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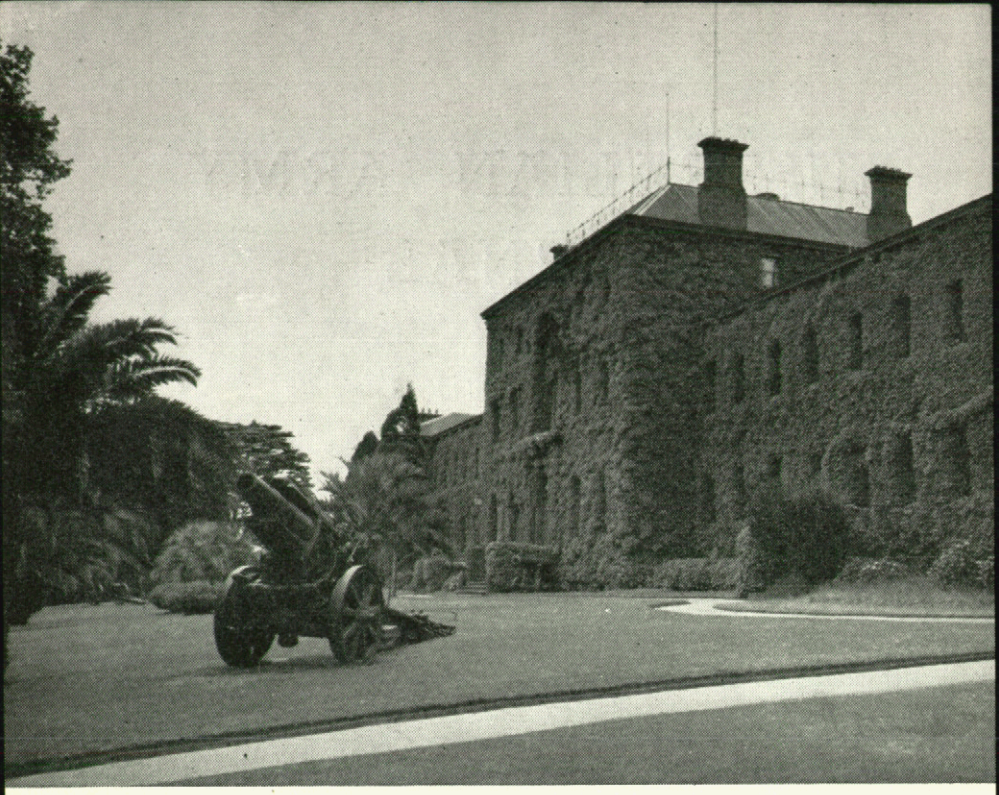

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Man Management in Hot, Humid Climates

A Guide to the Physiological Factors for Regimental Officers

This article is a condensation by Major E. M. Griff, MC, Jungle Training Centre, from the results of an investigation into this problem by Major J. O. Langtry, DCM, B Sc. The study of this subject was part of the work carried out by Major Langtry when he was DADSR with the Australian Army Component of Far Eastern Land Forces. A more complete account will shortly be published as a Report by the Australian Army Operational Research Group

— Editor.

HUMID, tropical climates impose a physiological stress on men required to live and work in such latitudes. Comfort and efficiency are adversely affected and ultimately, unless positive action is taken, there may be a deterioration of physiological and and psychological processes. A reduced capacity for performance of physical work is usually the first obvious unfavourable reaction. For the commander, a reduced performance in his unit as a whole may be the result of insidious small losses of efficiency in the individuals composing his unit.

Acclimatization

Definition

Acclimatization to high temperature and high humidity can be defined as the physiological and psychological adjustment resulting from exposure to these conditions.

Time required

In military planning, the time required to complete acclimatization to hot humid environments is a relevant factor. Various military manuals on army health state that acclimatization may take as long as two to six weeks. The implication is that a force recruited in a temperate zone and not acclimatized to humid heat should not be committed to battle before a minimum of two weeks, unless the commander is prepared to accept a lowered standard of efficiency. During World War II, when perhaps the tempo was less than that expected in future world wars, the time lag necessary to permit acquisition of acclimatization may not have been significant. With the advent of the atomic age, time has become a more critical factor in war. Minutes may count, days certainly will, and at the earliest instant optimum personal efficiency will be demanded in all services. It is conceivable that the degree of readiness for war with regard to acclimatization might be the key to success in certain operations. Even during the cold war, when the air transportation of a "police" force across the world to varying climatic environments wherein the force is expected to be fit to fight on arrival, the speed at which full acclimatization is achieved will have a bearing on individual and unit performances.

A significant degree of acclimatization can, however, be achieved in about one

week. Experiments have proved that men who are already in good physical condition can be expected to work effectively within a few days after they start work in a hot climate. By a few relatively short daily exposures to work in artificially heated rooms, they can be prepared to work immediately after they arrive in a hot climate. This process of acclimatization is not a substitute for the prolonged period of training necessary to produce good physical condition, but it is essential before men already in good physical condition can work effectively in the heat.

In view of the risks of exhaustion of a few subjects as a result of following too stringent a work programme during the early stages of acclimatization, and because acclimatization is not a substitute for physical fitness, it is desirable that acclimatization should be spread over at least 14 days. If commanders apply conscientiously the prescribed conditions, there can be no obstacle to a force working effectively in the heat at the conclusion of this period.

Conditions

The first requirement prior to acclimatization is the attainment of a high standard of physical fitness. The next is to initiate the force to a series of graded work or exercise programmes in conditions of climatic stress. The aim should be to exercise the subjects at up to the maximum tolerable level applicable to the climatic conditions, remembering that the routine need only be applied for the relatively short period each day of one, to one-and-a-half hours. From a military point of view, the acclimatization to heat of physically fit and hardened soldiers, in transit in crowded troopships for a period of about seven consecutive days in a tropical climate, can be produced and maintained with minimal facilities by relatively short exposures at a reasonably intense working rate, if such elements as seasickness, diarrhœa, etc, common on board troopships, do not interfere with physical fitness.

In the absence of a sound, practical work routine for use in acclimatization, commanders should rely upon their medical advisers for implementation of an "ad hoc" programme.

Since the capacity for production of physical energy is limited, every effort should be made to conserve it. Thus, once the work programme is concluded, an extended rest period, if practicable, will prove most beneficial. There is no doubt that in the beginning of acclimatization the troops will be fatigued. There is no way of avoiding this completely. Since rest is necessary for recovery, emphasis is given to designing the work programme so that long periods of rest follow the daily short, but intense, work schedule. Recuperation will be greatly facilitated by providing cool sleeping quarters as resting in humid heat does little to improve body adaptation.

Persistence

Heat acclimatization persists for at least three weeks of cold weather. The benefit conferred by this acclimatization is important for this time, but the advantage decreases from week to week. However, the more complete the degree of acclimatization the more persistent it is likely to be.

Military Significance

If in a temperate zone it is not possible to hold a force continuously at the requisite level of acclimatization to heat, then intermittent previous exposures to heat will be of material benefit. The more frequent the exposures the greater the benefit.

Men who are to work or fight in any area will do so more efficiently if they have lived in that area, or one similar climatically, at any previous time. Such men would still benefit from rapid artificial acclimatization before returning to that area.

It is of considerable benefit, even for those engaged in relatively sedentary occupations, to maintain the highest level of acclimatization. It increases tolerance to heat, and generally results in a sense of well-being which is one of

the most positive counters to lassitude and consequent neuroses. However, notwithstanding the benefits of acclimatization, troops strenuously employed in the field may become less efficient after six months of exposure due to the so-called "tropical fatigue".

Heat Exhaustion

The following is an extract from a survey of medical problems encountered during the Oman campaign July–August 1957.

"Undoubtedly this (heat exhaustion) achieved notorious publicity, but does not stand out as the most serious menace to health. It is my convinced opinion that it is almost wholly preventable and that the semi panic surrounding cases immediately they occur, and the fear engendered in the staunch yet often mentally mediocre British soldier by this fuss leads them to be rather too introspective, and the 'psychological' case of heat exhaustion was not infrequently encountered where little more than rest, reassurance and water were required.

"The following case illustrates the point. On 7 August during a particularly tiring journey by day, in open vehicles, and entailing slow convoy speeds and numerous halts, 10 cases of heat exhaustion occurred among British ranks, 7 of which has subsequently to be evacuated. Three cases when first seen were delirious and gave rise to some anxiety. The night before this the troops had been in convoy lasting 9 hours and at most had had 2 - 3 hours rest when they were again stood to, ready to move at 0600 hours. In the event a small striking force of scouts went forward and the troops were then standing by for a further 9 hours in hot sunshine interspersed with dust-storms. By mid-day the water bowsers were empty (water discipline was bad but there would have been insufficient anyway) and apart from their water bottles the troops had no water. The water in the bottles was hot, they did not possess canvas 'chagels'. At approximately 1500 hours they were called forward and the slow convoy grind began, plus the cases of heat exhaustion. The following morning reveille was at 0330 hours and a long arduous day during which the first serious resistance was encountered at Firq, and 3 more cases of heat exhaustion occurred.

"As background to this it must be remembered that these troops had arrived approximately 10 days before from Kenya, a more temperate climate and had spent that 10 days on the tarmac of Bahrain airfield loading stores. They also included largely the administrative element of the battalion, storemen, clerks, mess waiters, etc.

"A further factor was undoubtedly the inexperience of junior officers and NCOs. Despite all advice they seemed unable to absorb the maxim that it is better to lie down than to stand, walk rather than run, get under any form of cover rather than sit in the sun, and that when a man needs water he needs it and that he cannot be "trained" to do without it. These things unfortunately all seemingly had to be learned the hard way, and what better mentor than the Bedouin soldier."

Water

Water requirements deserve very particular attention during the early stages of acclimatization.

Sweating is practically the only mechanism for cooling the body in hot, humid climates. Water is the largest component of sweat, but is also contains inorganic salts of which common salt (sodium chloride) forms the greatest part.

Loss of sweat without replacement of water leads to rapid dehydration of cell tissue and will upset the volume and electrolytic balance between tissues and body fluid. The first symptoms are usually insidious and may appear as early as one hour after deprivation of water begins. Performance under these conditions is considerably reduced. Loss of 5 to 10 per cent of body weight may lead to heat stroke and death in the extreme cases. There are recognizable

intermediate symptoms such as lassitude, susceptibility to fatigue, loss of physical and mental efficiency, and heat cramps.

One of the peculiar features of man's metabolism is that when he is sweating heavily his sensations of thirst are not strong enough to demand sufficient water intake to replace water losses, resulting in the man ordinarily drinking much less than he is losing during an active period of work.

