PREVENTATIVE MEDICINE IN CONNECTION WITH
PUBLIC WORKS IN THE NEAR EAST.

Thesis for the Degree of M.D. 1914.

by

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SYNOPSIS.

The Barrage at Isna, Upper Egypt, will be taken as a type, with short notes on the reconstruction works at the Delta Barrage, Cairo, and the Hindia Barrage near Bagdad, Mesopotamia.

**Introduction** - to include reasons for Thesis:

a. Being R.M.O. to these Works.

b. The temporary nature of the work.

c. The lowest possible illness and death rate and the lowest possible expenditure.

d. The mixed character of the workers:
   - Natives - Copts (Christians) and Moslems.
   - Europeans - British, Italians, Greeks.

**Site of Barrage** - Why Chosen at Isna;

- Short description of surroundings;
- Conditions before and during formation of Barrage;
- Short description of the Barrage.

The Rise and Fall of the Nile.

Climate with special reference to Isna.

**Sanitary arrangements.**

- Soil.
- Dwellings.
- Water supply.
- Sewage Conservancy.

Medical/
Medical Arrangements:-

Description of Hospital Buildings.

Temporary "first aid" 1. at commencement,
2. when work at its height.

Prophylaxis for sunstroke and Instructions for treating cases.

Epidemics and Precautions against same.

Working expenses and general Medical expenses.

Miscellaneous, Conclusions, References, Photos.

Appendix - Reconstruction Works at the Delta Barrage near Cairo and the Hindia Barrage, Mesopotamia, Asiatic Turkey.
INTRODUCTION.

The following thesis is the result of observations made in the years 1907-1914 while the author was Resident Medical Officer to these several Works.

In the medical papers of the past few years attention has been directed to preventative rather than curative medicine. The mortality in the South African war from the prevalence of Dysentery and Typhoid fever opened the eyes of the nation to the immense dangers of fouled water supplies, bad camp sites, etc. In the De Lesseps period of office while the Panama Canal was in construction, it used to be said that the Canal would cost a life for every six feet of its length. In the Blue Book "Sanitary Matters in West Africa", recently issued by Professor Simpson, King's College, London, organization is strongly recommended, as in the campaign against Malaria - in parts good has resulted from cordial co-operation; in others West Africa is still the White man's grave.

It is gradually being brought home to large employers of labour, especially abroad, that before an undertaking can run to a successful issue, the first thing to be looked at is the general health of the employees.

In the construction of these Barrages the points from a Medical point of view are:-

1./
1. The temporary nature of the works, from three to five years being the average.

2. The mixed characters and nationalities of the workers; Europeans - British, Italians, Greeks; Natives - which include Copts (Christians) and Moslems.

3. The minimum of working expenditure, as these Barrages are build by contract.

4. The minimum of time on sick list in daily wage workers, in "Piece-workers" this is not so important, as the latter are paid by results.

SITE OF BARRAGE.

Isna was fixed upon by the Egyptian Government as the most convenient spot for the Barrage, as its position lent itself to the requirements of the large tract of country north of the town which would benefit by irrigation. The idea of the scheme roughly is to hold up enough water during a "low flood" which will give an even supply all the year round to the country lying northwards. The water held up is distributed by means of two canals, one on either bank, which take off close to the Barrage on the upstream side and run for many miles northwards, giving in their turn lesser feeders to the surrounding country. Isna is a long straggling town situated on the West bank of the Nile, and has a population of about 25,000 inhabitants. The Barrage lies to the North or downstream side of the town, where a large area of "stacking" ground, etc., was walled off by boundary walls on either side of the river, and these areas we may for our purpose term the "camp".

CONDITIONS/
CONDITIONS BEFORE AND WHILE BARRAGE IN FORMATION.

The first start was made in November, 1906. The preliminary works were very extensive and costly, while the total contracts amounted to about a million and a quarter sterling. The pioneer Engineers who had to live in Isna had to "rough it" pretty considerably. One Englishman died of gangrenous dysentery, while the Resident Engineer had to be invalided home, and it was not till the dwelling houses had been finally built complete could one be at all sure of coming safely away. Gradually however matters evolved themselves, the houses having been built, gardens were formed, and the sandy desert was gradually made to appear more civilized.

DESCRIPTION OF BARRAGE. See Photo.

The Barrage is a stone structure built across the Nile bed, composed of 120 piers and sluice gates and a Lock to permit of traffic being carried on up and down the river. It is three quarters of a mile long. There is a wide roadway which carries a Trolley line on the top, and which crosses a swing bridge over the Lock, which allows the river boats to have free passage. By means of this roadway the two sides of the river are in easy communication. Before the Barrage was built, Ferry boats were in use.
THE RISE AND FALL OF THE NILE.

