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HYGIENE ASPECTS OF THE EL ALAMEIN VICTORY, 1942

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The hygiene story of the El Alamein victory has its logical beginning in the misfortunes experienced during the retreat of the Eighth Army from Gazala in June, 1942. Though this retreat was, in an operational sense, always under control, it created an unhappy series of circumstances for the Army hygiene authorities. First, the inevitable confusion among formations and units moving back to the El Alamein line led to decrease of supervision by hygiene officers and sections, and an understandable slackening of unit and personal standards of hygiene and sanitation. Units became dispersed; there was no time to establish control of camping sites; equipment was lost, sanitary discipline relaxed, and much ground became badly fouled. Secondly, apart from the disturbance the retreat caused in the hygiene organization, it created a new problem by sweeping back hordes of natives, Bedouins, and others, to settle in an uncontrolled mass in the rear of the El Alamein line. These natives, normally lacking any high sanitary instincts, became a serious menace to the Army, and drastic action had eventually to be taken to have them removed to harmless areas further back still. Thirdly, contributing to the problem on the eve of and during the El Alamein battle was the inclusion in the Eighth Army of formations fresh from over-seas and lacking that full respect for the question of insanitation and tropical ill-health which is gained only by experience in warm climates. These formations were also "unsalted," and hence suffered more from such complaints as "gyppy tummy" and sandfly fever than the older hands. Fourthly, the retreat, the period of preparation, and the actual battle covered the late summer and autumn seasons, when many Egyptian health hazards are at their worst. Flies became a serious plague, necessitating special control measures. Sandflies took their toll in several base camps. The heat and dust were an added irritation, especially to new-comers.

This vast problem of hygiene was methodically tackled from the halt at El Alamein until the advance at the end of Oct., 1942. The hygiene organization was entirely reviewed and several major changes were made; the fly nuisance with its danger of spreading excremental disease was met by a special unit, the special new problems of Armoured Fighting Vehicles were gone into, and the very important problem of Army feeding was examined afresh and new ration scales and methods of cooking devised. Preparations were made for dealing with prisoners of war, who almost certainly would be lousy, and for cleaning up captured enemy areas and towns.

Once active operations had started there was little of interest concerning hygiene until the enemy broke early in November. Then the anticipated problems arose in captured territory—cleaning up fouled areas, purifying water supplies, delousing prisoners of war, and pushing forward apparatus to ensure the cleanliness of our troops. The last-named was necessary, because typhus fever had to be borne in mind as a hazard if our troops became lousy. Hygiene officers were included in each of the new area administrations, and without delay they organized the necessary measures.

The various aspects of the work undertaken during the preliminary and operational phases of the El Alamein battle will now be discussed in detail.

Hygiene Organization

Previous experience in the Western Desert had shown that the old hygiene organization was too rigid. Field hygiene sections were on a strict divisional and lines-of-communication basis. With the mobility of desert warfare such sections could not cope with the dispersion and changing constitution of formations, and smaller groups often had no field hygiene section assistance. Then the old defects in the method of recruiting and using unit water and sanitary duty personnel were again exposed. To overcome these defects and to meet the mobility and the kaleidoscopic conditions of desert warfare such as the Eighth Army anticipated in its projected advance, certain improvised reorganization of hygiene sections and personnel was undertaken. The principle governing this reorganization was that field hygiene sections would not rigidly adhere to their divisions, but would be held in corps and Army pools, for employment according to the needs of the situation. Its application to the Eighth Army for the battle period was made on the plan that the corps which carried out the initial assault would not follow up in the event of success but would make way for a second pursuing corps. Corps groups of three field hygiene sections each were accordingly formed. In the case of the pursuit corps, the officers commanding and detachments of the sections were allotted to brigades.

The scheme produced some excellent results; sanitary assistants were where they were required, and the workshops produced a steady flow of apparatus to supply troops moving forward into new areas. It was possible to send forward hygiene teams with stores and apparatus to captured areas, such as Mersa Matruh and Capuzzo, long before any permanent unit was available. One difficulty that arose was that the rapid changes in the composition of formations resulted in some sanitary assistants becoming completely divorced from their parent units. Unit personnel were improved by insistence on more care being given to their selection, and putting a responsibility on Os.C. and R.M.Os. to prevent sanitary and water-duty personnel being recruited from the useless misfits of the unit.