Another peculiarity of dehydration is that a man who has been deprived of water for a time desires less water than would suffice to restore his body weight. He does not feel thirsty although his body needs water. Yet, when he has both food and leisure, he spontaneously takes enough water to bring himself back to his original body weight. His refusal of sufficient water applies not only to the initial few minutes of the body's drinking but lasts for at least two hours. Therefore, a man although able to drink at the close of water privation, needs either food or compulsory drinking to make him recover.

The widespread belief that a person should not drink water during a march or hard work in the heat of the day can be a dangerous guide to water use. Experiments have shown that those who drink their water as they want it are under less physiological strain than those who refrain from drinking. Going without water is only a temporary economy; over an extended period this saving is wiped out when men who have "gone dry" for a time later rehydrate.

In hot humid climates a general shortage of water is unlikely to occur. If normal sterilization practice is followed, water is available in abundance. By restricting the water intake below the optimum requirement, the commander is in fact making a direct contribution to inevitable loss of efficiency.

Remembering that the taking of more water than is necessary to quench thirst is beneficial in maintaining efficiency, the guiding principles of commanders in areas where water is readily available should be as follows:—

(a) Ensure an adequate supply of cool drinking water.

(b) Do not tolerate the imposition of water restriction unless there is a genuine shortage or the tactical circumstances necessitate it.

(c) When troops are sweating freely, encourage them to drink frequently and copiously, pointing out that drinking somewhat more than their thirst demands is likely to benefit them. They must not, however, drink to distention – small quantities at 15 minute intervals is the most efficient method of replacement.

(d) If a period of water privation cannot be avoided, at the conclusion of the period the troops will need either food and water, and/or compulsory drinking to make them replace water lost in sweat, particularly if a period of rest is not practicable. The fact is, that immediately after a period of water privation the individual will desire less water than is necessary to meet his body's requirement.

(e) While large quantities of water are necessary for best performance, the human body can manage surprisingly well for short periods on very little water. As the physiological cost of these short periods is not immediately apparent, it is important that adequate water intake should be resumed as soon as possible.

For logistical planning in South-East Asia, it is fair to use the following figures for one soldier's water requirement for drinking:—

Minimum: 1¼ gallons (imp) a day (6 water bottles).

Maximum: 2½ to 3 gallons a day (10/12 water bottles).

Salt (Sodium Chloride)

The need for extra water during work in the tropics is much more urgent than the need for extra salt. Replacement of salt losses hour by hour has no demonstrable advantage. The salt loss can be replaced satisfactorily at meal time.

The average 24 hours diet containing 10 to 15 grams (1/3 – ½ oz or approximately two to three level teaspoons, or 10 to 16 salt tablets) of sodium chloride affords adequate protection against salt depletion. The reason for this is that there exists in fully acclimatized men an adaptive mechanism, whereby salt concentration of the sweat is remarkably and consistently diminished when the need for salt conservation becomes acute.

The trend in modern research and thinking is against the need or advisability of administering extra salt to men working in the heat, either in tablet form or as salinized drinking water, except possibly in the case of unacclimatized men.

The taking of salt tablets can also be dangerous. Individuals vary in their salt requirements, needing least when they are acclimatized. The persistent taking of excess salt can damage health. An excess which is not enough for this can lead not only to gastro-intestinal irritation with diarrhœa or vomiting but also to a measurable decrease in efficiency for work in the heat.

Ideally the loss of salt through sweat should be replaced by eating properly balanced meals. Loss of appetite (anorexia) which is so common in hot environments, may interfere with adequate food intake, in which case it may become desirable to supply salt in drinking water (0.1 per cent solution is recommended), or less satisfactorily in the form of tablets. (The issue salt tablet is 15 grains — 1¼ tablets in a water bottle is 0.1 per cent solution). The decision should be made by medical authorities and the extra salt administered according to their instructions. When it is necessary for salt to be administered prophylactically to ensure maximum efficiency, it should be taken before the work period begins.

Food

The chief nutritional problem is likely to be not how much and what the individual ought to eat, but what and how much he is willing to eat. In combat, it is necessary to maintain a high nutritional standard and to hold a body-reserve of all essential food factors. Physiological study has shown that when a body is physically damaged or deteriorated by illness it requires much more of these factors than normally.

Anorexia

The hot, humid climates favour the condition known as "anorexia" or "lack of appetite" which is characterized by a lack of desire for food in general, fats in particular. The higher the climatic stress and the more exhausting the work performed, the more pronounced may be this anorexia.

Appetite

Generally speaking, appetite is least on rising, being inhibited until after the period of physiological "warming up" has overcome natural lassitude. The duration of this period is more protracted in hot, humid climates. In the tropics, temperatures are quite high and humidities often very high early in the morning. If breakfast is taken before "warming up" is complete there is likely to be anorexia and it will require the most attractive, and relatively fat-free, food to stimulate a good appetite. A similar reaction is to be expected at the midday meal unless the subject has had time to rest and cool off thoroughly. The largest appetite in the tropics is most likely to occur at the evening meal, provided the subject is comfortable.

On the one hand, dishes rich in fat are generally unacceptable to Europeans in the tropics, while on the other, foods comparatively rich in protein are

generally the more appetising ones. Increase in protein may well be at the expense of fat, although a minimum of fat should be achieved to retain nutritional balance in a diet. Food in which a large proportion of fat is unavoidable should be served when natural appetite is greatest — usually the evening meal.

Habit

There is a popular misconception that local feeding habits in an overseas theatre of war influence greatly the feeding pattern voluntarily established by new arrivals. In fact it has been proved that acceptability of the local feeding pattern is low and it seems that any commander is wise to accept the feeding habits established by custom in the soldier's homeland as the general basis for prescribing a menu for a force operating in an alien environment; but emphasis should be placed on acceptable foods of high biological value.

Contrary to popular belief there is no justification for the assumption that "the working soldier needs considerably less food in the tropics". In fact the hard working soldier in the tropics needs to eat very nearly the same amount, the total requirement being something above 90 per cent of the requirement in a temperate climate. The sedentary worker who may need 1000 calories per day less than a hard worker still needs at least 90 per cent of his daily requirement in a temperate zone.

Sugar Requirement

In the circumstances where the lapse of time between meals is great, or where there is a natural tendency for physiological reasons to loss of appetite, the taking of sugar may facilitate a more sustained high level of performance. If the level of intake is low at breakfast and inadequate at lunch, then the value of sugar in an acceptable form as a between-meal snack cannot be denied. As insufficient food prior to a move is a predisposing factor to heat exhaustion, the ingestion of sugar food during the march may confer benefits. However, sugar in the form of glucose is neither a prevention nor a cure for heat exhaustion.

Feeding Habits

The aim should be to ensure at least three meals a day covering the work period. Appetite for breakfast can be stimulated to a satisfactory level by ensuring that the daily routine between reveille and breakfast provides at least one hour of low level administrative activity about the camp. At lunch time after four to five hours arduous marching, if subjects are encouraged to relax for at least 30 minutes before attempting to eat, during which time they drink water and tea, there is a marked improvement in subjective behaviour during the last hours of the afternoon's activity.

Synthetic Foods

Given sufficient incentive, "average" troops are capable of undertaking with efficiency and high level performance, the most arduous tasks on the most unpalatable food, or even in the extreme case, on synthetic food. But the commander must be quite sure before authorizing such a step that the particular task warrants deviation from the customary method of feeding. He must also ensure that the diet is sufficient calorificially, properly balanced and highly acceptable to his troops (so that wastage is negligible) otherwise at the conclusion of the experience the nutritional status of his troops may have fallen to a level considerably below optimum. A specific period of recuperation will be necessary before optimum nutritional status is regained.

Alcohol

Medicinal rum may be issued as a ration on medical advice to troops on arduous patrols in the tropics. Alcohol, often referred to as a "stimulant" is in fact a depressant drug which generally reduces efficiency. The taking of rum during the heat of the day by "fagged out" troops is likely to lower efficiency even further, and can be dangerous.

One of the effects of alcohol is to cause the skin to flush thus facilitating excessive water loss. In this way the thermal balance is upset and dehydration may be sufficient to cause collapse. The physiological tolerance to heat is reduced. Alcohol, taken as a "sun-downer" — in moderation — may confer psychological rather than physiological benefits.

In Summary

(a) A considerable variety of food items should be issued.

(b) The food items should be much the same as soldiers are accustomed to in ordinary life, but emphasis should be placed on food of high biological value.

(c) Calorific deficits must be avoided. From the standpoint of military efficiency, calorific deficiency was an important problem during the war while vitamin deficiencies were relatively unimportant.

Sleep

The effects of temperature during the working day upon physical and mental efficiency are generally appreciated. The climatic conditions prevailing during the off duty period are of equal and probably greater importance. A sound, comfortable sleep has a considerable value in alleviating the effects of heat stress encountered during the day.

When the nights are sufficiently cool to permit sound, refreshing sleep, a man's alibity to tolerate severe climatic conditions is enhanced. If conditions in sleeping quarters are unfavourable to restful sleep, and excessive night sweating is common, the tolerance to daytime conditions will be severely reduced. A steady decline in efficiency will ensue and, in severe cases, clinical conditions of heat exhaustion and cramp will occur.

Sleep during the day is apt to reduce efficiency. Usually, conditions are not conducive to refreshing sleep; excessive perspiration usually leaves a man feeling enervated when he wakes up. Some support may be found for short "cat naps" of twenty minutes or half an hour's relaxation but no more.

Rate of Work

Climatic stress occurs when the effective temperature rises above certain tolerable levels. A full account of the problem would be rather complex. As a guide to conditions which represent the upper limit for sustained physical effort, a reasonable criterion is described as a sunny day with a shade temperature of 85 degrees Farenheit and a relative humidity of 80 per cent and no perceptible breeze.

Under conditions equivalent to these, or worse, prolonged physical effort in the sunlight will lead to serious heat exhaustion. Either the rate of working must be reduced or the frequency of rest periods should be increased.

The rate of energy expenditure rises with the rate of working. A given task may be performed with fewer ill-effects if a more moderate rate can be accepted — for example, marching at 2½ instead of 3½ miles an hour.

Tropical Fatigue

Definition

Any definition of fatigue is difficult and probably best attempted by separating the three facts —

(a) Physical fatigue — Lowered efficiency and reduced performance resulting from previous activity.

(b) Mental fatigue — Inefficiency as a result of intense and prolonged mental activity, unrelated to emotional influences. "Boredom" is a useful description of the general symptoms, exemplified by lack of drive and sleepiness.

(c) Nervous fatigue — The most dramatic of the three, in that hypersensitivity to emotional stress is characteristic. Emotional anxiety and high psychological tension are predisposing factors. The symptoms are characterized by excessive irritability and irrational response.

When attempting to detect the presence of tropical fatigue or to assess the extent of deterioration within his force, a commander is faced with a difficult problem. The sufferer will not usually be able to distinguish the difference between organic and functional disorders. He will explain his condition by enumerating a series of complaints which generally follow this pattern —

(a) Loss of weight.

