formed, is still in its infancy, and has sprung into existence as the result of the completion of the Gezira Irrigation Scheme and of the construction of the Makwar Dam across the Blue Nile. This work, which caters solely for the Sudan Government, was undertaken by the staff of the Egyptian

*Note.*—The Egyptian Pound (which is divided into 100 piastres or 1,000 milliemes) is equivalent to £ 1-0-6. In any comparison of prices given below it is assumed (a) that the Egyptian pound is equivalent to the pound sterling, (b) that the rate of Indian exchange is 1/6 to the rupee. £ E 5·400 m/ms means 5·4 Egyptian pounds.

Irrigation Department, who were lent to the Sudan Government for the purpose, the dam itself (costing 13½ million pounds) being constructed by Messrs. Pearson & Company, contractors. A Punjab irrigation engineer (Mr. R. M. MacGregor) was lent to the Sudan Government some five years ago as advisory engineer—his work being largely concerned with the question of the water rights of Egypt, which is a matter of considerable complication. On the completion of the Gezira Irrigation Scheme last year the Sudan Irrigation Department, as such, was brought into existence, while Mr. MacGregor remained in his advisory capacity. The canalisation, distribution and revenue work generally are undertaken by the Sudan Plantations Syndicate, and the profits accruing are shared in fixed proportions between Government, the syndicate and the tenants. In a similar way a company known as the Kassala Cotton Company undertakes, under the control of the Irrigation and Agricultural Departments, the canalisation, etc., in a large and fertile portion of the Kassala Province, which obtains its water entirely by flood irrigation from the River Gash, which rises in Eritrea.

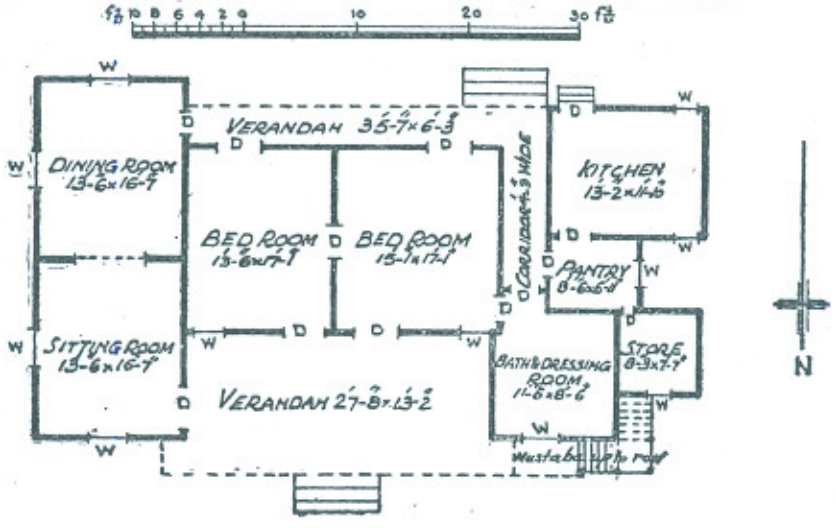
The Railway Department has entire control of the Sudan government railways and steamers, and, as in the case of the Punjab, undertakes all its own building work.

The Public Works Department corresponds in consequence to the Buildings and Roads Branch of this province, with the inclusion of water supplies and sanitary engineering. Its activities are confined primarily to building construction and water supplies, as in the present state of development of the country there are practically no metalled roads other than those in Khartoum itself which are maintained by the local municipality. Until 1925, the Khartoum electricity and water supply were also maintained by the Public Works Department, but these have since been handed over to the Sudan Light and Power Company—a concession company of which Government is a large shareholder. In addition to maintaining these services, the Company has undertaken to electrify the existing steam tramway service and to construct a bridge across the White Nile between Khartoum and Omdurman.

After the troubles in 1924, which culminated in the dastardly murder in Cairo of Sir Lee Stack, the Governor-General of the Sudan, the Egyptian army was evacuated from the Sudan and its place was taken by one very much reduced known as the Sudan Defence Force. This resulted in the sudden transfer of all military works in the Sudan, (which had hitherto been undertaken by the Military Works Department of the Egyptian Army) to the Public Works Department, thus very largely increasing its activities without any additional staff. A further strain was placed on the Department by the increase in the British garrison from one battalion to two and the consequent sudden demand for additional accommodation for British troops involving an expenditure of some £ 200,000. The Department possesses a large and well organised stores and workshops section at headquarters, which turns out practically all the steel work, joinery, etc., for all headquarters and out-station works.

## LINE PLAN OF RESIDENCE FOR GRADE II OFFICIAL KHARTOUM

Approximate cost including Out houses £E 1200 (Rs 16000)



Its activities include the maintenance of a central garage which supplies and maintains government cars for the whole country. The Governors of Provinces and all the more important touring government officials are provided with Ford cars, which are supplied, maintained and driven at government expense.