With the advance it was necessary to make arrangements for the sanitation of all captured areas used as lines of communication or bases. One field hygiene section carried out excellent work in depositing hygiene stores in such areas. With the establishment of sub-areas, three field hygiene sections were detailed to supervise their hygiene and sanitary restoration: two sections were allotted to Tobruk and Derna, and one field hygiene section to Benghazi.

Each new sub-area organization was provided also with a D.A.D.H., while a close liaison was built up with the Occupied Enemy Territory Administration medical organization responsible for the civilian medical services in Cyrenaica.

The bad sanitary conditions at El Alamein referred to above produced an appalling plague of flies. The emergency was quite beyond the power of the ordinary hygiene organization, so a special Fly Control Unit was created. This unit consisted of five officers and some 200 or 300 British other ranks and African pioneers, with several British N.C.O.s to act as supervisors. It was given a rapid course in fly-control methods and then sent to clean the El Alamein area of fly-breeding sources. Its work was thorough and efficacious, extending even to "no man's land," where corpses and other organic matter made one of the worst fly-breeding sources. In co-operation with field hygiene sections and unit personnel, it moved from area to area, clearing unit lines of refuse, debris, and bodies. As a measure to meet an unusual and serious emergency this temporary unit more than justified its creation.

Sanitation

The serious sanitary situation from July to September has been referred to above. Its particular causes lay in the general fouling of the whole El Alamein line and the areas in its rear. Vigorous action by field hygiene sections, unit personnel, and the special Fly Control Unit cleared up the region considerably, and fortunately prevented any serious outbreak of disease.

This experience demonstrated that the burial of refuse from unit lines was usually inefficiently done and contributed to the breeding of flies. Eventually incineration was accepted as the simplest and most practical method of rendering refuse innocuous. The simple oil-drum incinerator, easily improvised in the field, was most generally used. The food tin—the dominant feature of desert rations—became a menace. It was rarely emptied completely, and thus, besides increasing waste when discarded, became an annoying and difficult refuse problem. Emphatic instructions and persistent education to improve unit methods were adopted, and units gradually became more careful in clearing tins completely, burning them out, and disposing of them systematically. As will be discussed below, the return to company cooking assisted in the improvement of these conditions.

Latrines were not as troublesome a problem as might be thought. In many places the more stable camp communities were able to use deep pit latrines, though generally the rocky nature of the subsoil made deep excavations impossible. Here the petrol-tin latrine was efficacious. Daily burning reduced the dejecta to an innocuous dried mass. A simple squatting type of two-seat latrine superstructure was produced to provide the troops with at least some means of constructing field latrines. Though easily portable, being only just over 60 lb. in weight, it was a failure. With the limited transport available in the desert, units would not carry even the simplest latrine structure. Units met their latrine needs by improvisation of single seats from the ubiquitous petrol box and tin.

Waste water from field units in desert areas did not cause difficulty, partly because the water ration was so low that no large accumulations could occur, and also because the absorptive and evaporative capacity of the desert is so large.

Reference was made above to the cleaning up of captured areas. This was an immense task, as the enemy had left his fortresses, camps, and ports in an indescribably filthy condition. Previous acquaintance with enemy standards of hygiene and sanitation had shown how low they were. However, it was the advance from El Alamein which brought to light the full weakness of German and Italian hygiene organization. The enemy lines and camps at El Alamein and the bases at Matruh, Tobruk, Derna, and Benghazi were revolting in the masses of human faeces and camp debris lying everywhere. One of our hygiene officers charged with the distasteful task of supervising the clearance of the previously enemy-occupied El Alamein area reported:

"That portion of the battlefield previously occupied by the enemy is just one huge fly farm, and has to be seen to be believed. Whilst both Germans and Italians order the use of shallow trench latrines (and no oil seal), this order is scarcely ever carried out. Enemy defensive localities are obvious from the amount of faeces lying on the surface of the ground."