(b) Loss of energy and a constant feeling of tiredness.

(c) Inability to produce the customary amount of work in the tropics.

(d) An increase in ill health, especially "skin trouble".

(e) A feeling of general malaise.

(f) Complaints of dizziness on standing up — "black outs".

(g) Loss of appetite.

(h) Loss of memory.

(j) Loss of initiative.

(k) Slowness of mental processes.

(l) Increase in irritability or loss of temper.

(m) Increased intolerance to heat.

Standards of leadership and discipline within a unit are factors which influence the extent of tropical fatigue. By a more detailed understanding of the factors predisposing to deterioration, commanders should be able to take aggressive action to counter it.

Physical Deterioration

Hot, humid climates do impose a considerable physiological strain upon man. With the passage of time fatigue sets in and psychological deterioration is evidenced by the increased incidence of ill health — notably skin diseases and increased difficulty in performing hard, muscular work. These symptoms are tangible and can be dealt with reasonably successfully. The discovery of new drugs has facilitated control of certain skin diseases, although prickly heat still poses a particular problem. As for general ill health and reduced efficiency at physical work, the emphasis must be upon prophylaxis. The aim must be to reduce the extent of physiological strain by ensuring that the body is near perfect in adjustment to cope with the environmental stress. Attention must be given to maintaining physical fitness. The danger of under-activity for a person in a sedentary occupation is particularly important. It is only too easy to slip imperceptibly into lax physical (and mental) habits. It requires a constant and deliberate exercise of will power to overcome this tendency — both by the individual and the leader when setting the example.

Hand in hand with maintenance of physical fitness must be considered acclimatization. The maximum level of acclimatization must be the aim at all times. Rest is as important for physical fitness as is exercise. Also, regular relief from the climatic stress at cool weather stations will give a dramatic physiological as well as psychological response. Vigour should be rapidly restored.

Special attention should be given to personal hygiene. Just as men become increasingly intolerant to the tropical environment after six months, so do they become increasingly susceptible to skin diseases unless personal hygiene is of a high level. Diet is most important. Optimum nutritional status should be maintained at all times. An adequate intake of water and salt is essential.

Psychological Deterioration

There are two aspects of psychological deterioration to be considered —

(a) Deterioration due to non-climatic factors.

(b) Deterioration resulting directly from climatic stress.

Under some conditions troops might be inclined to exert themselves and rise superior to a disadvantageous climatic situation. Under others, they might be less inclined to accept discomfort and might suffer an increase in boredom and lapse further into inactivity. From a soldier's point of view, it is considered

that the incentives might be grouped under three headings —

(a) **Operational incentives** — By this is meant proximity to active service. Common experience shows that boredom and discontent are particularly prone to flourish in places far removed from operational areas, especially if they are devoid of the customary amenities of civilized living.

(b) **Promotion incentives** — The importance of the proximity of promotion as an incentive to exertion and the production of a sense of contentment is too obvious to be stressed. This applies not only to the prospect of further promotion but also to promotion already experienced.

(c) **Unit incentives** — A matter of unit esprit-de-corps, morale and those intangible things that serve to distinguish the good unit from the bad. The emphasis is on the need for sound man management.

Uncomfortable and distressing climatic conditions will aggravate the effects of any worries or sense of grievance on the psychological conditions of men. Nevertheless, if the worries are removed (and good general health is maintained) then overall deterioration is limited in degree largely to that resulting from climatic stress. Provision of objectives as part of personal as well as unit planning will do much to restore the situation by stimulating mental processes and encouraging initiative.

Environmental Stress

Environmental stress is a term used to denote the overall stress imposed on man by the three variables —

(a) Rate of expenditure of energy on work and the duration of the work task.

(b) Climatic stress.

(c) State of dress.

A lessening of the stress due to any one variable automatically lowers the overall environmental stress.

Outdoors, apart from seeking shaded conditions, little can be done to alleviate climatic stress. Ideally, soldiers should work stripped to the waist.

When climatic stress is high, increased attention must be given to reducing the metabolic cost of work by —

(a) Reducing the total output of work, and/or

(b) Decreasing the rate of energy expenditure during the performance of the task.

Conclusion

The foregoing may be summed up as follows:—

(a) Physiological status is a major factor in determining the optimum and maximum performance of man.

(b) For maximum performance, physiological resources must be husbanded — the maximum of physiological efficiency is a prerequisite.

(c) Slight reduction in the efficiency of the individual may lead to gross inefficiency in a force.

(d) Since the efficiency of a force is the personal concern of the commander, it follows that he must master the basic principles of man's physiology and be able to supervise their correct application.

The Army's Role in the Future

General Maxwell D. Taylor,
Chief of Staff, United States Army

Reprinted from Army Information Digest, USA

IN its simplest terms, the role of the Army in the coming years will be to provide a maximum contribution to the deterrence of war. This contribution will be made not as an isolated service, but as a part of the tri-service team of the Army, Navy and Air Force.

The Army will discharge this role in an era of mutual deterrence in which both sides of the international power bloc will have the atomic weapons and the delivery means to cripple one another in a general atomic war. Hence, it is to be anticipated that the primary effort of all governments — certainly of our own — will be to avoid that international catastrophe without abandoning our national objectives.

It is important that under such conditions the military forces of the United States have sufficient flexibility to permit the application of varying degrees of force without sole dependence on weapons, the use of which is tantamount to general atomic war. To obtain this flexibility the Army must prepare itself to fight with atomic weapons, without atomic weapons, or with atomic weapons employed under certain ground rules. It must have the means to suppress local conflicts quickly, since their continuation may lead to the great atomic war which it is our purpose to avoid.

This philisophy of the deterrence of war as the objective of the Armed Forces is so fundamental to a discussion such as the present one as to deserve some amplification. Its point of departure is a positive requirement for the existence of civilization to deter general atomic war.

However, it is unsafe to assume that strong nations inclined to aggression will abandon the use of force to obtain their goals. It would appear more likely that they will operate by means of subversion and infiltration, limiting their military ventures to those which are not likely to lead to general war.

Thus, while there is the requirement on the part of the United States to maintain strong forces which present visible evidence of our ability to retaliate in the case of general atomic war, it is also essential to have those capable of deterring or winning in any situation short of a general war. Unfortunately for the simplicity of defence planning, the forces required for general war and for limited war are not identical.

So important will it be to prevent breaches of the world peace that the requirements for deterrent forces appropriate to this purpose should be adequately met before we are justified in making any large outlay to meet the consequences of the failure of deterrence — that is, to fight a general atomic war.

If we must assume that we cannot deter this general atomic war, we will be led into astronomical expenditures to meet the full needs of distant early warning, civil defence, the dispersion of industry,

continental air defence, and similar activities. Efforts to meet such needs as these will tend to obscure the requirements of deterrence which in all logic should always come first. Hence, our efforts to hedge against failure of deterrence must be made on a carefully selected basis. The top priority must be given to those categories of military forces which will contribute to the prevention of general war, and these include those necessary to deter or win quickly conflicts short of general war.

With the foregoing philosophy in mind, the Army of the future will be organized to meet, in order of priority, three possible military situations, namely, cold war, limited war, and general atomic war. To insure its readiness to meet these three conditions, the Army will be composed of five major categories of forces —

Overseas Deployments
Strategic Army Forces
Reserve Strategic Army Forces
Continental Air Defence
Mobilization Forces.

Overseas Deployments — These forces will continue to be a necessary contribution to the cold war effort of the Free World and as a deterrent to limited and general war. Army forces deployed overseas must be sufficiently strong to convince our allies of our will and ability to contribute substantially to their defence and to convince any aggressor that a forward movement in important strategic areas will be blocked on the ground long enough to permit our heavy atomic weapons to destroy hostile forces short of the objective of aggression. These forces in conjunction with those of our allies cannot be merely a trip wire to sound the alarm of attack; they must have real defensive strength in being. The US Army forces in these deployments must be units of the active Army maintained constantly at a high level of combat-readiness.

Strategic Army Forces — Backing up our overseas deployments and essential to our defence posture in cold, limited, or general war are those Army divisions and supporting units located in strategic reserve in the United States. In cold war these forces will show both ally and potential aggressor that we have ready reserve strength, prepared for limited or general war. As limited war forces, these strategic striking units would be the first elements to be deployed to counter the aggression, and to prevent its spread into general war. They have a concurrent capability for a general war, in which case they would reinforce our overseas units and discharge our obligations to them and to our allies.

Reserve Strategic Army Forces — This category of Army strength will be made up of selected reserve divisions and supporting units of the National Guard and US Army Reserve which will be earmarked, trained, and ready for deployment in the period immediately following M-Day. We must have these forces to replace rapidly the active Army forces moved abroad at the outset of hostilities, to provide the additional divisions — beyond those of the active Army — necessary to fulfil our NATO commitments, and to increase our readiness for possible general war. The Reserve Strategic Army Forces have initial wartime missions so important as to justify giving them special assistance in raising their level of combat readiness.

Continental Air Defence — The Army's future contribution to the air defence of the Nation will consist of increasing numbers of active and reserve battalions manning Nike, Hawk, and perhaps Talos missiles. The Army is keenly aware of the need to provide the Nation with an acceptable level of air defence. However, the requirements for this essentially defensive element in our military structure must be balanced against the needs of the mobile, offensive forces to which the Army should always give a high priority.

Mobilization Forces — These are the additional reserve component forces which will be placed in training as soon after M-Day as the situation and facilities

will permit. The number of units involved will depend to a considerable extent upon the situation existing at the time. These forces will comprise units of the National Guard and the US Army Reserve, the members of which have been on a paid drill status. The Mobilization Forces represent the requirements to prolong our military effectiveness beyond the first six months of war or emergency. The magnitude of these requirements is difficult to establish in advance, but the need for capability to generate additional strength rapidly must be recognized in our military preparations for the future.

Future Structure for Deterrence

The foregoing paragraphs have indicated the categories of Army forces which will be required in the next few years. The size of these forces will depend upon a variety of factors. For example, our overseas deployments are where they are because of commitments which we have undertaken with our allies. Before they can be withdrawn, it will be necessary for the political leadership of our country to modify present understandings. Apart from their international significance, from a purely national point of view their presence aboard provides the United States with valuable outposts which give depth to our defensive dispositions. To give up these advance positions would contract significantly the range of our strategic capabilities.

The Strategic Army Forces are the hard core of the striking power of the Army in being. As the importance of coping with limited war tends to increase, so increases the requirement for strong, ready Army Forces held in reserve in the continental United States. A measure for the size of these forces is the ability of the Air Force and the Navy to transport Army forces rapidly overseas. The present strength, eight ready Army divisions, and supporting forces, appears to be about the right allocation of means for the future to this important category of strength.