The flooding of the Nile is mostly due to the rainwater from the mountains in its upper reaches. It comes annually, almost with the regularity of clockwork. At Khartoum, signs of it are seen early in April, but the regular increase does not appear at Isna till about midsummer. The true flood is usually preceded for more than a fortnight by the passage of the "Green Waters" which are the stagnant waters full of algae from the swamps in the upper reaches. It then changes from green to brown, the brown getting more concentrated till the water almost assumes a red hue. It is turbid for the period of rise, and retains its turbidity though in less degree for the year till the following flood, the river is always "muddy". The water is extremely sweet, especially in the turbid state and is considered by the natives to be very wholesome except when green. The flood is at its height about mid September and subject to one or two gradations steadily settles to decrease from that time. At flood time there is such a tremendous alteration in the river's volume that the river is actually doubled in width in most parts, the rise at Isna being about 36 feet, so that during construction the Works were temporarily flooded over, and operations were practically at a standstill for some months. The current during low Nile is about three miles per hour, while at flood time this is increased to nearly five miles per hour.

CLIMATE/
CLIMATE WITH SPECIAL REFERENCE TO ISNA.

To those who are fortunate enough to stand great heat the climate is equable.

Rainfall. Rain is practically unknown, and during the time the author was at Isna there was only one shower in April.

Winds. The prevailing wind is from the North West or North, the South winds being few and blowing chiefly in the months of April and May. These winds are very trying, being furnace-like in their great heat. They are usually accompanied by blinding dust storms and cause intense discomfort to everybody, but principally to Europeans. Fortunately, at this Khamsin time (Arabic; period of fifty days) these dust storms almost invariably ceased precisely as the sun set, when one could go out in comparative comfort.

Atmosphere. One of extraordinary clearness.

Seasons. Correspond narrowly to our English ones.

Winter. Roughly from October to March.

Spring. A time of growth as in England, April, May.

Summer. June, July, August. September roughly an Autumn month.

The winter months from October to March are exceedingly pleasant. The nights are cold, sometimes extremely so, and one was not helped by the fact that the dwelling-houses/
dwelling-houses were built to withstand tropical heat, and were mostly without fireplaces. Clothing of ordinary thickness can be worn, and there is no need of a helmet generally.

In summer the heat is at its maximum about 2 p.m., the sun is vertically overhead and the air shimmering with heat. Perspiration dries almost as quickly as it forms, owing to the excessively dry atmosphere.

The Khamain time (see above) is the worst time of the year. Eye troubles are very frequent, and to get about in comfort, motor spectacles had to be worn. The dust is not coarse desert sand particles, but powdered Nile mud, and nothing describes a sand storm better than to compare it to a London fog, substituting dust for the water particles. When the Nile is decreasing owing to the subsoil being inundated to some considerable distance from the river, the air is somewhat humid and, with the heat, makes this an oppressive time.

SANITARY ARRANGEMENTS.

Dwellings.

A. Staff Quarters.
B. British Artisan Quarters.
C. European Quarters.
D. Native do.
A. Staff Quarters.

These were of the bungalow type. They consisted of Entrance Hall, Dining-room, four Bedrooms, Bathroom, Pantry and Latrine. They were generally raised from the ground about 3 feet. The foundations consisted of Rubble masonry, while the floors were of solid concrete in nearly every instance. The walls were composed of sun-dried mud bricks with the exception of the first course, which was made of burnt brick in order to facilitate the washing out of the rooms and also to prevent the access of vermin. The roofs flat, made of beams and boarding covered with mud bricks. The exterior of the houses were painted with yellow or white wash; the interiors as fancy dictated. Spacious verandahs of wood covered three sides of the house, the fourth not requiring shade as it faced the North. The windows/
windows were so placed so as to allow of a through draught airing every room. The windows were lofty and had both glass and wire gauze screens, the whole being enclosed by wooden jalousies. These latter kept the heat out, as they were all shut early in the morning and not opened again till sunset. The rooms were mostly about 14 feet high, having an air space to bedrooms of 2,744 cubic feet. The verandahs had concrete flooring. The baths were of European pattern with shower attachments.

The kitchens, the washing-houses and the servants' quarters were in a separate building well away from the dwelling-houses, while the servants' sleeping rooms were not in any way connected with the kitchens.

Kitchens - Blocks.
B. Artisans' Quarters.

These were of the dormitory type with the same wall construction. There was a central passage running from one end of the building to the other, bedrooms on one side, living rooms on the other. These quarters all possessed a verandah built of concrete and of sufficient width and shade. Accommodation was allowed for six persons. Gauze window screens were not supplied to these quarters, but the men all used mosquito curtains. The baths were made of solid concrete, while showers were also supplied, the whole being under medical inspection.
C. European Quarters.

European Barracks.

Interior of Barracks.

On both banks of the river quarters were provided for the European masons and also for many of the natives, though these to a great extent lodged in Isana town itself, or at special times sleeping in tents. Quarters were of the barrack type, generally on the block system of four large common sleeping rooms to one/
one building. Accommodation was allowed for twenty persons in each section. They were single-storied, well-lighted and airy, mud-brick walls on rubble foundations, the floors being of beaten earth. The walls were mud plastered and coated with white wash, the exteriors painted with yellow distemper. The disadvantage of mud flooring was very soon evident as rats simply abounded, and later during plague time gave some anxiety. The expense of a concrete floor for this type of building would have been out of the question, so a means was taken to keep down the rats, which was successful. Later it was seen in many of these quarters to be inadvisable that the cooking of the food should be done in the same living-room, so wooden lean-to kitchens were attached, nothing more elaborate being required, as for cooking, kerosene pump stoves were used and not coal fires. On the Assouan Dam Heightening Works (1909) a better method was to have mud brick stalls built with mud brick platforms for these stoves.

and in addition the men have their meals served in a separate shelter.