The enemy paid for his contempt of hygiene, as these insanitary conditions had the inevitable result of causing a heavy incidence of excremental disease. This became such a menace to the enemy as to affect from 40 to 50% of his front-line troops, as interrogation of captured medical officers revealed. To quote one of our hygiene reports:

"It has, however, been heartening to observe the difference between the enemy sanitation and dysentery/diarrhoea rate and our own. The enemy appears to have no conception of the most elementary measures, and has a dysentery/diarrhoea rate so very much higher than ours that it is believed that the poor physical condition of his troops played a great part in the recent victory at El Alamein."

Rations and Feeding Problems

Previous desert operations had caused some medical anxiety over the retention of troops for long periods on a battle ration designed for one week only. This unnecessarily prolonged use of battle rations was on occasion unavoidable when troops became isolated or when lines of communication were seriously interfered with. However, it is to be regretted that in the early campaigns the danger of a low-calorie and dry ration was not always fully appreciated by some local formation supply authorities.

An attempt was made, for the El Alamein plan, to evolve a battle ration—i.e., a minimum ration of low weight and readily prepared items—which need not be limited to seven or ten days only. This ration, with 3,600 calories, adequate vitamin A, B series, and C values, composed of items available in the Middle East and not too difficult to prepare in the absence of water and cooking facilities, was rejected as being beyond the weight limits permissible by available transport. Eventually a new battle ration of approximately 3,100 calories per man per day was evolved, with the strict condition of use for not more than an absolute maximum period of ten days. It was a great advance on the old battle ration in providing variety, including such items as sausages, cheese, jam, onions, and tinned fish. Medical concern that the period of ten days should not be exceeded was fully appreciated by the "Q" authorities. The result was that throughout the October and November operations the battle ration was limited to essential occasions—in fact, only a few troops were forced to use it, and then merely for a few days at a time—a testimony to the very efficient supply arrangements of the Eighth Army.

For the rest—i.e., for most of the advance—the Eighth Army existed on the Middle East field service ration (hard) scale. This, in terms of the General Order, is the normal scale of rations, but with tinned or "hard" items substituted for fresh equivalents—e.g., tinned vegetables instead of fresh vegetables, biscuits instead of flour, etc. To prepare meals from hard-scale rations requires only the provision of boiling water. This scale was constructed under the general limiting factors operative in the Middle East—i.e., the availability of local supplies, the need to use imported and tinned items sparingly, and the limited amount of water provided for cooking in the desert. However, a satisfactory scale was produced with an average calorie value of 3,800 and the following average vitamin values: A, 2,500–3,000 i.u.; B_1, 350–450 i.u.; B_2, 1.3 mg.; nicotinic acid, 22–25 mg.; C, 15 mg. Yeast tablets and ascorbic acid tablets were of course available for issue on medical recommendation.

In spite of the exceedingly difficult problems of supply arising out of the rapid advance, it was not even necessary to maintain the Army on the hard scale for long periods. In a very short time after occupation, for example, field bakeries were operating in Tobruk and Benghazi and sending forward fresh bread, while consignments of frozen meat were also shipped to these ports. Fresh vegetables and oranges were supplied as opportunity allowed; but obviously, being more perishable, these could not reach as far forward as bread and meat supplies.

The construction and supply of a ration scale is only part of the procedure of feeding an army. As the Middle East campaigns have shown, however satisfactorily a well-balanced and adequate ration emerges from Details Issue Depots, much can happen to destroy its value before consumption by the troops. Apart from the time taken to train cooks in a large

civilian army, the dispersal of units resulted in the disappearance of organized company cooking in the field. There grew up the practice of each small group, usually each vehicle crew, fending for its meals. Such vehicle or section cooking is very unsatisfactory. Well-cooked complete meals, at regular intervals, are replaced by casual feeding out of a tin. This results in waste of rations, and the debris from cooking and feeding is scattered far and wide over camping areas. A corollary to this problem arose in the case of A.F.V.s. Fighting all day, leaguered in strict black-out conditions at night too tired to look after themselves, the crews of tanks and armoured cars were too often unable to get more than an occasional bite of a biscuit. To counter these unsatisfactory methods, company cooking was reintroduced, and, except in actual highly mobile phases, most units used it during operations. For armoured units, a mobile cooking lorry was evolved by fitting a No. 2 petrol cooker and food-containers to a three-ton lorry. This simple improvised vehicle carried hot meals forward to the fighting crews and, in general, proved most valuable during the El Alamein operations.