The size of the Reserve Strategic Army Forces will be related to the strength of the preceding category, the Strategic Army Forces. We shall need the ability to generate reserve strength as rapidly as we deploy strength in being to overseas locations. Fortunately, the success of our reserve force programme gives us assurance of being able soon to have reserve units completely filled with trained men. Thus, the time requirement for mobilizing and preparing such units for combat will be significantly reduced. Consequently, with better trained and more carefully integrated reserve elements in our over-all defence structure, the Army will have an increased capability for generating strength rapidly to meet any emergency.

The size of the Army Air Defence Command should grow just as rapidly as is possible without destroying the over-all balance in the use of the Army's assets. Certainly, it is most important from the point of view of deterrence to assure the protection of our air retaliatory force as well as the principal centres of our civilian population.

We may anticipate a progressive increase in the number of Army surface-to-air missile units as the emphasis in continental air defence shifts from the manned interceptor to the surface-to-air missile. However, it will be a mistake to attempt to erect a Chinese wall of static air defence around the United States at the expense of our offensive means of reaction. This is an area in which it will be most important, from a national point of view, to establish early a common sense yardstick of sufficiency for our objectives.

So much for the trends in size of future Army forces. Now a few comments as to their quality.

The field forces of the Army, particularly the divisions, are at present undergoing a drastic reorganization along Pentomic lines. In the years to come it may be anticipated that these new organizations will be refined as continuing experimentation develops and improves our tactics and techniques. Hand-in-hand with this process of refinement will

go the creation and modification of new logistical processes. All our effort to improve our signal communications will give greater flexibility to commanders and allow a ready adaption of Army units to the requirements of the atomic battlefield.

Mobility on the road, across country, and in the air above the combat zone, will continue to progress by virtue of the present emphasis being laid upon mobility *in the research and development* programmes of the Army. Firepower has already made great strides as it assumes the form of the missile-borne atomic warhead. Additional progress is anticipated in the future, particularly in the improvement of our Nike surface-to-air missile family, the introduction of Hawk and the development of longer range tactical surface-to-surface missiles.

Both the Army's quality and size in the future will be vitally affected by budgetary considerations. It appears likely that the Army will have to live within dollar budgets about the same as those of the present time. This requirement will impose a severe restriction upon the development of our forces.

There are numerous factors which will contribute to this difficulty. In the first place it is to be anticipated that prices will continue to rise so that the effective purchasing power of our dollar will decrease. We are finding that the new weapons essential to the modernization of our forces are more expensive than had been anticipated. *Thus, the bills for* military hardware tend each year to absorb a greater proportion of our budget.

As our weapons become better they become more complicated, and as they become more complicated they require higher levels of training among our personnel. Once having trained our leaders and specialists, it becomes very important to retain them in the service. Unfortunately, their skills find a ready adaption to the needs in civilian industry so that the Army is losing many of its skilled people after training them at great expense. It is to be anticipated that in the coming years it will be necessary to pay Army personnel at higher scales if we are to retain the competence which is indispensable in this modern force.

Finally, our fiscal problems will be aggravated by the fact that some of our programmes are expanding and should not be levelled off. Two examples of such are the surface-to-air missile programme and the reserve programme. The first of these should be accelerated in order to reach a minimum satisfactory level of air defence in the United States. Army technology has been successful in providing the kind of missiles required. It is important that we now have sufficient funds to form the units and to place on site the operational missiles *necessary for a minimum level of* satisfactory defence.

Likewise, the successful reserve forces programme is creating additional dollar costs which it is most desirable to meet. If we are to utilize these reserve forces with their increased levels of readiness, the Army will be obliged to spend more money on armories, reserve training, and related activities. *If we fail to make* adequate provision for these reserve activities, we will sacrifice in part the new effectiveness which is within our reach.

In anticipation of these budgetary stresses it is most important that all members of the Army view most seriously their part in the effective utilization of Army assets. With these pressing requirements to support vital Army activities there is no room for inefficiency, or for the expenditure of funds for marginal returns. Commanders at all echelons must be keenly aware of the requirement to reappraise Army activities to be sure that we are placing first things first and expending our resources on activities and on things with an identifiable relation to combat essentiality.

In closing this survey of the future Army, I would stress that it must

progress in four vital areas. It must continue to develop better firepower, greater mobility, more reliable and more rapid communications, and better people. Success in all four areas is essential, but nowhere as important as in the area of people.

The Army will never be any better than the individuals who make it up. Every member of the Army has a part to play in this field of self-improvement. He must make himself a better member of the Army community and at the same time insist upon the maintenance of higher standards by his subordinates. We cannot afford to maintain in the Army marginal, or substandard individuals. They should not be admitted at the point of intake but if they succeed in entering our ranks, they should be quickly identified and eliminated.

Only an Army which is filled with first-class people can in the long run be itself first-class.

"In any sort of society . . . . somebody has to give the orders. Orders have to be carried out. But wherever it is possible, it is a very good thing to explain why an order is given, why things are done in a certain way . . . . Let the man see a bit further along the chain in which he is a link . . . . It is not that conditions are bad that upsets men so much as the delay or failure to recognise that they are and to take steps to improve them . . . . "

— Field Marshal Sir William Slim

ARMY MISSILES

The following tabulation shows the arsenal of artillery-type missiles to be operational in the United States Army of 1962 — unless they are sooner replaced by something even newer and better.

Reprinted from Army Information Digest, USA

Surface-to-Air

NIKE-AJAX. In test after test the supersonic Nike-Ajax — already operational — has knocked down every type of target offered it. Set in motion by a solid fuel booster, it is powered by liquid fuel and controlled by a system of command guidance. The missile itself is about 20 feet long and one foot in diameter. Missile and booster together weigh more than one ton. The entire system is mobile, suitable for field or fixed use.

NIKE-HERCULES. Capable of carrying an atomic warhead, this missile flies higher, faster and farther than Nike-Ajax. The missile is about 27 feet long, booster 14.5 feet long; and both will use solid propellant. Nike-Hercules will be operational in the near future.

HAWK. About 16 feet long and 14 inches in diameter, this "bullet with a brain" will be used for defence against low-flying aircraft. It has a lethal, modern warhead and extremely successful guidance techniques. Already in the "hardware" stage, it is now successfully undergoing test. It uses a solid-fuel propellant.

Surface-to-Surface

DART. This highly mobile guided anti-tank missile offers a high probability of first-round hit with a warhead which can defeat any known armour. Already in the hardware stage, it is now undergoing test.

LITTLE JOHN. This supersonic free-flight rocket — about 12 feet long, 1 foot in diameter, and powered by solid propellant — has a range of medium artillery. It can be transported by helicopter. Hardware now successfully undergoing test.

LACROSSE. This supersonic close-support guided missile — about 19 feet long, 20 inches in diameter, and powered by solid propellant — is highly mobile, fired from a launcher mounted on a standard truck. Now in production.

HONEST JOHN. This supersonic free-flight rocket — about 27 feet long, 30 inches in diameter and powered by solid propellant — can carry an atomic or high explosive warhead to a range equivalent to long-range artillery. Highly mobile on its truck transporter-launcher, it is operational in CONUS and overseas.

SERGEANT. Details classified.

CORPORAL. This supersonic guided missile — about 45 feet high and powered by liquid propellant — can carry an atomic or HE warhead to a range of about 75 miles. Operational in CONUS and overseas.

REDSTONE. This supersonic guided missile — 69 feet high, 70 inches in diameter and powered by liquid propellant — can carry an atomic or HE warhead to a range of about 200 miles. The 40th Field Artillery Missile Group, consisting of the 217th FA Battalion (Redstone), 630th Ordnance Company and 580th Engineer Company was activated at Redstone Arsenal in September 1957. It will be assigned to the Third Army as a part of the Strategic Army Force.

THE NUCLEAR ORGANIZATION

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The views expressed in this paper are those of the author and do not represent official doctrine.— Editor.

THE Brigade Group organization is the first direct result of the planning for nuclear war. Whether the brigade organization will stand the test is the question which is exercising the minds of all at the present time.

In deciding upon the final organization one must first examine the tasks required of units in the tactical battle in relation to the probable action of the enemy forces.

Let us examine our present tactical concept. In defence we have departed from the closely knit organization of World War II to a concept which visualizes brigades covering frontages of some 10,000 yards. Within the brigade area battalions occupy ground on a frontage of 1200 to 1500 yards with large gaps between battalions. These gaps in open warfare are of a minimum of 2000 yards with a much larger gap between brigades; up to 8000 yards. This presents two major problems on battalions level, viz, control of the gaps and the concealment/deception problem of battalion areas. In attack with nuclear support one visualizes the attack being mounted from great depth and penetrating to great depth. The rapid concentration and dispersion of the attacking force is a real problem, as our present organization and equipment does not permit it to become really effective.

Now the enemy. He possesses great superiority in armour and manpower. He outnumbers us greatly in immediate fire support for his tactical sub-units. His is an almost completely mechanized army with good communications and reasonable administration and he has airborne and amphibious formation which can quickly exploit any nuclear attack. He is training to this end and uses his great superiority to move on a very wide front to defeat our nuclear threat. He uses all approaches, so there is not any defined approach to any one position. Because of his hard-hitting army it will be difficult to halt him unless one has a major obstacle which might cause him to canalize or delay his approach for a limited time. In future, therefore, our defence must, if possible, be based on a major obstacle. Such an obstacle will enable use to be made of any nuclear weapon when the enemy concentrates either before the obstacle, when crossing the obstacle, or immediately on the other side of the obstacle.

One visualizes frontages in the future increasing for the reasons of nuclear threat and manpower difficulties. It is easy to imagine a brigade group extending to 20,000 yards in certain instances. If the enemy is going to approach on this wide front then we must have forces observing the entire front if use is to be made of the tactical nuclear weapon. Because of the extent of the front visualized it is not possible to hold ground covering an obstacle — our present defence concept therefore

falls. The forces posted along an obstacle should be there to gain observation of the enemy and to give early warning. By nature of their organization they may be able to deal with small infiltrating parties of foot or airborne troops. These "observing" forces must be able to move quickly from place to place. They should not become involved in a dog fight for any particular piece of ground, but they should harass and seek to impose a delay on the enemy. Our present doctrine and organization does not permit the above tasks to be carried out. It is old fashioned in outlook; within the infantry brigade organization the bulk of the vehicles are thin skinned presenting no thermal screen and being very vulnerable to nuclear attack. The force cannot move quickly and it will be discovered, attacked and destroyed by nuclear weapons.