D. Natives.

The Soudanese employed as Sanitary men and "Ghaffirs", (Native Watchmen) on the Works were permitted to construct their own huts in a special settlement set apart for them. These were also of mud bricks, very low roofs, roughly thatched with dhurra (maize) stalks, and were quite dark inside. They had beds which were merely mud brick platforms. They were kept scrupulously clean, and were also medically inspected.

WATER SUPPLY.

The source was the Nile itself. A complete installation was laid down on both sides of the river which was supplied by pumping. The supply had to include not only household requirements, but a large amount for engines, concrete mixing, and in addition sufficient to moisten the stone-work of the Barrage itself, to prevent its too quick settlement in the great heat.

Powerful Force Pumps were used and were duplicated in case of breakdowns. The Pump sites were on the upstream side of the Works. Unfortunately on the West Bank the site was not ideal, as the town of Isna was immediately above. On the East Bank there were less chances of contamination, as no native villages were in the/
the neighbourhood. To lessen the risks further, no boats were allowed to moor within 300 yards of the Pumps, and a Ghaffir was always stationed at the Pumps to prevent any human pollution of the ground close by. The inlet pipes were well advanced into the river's current about 50 feet in each case, and had perforated closed ends. From the Pumps the water was forced through nearly a mile of 4 inch piping to large elevated wooden tanks. From these tanks the water was led by 2 inch piping to all parts of the Works. These reservoirs were two in number on the East Bank and four on the West, and had a store capacity for each of six tons. The groups of tanks were in communication with each other by piping, the outlet in each tank being situated a foot to a foot and a half above the floor level to allow a certain amount of sedimentation to take place before distribution. Once a fortnight the reservoirs were emptied and cleaned out. In order to efficiently work the Berkfeld Filters on the East and West Banks the respective tank elevations were 33 and 25 feet.

Berkfeld Filters were fitted to every better class quarter, generally one to each household. Owing to the muddy state of the Nile water, the Filter candles had to be frequently cleansed, often less than a hour's running clogging them up. As a consequence the candles wore out very quickly, as friction with a hard brush was required to remove the sludge coating. There was a/
a risk here also of the native servant letting the wear take place till the porous clay was at times found to be worn away to the thinness of a tea-cup edge. Though filtration through a Berkfeld kept properly as by baking about once weekly was judged to be safe through three quarters of the year, during the hot summer months and especially when the "green waters" were coming down it was decided in addition to the filtration to boil the water as well, as a safeguard.

For this purpose on each bank of the river were erected special boilers and Storage Tanks. In order not to incur heavy expenses Portable Engine boilers were adapted to suit this purpose, as they were extensively used on the Works and could be spared for a time. An ample drinking allowance of three gallons per day per white man was allowed for 240 gallons on each bank being boiled per day. This special water was only allowed for Europeans.

To convert the boilers to their new uses one was placed vertically, the boiler, the other horizontally, the storage tank, a series of six filters placed on top of boiler, the water first filtered through these passed into the vertical boiler, boiled at high pressure for at least fifteen minutes then by means of a U connecting tube the water forced by steam pressure into the horizontal tank. This boiling process took place in the afternoon and evening, and the next process was to cool the water down sufficiently to make it/
it potable next morning. From the horizontal tank a pipe lead to a water house partially enclosed with canvas so that air could circulate widely. In this house native Zeers or porous jars were placed on stands. From these Zeers the water fell by slow drops cooling thus into special pails underneath, and from these pails the water was distributed. The series of Zeers was filled by a hose pipe.

Zeer House.

There were seen to be many objections to this scheme. It worked for a season, but one had always to be watching the cleanliness of the native attendant. Next season the plan was modified. On the works Calcium Carbide flare lamps were used to light up the night squads at work. The Carbide was imported in large clean tins, so a number of these were converted at very little/
little expense to hold water instead, taps being fitted, the lids soldered down, and only a small funnel-shaped opening left, fitted with a wood wedge cork, so that no native could possibly get at the water except by withdrawing it from the tap. To cool these tins, coarse sacking in several thicknesses was sewn round, and the sacking kept constantly soaked, water being poured on it at intervals by the native attendant.

Boiled Water Tins canvas covered.

This device resulted in getting the water cooled down very quickly. A difficulty was found here, though the tins were regularly steamed from a special tube on the boiler, the water in time tended to assume a somewhat rusty hue. It would have been preferable to have had padlocked lids and the tins could then have been scrubbed out systematically under European supervision.

The/
The European households sent daily to these water houses for supplies with clean bottles which were directly filled from the tank pipe. These bottles were afterwards placed in small porous jars filled with water called "Gadouses"; or the Masons on the Masonry used to send their "Goulah" boys to the houses to get a supply for the day. These various types of evaporating water vessels are all illustrated in photo.

Zeer "gulas" Ibrigs etc. gadoos.

![Image of water vessels](image)

After being somewhat cooled in these porous vessels, the bottles were next placed on ice in the ice chests supplied to the various quarters. The water was somewhat insipid after the boiling, and was found to be greatly improved by being aerated in Seltzogen Syphons.