A further special ration problem which received some attention prior to the operations was the provision of a pack ration for A.F.V.s. Tanks and armoured cars have to face occasional periods of isolation. They must be self-contained to meet such emergencies, and the provision of food, including liquids, led to the trial of the packs produced in the United Kingdom of two-men and three-men one-day rations and, on a smaller scale, of an American pack ration. In addition, most A.F.V.s were supplied with special half-gallon vacuum-flasks for hot drinks. This was a valuable measure. However, experience under desert conditions suggests that pack rations have a limited value for A.F.V.s.

Generally, the operations showed that continuous training and propaganda are necessary to ensure that all units are provided with good cooks, proper company cooking arrangements, and a fully developed sense of cookhouse hygiene and sanitation. The work being done by the Catering Advisers to the Army is going a long way to achieving the necessary improvements in the shortest possible time.

Water Supplies

In the initial stages of the operations the water supply was almost entirely from points on pipe-lines originating in Alexandria. This reticular system, branching out into the desert, equipped with booster pumping stations, and carrying purified water to distances of 50 miles and to within a few miles of the front line, was a triumph of the Army water engineers. It carried chlorinated water to forward units, and at least one gallon a day per man was provided in the preparatory phase during September and October.

The advance required early inspection, and usually repair and clearance, of captured water points. Hygiene personnel assisted the engineers in this duty. The majority of wells and birs had been both damaged and polluted by the enemy. The methods of pollution used were those seen in previous desert campaigns—namely, introduction of diesel oil, bone-oil, dead bodies, and filth of any kind. The destruction and pollution rarely held up our units long. Pumps were repaired or replaced and wells were vigorously pumped clear, with the addition, where necessary, of water-sterilizing powder to neutralize contamination. Hygiene personnel undertook the necessary water analysis and supervised water purification, using the standard methods of superchlorination with bleaching powder and "de-tasting" with sodium thiosulphate.

The advance carried troops considerable distances ahead of water points, and transport of water became difficult. This led to the daily ration being reduced to half a gallon for certain periods. For this purpose a variety of containers were used, the commonest being a two-gallon tin, tens of thousands of which were filled and transported by the supply organization. The most popular vessel was the captured two-gallon container —the "jerrican"—a stout metal receptacle with a good screw cap. The majority of units soon equipped themselves with these. The geology of the desert right up to Agheila, in the Gulf of Sirte, was known, so that the problems associated with saline wells were not new. Certain of these wells had to be used; in some a salinity of over 300 parts per 100,000 was tolerated by the troops without serious results. The efficiency of the water supply was shown by the absence of any water-borne disease during the months of the attack and the advance.

Disease Incidence

The index of the health of the Eighth Army for the period is given by the admissions to C.C.S.s and Field Ambulances (Table I):

TABLE I.—*Admissions to C.C.S.s and Field Ambulances*

1942	Sick	Battle Casualties	Daily Rate of Admission per 1,000 Strength
Sept. ..	10,417	1,470	1·96
Oct. ..	11,144	7,634	1·67
Nov. ..	8,698	3,602	1·59

This table shows the excellent health of the Eighth Army in the prelude and in the actual battle. A daily admission rate below 2 per 1,000 was not only satisfactory, it was remarkable. A further feature to note is that, even in the acute battle period, admissions due to battle casualties still remained considerably less numerous than those due to disease.