**The Budget.**

The preparation of the Public Works Department budget is a very simple matter, as it includes solely the annual maintenance charges, salaries of personnel, "allowances and services" and revenue. The total annual cost of the Public Works Department personnel is approximately £ 41,000, while the "allowances and services," which include travelling allowance, climate allowance, etc., amount to £ 8,000, bringing the total to £ 49,000. Proposals for major and minor works are dealt with separately, the funds being provided from the Central Government Reserve Fund. The total number of votes from the fund concerned for expenditure by the Public Works Department in 1926 amounted to £ 421,856. In the autumn of 1923 a new system was introduced in the shape of a three years' building programme. The Governors and Heads of Departments were called on to submit, through the divisional engineers of the provinces concerned, rough projects for their building proposals for the next three years, the works concerned being shown in order of urgency. This programme was submitted to the Public Works Committee, which consisted of the Financial Secretary, the Civil Secretary, and the Director of Public Works—an indication being given by the Financial Secretary of the rough amount for which he was prepared to apply to the Council for a vote from the Central Reserve Fund for the first of the three years under consideration. The list was then examined carefully by the Committee and divided into two parts. The first part included those works, up to the amount intimated, which were considered to be of primary urgency. The necessary vote having been obtained, funds were allotted, and the detailed projects were put in hand to enable the work to be completed during the ensuing working season. The following year Governors and Heads of Departments were asked to resubmit the list of the balance of works with any modifications required, and this was similarly dealt with by the Public Works Committee. The plan worked with entire satisfaction, and the procedure was repeated with a fresh three years' programme in 1926.

**Government Residences.**

Speaking generally as far as Khartoum is concerned, it may be said that the accommodation provided is inferior to that provided for the average government official in the Punjab. This is due to several causes :—

(i) Owing to the high price of labour and materials the cost of construction in the case of single storey residences is about £ 6 per metre square or Rs. 7-8 per square foot, *i.e.*, almost double that of similar construction in the Punjab, so rendering

it impossible to provide accommodation on a rental basis which does not incur loss to Government.

**(ii)** The climatic conditions during the winter months are about the same as during late March or early April in the Punjab plains, and rain is practically unknown. Consequently fires are unnecessary, practically all social entertaining takes place out of doors, and the provision of large reception rooms is unnecessary.

**(iii)** Ninety days' leave is ordinarily obtainable every summer and very liberal passage allowances are granted to officials, their wives and families; consequently the ordinary *mem-sahib* remains at home during the whole of the hot weather and is inclined to regard England rather than the Sudan as her permanent home. There is, therefore, not a very great demand for houses with high rents.

**(iv)** There is an adequate water-supply system, and each house is supplied with one or, at the outside, two bath-rooms only, furnished with modern long baths which are common to the whole household as in England.

**(v)** The sanitary arrangements differ from those in the Punjab, in that the commode system is replaced by the earth closet, there being, at the most, two to each house corresponding to the water closet in England. Consequent on this and on the arrangements described in para. **(iv)** above there is no necessity for separate bath-rooms for each bedroom.

On the other hand the general finish is distinctly superior to that of the average house in the Punjab plains. The joinery is more elaborate; the doors and windows are provided with superior fittings, architraves, etc.; the plaster is in all cases pucca, and the roofs are generally of reinforced concrete supported on reinforced concrete beams, neatly finished and moulded. The main difference, however, lies in the floor construction, which in practically all cases consists of glazed Marseilles tiles for all rooms, verandahs and kitchens—as also for all government offices. Their smooth and extremely durable surface renders them easy to clean after duststorms, while their neat appearance does away with the necessity for *chittai* or *durries*. The cost of these floors laid complete is 40 piastres per metre square, which is equivalent to Rs. 50 per hundred square feet. The front verandah which is used largely in lieu of the reception rooms, is spacious—usually 12 feet wide, and is provided with a light, sloping, tiled roof, supported on wooden posts or reinforced concrete columns, adequate ventilation being provided at its junction with the main wall either by means of a series of tile-ventilators or of a continuous roofed-over space. It is generally considered that this type of verandah is cooler and far less apt to retain the afternoon heat than the flat-roofed, arched verandahs so prevalent in the Punjab. It is not considered by any means necessary to surround a house entirely with

verandahs, the windows and doors in all unprotected outer walls being provided with jalousies opening outwards. There has been a tendency in the past to economize in the matter of height, the allowance for main rooms from floor to ceiling being 12½ feet only. In houses which have been constructed recently, however, this has been increased to 14 feet. This, though a distinct improvement, is not sufficient to allow for clerestory windows. Owing to the extremely sandy nature of the soil good mud is not easily obtainable either for mortar or plaster, and this cause contributes largely to the permanent finish of the buildings concerned. The local lime is inferior and expensive, and it is, therefore, more economical and satisfactory to use cement and sand mortar in the proportion of 8 sand to 1 cement, with pointing 6 to 1. The price of Portland cement, landed in Khartoum, is £ E 5.400 m/ms. *i.e.*, Rs. 72 per ton. Very occasionally *gishra* work, *i.e.*, mud bricks faced with pucca bricks, has been allowed in the provinces, but only on the ground of extreme economy, and it has not been by any means a success. If really good mud were obtainable this could be used with advantage in the northern provinces, such as Halfa, where the rainfall is practically negligible. At Khartoum the annual rainfall is 5·67 inches only, whereas farther south it increases considerably.

**Rents.**

The rents of government residences are not fixed on an economic basis, nor is the capital cost taken into consideration, varying as it does with different localities. A rent of 3 per cent. per annum is charged on the assumed capital cost, which is based solely on the accommodation provided and on the nature of construction. The following is the basis of calculation of assumed capital value :—

*Permanent buildings. Single storey.*

Main rooms £E 7.500 m/ms. per metre square of floor area.