During "High Nile" the water rises a foot or more a day and thus the pumps had to be altered to keep pace with this. Pontoons or barges were used, the pumps placed/
placed on these, and a flexible connection united the pump to the fixed water main.

Pumps on platoons for flood time.

CONSERVANCY: SOIL.

The soil in the Barrage neighbourhood has been formed by successive layers of Nile silt. As a consequence it is highly fertile and also highly porous, which fact was taken advantage of in the sanitary schemes. The conservancy includes Sewage collection

A. on the Works.
B. in the Dwellings.

Waste water disposal.
Refuse collection and disposal.
SEWAGE COLLECTION, ETC. A. ON THE WORKS PROPER.

There was a special sanitary native corps numbering about 100 men when the work was at its height. They had a distinctive dress and were drawn mostly from the lowest classes. A sanitary man judged by his fellow workers is a pariah and consequently lazy, requiring a great deal of supervision. They were directly under a "Rais" or native orderly. These in turn were under a European Inspector, who was responsible to the Medical Officer. In addition the native "Ghaffirs" who policed the Works had to prevent any pollution of the ground.

Latrines made of wood and furnished with poles for carrying about purposes were used.

Portable Latrines.

These latrines were all distinctly numbered in English and Arabic numerals, so that they could be easily identified,
identified, in addition to which they were frequently white-washed. For the European workers, plain wood ones were furnished, kept locked, and a key was supplied on request from the nearest watchman. Each native sanitary man had certain latrines to be responsible for; sometimes two, sometimes six, according to need. Iron pails were in use and each latrine had a separate utensil for urine. These pails were in duplicate, so a clean one was substituted when necessary, the full one being carried away to the excrement pits which were situated at a reasonable distance from the Works. These pits were about 10 feet long and 10 feet deep. The excrement was thrown in and after it a layer of dry earth. This was repeated till within about a couple of feet from the surface when the surplus space was filled with dry earth only. To ensure cleanliness and freedom from odour, the wooden latrines were washed down several times daily, and every second day or so removed to a fresh site, the old site being well sprinkled with unslaked lime. The limestone had to be burnt for mortar making in any case, so that this was found to be the cheapest available disinfectant.

At first the latrines for the natives were furnished with the usual European seat, but it was found that a better method was to dig an oblong hole in the ground, fit this with a wooden frame in which the pails were placed, the native being used to the squatting posture, less/
less pollution resulted.

In spite of latrines being placed near native barracks, etc. the natives still adhered to their primitive customs, so a spade man was detailed especially to go round and collect excrement which was carried to the burial pits. In time, however, the laws against ground pollution became more stringent, and with the aid of the local authorities any native convicted of an offence after due enquiry had to go to prison. Each morning the whole camp was inspected by the European Inspector, and by the Medical Officer at least once weekly.

B. IN THE DWELLINGS.

Here the dry earth system was universal. The closets were at first in direct communication with the houses, but when condemned were built attached to the houses with an entrance from outside. (See photo 2.) A sufficient air space was provided between the roof and the walls and the pails removed through a special door, so that the Sanitary man did not enter the closet at all. In the Staff quarters the closets were built of concrete, with a sloping floor so that the pails were tilted to be in contact with the seat supports, and were thus absolutely water-tight and easily flushed out daily. The odour of these latrines was practically reduced to a minimum and could compare favourably with the ordinary water-closet. A box full of finely sifted earth/
earth was used, with a wooden shovel, to cover up the excrement. There was generally one Sanitary man to three houses, and the pails removed and cleaned at least twice daily.

**WASTE WATER DISPOSAL.**

The bath waste pipes ran directly into the gardens round the houses, and this water was soon used up by the plants. Banana trees were found to be the best means of using this excess to some purpose. Kitchen waste water being unsuitable for plant growth was led into cess pits about three feet deep. When these were full they were emptied by the Sanitary men who carried the water outside and spread it over open ground. Owing to the intense heat of the sun it soon dried up, and a few hours later no traces were left.

**REFUSE COLLECTION AND DISPOSAL.**

The refuse was collected by means of boxes or tins placed outside the kitchens of the respective quarters. These tins were emptied into special pits and when half full covered over with sand or earth and fresh pits dug. Rags and waste papers were sprinkled with paraffin and set on fire.

**THE HOSPITAL.**

The site fixed upon for the Hospital was on the West Bank of the River. It lay situated between the Barrage/
Isna Barrage

Plan of Hospital

REFERENCE.

1. 1st Class European Ward.
2. 2nd " " "
3. 3rd " " "
4. Consulting Room and Operating Theatre.
5. Native Wards.
7. Medical Officer's House.
Barrage and Isna town itself. There were two reasons at least in favour of the site being chosen. Firstly, it isolated the Buildings in case of infectious diseases, thus lessening the risk of infection, by being built away from the majority of the dwellings on the East Bank, and secondly, as all materials came on to the works by Railway connection, the continuous noise of traffic, both day and night, would have been a source of disturbance to any serious case under treatment.

The administrative buildings were mostly on the opposite bank of the River, so as to be near the Railway which is on the East Bank. There were several dwellings on the town side, however, the principal one being the Hospital. The surroundings were very bare, chiefly sandy desert and, about nine miles distant on either side of the River, chains of desolate limestone hills.