The commoner causes of admissions are given in Table II:

TABLE II.—*Admissions to Field Medical Units*

Disease	Sept.	Oct.	Nov.
Dysentery/diarrhoea	1,793	1,391	1,293
Pyrexia not yet diagnosed	1,073	847	591
Digestive	933	816	517
Inflammation of areolar and skin tissue ..	927	944	622
Accidental injuries	858	825	736
Infective hepatitis	449	1,438	1,861

This table shows clearly that, in spite of modern Army hygiene progress, much preventable sickness still occurs. Dysentery/diarrhoea, inflammation of the areolar tissue, and accidental injuries, among the commonest causes of disease in the desert campaign, are still too prevalent in our armies.

Certain conditions deserve a few paragraphs of mention:

Typhus Fever.—Typhus does not appear in the above list of diseases; nevertheless much thought and work were given to this disease. It is endemic in many parts of the Middle East, and all the circumstances seemed set for it to become epidemic —e.g., social disorganization, spread of lousiness in civilian and, to a lesser extent, in some Army populations, etc. Adequate precautions to meet lousiness during the campaign—possible in our own troops, certain in the enemy—had therefore to be taken. Mobile disinfesting and cleansing teams were trained and pools of disinfesting apparatus and stores were created. Vaccination could not be made general owing to the then shortage of supplies.

As the Army advanced it was strongly recommended that mobile bath units and, if possible, laundries should follow. Troops were thus able to bathe occasionally, and keep their clothing clean. The organization to deal with prisoners of war had heavy work in delousing them, as infestation was high. The various measures to keep troops and prisoners of war clean and louse-free were successful, and hence typhus did not menace either our forces or our labour personnel.

Infective Hepatitis.—This disease still baffles investigation, and the lack of knowledge of its source and mode of spread meant that no specific preventive measures were available. Its seasonal incidence (late autumn) affected the Eighth Army during the battle phase, large numbers of cases being admitted in October and November. It was most prevalent first in a New Zealand division, but subsequently caused as many cases in Australian and U.K. divisions. From Table II it is apparent how serious a cause of disability it was in the later stages of the battle. This disease is an annoying element in wartime, not because of its seriousness to the individual, but because it immobilizes large numbers in hospital for not inconsiderable periods of treatment. Every effort, both clinically and epidemiologically, was made to determine its cause and mode of spread, unfortunately without success.

Desert Sores.—This condition, or group of conditions, was troublesome. Its incidence, too, was highest in the desert in

autumn. The aetiology and epidemiology, as with infective hepatitis, are not definitely known. Controversy thus had free scope, and included the argument that a vitamin deficiency, especially of vitamin C, is the cause. There seems to be no justification for this extreme view, which unfortunately received much publicity. This did a certain amount of harm in producing an unjustified distrust, and even an anxiety, about the adequacy of the various Army ration scales. These scales, as discussed above, were prepared with full appreciation of the vitamin needs of the soldier. The generally accepted Middle East opinion of this condition may be stated as follows:

(*a*) It is a vague condition covering a whole variety of ulcerative skin lesions. (*b*) A minor injury is an antecedent in the majority of cases. Scratches, bruises, insect bites, etc., are the commonest injuries, and their location on exposed parts, such as forearms, hands, and knees, is thus directly parallel with the commonest sites of desert sores. (*c*) On occasion troops on full fresh rations have shown a high incidence, while, conversely, troops on the so-called "hard" scale have frequently been free of the affliction. There has not been any correlation, therefore, between adequacy of rations and incidence of the disease. Further, in cases of desert sore no true evidence of avitaminosis (scurvy, etc.) has been reported.

Accepting the correlation of sun, dust, dirt, flies, and minor injuries with the incidence and site distribution of so-called desert sores, protective action on general lines was planned. An attempt was made to get all troops into slacks and long-sleeved upper garments to cover the most susceptible exposed areas. Every effort was made, too, towards improving the washing facilities by pushing forward bath and laundry units, by making available simple showers, and by supplying sea-soap. Warnings and instructions to personnel and to regimental officers of the necessity for early treatment of minor cuts, bites, and bruises were issued, and the necessity for seeking medical treatment of sores was emphasized. An experiment in the use of an emollient cream on exposed parts to reduce injuries and to soften and protect the skin could not be completed owing to the operations. All in all, desert sores seemed to be relatively less in incidence, and were certainly less severe, in 1942 than in 1941.