At present, infantry have to march on their feet and fire power is limited to an extent, by the various supply problems. Should infantry have to move quickly they have to take advantage of any armoured force which is in their area, otherwise their vehicles are, to an extent, road-bound and vulnerable to enemy air as well as nuclears. Infantry require thermal shields to give adequate protection against any enemy nuclear. They require vehicles which have an excellent cross-country performance and can move them quickly from one part of the front to another. In all, the infantry battalion must be completely mobile. The battalion will then be able to operate widely deployed, to concentrate quickly, to reinforce areas that are threatened and to continually harass the enemy by moving along with him, thus delaying his penetration. This dictates that infantry should be organized with a complete armoured personnel carrier lift if they are to carry out the tasks required of them in the future.

Infantry battalions should not "hold" ground in a static manner. They should be responsible for an area and should move from position to position to cover the large frontages involved and to deceive the enemy as to their actual location for the battle. This concept will enable the infantry to break off battle quickly and to permit them to conform completely to the principles of war —

(a) Concentration of effort.
(b) Surprise.
(c) Economy of force.
(d) Security.
(e) Mobility.
(f) Offensive action.
(g) Co-operation.

The flexibility given by armoured personnel carriers will permit the infantry to fight from dispersed positions, providing adequate communications are made available. Armoured personnel carriers can carry fully equipped tactical loads and should be able to remain in action for reasonably long periods. Each armoured personnel carrier should have a very heavy machine gun mounted on it to deal with enemy armoured personnel carriers.

All the above points suggest strongly that the infantry should be organized in small groups of armoured personnel carriers. With the present organization of four rifle companies, the infantry battalion would require some 65 armoured personnel carriers. These armoured personnel carriers should also be able to maintain the battalion and there will therefore be no need for A and B echelon vehicles as we have them today. Armoured personnel carriers from within the battalion can be used as medical vehicles and supply vehicles.

As armoured personnel carriers appear to be the answer on the vehicle organization one must now consider the weapon and equipment problem. If we consider that the enemy force is greatly superior in armour, then there is a definite need for tanks and self-propelled anti-tank guns to deal with enemy armoured threats, and contain his forces for a nuclear strike.

The conventional anti-tank gun is not suitable as it does not offer any thermal screen and it lacks mobility. What the

infantry needs is a mobile anti-tank gun, either our present form of MOBAT, mounted in an armoured personnel carrier, or the medium or heavy gun tank; this would then satisfy the requirement for thermal screening. This anti-tank weapon, either tank or self-propelled anti-tank gun, must be allotted down to platoon level if the infantry are going to contain the enemy force over a wide area. If one hopes to retain central control of the anti-tank weapon with the frontages involved there is a strong doubt whether it could be placed in the right area in time to prevent the enemy making a clean break-through.

In addition to the anti-tank weapon requirement on this lower level there is a definite need for some engineers. Infantry in the future will be required to lay minefields, improve obstacles, prepare bridges, etc, for demolitions. Emphasis must be placed on engineer training for infantry and in addition engineer personnel should be provided on company and platoon level, as every little delay imposed on the initial enemy advance will assist in delaying his main force and possibly cause him to concentrate.

One should now consider the small arms organization. The enemy make maximum use of night, therefore at platoon level there will be a need for some mortar illuminator if he is to be observed and harassed. This proved of great value in Korea when the Chinese fought at night. In addition illuminators raise the morale of troops at night.

No longer can one afford to let the enemy close up to a position. He should be hit as far away as possible in order to delay him. This suggests the need for a machine gun in the platoon which can reach out to a tactical range of 2000 yards and the ability to take on harassing tasks at 3000 yards. This will do away with the need for a medium machine gun platoon centralized under battalion control.

So now one has a platoon composed of anti-tank, engineer, mortar and machine gun elements, carried on armoured personnel carriers with communications which will permit it to fight over very large areas. The platoon should be self-contained and able to operate for a reasonably long time (3 to 4 days) on its own.

The question of control in this moving type of battle is of major importance and strong consideration must be given to reducing the number of sub-units one has to control. Large frontages present many difficulties on the control level, particularly if the forces are moving continually. There is good argument for basing the battalion organization on a three company, three platoon organization. In addition to a change in the basic infantry structure there is an urgent need for better wireless communication if control is to be really effective.

In view of the frontage it can be assumed that companies will have to operate over large areas. Platoon groups may even be well dispersed in the company area. There is, accordingly, a requirement for fire support on company level. Our present concept of centralizing control of battalion support weapons will not work from the range aspect alone. Consideration should therefore, be given for a mortar section to be permanently attached to each company. This mortar section should be capable of firing at a range of approximately 400 yards and it should be mounted in armoured personnel carriers. If any weight of conventional fire is to be placed on the ground then the infantry battalions should be given heavy mortars with a range of approximately 8000 yards to support companies.

In mobile operations the Battalion Commander must have a force which he can move quickly to contain enemy penetration and consideration should be given to having a medium tank company in the battalion organization. This force can be initially positioned to deal with enemy armoured penetration and should be the backbone of the containing

element of the infantry battalion. As can be seen from the suggested organization, it contains a major anti-tank element which could deal with a heavy enemy armoured attack. The anti-tank element, being protected to a limited extent from nuclear effects, could deploy quickly and deal with attacks of up to 100/150 enemy armoured vehicles on the battalion front.

With such an organization, viz, three rifle company groups, one tank company, one heavy mortar platoon completely mobile, the infantry battalion should be able to deploy on a front of some 7/8000 yards and to operate in an area some 10,000 yards deep. Well organized platoons with tank support can deal quickly with small enemy infiltrating parties. It will not be possible to prevent infiltration at night in small numbers, but with an organization such as this it should be possible to observe all vehicle approaches, all crossing sites on obstacles and any natural defiles or centres of communications. This suggested organization gives a great saving in manpower on our present infantry battalion organization.

Within the infantry brigade, again from the question of control, there should be three battalion groups. However, at this level one has a major problem in providing the force necessary as a screen forward of the obstacle and for counter-attack, mopping up operations. At present this falls to the reserve battalion and its affiliated squadron of tanks, but this will no longer be possible, as there may be occasions when all three battalions are forward in the brigade area because of frontage problems. It is suggested that there is a requirement for a separate force under brigade control for this role. It should consist of tanks and infantry and the armoured regiment infantry company group is probably a reasonable ratio.

The day of the towed field artillery piece has gone. Towed artillery is no good in the nuclear war. It has to be dug in and there is always the task of protecting the immobile gun elements. Available nuclear support does, to a certain extent, do away with the need for normal field artillery and there is a need for a heavy gun which can fire normal conventional and nuclear projectiles. That points to the introduction of the medium self-propelled gun as a permanent part of the infantry brigade as the basic artillery unit.

We have emphasized the need for imposing a delay upon the enemy and this does emphasize the value of demolitions, the laying and breaching of minefields, the building and blowing of bridges. In addition to the small engineer elements on platoon/company levels there is a need for engineers on brigade level. They should be mounted in armoured personnel carriers and capable of operating independently for reasonably long periods.

In the war of the future, covering vast frontages, I would suggest strongly that the battalion commander requires some form of helicopter flight. This reconnaissance vehicle will permit him to observe the enemy at much greater ranges and this will give him the necessary planning time in which to base his request for nuclear support. Helicopters will also permit the Battalion Commander to exert more personal control over his large battalion area.

The question of control of the brigade perhaps should be mentioned. It is visualized at present that Corps will initially control brigade groups and that there is a limited need for a divisional headquarters. Much criticism has been voiced on the need for a divisional headquarters. No doubt the divisional headquarters of the future will undergo major changes. The power of the various commanders and advisers on this headquarters will be greatly reduced in the future. Is there any need for the service representatives as we have them at present? If divisional headquarters is to function effectively is should be pruned. It should become a second planning headquarters as in the nuclear

age one missile can destroy the complete headquarters organization in one blow.

This widely dispersed battalion/brigade group organization visualizes our complex and tedious battle deployment procedure undergoing a radical change. Commanders in the future must be able to operate on instructions rather than detailed orders, but everyone must know the overall plan. Leaders should be prepared to issue and receive orders or instructions by wireless and there may be occasions when, for the sake of speed, junior officers may not see the ground over which they are to operate. Training of junior officers and non-commissioned officers should also undergo a radical change. Section commanders must be prepared to act on their initiative at all times. The junior officer and non-commissioned officer become extremely important in this new concept.

It may be argued that there are many reasons against the complete change round in organization and that our present organization should be adapted to meet the nuclear form. Arguments of finance are not really good ones, when one visualizes the vast saving in manpower, the saving on artillery (field artillery to go) the saving in maintenance (the old system — many different types of vehicles — new system — one only; armoured personnel carrier) and finally the cutting of many unnecessary appointments.

New firepower and mobility capabilities, plus new and improved means of control, permit wide flexibility in selection of the manœuvre plan. Tactics should be designed to locate the enemy, determine his configuration, deliver appropriate fires on acquired targets, and exploit the resultant situations with highly mobile forces. On a strategic level, forces must be organized and equipped so that they can be delivered by air or surface transportation to any area of the world for engagement in either atomic or non-atomic situations on any reasonable type of terrain. Suitable air and surface lift must be provided. The time of initial intervention, particularly in limited war, may be just as important as the time required to close a sizeable force.

— Brigadier-General T. F. Bogart, US Army

SOME PRACTICAL ASPECTS OF EARTH SATELLITES

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AN attempt is made to study the fuel requirements and accuracy requirements for present and future satellites, with a view to gauging the practicability of these projects. With this knowledge it is possible to assess a country's capability of embarking on Space investigations. The immediate uses of earth satellites are also discussed, particularly with reference to Pure and Applied Sciences.

Energy Requirements

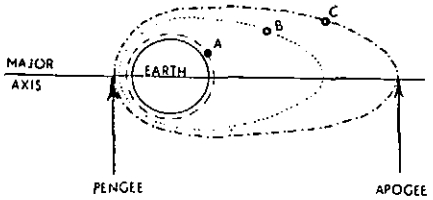
In an attempt to understand the implications of the present and projected journeys of satellites, it is worth while studying their energy requirements. Rather than talk in terms of strict energy units which would involve a certain amount of tiresome mathematics, we will speak in terms of "Equivalent Velocity Changes" necessary for a satellite to perform a certain function. There is a mathematical relation between "Equivalent Velocity Change" and energy but it is not important to our story.

The first fundamental point is that neglecting the resistance of the Earth's atmosphere (and this can usually be done), for a satellite to exist in a circular orbit close to the Earth the velocity in the orbit must be such that the outward centrifugal force exactly balances the gravitational attraction. Speaking in terms of "Equivalent Velocity", this means that to launch a satellite close to the earth (neglecting air resistance) it must be given a velocity of 4.9 miles per second. If the velocity is greater than this, the satellite takes up an orbit that is not circular but elliptical, and the greater this velocity, the more elliptical the orbit becomes. Figure 1 illustrates this.