**MEDICAL ARRANGEMENTS.**

Accommodation was allowed for thirty in-patients as a minimum, though it was capable of expansion to forty if need arose.

For position of various wards see Plan.

**DESCRIPTION.**

The buildings consisted of five blocks built in rubble masonry foundations, the walls being of sun-dried sand bricks. The floors were of cement and raised generally three feet from the ground. The angles of all/
all the wards were rounded, the cement flooring being continued up the walls to a height of six feet to allow of water being used for cleansing purposes. The roofs were composed of beams and boarding, and were covered with a thick layer of mud, while the ceilings were left unpainted. With the exception of the native wards, all the wards were provided with verandahs. The wards were divided as follows:

1st Class European to accommodate members of the Government and Contractors Staffs.

2nd Class European for English artisans, Italians and Greeks.

3rd Class. Natives only.

The Staff Wards held a single bed, having an attendance room with bathroom and separate latrine. The air capacity amounted to 4806 cubic feet. A Berkfeld Filter and a sink were supplied to the attendance room.

The European Wards had four beds in each, and a common attendance room, the cubic space being about 2403 feet.

Native Wards had eight beds to each, attendance and bathroom with a concrete bath, three latrines and a stool disinfecting room where the excreta from Typhoid and Dysenteric patients were sterilized before removal to the sewage trenches. These wards also were fitted throughout with Berkfeld Filters. This cubic space was about 1,602 feet. They were well ventilated by means of the doors and windows, which were kept constantly/
constantly open, the mildness of the climate allowing of this being done. To all the doors and windows wire gauze was fitted, the doors being double ones of wood. These latter had spring hinges thus closing automatically. For eye examinations and laboratory work a special room was built, and also a store room, Storekeepers quarters and a reception room for preliminary examinations.

OPERATING THEATRE.

This was placed in the centre of the blocks. It was well lighted by a roof light. Owing to the heat of the sun, the glass was covered over with white canvas through which a good light passed. For night work a powerful hanging lamp was used. All instruments and fittings were of excellent quality, being mostly brought from England. A Berkel Filter gave a free water supply. Owing to difficulties of working aseptic methods, antiseptics were used generally, though all operating instruments were boiled.

GENERAL EQUIPMENT.

English bedsteads of Hospital pattern were brought out from England and had ordinary and spring mattresses, pillows, bolsters, and sheets. Hospital clothing was issued to all patients, except for Staff and 1st Class European patients. Eating utensils were also supplied to each patient according to class.

NURSING/
NURSING STAFF.

Males only were employed.

The head attendant was an Englishman with Army training, whose duty it was to look after stores as well. Under him there was a native head orderly with five or more attendants under him. Next came the cleaners who looked after the Wards generally, a washerwoman, and a sewage man who looked after the stool disinfection. In 1907 a special "suspect" room was erected away from the other wards and having its own special equipment.

A tent was used for a mortuary, as generally the duration of the keeping of a body was only a few hours.

A laundry was thought of, but it is almost impossible to alter the customs of the native washerwoman, who will always squat at her work, so the idea was abandoned.

The Medical Officers house was fitted with a telephone which was in communication, by means of a private cable laid under the river, with the main office on the East bank of the river, so that urgent messages could always be transmitted should occasion arise.

Kitchen and sleeping quarters for the native orderlies were in a separate block, the kitchen window having a wicket through which the daily rations were distributed for the patients.

"FIRST/
"FIRST AID" ARRANGEMENTS AT THE START OF THE WORKS.

During the commencement of the extensive preliminary works which were being carried on, Bell pattern tents were used for "first aid". These tents were moved when necessary to the places where the most men were employed. They were marked by flying a red cross flag, and were in charge of a trained orderly. As the work advanced further, these were found to be inadequate, so wooden huts were made with the sides and roof erected in separate pieces, these being bolted together.

Dressing Station - Red Cross.
By this means their removal was facilitated to sites where they were found to be in greater demand. These dressing stations were equipped as follows:

1. Folding Stretcher.

2. Box containing:
   
   Small supply of splints.
   Cotton-wool lint and bandages.
   Lotions "Chinosol" as non-poisonous.
   Kidney dressing dish with scissors.
   Safety pins.
   Iodoform powder in a dredger.

3. Zinc bath always kept full of water in the summer months.

4. Blanket to wrap sunstroke patient in.

5. Clinical Thermometer.

6. A supply of ice in the summer months kept in a special Ice-chest. The quantity per day found sufficient was 25 kilos. (about 65 lbs). The ice was wrapped in sacking to keep it from melting too quickly. In spite of well-made Ice-chests there was a great deal of waste through the intense heat.

In a conspicuous position outside the dressing station/
RED-CROSS STATIONS

Emergency stations for the immediate treatment of sudden cases of illness, or injury are provided on the works. These are indicated by red-cross flags and are of two kinds (a) Tents (b) Wooden huts.

All these stations are provided with stretchers, boxes of dressings and splints.

In addition, each hut contains a bath, an ice-chest containing ice, a clinical thermometer and a bed sheet.

Sunstroke. In the event of a sudden case of unconsciousness occurring on the works, medical assistance should be sent for at once.