Dysentery/Diarrhoea.—During the early preparatory stage, and even right into the start of the battle, these diseases caused much anxiety. As indicated above, it was a combination of seasonal changes as well as control measures which reduced the fly population, and hence the incidence of dysentery and diarrhoea. To repeat, these diseases were the result of the insanitary conditions arising out of the general fouling of the battle area of El Alamein due to the retreat and the bad disposal of waste, especially food. Though to us the excremental diseases were a bad enough problem, they became a crippling menace to the Germans and Italians owing to the absence of any hygiene control by them. Our troops, too, had the benefit of the efficient protection afforded by our T.A.B. vaccine.

Heat and Sun Effects.—The desert on the whole has not been intolerable on account of heat and glare. Wherever possible, troops from temperate zones have served a preliminary period of 3 to 6 weeks in relative quietness in the Canal Zone before proceeding to the Western Desert. This has proved an important process of acclimatization not only against heat and sun, but also against many of the dietetic and other irritations of an Oriental location. Unfortunately, certain reinforcements for the Eighth Army at the critical stage at El Alamein had to be pushed forward sooner than usual, and these at first felt the desert conditions to a certain extent. No cases of heat- or sun-stroke, or other effects due directly to exposure to heat or sun, have been reported. In fact, accepting modern views of the mode of action of temperature, light, and humidity on the human organism, it was decided that the bulkiness, fragility, short life, and distaste by the troops of the huge sun topee did not justify its retention for Middle East troops. Its abandonment has had no evil results. Even in tanks and armoured cars the desert heat led to no disastrous incapacitation. The high evaporative power of the desert air saved the heat-regulating mechanism of the body from any undue strain, so that as long as the tank engine, and hence the engine-ventilating system, was pumping air through the vehicles conditions were not dangerous. In the desert, therefore, there was no call for special air-conditioning devices for A.F.V.s. The indirect effects of sun, dust, and irritation on the skin have been referred to in the discussion on desert sores.

Glare requires a short comment. The new-comer to the Middle East, alarmed by tales of the dangers of the desert sun, is usually conspicuous by the blackish sun-glasses he affects, but the older "hand" generally discards them. This indicates the Middle East policy on sun-glasses, which is that for the vast majority of individuals they are quite unnecessary under all normal conditions. In fact, such devices, by reducing the tolerance of the eye to light and by not affording it opportunities for adaptation—which quality it possesses in high degree—may actually be harmful. A wearer of dark or tinted glasses in the relatively non-glaring atmosphere of, say, Cairo, if suddenly transported to the white-sand areas of the Western Desert, will suffer intensely and be crippled in vision because his eyes have never been exercised in toleration to light. Sun-glasses have accordingly, in spite of certain demands, not been made a general issue in the Middle East, though in conditions in which glasses are both protective against dust and glare special issues have been made to limited groups of drivers, A.A. gunners, etc. No untoward damage has been reported by ophthalmologists as a result of this policy.

Accidental Injuries.—Accidents are as alarming a feature of modern society at war as they are during peace. This largely unnecessary drain of man-power and strain on medical facilities has occupied the attention of several branches of Army administration in the Middle East. Analysis of motor accidents, exhortations for care in handling petrol, instructions in precautions in handling explosives and mines, seem to have had only a gradual influence on the frequency and degree of accidents. Burns were the form of accident which came into prominence during the El Alamein phase. It was noteworthy that over the whole period accidental burns usually outnumbered those due to enemy action—e.g., setting tanks, etc., on fire. Petrol, of course, was the origin of most of the accidental burns seen in the Eighth Army. It is surprising how long it takes the average soldier to gain that essential healthy respect necessary in handling that extremely volatile and inflammable fluid. Lacking fuel in the form of coal or wood, fire in the desert was made with petrol for all purposes—cooking, boiling water, sterilizing apparatus, etc. There was evolved the so-called "desert stove"—a petrol tin, suitably ventilated, containing a small quantity of sand on which petrol was poured. Too often the inexperienced replenished this type of fire by flinging quantities of petrol on to the hot sand, with the inevitable explosion and burns. Many serious burns followed the use of petrol as an insecticide in dug-outs and other ill-ventilated premises. The lighting of a cigarette in such a heavily charged atmosphere, too, produced unfortunate results. A useful and simple safeguard against serious burns came to light in the investigation by No. 1 Medical Research Section of burns in A.F.V.s during the retreat from Gazala—viz., the great protection given by ordinary clothing. Consequently, instructions were issued that tank crews were to wear slacks to cover the knees, and sleeves down to cover the arms. Ordinary accidents should receive more and more attention from military hygiene, as they are a most serious cause of army inefficiency. It is a difficult subject, as their variety and causation are so complex, especially in a hastily trained army handling so many powerful mechanical forces and agents—explosives, volatile fluids, gases, armoured fighting vehicles, and ordinary transport.