Verandahs £E 4.500 m/ms. per metre square of floor area.

*Permanent buildings. Double storey.*

Main rooms £E 13.500 m/ms. per metre square of floor area.

Verandahs £E 8.250 m/ms. per metre square of floor area.

*Permanent out-buildings,* £ E 3.750 m/ms. per metre square over all.

*"Gishra" buildings.*

With permanent roof £ E 5.000 m/ms. per metre square over all.

With thatched roof £E 4.500 m/ms. per metre square over all.

The above rents are subject to a maximum of £E 96 per annum or approximately Rs. 107 per month. In Khartoum itself the gardens of all government residences are maintained by Government under the supervision of a garden superintendent. A compulsory rent is charged, varying from £E 1.500 m/ms. to £ E 3 per month according to the size of the garden. This includes pump irrigation (from the Nile), mowing

and marking the tennis courts, the erection of screens and nets and the provision and planting of seeds, etc. The irrigation is arranged by rotation, and the tennis courts, which are all of grass, are only played on for two days a week.

**Cotton Soil.**

One of the principal difficulties with which the engineer is faced in building construction, more especially in the Blue Nile and Upper Nile Provinces, is the prevalence of cotton soil. This soil during the dry season becomes fissured, with large cracks reaching down anything to 12 feet below the surface. During the rains the ground swells and rises. In one case a careful observation showed a movement of two inches vertically and four inches horizontally. There are various methods of attempting to overcome this difficulty, none of which are entirely satisfactory and some of which are very costly: (**a**) concrete piles, (**b**) concrete rafts, (**c**) excavating all round the foundations and replacing the cotton soil with sand, (**d**) covering the area around the plinth with a pucca platform 6 to 8 feet in width. A fairly efficacious, though by no means ideal practice which has largely been adopted, especially where economy has been a determining factor, has been to provide light foundations only, but to insert steel tie-bars throughout the building at plinth and roof level. This, while it in no way stops cracks from appearing, at any rate renders the building more or less safe from collapse, their introduction being far easier at the time of construction than later on, when in most cases it is found necessary.

**Roads.**

There are practically no permanent metalled and bridged roads in the Sudan as yet. The main artery of communication south of Khartoum is of course the River Nile, which is navigable as far as Rejaf, the distance of which is 1,102 miles. A metalled all-weather road 123 miles in length has recently been constructed by the Public Works Department from Rejaf to Aba in the Belgian Congo, linking up with other roads in the Congo which are mainly used in connection with copper mines. There is a dry weather road, 96 miles in length, between Rejaf and Nimule (the unnavigable portion of the Nile between the Sudan and Uganda) and a project is in hand for converting this into an all weather road. The route passes through the sleeping sickness area, the rainfall is extremely heavy for several months in the year and there are many formidable rivers to cross. It is unlikely, therefore, that this project will materialize for some years to come except by a gradual process, in view of the fact that in the present stage of development of the country its construction would be mainly of a sentimental value, *i.e.*, that of linking the Cape with Cairo. This, and other dry weather roads in the various provinces, are maintained at present by the Governors concerned, with local labour, a British foreman of works being deputed to them by the Public Works Department in certain cases where technical difficulties are involved.

**Agency for carrying out Work.**

In Khartoum and other of the larger provincial headquarters most works are done by contract, the contractors being almost invariably Greeks. On the whole there is very little to choose between them and the ordinary Punjab contractors. They possess no technical knowledge and are primarily procurers of labour. With rare exceptions they cannot speak English, all negotiations being conducted in Arabic which they usually speak fluently—Their want of knowledge of English often results, as it does in the Punjab, in the signing of contracts, the details of which they do not fully understand, and the subsequent putting forward of claims for compensation, extension of time limit, etc. The Greeks are a very large community in Khartoum and form the bulk of the shopkeeper class. They are extremely enterprising, and are generally first in the field where even the most remote out-station develops sufficiently to justify the opening of a general store.

In the more remote Provinces where there are no contractors, work is done entirely by daily labour and generally under a British foreman of works, who, as a rule, has a sufficient amount of work, original or repairs, to justify the maintenance of a permanent working party, consisting of local labour assisted by a few Greek artisians. In the case of out-stations where no materials are available the foreman has to arrange for the transport of these, usually by river steamer, and in such cases he proceeds there with his entire party and remains there till the work concerned and the annual repairs to all other buildings are completed.

**Water Supplies.**

The question of water supply in the Sudan is one of paramount importance, except of course in places which actually lie on the River Nile. The natives of the country are prepared to pay almost any price for good drinking water, and Government has done much in the way of sinking deep wells on the various trade routes. The scarcity of water in places such as Kordofan and Darfur is such that the cattle are quite accustomed to being watered only every second or third day. In Kordofan a large amount of water is stored by the natives themselves during the short rainy season in *tebeldi* trees. These trees have the peculiarity of possessing interior hollows capable of artificial enlargement to a capacity which in some cases amounts to 5,000 gallons. The water storing cavity has an opening just above the first branch rarely more than 15 feet from the ground and extends to within about 7 feet from the ground. After the cavity is filled with water, the opening is sealed with mud and the water is then sold by the tree owner during the dry season. These storage cavities are, in some cases, so large that a man can lie at full length in them with his arms extended above his head. It is roughly estimated that there are 33,000 such trees in the Province, with a total capacity of 11 million gallons. The botanical name of the trees is *adansonia digitata*. It is known also on the west coast of Africa, though

the author has never heard of its being used for storage purposes elsewhere than in the Sudan. Its average age is said to be 400 to 500 years.