In the meantime the patients clothing should be loosened, his shirt being unbuttoned at the neck and any belt or other tight article of clothing removed. He should then be taken on a stretcher, or a plank, or whatever is handiest, quickly to the nearest red cross hut, his hat being replaced, so as to protect his head from the sun.

Taking the temperature. There to facilitate the taking of his temperature his jacket and shirt should be taken off, exposing the upper part of his body and his temperature taken by the thermometer which will be found in each red cross hut.

To take the temperature, the mercury in the thermometer must be shaken down below the mark which indicates normal. Before this can be done, in hot weather it may be necessary to cool the thermometer by dipping it in cold water or putting it on ice for a few seconds before shaking it down.

The mercury having been shaken down, the bulb of the thermometer must then be put in the patients armpit and his arm crossed over his chest taking care that the bulb is in the armpit and not protruding behind.

The non-removal of his shirt and jacket may lead to an error in the temperature since the clothing may prevent complete closure of the armpit. For this reason the clothing must always be removed to ensure the correctness of the temperature.

The thermometer should be left in the armpit for a full minute and the temperature then read.

Temperature below 104°. Should the patients temperature be below 104° nothing should be done until the arrival of medical aid. In such a case, however, the temperature should be taken every few minutes, to make certain that it does not rise above this, always remembering to shake down the mercury first before inserting the thermometer.

Temperature above 104° or rapidly rising. If the temperature should be above 104° or if it be found, on taking the temperature at intervals, that it is rising rapidly, the patient should be immediately stripped, wrapped in a sheet and put in the bath, the water of which is to be cooled by adding ice from the ice chest. Here he should remain until the arrival of a medical officer.

Accidents. On the occurrence of any accident a stretcher and dressings should be procured from the nearest emergency station.
WOUNDS. No attempt should be made to clean any wounds. These should be merely covered with a dressing and bandaged.

Excessive bleeding. In the event of there being excessive bleeding a handkerchief should be applied, in the case of a limb, at a point above, i.e. nearer the body, than the wound and twisted up tightly with a stick. The middle of the thigh in the case of a leg wound and the arm between the shoulders and the elbow, in an arm wound, are the best places to apply the handkerchief, provided the wound is not nearer the body than these points. In cases where from the situation of the wound a handkerchief cannot be applied pressure over the wound itself by a rolled bandage used as a pad should be tried.

Fracture. In the case of an injury to a limb where there is any reason to suspect fracture a splint should be applied to the limb to prevent movement. It is not necessary that the splint should be actually bandaged to the limb. Three or four short lengths of bandage tied round the splint and limb at intervals is all that is required.

Great care should always be taken in lifting a patient on to the stretcher. As soon as first aid has been applied, the patient should be at once removed to the hospital.

Drinking water. During the summer months a supply of boiled filtered drinking water will be kept in the red cross huts. No cups of other drinking utensils will be kept here but water bottles or «Gulas» sent to the huts will be filled by the attendant in charge.
station printed instructions were pasted on Notice boards (See Form) for First Aid in sunstroke and accident cases for the guidance of any of the Foremen or others who happened to be in the vicinity at the time.

For treating minor ailments, slight wounds, in addition to these dressing stations a well equipped surgery was available on either bank within easy reach of the workmen. Here there was always a trained orderly in attendance, and at certain fixed hours the Surgery was visited by the Medical Officer.

PROPHYLAXIS FOR SUNSTROKE CASES.

1. By regulating the working hours and so making things easier from a health point, for everybody during the summer months, more time was allowed off at mid-day, and an earlier start made in the morning, the hours being 5.30 to 8.0, 8.30 to 12.0, and 2.30 to 6.30, giving a ten hours' day.

2. To all the European Staff of English and Italian Foremen, etc., special sun helmets were distributed, these being imported from Calcutta were especially adapted to protect the lower part of the neck, as while at work much stooping had to be done.

3. For the protection of the stone-cutters, etc., whose work was of a stationary nature and being in the sun all day, shields or easels made of wood and canvas were provided/
and moved as required from place to place.

4. The emergency baths and ice supply guaranteed the best possible chance of recovery if a case occurred on the Works.

EPIDEMICS AND PRECAUTIONS AGAINST.

The two chief fears which faced the camp were outbreaks of plague and cholera, the annual pilgrimage to and from Mecca giving us anxiety as odd cases might escape from the borders of the Red Sea and get into our vicinity. While the author was at Isna, there were two outbreaks of Plague, one in the Spring of 1907 and one in 1908. In the town of Isna over 70 deaths occurred from March to June in 1908, while in the Camp itself one definite case of Bubonic Plague occurred in 1908. In 1907 just outside the boundary wall in a native/
native shop, a case of Pneumonic occurred. Both of these cases were fatal. As there were generally from 7,000 to 8,000 natives employed on the Work, especial care and supervision had to be enforced. During these epidemic periods there was a very thorough system of Camp inspection. The Camp was divided up into sections and over each section there was a native Inspector usually better educated than the "Ghaffir" class. His duties were to go round all buildings, servants' quarters etc., and look for any sick. He reported straightway to the Medical Officer. A heavy fine was imposed if he failed to report. This method was found to be most efficacious, as the native especially at these times hesitated through fear to report sickness at all, while a case might easily have lain for days concealed by friends. If this Red Cross Inspector found a sick case and it was proved to be Plague, he was stimulated by a monetary reward. On a case of Plague occurring, the contacts were isolated and the patient removed to the town cordon camp at once. To prevent confusion with the town Plague work, an arrangement was come to with the Public Health Department by which we examined all our own contacts, ten day's quarantine being the rule. They were isolated and cordoned by our own Camp Police.