Figure 1 shows that for a satellite which comes close to the Earth, increasing its circular velocity (4.9 miles/sec) results in an elliptical orbit which is distinguished by greater and greater distances of farthest departure from the Earth (apogee). These orbits will all have about the same close approach to the Earth (perigee).

For a given equivalent velocity, which is greater than the circular velocity, it is nevertheless possible to put the satellite *into an orbit which is almost circular;* but this orbit must have a greater perigee distance and consequently a smaller maximum velocity in its orbit.

If it is desired that the satellite follow a circular orbit at some significant distance from the Earth's surface,



Satellite close to Earth

	ORBIT	VELOCITY IMPARTED TO SATELLITE	LENGTH OF MAJOR AXIS
A	CIRCULAR	4.9 MILES/SEC	8,000 MILES
B	ELLIPSE	5.6 MILES/ SEC	11,200 MILES
C	ELLIPSE	6.2 MILES/ SEC	19,900 MILES

Figure 1. Satellite Orbits

naturally the circular velocity will be smaller. Table 2 illustrates this.

Table 2

CIRCULAR ORBITS

Height above Earth's Surface	Orbital Velocity in Miles/sec
Very Close	4.9
1000 miles	4.4
5000 miles	3.3
10,000 miles	2.65

If the equivalent velocity is increased to 7.0 miles per second the path becomes a parabola and the satellite will not orbit. This is known as the "Escape Velocity". The return journey to the moon is an example of an elliptic satellite orbit with a very long major axis. As a matter of fact, the equivalent velocity required for this orbit is almost equal to the escape velocity of 7 miles per second. Thus, to return safely to the Earth the whole of the satellite velocity would have to be cancelled by rocket action, and the velocity which would need to be given to the vehicle by the energy stored in its propellant would, therefore, have to be 14 miles per second.

This energy requirement can be further illustrated by another example of inter-planetary travel — a one-way trip from Earth to Venus.

Escape from Earth	7.0 miles/sec
Transfer from Earth's orbit to journey path	1.6 miles/sec
Transfer from journey path or orbit of Venus	1.7 miles/sec
Landing on Venus	10.4 miles/sec
Equivalent Velocity	20.7 miles/sec

This again is a measure of the velocity which would need to be given to the vehicle by the energy stored in the propellant.

The Energies Available From Known Fuels

The above considerations give us an idea of what energies are required to propel satellites, let us now study the energies available from known fuels.

A recent paper by Dr L. R. Shepherd suggests the means of solving this problem. In this paper he points out that the performance of a rocket vehicle, in terms of maximum velocity which can be achieved when all the propellant is expended and in the absence of a gravitational field, depends on the velocity of the exhaust gases relative to the rocket, and on the overall mass ratio —

$$\text{Mass Ratio} = \frac{\text{Mass of fully-loaded rocket}}{\text{Mass of rocket when empty}}$$

Even with a very high exhaust velocity however, such as is given by a combination of liquid hydrogen and liquid oxygen (2.36 miles/sec) the close satellite orbit still requires a mass ratio of 14. This cannot be achieved with single-stage rockets.

Moreover, the mass of an empty rocket is affected by the payload, which means that for a greater payload, the mass of the fully-loaded rocket must become even larger. However, by using a number of stages, fired in sequence, the total mass ratio is given by the product of the individual mass ratios. Table 3, taken from Dr Shepherd's paper, gives the ratio of payload mass to all-up mass which is available from currently known chemical propellants. The number of similar stages of equal-mass ratio required are also shown.

Let us taken an example and see what would be required to place a vehicle with a load of 200 lb of instruments on the moon using a rocket with liquid oxygen and kerosene as fuel.

The vehicle would require five stages and a take-off mass of 145 tons ($\frac{200}{.0003}$ lb) which is quite within the capabilities of currently used techniques.

However, for men to go and explore the moon and return, we can say conservatively that the payload (men plus transported earthly environment and instruments) would approach say 20 tons. On the assumption that the liquid hydrogen-liquid oxygen fuel system could be perfected; from the table we see that this would require a rocket of 100,000 tons take-off ($\frac{20}{.0002}$ tons). Since vehicles of this type are liable to cost between £5000 and £10,000 per ton of launching mass, it will be seen that the bill for a single vehicle would be between £100 million and £1000 million, which is quite a lot.

If the trip could be started, however, from a close satellite orbit, the vehicle would certainly be smaller, but the requirement would still exist to ferry the components of this vehicle into the orbit, and this is still a problem which needs to be solved. The real answer is undoubtedly the development of propellants with much higher exhaust velocities to make such projects "economic".

Importance of Accuracy

With only limited amounts of energy available, it is important that none is wasted in correcting launching errors later in the flight. For an unmanned vehicle using inertial guidance it is necessary to know what errors in guidance can be tolerated if the vehicle is to perform satisfactorily.

The following figures have been published by Milton W. Rosen on the "Vanguard" Satellite in order to keep the perigee distance at about 200 miles:—

(a) If the final orbital velocity at launch were more than 1 per cent short of the desired value for the appropriate height (4.76 mps) the satellite would fall below 200 miles on its first revolution, no matter what the elevation angle was.

(b) If the final orbital velocity at launch was 5 per cent above the desired value the apogee, instead of being 300 miles, could be as much as 1400 miles.

For more ambitious journeys such as moon trips, Hans A. Lieske has computed the permissible errors. He obtained the values shown in Table 4 using the nominal initial velocity away from the Earth as 6.65 mps at a height of 350 miles. As can be seen, these sort of accuracies are little short of fantastic — for example, 2 ft/sec represents an accuracy of .0057 per cent.

RATIO OF PAYLOAD TO LAUNCHING MASS (P) — Table 3

Journey and actual equivalent velocity required	EXHAUST VELOCITY							
	Liquid Hydrogen and Liquid Oxygen (2.36 mps)		Hydrazine and Liquid Flourine (1.99 mps)		Liquid Oxygen and Kerosene (1.68 mps)		Solid Propellant (1.37 mps)	
	P	No of Stages	P	No of Stages	P	No of Stages	P	No of Stages
Earth Satellite (6.2 mps)	.033	2	.022	3	.0096	3	.0037	4
Escape Rocket (7.0 mps)	.012	3	.006	4	.0019	4	.0004	5
One-way Moon Vehicle (10.6 mps)	.0042	4	.0012	4	.0003	5	.00006	6
Return Moon Vehicle (15.5 mps)	.0002	5	.00005	6	.000012	7	.0000006	–

Table 4

Requirement	Velocity accuracy required in ft/sec	Directional accuracy required in degrees
To hit the moon at all	± 40 ft/sec	± ¼°
To hit the moon within a given circle of 100 miles radius	± 2 ft/sec	± .01°
To put the vehicle into an orbit round the moon with an altitude accurate to within 100 miles	± 2 ft/sec	± .01°
To go to the moon, orbit, and land back on Earth with 1000-mile landing uncertainty	± 1.12 ft/sec	± .01°

NB — 6.65 miles/sec = 35,112 ft/sec

Immediate Uses of Earth Satellites

Even a satellite without instruments provides valuable information in many fields. In research its main advantages are its situation outside the Earth's atmosphere and the fact that it is falling freely. In other applications its value stems from its great height. Introducing instruments yields further reward, while the manned satellite is a research worker's dream. For the purpose of this paper we will consider the uses of satellites under two main headings, viz, "Research" and "Utilitarian" uses.

Research Uses

Astronomy

A wide spectrum of radiation in the form of light, heat, radio waves, etc, falls on the Earth from the sun and other bodies, but only a small portion actually reaches the surface. The remainder is absorbed by the atmosphere. Although absorption of certain radiation by the atmosphere is essential to life it is a source of frustration to the astronomer. He can only study celestial system optically or by radio in the frequency range 150 to 15,000 Mcs. Optical photographs are marred by fuzziness in reproduction which is again caused by irregularities in the atmosphere. A satellite equipped with telescope and camera would achieve optical results far superior to those obtained by the best telescope on Earth. There are two ways to get this data back to ground. It could either be transmitted by radio (telemetered) or else photographs could be taken and recovered later.

The most important regions of the spectrum are the Ultra Violet and the Cosmic Ray region. Simple studies on Cosmic Rays can be made using counter techniques.

Earth Sciences

Experiments with Earth Satellites can be of great value to the sciences of geophysics, geology, geomorphology, and

meteorology.. The following examples will give an indication of the type of information which is possible.

By precise measurements of the orbit of the satellite and the resulting knowledge of its regression and variation from a true ellipse, it is possible to get valuable data on the true shape of the Earth and the distribution of masses in its crust.

By installing a magnetometer (approx weight 3 lb) in the satellite, information about the Earth's magnetic field above the ionosphere can be obtained.

The descent of the satellite, if it is tracked accurately, will provide perhaps the most valuable data that a simple satellite can give, namely a measure of the atmospheric density at great altitudes.

By using such substances as sodium vapour or nitric oxide to mark the path of the satellite, the behaviour of the vapour, its rate and manner of dispersal, will give information on the processes occurring in the upper atmosphere.

The study of radio propagation from the satellite will furnish information about the ionosphere.

Meteoric dust which impinges on the satellite skin, causing erosion, can be easily studied using certain radio-activity techniques.

A very simple photocell in the satellite could make continuous measurements of the Earth's reflecting power (albedo) as the vehicle travelled above the atmosphere, so that a fair picture of the cloud distribution could be obtained for use in meteorology and weather forecasting.

Physics and Chemistry

Although early satellites will probably be mainly concerned with physical or chemical experiments which are connected with the upper atmosphere, satellites present the scientist with a new set of conditions for experiments. For example, the study of particles in free space will be of interest.

Similarly the study of materials and rates of chemical reactions under extreme conditions of temperature and radiation is very important.

Biological Sciences

Obviously before man can travel in outer space, the behaviour of organisms in these regions (free-fall regions) must be studied. The study of food supplies, air supplies, biological functions, psychological effect, needs to be carried out in flights of long duration, before man is ready for space travel. Experiments with animals will probably precede those with humans.

Solar System Studies

Most of the previous research applications mentioned require the telemetering of data back to Earth. When a satellite can be put into a free orbit round the moon, it will be essential to radio information back concerning the conditions encountered there. It would be ideal to use television, but the present size of power supplies for such equipment is too great. Further problems will be encountered due to cosmic-ray bombardment affecting practically all electronic equipment and photographic film.

Utilitarian Uses of Earth Satellites

General

As an instrument of surveillance the potentialities of a satellite are enormous. Its orbit can be chosen in such a way that it can rapidly encircle the Earth in a few hours or it could be orbited to remain stationary above a particular place; this in itself is full of possibilities.

Observation

By equipping the satellite with a television camera, detailed observation of the Earth and lower atmosphere is possible. The following are the types of information that could be obtained:—

(a) Path of hurricanes.
(b) Troop movements.
(c) Shipping and aircraft movements.
(d) Nuclear tests.