Summary and Conclusion

The retreat by the Eighth Army from Gazala in June, the defensive phase on the El Alamein line from July to October, and the eventual attack and victory in October and November, 1942, created the conditions and setting of serious and complex preventive medical and hygiene problems.

Questions of sanitation and the spread of excremental disease, of the prevention of typhus, desert sores, and other diseases, of the provision of adequate properly balanced rations and a pure water supply; and of dealing with the dangers of captured fouled areas—all were studied and, on the whole, successfully solved. In the opposite camp of the enemy, as captured ground and documents showed, hygiene was not energetically studied, and to-day the Italians and the Germans must regretfully realize that their neglect contributed seriously to their inability to resist our attack. A front-line force with 40 to 50% of its strength affected by dysentery and

diarrhoea can scarcely be called a vigorous army, and this was the incidence in Italian and German units.

In contrast, the Eighth Army in October and November was probably as fit mentally and physically as any army has ever been. The contribution of preventive medicine to this standard can be measured from the degree of success achieved in protecting our troops from infectious disease, in maintaining a high level of physical fitness, in ensuring adequate rations and water supply, and in adapting so far as possible the Army's clothes, fighting, and other equipment and camping conditions to accepted physiological standards. The hygiene officers and other ranks of the Eighth Army, by their enthusiastic application of modern public health principles to a heterogeneous force in a difficult environment, did good work. They —hygiene men recruited from the United Kingdom, New Zealand, South Africa, Australia, and India—may not have the glamour, glory, and excitement of their brothers in the clinical units, the field ambulances, and casualty clearing stations, of the medical services, but they have the satisfaction of knowing that the health of the Eighth Army, and hence in large measure its physical and mental capacity for forceful action, shown at El Alamein, owed much to them.

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A STUDY OF A SELECTED GROUP OF WOMEN EMPLOYED ON EXTREMELY FINE WORK

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The ability to perform fine work for long periods without ocular fatigue or symptoms of any kind depends on a variety of factors at present incompletely known and of the relative importance of which we have only an imperfect idea. The obvious factors to be taken into account are the individual's refraction, visual acuity, muscle balance, accommodative power, and psychological adjustment to the work. The present study was undertaken with a view to establishing what degrees of these make for success in close work, and to assess their relative importance. Most previous analyses of the condition of healthy eyes have been made on large groups of hospital or private patients, and are therefore probably not entirely representative, since the patient had himself come for examination and thus could not be regarded as entirely symptom-free. An attempt to correlate the findings in one field (convergence deficiency) between a group of private patients (unselected) and a group of R.A.F. recruits, without symptoms, has already been made,[1 2] with the result that the difficulties of the subject have become more apparent. The outstanding feature which emerged was the high percentage of convergence deficiency, and indeed of all phorias, in the group of 7,019 recruits who made no complaint of symptoms. In the group of 6,400 private patients with which they were compared the number complaining of symptoms associated with convergence deficiency was much higher, though the incidence of such deficiency in the whole group was actually lower (2 to 3%) than in the symptom-free recruits. It therefore seemed to us that the answer might partly lie in the kind of work done by the two groups. In the group of private patients the number who were engaged in close work was much higher than that in the recruits, and it thus appeared likely to be profitable to study the characteristics of a group doing extremely close work for long hours without symptoms. In this way one might find certain characteristics in which such a group differed from the two previously selected groups. The following study was undertaken with this end in view and, although the number examined is extremely small, the results are uniform enough to be significant.