Had an Epidemic of Cholera or Smallpox broken out, there was in store a complete equipment of tents, etc., which could be run out at once into the desert by a light/
light railway, or an alternative plan was to run up huts of dhurra or maize stalks, somewhat similar to those shown in photo of Plague huts.

Plague Huts, Isna.

While the Plague epidemic was at its height, there was found to be some considerable risk of a concealed case occurring on one or other of the stone barges or boats which brought material from the quarries to the Barrage, so a system of thorough boat inspection was instituted as well. Excavation was also being carried on by new squads who came from distant villages. These men lived in tents pitched near their work, and these tents were also narrowly inspected daily, as the native tent-dweller is none too cleanly in his habits.

MISCELLANEOUS.

Food supply. Arrangements were made with a Cairo firm/
firm to open a branch establishment especially for the Works, having butchers, bakers and grocery departments. These were all inspected by the Medical Officer. The Slaughter-house for the killing of animals was placed in the open, well outside the boundary walls, and so placed that the prevailing winds did not carry any odours towards the Camp. All skins, blood, manure and garbage had to be removed within a reasonable time. The animals requiring fattening were kept and fed in a special lair and pound. The abattoir was under the control of the Sanitary Inspector, and the meat inspected by the Medical Officer.

In the town of Isna fruits and fresh vegetables were always obtainable.

Recreations for the Staff for general health maintenance.

A large open space was cleared, levelled and used as a Football ground.

A concrete Tennis Court was laid down and all accessories supplied by the Company. Cricket was also played, cocoa-nut matting being laid down on rolled mud, the outfield being a level patch of sandy waste.

MEDICAL AND GENERAL WORKING EXPENSES.

These must be taken as only applicable to Egypt.

From May 1907 to May 1909.

Medical Expenses.

<table>
<thead>
<tr>
<th>Hospital Buildings</th>
<th>£ 1,300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out-patient Buildings</td>
<td>250</td>
</tr>
<tr>
<td>Equipment/</td>
<td></td>
</tr>
</tbody>
</table>

Equipment and Furnishing  . . .  £ 600
Wages  . . . . . . .  400
Provisions  . . . . . . .  290
Surgical dressings and Medicines  .  334
Ice included Sunstroke Stations  .  54
Fire and Lighting  . . . . .  50

Scale of Wages.

English Orderly,  @  £12 per mensem.
Head Native Attendant,  @  2/- " day.
Orderly Native,  @  1/4 " "
Out-patient Orderly,  @  1/9 " "

Sanitation.

Wages includes European Inspector  . .  £ 800
Boiling and Filtering Water  . .  270
Quicklime and Disinfecting Powders  . .  100
Repairs to Dressing Stations, Latrines, etc.  90

Scale of Wages.

European Inspector,  @  £10 per mensem.
Head of Gangs, (Native)  @  2/- " day.
Ordinary Sanitary man,  @  1/- " "

CONCLUSIONS./
CONCLUSIONS.

The Sanitary conservancy methods in this thesis are very open to criticism, yet they worked without a hitch in the rainless climate of Upper Egypt.

The working expenses detailed seem very formidable, yet in comparison to the capital cost of the Barrage were not excessive. Any more elaborate drainage scheme would have been extravagant, as the Barrage was completed a year earlier than the contract time, and now almost every trace of our alien occupation is obliterated.

The smooth running of the arrangements in the Camp was greatly due to the far-seeing policy and co-operation of the Company's Agent who saw that though the initial expenditure seemed great, the end justified the expenditure. With the experience gained in many ways it would be possible to economise considerably in any future work of the kind.

Even in a year's time it was noticeable that the primitive Eastern mind of the native became educated to our Western ideas of cleanliness. It was remarkable to note when fresh gangs of Fellaeen were brought to work the great difference in how they fell into our ways through the influence of their "Sheikh" or head man, who had then become more or less a resident.

In/
In a paper entitled "The Relative Efficiency of the Doulton, Berkefeld and Brownlow Filters", which has been published since this essay was commenced, the Berkefeld Filter has been condemned as the least reliable of the three mentioned. We were thus justified in not entirely trusting to filtration of drinking water only, in the bad seasons. In flood time there is much less risk owing to the greater volume and rate of flow of the Nile.
REFERENCES.


4. Wellcome Laboratories Reports, Khartoum, 1908, Sanitary Notes, p. 72.


APPENDIX.

Short Notes on Delta Barrage, Cairo, 1910.

Sanitary Arrangements. There were between 3000 and 4000 natives living mostly on the Works, a few having tents, the majority building zareebas or rough shelters of palms and branches. Owing to the short time the men were employed it was not feasible to build barracks for their accommodation, but stringent inspection of their camps was enforced to see that they were cleanly kept.