A successful experiment has recently been made of issuing light metal cylindrical tanks to local sheikhs for water storage in places where these *tebeldi* trees are scarce.

In certain parts of the Sudan, north of Khartoum, where the undulations of the ground permit of it, water storage is undertaken by the natives by means of *hafirs*, *i.e.*, ground tanks artificially constructed and aided by the configuration of the ground. The filthy water which they are reduced to use when these *hafirs* are nearly dry is in itself an indication of the necessity for a system of wells, which Government is gradually undertaking as funds permit.

The greatest difficulty was experienced in obtaining water along the important military route between El Obeid (Kordofan) and Fasher (Darfur)—there being a waterless gap of 236 miles between Nahud and Fasher. After no less than seven unsuccessful attempts, lasting over several years, water was at last found at Khereit at a depth of 222 feet. The total cost involved in this undertaking—from start to finish—amounted roughly to £ 4,000. Well-sinking in such cases is carried out under the supervision of British drillers with a star rig and steel casing, the water, when found, being extracted by a Duke and Ockenden pump.

**Port Sudan Water Supply.**

Up to three years ago the rapidly developing town of Port Sudan had to rely mainly on condensed water for drinking purposes. A new water supply was undertaken in 1924 at a cost of approximately £ 50,000—the water being brought by gravity from Khor Abat, 18 miles north, through a 6-inch steel main. Owing to the rapid development of the port and the demand for water by shipping, it was decided subsequently to double this supply, and this work, which includes the provision of two 500-ton overhead balancing tanks, and a 5,000 ton ground-storage reservoir, was recently completed at a cost of £ 56,000. The question of transport of the steel mains (one mile of 8-inch and 17 miles of 6-inch) was one of considerable difficulty. At first mechanical transport was resorted to —F. W. D. and Ford one-ton lorries—but after continuous breakdowns, owing to the bad road and inexperienced drivers, the work was completed by camel transport. The screwing up of the pipes was undertaken entirely by native labour, each gang, after a certain amount of practice, doing from 35 to 40 joints per day. As the trenches were constantly liable to be filled with drift sand during dust storms, they were only opened as little as possible ahead of the pipe laying. Each section of piping, about a mile in length, was cleaned out, before coupling up to the preceding section by means of an air compressor working at 100 lb. to the square inch. The installation on completion was found capable of delivering 2,160 tons per day at Port Sudan, which ought to suffice for many years in spite of the rapid development of the port, the rate of which

is illustrated by the following figures shewing the tonnage of vessels which have visited it during the last few years :—

| Year. | No. of vessels. | Tons. |
|---|---|---|
| 1920 .. .. .. | 303 | 737,202 |
| 1921 .. .. .. | 451 | 1,403,587 |
| 1922 .. .. .. | 452 | 1,499,935 |
| 1923 .. .. .. | 609 | 2,265,375 |
| 1924 .. .. .. | 699 | 2,523,229 |
| 1925 .. .. .. | 786 | 3,174,500 |

The harbour, which at present contains warfage for five ocean steamers, is now being extended by two wharfs wth four electrically driven coal transporters at a cost of about £ 180,000 or Rs. 24,00,000.

Piped water supplies have also been installed during the last two years at Tokar and El Obeid at a cost of about £ 12,000 each, the supply in each case being obtained by means of tube wells.

**Sanitation.**

As mentioned above, the system in Khartoum and other of the larger towns, where any system exists at all, is that of the earth closet. The pails are removed every night by means of camel carts, clean ones being supplied in their places. The night-soil is taken by means of these carts to the out-skirts of the town and thence by Decauville track to a depot two miles away in the desert, where it is trenched. There is no sweeper caste in the Sudan, and the labour for this work is recruited from certain tribes in Darfur. Owing to the anticipated difficulty in the supply of this labour and the possibilities of a strike, it was decided two years ago to investigate the possibilities of a water-borne sewage system. Expert advice was taken in England and a rough scheme was eventually prepared by Mr. G. B. Kershaw, engineer to the Royal Commission on Sewage. The cost of this scheme amounted to £ 134,000. It provided for the linking up of the better class houses with the system, and for the provision of water-flushed latrines in the native quarters, the flow to the main pumping station being effected by air ejectors. The sewage was to be pumped from there to a sewage farm 2½ miles away in the desert, where, after light tank treatment allowing it to remain in settling tanks for two hours, it was to be allowed to flow on to the land. The cost was of course, very high for a population of 30,000 only, and as the labour situation has been considerably eased, the scheme has been dropped for the present.