The work was made possible by the courtesy of a leading firm of electrical engineers actively engaged in the manufacture of electric lamps. Our sincere thanks are due to them for their co-operation and assistance. The group investigated consisted of 28 women and girls between the ages of 15 and 40, employed on what is known as "spiral inspection." This job is a suitable one for our purpose, since it demands an extremely high degree of visual concentration at an average distance of 250 mm., thus requiring accommodative effort and convergence to a greater amount than ordinary clerical work, as well as a high degree of visual acuity. The group comes into being by a process of natural selection, a number of girls being tried out on it and only those who can do it accurately without fatigue being retained. In this way the group should indicate the characteristics of persons suited to continued close work.

The work consists in sorting (by direct inspection on an illuminated green glass plate) the spiral filaments for electric-light bulbs according to their perfection, all flawed filaments being rejected. The smallest spiral dealt with has 1,400 turns to the inch. The diameter of the wire is 0.00057 in. and the separation is 0.00059 in. The girls look for two turns of the spiral in contact, for gaps, or for unevenness of pitch and of total length of the filament. This length is 60 or 100 mm., and must be accurate to 0.25 mm. A good worker will sort 10,000 filaments a day, and is actually at work 40 hours of a week of 47 hours. The average number sorted is 6,000 a day. The work begins at 7.30 a.m. At 9.30 a.m. there is a ten-minute break, at 12 noon an hour's break, and at 3 p.m. a ten-minute break. Work ends at 5 p.m. The girls do not wear any special optical appliance. They are provided with loupes magnifying about 8 diameters or less, but they use these only occasionally, when in doubt.

The degree of visual acuity involved is interesting. Using Gullstrand's constants, and calculating the size of the retinal image of the separating gap between the smallest coils (0.00014 in.) at a working distance of 250 mm., we find:

$$\text{Size of image} = \frac{1.4}{39.37} \times \frac{17.05}{250} = 0.0025 \text{ mm.}$$

Since the diameter of a foveal cone is approximately 0.002 mm. and the angle θ usually given as 24.14″ it is obvious that we are working very near the limit of resolvability for the human eye. The 28 girls interrogated had been employed for periods varying between 6 months and 13 years and made no complaints of eye strain, though six said the job was rather dull and uninteresting.

The girls were tested for visual acuity on the Snellen and Jaeger types, for muscle balance (Maddox wing, Maddox rod and cover test), for stereoscopic vision, for convergence, and for voluntary convergence. They were also interrogated about their general health and their hobbies to see whether after working-hours they chose occupations involving further close work. Since we have always strongly suspected that there is a large psychological element in the production of asthenopic symptoms, one of us (D. A.) performed a group Rorschach test, using the Harrower-Erickson[3] multiple choice technique, with a view to estimating the psychological adjustment of these 28 workers. The Rorschach method[4] of personality evaluation has been in use for 20 years and has been validated by a great deal of research, carried out on normal persons, psychotics, and patients with organic nervous disease. It is in use in the Armies of most of the nations engaged in the present war. It consists in showing the subjects a set of standardized ink-blots, and recording what they see in the blots, and what features they use in them to construct the images. Until recently it remained an individual test, but a modification for rapid screening-out of maladjusted subjects has been devised in America to meet the wartime need for dealing with very large groups of individuals. The ink-blots are projected on to a screen and the subjects are presented with a series of responses and asked to mark those which best describe what they see in the blots. The responses have been chosen from the most usual ones found in the records of a thousand subjects whose psychological adjustment is known. This modification does not make detailed individual analysis of personality possible, but provides a method of rapid assortment into groups. It is undoubtedly susceptible of improvement, but it already seems to be the best test available for forming a general estimate of the emotional adjustment of groups of unknown subjects.

The Rorschach test is based on the principle that the meaning with which an individual invests a stimulus that is in itself meaningless reveals the inner organization of that indi-