(e) Icebergs.

(f) Thunderstorms.

Navigation

A satellite that was clearly visible at all times would, of course, be a valuable aid to navigation, but until high-powered solar batteries can be developed that would make the sattelite continue to shine at night, such a device is not practicable.

Radio beacons on the Earth are limited in range; but this is not so if a satellite beacon could be used. One suggestion has been to consider three polar-orbited satellites each containing transmitters. The position of an observer on the ground could then be fixed with an electronic sextant and an almanac. This system would have advantages where hourly fixes were required under conditions which preclude normal celestial navigation.

Communications

Two basic systems are possible. Either the satellite is used as a simple metal reflector, or else it acts as a relay station, having an in-built transmitter and receiver.

In the first system, transmitters and receivers on Earth making use of reflection from a satellite would require automatic tracking mechanism to follow it across the sky.

Introduction of relay equipment simplifies the ground equipment; but the satellite requires a power supply. It appears possible that this may eventually come from solar or nuclear sources.

The possible applications to television are immense. By means of a hovering satellite acting as a relay station the range of TV can be increased to almost any distance required.

Military Uses

Since the establishment of an Earth satellite is largely the result of military research into rockets, it is important to consider its military aspects. Some of these are as follows:—

(a) It has great propaganda value since it flies over enemy territory unhindered.

(b) It has great observational power and forces considerable concealment which is a hamper to mobility.

(c) It is probably not of great use as a launching platform for nuclear weapons since these can be delivered so much cheaper by guided missiles.

Russian Satellite Programme

It may be fitting to conclude with a few words about the Russian programme. In general it appears that the Soviet satellite programme does not coincide on all points with that of the United States. Summarized the Russian programme appears to have the following *main research objectives:*—

(a) Temperature, pressure and density of the upper atmosphere.

(b) Structure and chemical composition of the ionosphere.

(c) The nature of corpuscular solar radiation (eg, electrons, propons, neutrons, alpha-particles, etc).

(d) The composition of cosmic radiation and variations in this radiation in terms of time and latitude.

(e) Measurement of the solar ultraviolet and X-ray radiations.

(f) Measurement of the electrostatic field of the upper atmosphere.

(g) Composition and variation in time of the terrestrial magnetic field, and the origin of so called circular currents.

(h) The effects of a cosmic environment on living creatures and the physiological results of weightlessness.

Strategic Review

The Middle East

SINCE the dawn of recorded history the area now known as the Middle East has been one of the most important strategic areas in the world. Two thousand years before the birth of Our Lord it was a great corridor of commerce and conquest. Through it the ancient Egyptiac, Sumeric and Syriac civilizations exchanged their merchandise and marched to war. Through it the East launched their onslaughts upon the West, and through it the West delivered their counter-strokes.

For a time the development of the ocean-going ship and the discovery of the Cape route lessened the importance of the Middle East as a military and commercial highway. The ship gave the merchant a better means of peddling his wares, and enabled Europe to counter the Islamic invasion by sailing around its flank and attacking it at its source. Then the opening of the Suez Canal restored the Middle East to its ancient commercial, and consequently military, importance. Quite apart from any economic value of its own, the importance of the area purely as a commercial highway may be gauged from the fact that in the year 1950 traffic weighing 81,795,523 nett tons passed through the Canal. If all this shipping had to pass around the Cape of Good Hope transportation costs would rise enormously. To give but one example — an oil tanker running between New York and the Persian Gulf would have to travel another 6000 miles.

The Middle East has always been a turbulent place. No sooner has one disturbance subsided than another has boiled up. Today three ingredients are working like yeast within the area itself to produce an explosion — Arab nationalism, Israel and oil. And on the edge of the brew stand the opposing rivalries of Communist ambition and the vital interests of Western civilization.

As used by a good many writers the term 'nationalism' seems to have an undesirable ring about it. Nationalism in fact may be a very good thing provided it is tempered with reason and with consideration for the rights and interests of others. With that proviso it can, even when narrowly based, be the source of inspiration and impulse for good. It becomes evil only when it lends itself to the advancement of demagogues, or permits itself to be used as a pawn by great powers to further their own ambitions. In passing it may perhaps be noted that a good many people, driven by nationalistic fervour, are attempting to take from the book of history a page that Europe seems about to turn over.

Fundamentally Arab nationalism is more broadly based than most nationalisms. Its emotional appeal lies not so much in a passionate attachment to this or that area of ground as in the concept of the brotherhood of all Arabs, in the dream of the restoration of the unity the Arabs enjoyed under the Caliphs. Superimposed on this dream of reunification is a thick crust of dynastic and family feuds and rivalries shot through and through with personal greed and ambition. It is this crust, of course, that catches the eye, but we should be very unwise indeed to ignore the strength, dimensions and purity of the current beneath it.

Colonel Nasser at any rate has not ignored Pan-Arabism. If Pan-Arabism had not existed he would have had to invent it. For Nasser's ambitions extend far beyond the delta of the Nile. Other, gentler dreamers could see no way of

providing the political unity without which Pan-Arabism could not find practical, constructive expression. From the beginning of his meteoric career he was in no doubt at all that he could provide the leadership and that he was going to do it. Shrewd, daring, resourceful, he has skilfully bent Pan-Arabism to his own purpose, and has already achieved a measure of the longed-for unity. The United Arab Republic of Egypt and Syria was proclaimed on 2 February 1958, the announcement stating that the Republic would have one flag, one army, and a presidential, democratic constitution. In the few months that have elapsed Yemen has joined the new Republic, and the real ruler of Saudi Arabia, the power behind the throne, has signified his approval and support. Against these successes the cousinly rulers of Jordan and Iraq, whose version of Pan-Arabism does not visualize Nasser at the top, have to some extent merged the political institutions of their two countries. Lebanon, with strong commercial ties with the West, has refused to join Nasser's Republic.

Early in his career Nasser tried to have the best of both worlds, to simultaneously extract the utmost economic advantage from the West and from the Soviets. In this game the Soviets took the longer, more ruthless view. They made commercial deals with Egypt without bothering too much about their economic soundness. They provided Nasser with arms when the West sought to restrict the supply in order to maintain the balance of power as between Israel and the Arab states. Ostensibly because he had arrived at the conclusion that it was economically unsound, the American Secretary of State suddenly withdrew financial support for Egypt's Aswan dam project. Nasser, no doubt with Soviet connivance, responded by seizing the Suez Canal. From the resultant armed clash and sulphuric diplomatic debate, he has emerged, whether we like it or not, with his reputation very greatly enhanced. On the material side, if he failed to get finance for the Aswan dam, he did get the Canal and the British military base in Egypt and all that it contained. And the poorly-timed, badly-conducted Anglo-French attempt to regain possession of the Canal enabled him to avoid the appearance of military defeat at the hands of Israel.

Thus, through Western ineptitude on the one hand, Soviet shrewdness on the other, and Nasser's personal ambitions in between, the tide of Arab nationalism seems, for the time being at any rate, to be running strongly against the West. Although Pan-Arabism has so far failed to find the political unity it dreams of, there is one unifying factor, one common denominator of aspirations which no Arab ruler or government can afford to ignore. That factor is the State of Israel.

Israel established herself as a nation by the ruthless, bloody application of force soon after the close of World War 2. Wherever our sympathies lie we cannot ignore the fact that over a million Palestinian Arabs were driven at the point of the bayonet from the land they had occupied for 700 years, driven out into the wilderness to survive as best they could. A nation which establishes itself by these means cannot expect to be loved by the dispossessed. In this case the dispossessed, who cannot be absorbed by the economies of neighbouring Arab states, are still eking out a miserable existence in refugee camps. To the running sore of hatred thus created must be added the deep injury to the national pride of all the Arabs.

Israel is a tiny state poorly endowed with natural resources. She is taking in immigrants at a terrific rate. The Arab states see in this phenomenon an ever-increasing threat to their own security. As they see it, sooner or later Israel must attempt to relieve the pressure on her resources by expansion — and expansion can take place only at their expense. Thus to the emotion of hatred is added the emotion of fear, and the one feeds upon the other.