**Personnel.**

The senior personnel of the Department consists of a Director of Works, a Deputy Director of Works (a newly created appointment), Divisional Engineers, District Engineers and Assistant District Engineers. An overlapping grading system (which is the same for all technical departments) exists, whereby an engineer on first appointment as Assistant District Engineer starts in Grade III on initial pay according to age and qualifications, the minimum of which is £ E 480 per annum rising in ten years to £E 780. The next is Grade II, starting at £E 852 and rising in six years to £E 1,080 with a "special maximum" of £E 1,200 after three years at the highest rate. The top grade is Grade I, starting at £E 1,200 and rising in three years to £E 1,500 with a special maximum of £E 1,750 after three years at the highest rate. With very rare exceptions Grade I is reserved entirely for heads of departments. The junior or subordinate establishment consists of the following overlapping grades :—

Grade VIII from £E 60 to £E 168 in 21 years.
,, VII from £E 96 to £E 276 in 24 years.
,, VI from £E 168 to £E 396 in 21 ,,
,, V from £E 252 to £E 540 in 18 ,,
,, IV from £E 432 to £E 720 in 11 years.

There is no income-tax in the country.

Owing to the almost entire absence of institutions for giving technical education in the country, the senior subordinates, technical and clerical, are recruited from England and start in Grade V on pay in accordance with age and qualifications. Grade IV is reserved almost exclusively for superintendents of works and head office superintendents. There is a very good officers and widows pension to which officers contribute five per cent. of their pay. The age of superannuation is 50. No officer is taken on the permanent establishment until he has completed two years probationary service, which counts as service towards pension on his being made permanent. The recruitment of British staff is undertaken by the advisory engineer at the London office, with the assistance of the Director of Works on his representation when on leave.

**Promotion.**

The arrangements by which promotions are made either within a grade or to the next superior grade are distinctly unwieldly, and rest (subject to final financial approval) in the hands of a cadre committee, consisting of selected senior officials irrespective of their departments. The grading system was introduced some years ago with a view to make promotion more or less automatic (except in very special circumstances) and dependent on the time scale and vacancies in the various grades. Frequent precedents have been established, however, for departing from this rule, with the result that the continuous and frequently justi-

fied applications for special increments, increased acceleration, special promotion, etc., render the work involved by no means easy either for the cadre committee or the head of the department who has to submit the case with his recommendations, the claims concerned being frequently based on alleged preferential treatment in other departments. The head of the department can claim the right to attend the meeting when the case of one of his own personnel is being considered.

**Leave.**

The leave conditions are very liberal indeed, owing to the fact that there are no good hill stations in the country and that the hot weather, with its continuous dust storms, can be very unpleasant, the average maximum temperature between April and October being well over 100 degrees. There are, as a matter of fact, two so-called hill stations in the Sudan, both in the Red Sea Province, Sinkat, 2,850 feet, and Erkoweit, 3,550 feet above sea level, but they are seldom used as such. The former is a small district headquarters and the latter is occasionally used as a summer camp by the Governor-General.

Government officials are granted 90 days leave every year or 122 days every two years, leave commencing and ending at Cairo. Assisted passages are granted on all occasions of leave, and consist of free railway warrants to Alexandria or Port Sudan, and £E 22.500 m/ms. passage money each way, or £E 40 if previous leave has not been taken for two years. The same privilege is extended to wives and families.