Sewage Disposal. Methods were similar to those on the Isna Barrage; in addition tramway lines which were in existence before these works were commenced, were utilized to convey the excrement pails to the pits, "bogie" trucks were made, each holding from 16 - 20 pails. Two men ran the truck, emptied and cleaned the pails and brought them to the "carriers" who distributed them. The sanitary gang consisted of about 18 men. Firing the men for laziness was found to be a fairly effective method of keeping them up to the mark.

English and Staff Quarters. These were acquired temporarily from the Government, and were situated in a well sheltered part with plenty of trees in the vicinity. The indoor kitchen and servants' (native) rooms were abolished, new brick kitchens with concrete floors being built away from the main buildings in open/
open ground behind; latrines were also internal so brick and concrete ones replaced these outside. They were provided with English pattern seats, with the roofs open at the sides. As the climate is colder than that of Upper Egypt, stoves had to be fitted to the living rooms. Water was laid on from a main in the near neighbourhood to supply filters and baths. The house roofs were flat, had rain gutters, and were coated over with thick asphalt to render them waterproof.

Boiling Water Supply. The water supply was found to be malodorous when the Nile was very low, even after filtration, so a limited quantity of 40 gallons a day was boiled. Two sets of three candle Berkfields were used, which supplied moderately quickly sufficient water to fill calcium carbide tins which were filled with tip cocks, hinged lids and padlocks.

Boiling Filtered Water.
The water was boiled by a series of petroleum stoves, then passed into storage tins, and the water cooled rapidly by constant soakage and evaporation.

Storage Filtered Water.

Practically speaking $\frac{3}{2}$ hours was required to render the water potable.

**Epidemics.** Relapsing fever broke out in the camp in May 1910. Owing to our vicinity to Cairo, the Public Health Department were able to supply the camp with Hospital Tents and equipment for twenty cases for the works alone. The camp was declared free in the middle of June and ten cases were treated, with two deaths. Relapsing fever is endemic in the Delta.

**Medical Arrangements.** Owing to the short time (six months) the reconstruction works were in operation, no Hospital could be erected. Arrangements were made with a private native Hospital some seven miles distant to/
to receive severe accidents and bad medical cases. The Hospital was within a few hundred yards of the railway line to the Barrage, and accident cases were run on a trolley from the tramway lines of the works to the railway stations, and transported on stretchers either in an empty horse box if available, or failing this in the luggage van.

Climatic Conditions, etc. These were totally dissimilar to those in Upper Egypt. The air is much more humid and vegetable growth abundant. The nights are distinctly cool; the troublesome dust storms experienced at Isna and Assuan are infrequent. Dysentery and other zymotic diseases are not so prevalent. Through the courtesy of the Egyptian Public Health Department, daily and weekly bulletins of the state of health in this vicinity were furnished to the Medical Officer, thus enabling one to be early on the look-out, should typhus or plague make its appearance.

Hindia Barrage, Mesopotamia, Asiatic Turkey, 1911-14.

This Barrage was constructed across the river Euphrates to irrigate the land in the vicinity of Babylon and the town of Hilla which lies about an hour distant from Babylon. Arab labour was wholly employed with English supervision. As this was the first work of this kind carried out since the days when Babylon was a great city, all the men had to be even taught how to work.

Sanitary/
Sanitary Arrangements. It was impossible to get any efficient policing of the works, as there were only a handful of Arab gendarmerie under the Turkish Government who were totally out of sympathy with Western methods. There was tremendous difficulty at first in getting men to take up sanitary work at all, and only by offering very high rates was a Sanitary gang got to work. The movable latrine system was not to be thought of so trenches two metres long by one metre wide were dug at various points on the works, fitted over with slit covers allowing the men to use the squatting posture. These covers were hinged and could be lifted clear to allow of lime being thrown on the daily detritus. The Arabs had another habit unusual in Egypt of always using water to wash after micturition and defaecation, and carried a special pot with a long spout for this purpose. This water was a factor to be dealt with, as the soil was of very clayey consistence and not porous.

Latrines of Reed Mats.
Prevention of Accidents. During the building of the isolated "piers" of the Barrage there was a great risk of accidents from falling on to the solid concrete foundation "floor" of the Barrage - it was recommended to protect as far as possible all the gangways and scaffolding by high handrails to which were nailed the staves from cement barrels in which the cement was imported to Turkey from England. Hundreds of very small boys and girls were employed to carry mortar to the masons, and it was to guard against these being injured that this was done.

Protection Works.

Boiled water and soda water supply. The method of storage and cooling employed was similar to that used in Egypt, with the exception that each water tin was personally sealed and inspected before distribution.
as the natives were fond of emptying the boiled water and replacing same with muddy water taken directly from the river! The apparatus used for boiling the water was a large tank with a central flue in which wood fuel was used for heating, there being no difficulty in procuring any quantity of this, which grows plentifully on the banks of the Euphrates; the principle of the tank being that of the Russian "Samovar".

"Samovar" for boiling water.

The soda machine was of the type greatly in use in India, compressed gas being procured in cylinders from/
from Karachi or Bombay, the great drawback being the enormous difficulty of transport across the desert and the time taken in reaching Bagdad via the Tigris.

Soda Machine.