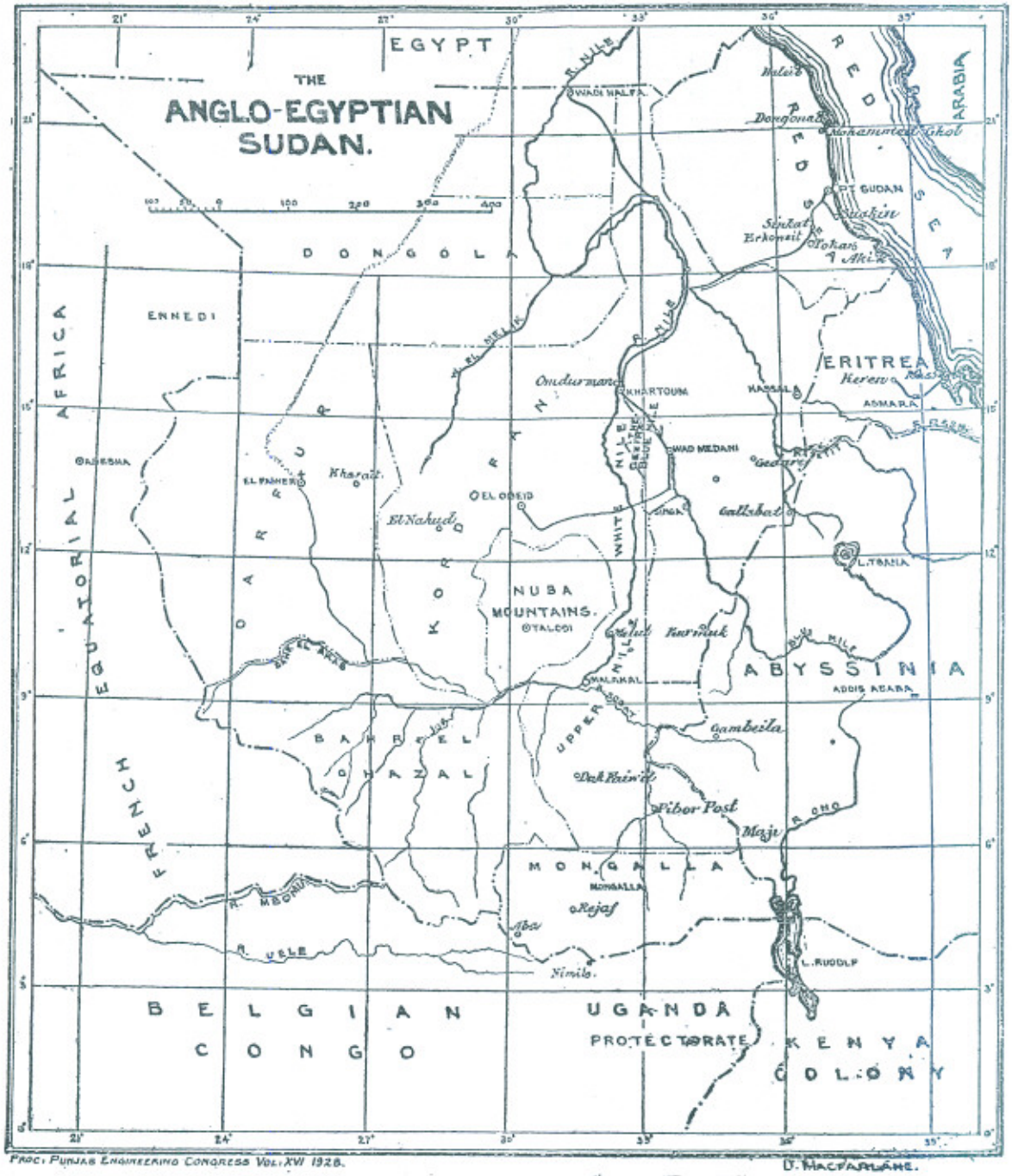
**Education.**

As mentioned above, technical education, in fact all education, can be regarded as in its infancy, as compared with India. There are no engineering colleges, and, although the principal educational institution—the Gordon College at Khartoum—has an engineering course, the material on which it has to work is extremely poor—recruited as it is from a race of comparative savagery. The out-turn is, in consequence, very unsatisfactory, and the demand far in excess of the supply. It will, therefore, in all probability be many years before the indigenous product can hope to replace entirely the present extremely expensive British subordinate. The difficulties in this respect were of course vastly increased in the autumn of 1924 by the removal from the Sudan, not only of the Egyptian army, but of all Egyptian clerical and technical personnel who were found, as many of them were, to be involved in anti-British intrigue.

**Concluding Note on General Efficiency of Administration.**

The Sudan since the days of the re-occupation until within the last few years has existed in comparative peace and quietness. The country was faced with no serious problems; the natives were content with our administration, based very largely on existing tribal laws exercised by the local sheikhs with the assistance of political officers, the educational qualifications of whom were not essentially of an exceptionally high standard; and the word "sedition" was unknown in the land. Local risings

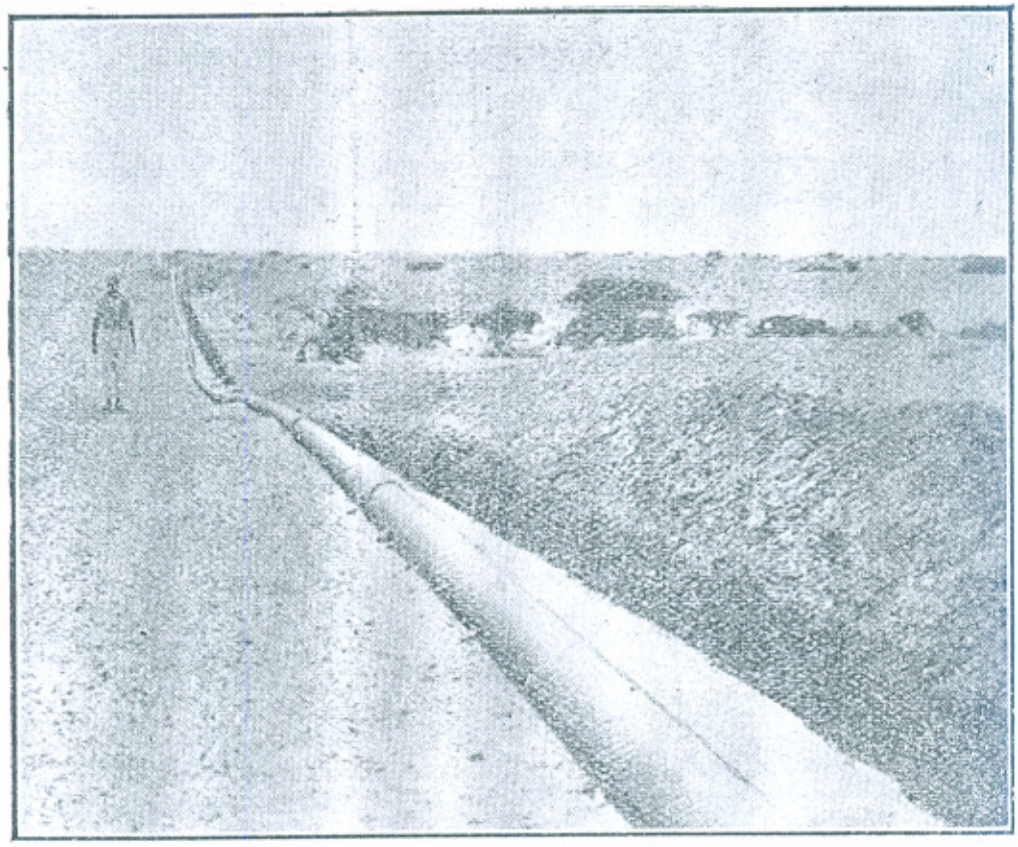
of course took place from time to time among the more warlike tribes, but these were nowhere of sufficient magnitude, to effect the administration as a whole. The general upheaval of the Great War, followed by the desire for self determination and a feeling of general unrest in Egypt, has unfortunately had its repercussion in the Sudan. Moreover the fact that the status of the Sudan with relation to the British and Egyptian governments is still regarded by the latter as a source of grievance, renders the question of politics on all matters in which that country is concerned (and of which engineering projects form a considerable part) by no means an easy one. The rapid development of irrigation, and the vast increase in the out-turn of cotton and other exports competing with the Egyptian market, have brought the question of the established water-rights of Egypt very much into prominence. The gradual increase in education and the rapid increase in wealth and civilisation generally, has thrown a great strain on the engineering and other technical departments. Thus there are many important problems necessitating reference to the highest authorities on the spot. On the other hand the administration is so closely involved, in politics with the Foreign Office, and in finance with the Treasury, that the Governor-General and the Financial Secretary find it necessary to spend a considerable portion of the summer at the Sudan Government's London office, and this, coupled with the liberal leave conditions described above, results in a natural tendency to control the country from London in the summer, and to crowd the bulk of the year's work into the few winter months, when the Central Government and all heads of departments are on the spot. It is a matter for speculation, therefore, whether some radical change is not inevitable in the near future such as the establishment of a hill station to which the Secretariat can move *en bloc* during the summer, with a considerable reduction of the present leave privileges. Failing this, the effect of the present stagnation that exists in the summer months could be reduced to a great extent by the insistence that all members of council and heads of departments take their leave at the same time, and when doing so remain within easy call of the London office.



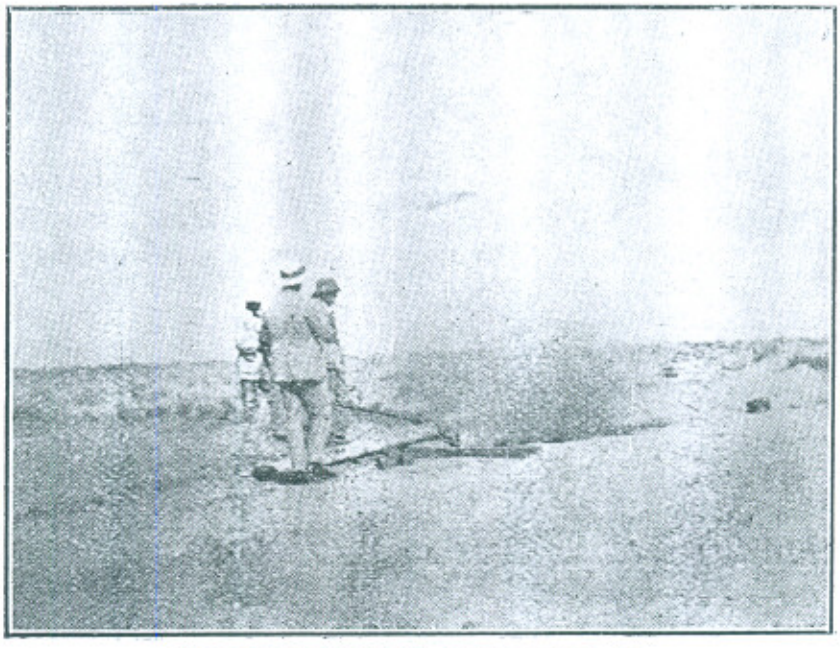

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D. MACFARLANE.

# PORT SUDAN WATER SUPPLY.



6" Steel Main (Stewart and Lloyds).



Clearing Main with Compressed Air.



Tebeldi Tree as used for water storage in Kordofan.



Verandah of Grade II Residence.

# PORT SUDAN WATER SUPPLY



Camel transport.

## DISCUSSION.

MR. MACFARLANE in introducing his paper apologised for the fact that it was by no means confined strictly to engineering matters, as for example, the first page looked rather an extract from Whittaker's Almanack. These relative figures, however, were of interest when compared with the relative conditions under which the Engineers had to work in India and the Sudan. He wished that the photos were included to make the paper more interesting.

Continuing he stated that on his first arrival in the Sudan there was a very great tendency to call in expert assistance from England on all technical matters of importance ; as, for example, Government was paying a retaining fee of £ 500 a year to the well known firm of Messrs. A. Beeby Thompson and Partners for advice on all matters in connection with oil and water supplies, including one visit to the Sudan every year by the head of the firm with all expenses paid. These experts, though hampered by an absence of knowledge of local conditions, were of course of the greatest assistance.

He further drew attention to the heading of "Port Sudan Water Supply" on page 40 of his paper in which he had referred to the failure of the motor transport which was used for the conveyance of the water mains 18 miles across the desert. In this connection he stated that he has recently had a somewhat similar experience with a Super Sentinel Tractor which had been employed in carting stone metal along the Pipli-Saharanpur Road. The extent to which the failure in this case was due to inherent faults in the machine was a moot point and one which the suppliers were doing their best to elucidate, but his own view was that *no* type of mechanical transport was of any use for heavy loads unless it was employed on a large scale with properly organised repair depots, skilled drivers and spare vehicles. The employment of one vehicle only was an undertaking which, with the entire absence of such elaborate arrangements or proper supervision, was merely courting disaster.

He thought that there were three instances over which the Punjab might in certain circumstances follow the procedure in the Sudan and on which discussion might be invited, namely :—

(1) The use of 8-1 cement mortar in lieu of lime mortar.

(2) The use of glazed tiles for floors.

(3) The use of louvered shutters for windows in lieu of verandahs.

In connection with No. (3) he said that a good deal had already been written about reducing the heat in buildings by providing hollow external walls. His own opinion, however, was that no matter what arrangements were made for protecting the walls themselves, very little advantage was gained when a high percentage of the area concerned consisted of single glazed doors or windows. The protection of these

by louvered shutters was a practice universally adopted in the Sudan and gave excellent results.

In conclusion he wished to emphasize the importance of the maintenance by Government of all the gardens attached to residential buildings, as is done in Khartoum under the supervision of a garden superintendent. He considered that this practice, if adopted, would considerably improve the state of these gardens, as everyone knew the amount of time and money that one had to spend in the lay-out and upkeep of a garden which was usually neglected when handed over to a successor.

MR. ADLARD agreed with Mr. Macfarlane that no type of mechanical transport was of any use for heavy loads unless it was employed on a large scale with properly organised repair depots, skilled drivers and spare vehicles. He quoted an instance of a single tractor which was working at Jagadhri and carried stone about 15 miles down the road, but as it was the only one to be used it soon went to pieces. He suggested that it was essential that there should be three or four such vehicles, if the mechanical transport in this country was to be introduced at all on satisfactory basis. He could see no object in purchasing one tractor costing as much as Rs. 13,000 when 3 or 4 Ford tractors could be obtained for the same amount. Further he stated that the local mistris were unable to keep them in proper repair.

Mr. Adlard further touched upon the question of using cement and sand instead of lime and surkhi and was of opinion that the latter should be completely excluded from the schedule of rates in the Punjab Public Works Department. Cement mortars are decidedly cheaper and, if cinders could be obtained he would suggest substituting these for sand as they are better. They are generally obtainable in places like Lahore, Delhi, etc., where they could be used with advantage.

MR. VESUGAR.—As regards the question of using cement for all mortar instead of lime, Mr. Vesugar enquired what process was adopted for plaster work. If cement was used without admixture of lime or milk of lime, was there any trouble with hair cracks appearing.

MR. TREVOR JONES, made an enquiry regarding the type of contractor employed in the Sudan. He noticed that they were mostly Greek and wondered that this ancient and intelligent race should not produce men capable of carrying out lump sum contracts and possessing the technical qualities to do so. The question was largely prompted by the remark made by H. E. the Governor that morning as to the desirability of the management of that type of contractor in the Punjab. He further enquired what was the system of T. A. in force in the Sudan.

MR. MACFARLANE.—In reply to Mr. Vesugar's question regarding the proportions used in sand plaster, Mr. Macfarlane stated that the proportion of sand was 8 : 1 for ordinary plaster and 6 : 1 for pointing.

Replying to Mr. Trevor Jones' enquiry, he said that there were no reliable British contractors in the Sudan. The contractors there

are mostly Greeks, and as far as their capabilities are concerned, they are practically the same as those in the Punjab and very little better than mere procurers of labour. He added that there were many reliable firms in Cairo and he had recently employed one of them on a big building scheme costing a hundred thousand pounds, with a view to encouraging others. Lump sum contracts were not in vogue, the method employed being the usual item rate contract.

As regards travelling allowances, Mr. Macfarlane stated that these were extremely liberal. As would be seen from his paper the more important Government officials were given Ford cars for the discharge of their duties. These were supplied with free drivers, petrol, etc., and were maintained by the Stores and Workshops section of the Public Works Department. Officials living in Khartoum and other large towns who wished to use these cars in addition for their private use were permitted to do so on a payment to Government of £ 3 per month. Mileage rates were, of course, in the circumstances not given but a daily allowance was provided of 16 shillings per day. For all other incidental expenses, such as cooly hire, etc., actual expenses were paid. Travelling by rail was done by means of a railway warrant authorising the free issue of tickets.

Mr. Macfarlane realised that the arrangement of providing officials with Government cars was an expensive one as it was naturally difficult to ensure that the cars were carefully driven and maintained. Shortly before he left, the Sudan Government were endeavouring to break down this system by giving advances for the purchase of cars and the introduction of mileage allowance for privately owned cars. He was engaged on the drawing up of these rules on more of less the same bases as those existing in India. The Sudan being a young country is fortunately almost entirely free from " Red Tape " and he, therefore, endeavoured to make the rules as simple as possible. Members are, of course, aware that under our rules advances for the purchase of a car in England are only granted within six weeks of an officer's return to India. The same condition was included in the Sudan Government rules, but within a fortnight of their issue, it was defeated by an enterprising official who obtained his advance through the head of his department and proceeded on leave to England the next day.