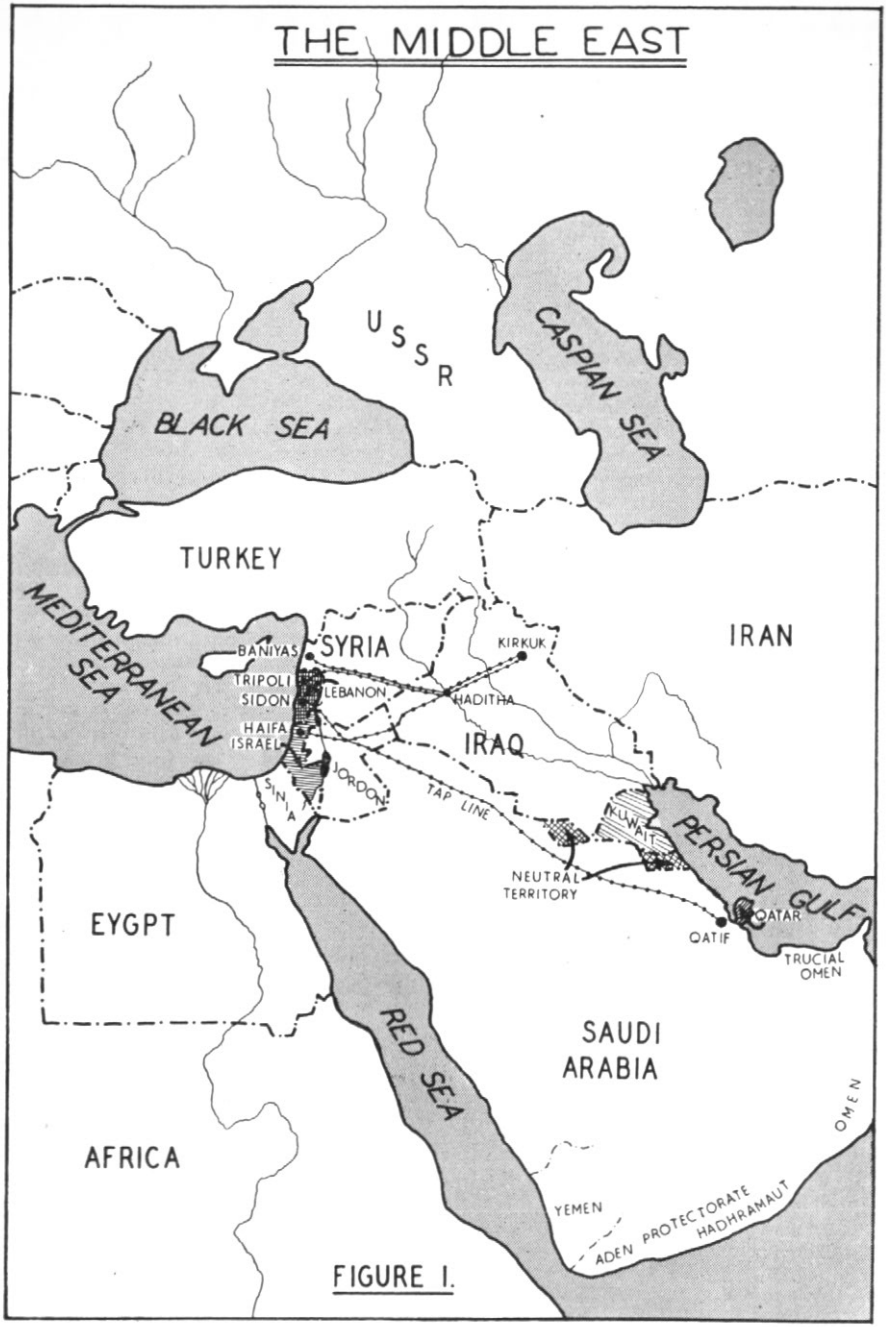

THE MIDDLE EAST
U S S R
CASPIAN SEA
BLACK SEA
TURKEY
MEDITERRANEAN SEA
BANIYAS
SYRIA
KIRKUK
IRAN
TRIPOLI
SIDON
LEBANON
HADITHA
HAIFA
ISRAEL
IRAQ
JORDON
SINAI
TAP LINE
KUWAIT
PERSIAN GULF
NEUTRAL TERRITORY
QATAR
QATIF
TRUCIAL OMEN
EYGPT
RED SEA
SAUDI ARABIA
OMEN
AFRICA
YEMEN
ADEN PROTECTORATE
HADHRAMAUT

FIGURE I.

The Arabs maintain that the Western powers have favoured Israel from the very beginning. They point to the strong moral support given by the United States to the establishment of the new nation, and her eagerness to recognize its existence. They maintain that it was American pressure which impelled the United Nations to impose an armistice at the moment when they had a good chance of winning. Furthermore they maintain that the Western powers have denied them the arms necessary to enable them to redress their wrongs, but have at the same time provided Israel with sufficient war material to enable her not only to maintain a state of equilibrium, but to strike swift expanionist blows. It was this sense of frustration which drove Syria to accept Soviet weapons, with consequential Soviet infiltration, in the first place, and into the arms of Nasser in the second place.

Thus Arab hatred of Israel is a compound of a desire for revenge for the wrongs inflicted upon their people and very real, practical fear for their own security. On this point all Arabs, no matter what their station in life, are brothers. On this point all their governments are closely united. No Arab government which sought to arrive at an accommodation with Israel could maintain its authority for long.

What an opportunity for stirring up trouble this situation presents to the Soviets. They have no commitments at all to Israel, they have no inhibitions, their hands are completely free. Overtly and covertly they can materially and morally support the Arabs against Israel. The West, on the other hand, must try to walk a tight-rope. Support of the Arabs against Israel could land their governments in serious political difficulties at home, while support of Israel would increase the hostility of the Arabs and tend to drive them still further into Soviet arms. It is all very difficult.

Then there is the oil, the life blood of modern industry and modern war. 64.1 per cent of the proved oil reserves of the world lie in the Middle East, though at present only about 20 per cent of the world's actual production comes from there. This 20 per cent, however, represents the imposing total of 2.41 million barrels a day, a great deal of which goes to sustain the wheels of European industry.

Originally oil from the Persian Gulf was shipped to Europe through the Suez Canal. But with the development of the Kirkuk field, which is about equidistant from the Persian Gulf and the Mediterranean, the economic advantages of piping oil direct to Mediterranean ports become over-riding. Accordingly a pipe line was built from Kirkuk to Haditha. At Haditha the line branched, one leg going to Haifa in Israel and the other to Tripoli in Lebanon. In 1945 work was started on the duplication of these lines, but the refusal of the Arab states to allow oil to go through or to Israel led to the abandonment of the Haifa leg. To compensate for the loss of this capacity, another line was built parallel to the Kirkuk-Tripoli line as far as the Homs gap, thence along the Lebanese coast to Baniyas. With the further development of the Persian Gulf fields another line was built from Qatif in Saudi Arabia to Sidon in Lebanon. At present this line known as the "Tapline" has a capacity of 320,000 barrels a day. When the construction of additional pumping stations is finished it will have a capacity of 410,000 barrels a day. Between them the three lines deliver about 785,000 barrels a day to Mediterranean terminals. All the lines run through Arab lands and can be cut with the greatest of ease. A glance at the map shows that it is not possible to build a line from the fields to the Mediterranean which is not subject to this disadvantage.

When the flow of oil through the pipelines and the Suez Canal was interrupted for a short period during the Suez crisis in 1956 an immediate oil shortage occurred in Europe. This shortage was overcome with much difficulty and at great expense by pressing into service every available tanker and augmenting

the flow by the Cape route with heavy shipments from the United States and Venezuela. The immediate economic effects may be gauged from the fact that Middle East oil costs 2.59 dollars a barrel at Mediterranean terminals; American oil costs 3.00 dollars at USA ports and 2.80 dollars at Venezuelan. The additional tanker mileage also had to be paid for.

The 1956 stoppage lasted only a short time, and the crisis was overcome without wrecking the European economy and without unduly overloading the alternative sources of supply from the western hemisphere. However, it is not hard to imagine the very serious effects on Europe's economy and war potential which would follow from a prolonged stoppage, or a recurring series of relatively short stoppages.

It is interesting to note the proximity of Soviet air bases to the Middle East oil fields. From Russian territory near the Caspian Sea to the head of the Persian Gulf the flying distance is about 700 miles, while to the Kirkuk field it is only about 320 miles. Both these producing areas, together with their loading or pumping installations, are within easy reach of Soviet light bombers.

For centuries Russia has aspired to warm water ports and access to the Mediterranean through the Dardanelles. Revolutions don't change fundamental national ambitions, they change only the means of attaining them: That the Soviets inherited the ancient dream of the Czars is shown by the wording of a secret protocol attached to the draft treaty between Germany and the USSR in 1940: "The Soviet Union declares that its territorial aspirations centre south of the national territory of the Soviet Union in the direction of the Indian Ocean." What could be plainer than that?

Russia has always pursued her aims with remarkable patience and persistency. She is pursuing them today throughout the world by exerting steady, unremitting pressure at all points. Nowhere is this pressure greater than in the Middle East. At the time of writing a rebellion, Communist inspired and aided by Syrian and Egyptian 'volunteers', is raging in Lebanon with the avowed object of detaching that country from its Western interests. Trouble is simmering around the important communications centre of Aden. When that dies down trouble will brew up somewhere else. The Soviets will see to that.

Most Western people, and perhaps some Western governments, are still thinking in terms which rigidly compartmentalize international relations into several distinct forms of activity — hot war, cold war, and diplomatic debate. The Communists gave up thinking that way long ago. There is a unity about their thinking on international relations which ours does not have to anything like the same degree. They see every event, from polite diplomatic exchanges to armed conflict in its various graduations, as but different aspects of the same conflict, directed towards the same ultimate aim. With energy, persistence and patience they seize upon every situation and endeavour to develop it to their own advantage.

There is no doubt that the Soviets have developed the situation in the Middle East to their own decided advantage. The realization of Russia's ancient dream is almost within their grasp. Clearly the initiative lies with them, and they are moving things along at a cracking pace. If events continue on their present course, and there is little reason to think that they will not, it is not improbable that the point will soon be reached when the West will have to surrender its last foothold or fight for it. If they surrender it or lose the fight the effect on the whole world strategic situation will be immense.

1 June 1958 — E.G.K.

Chinese Emigration in the Pacific

Staff Sergeant P. G. Gittins,
20 National Service Training Battalion

LIKE the Briton, the Chinese are found nearly everywhere. The Chinaman has the faculty of making himself at home abroad; and, like the Briton, he looks forward, after making his pile, to return to his home and spend the remainder of his days in ease and comfort. And again like the Briton, the countries he blesses by his presence owe to him, in some cases, their economic and financial salvation, and in others, incalculable benefits to him.

How well adapted John Chinaman is for going abroad, the following quotation from Sir Walter Medhurst's pen will show —

"The phases of character in which the Chinese possess the most interest to us Western peoples, are those which so peculiarly fit them for competing in the great labour market of the world. They are good agriculturists, mechanics, labourers and sailors; and they possess all the intelligence, delicacy of touch, and unwearying patience which are necessary to render them first rate machinists and manufacturers. They are, moreover, docile, sober, thrifty, industrious, self-denying, enduring and peace loving. They are equal to any climate, be it hot or frigid; all that is needed is teaching and guiding, combined with capital and enterprise, to convert them into the most efficient workmen to be found on the face of the earth.

"Wherever the tide of Chinese emigration has set in, there they have proved themselves veritable working bees, and made good their footing, to the exclusion of less quiet, less exacting, less active, or less intelligent artisans and labourers".

Early Emigration

It is not only in recent years that the Chinese have gone abroad as emigrants, diplomatists, and students, but records show that they were as enterprising and daring in their expeditions in former periods as any Western nations were at such times. The use of the mariner's compass enabled the Chinese to put to sea with a confidence they would otherwise not have possessed when fogs obscured the headlands by day or mists clouded the stars at night.

The compass was first used by the geomancers who even observed its variation. A simpler kind was employed at sea, and this compass, so primitive in its construction — and it is interesting to note it was originally a floating compass — has been used by the Chinese for about eight hundred years. They took voyages to Japan and Korea — one to the latter country being taken three hundred years before Columbus launched his frail barques in search of the New World across the Atlantic.

They not only went in their own vessels, but during the T'ang Dynasty, in the 9th Century, the Chinese merchants at Canton were in the habit of chartering foreign — probably Arab — vessels with foreign sailing masters to trade between Canton and Colombo. They took carrier pigeons with them, and sent back word by them to their charterers.

The Mongols, ruling at one time in both China and Persia, carried on intercourse between these two countries by sea — thus circumnavigating Asia — in large fleets, carrying ambassadors and merchandise. Aided by the compass and taking advantage of the north-east monsoon, they started on their long and hazardous voyage, returning with the favourable gales of the south-east monsoon. Traffic was even kept up to recent years, with the numerous islands to the south-east of Asia in the neighbourhood of Malaya and the Straits Settlements, Borneo and Celebes; and the same navigation was carried on between the north and south of China till the steamer traffic drove the slow and unwieldy junk from the trade. In olden days, however, not only Java, but India, Ceylon, the Persian Gulf and Arabia were all visited by the enterprising and commercial Chinese. All this was done before the days of Vasco da Gama, and the credit of the first use of the mariner's compass must be awarded to the Chinese. The Arabs borrowed it from them, and it then passed to the Red Sea and the Mediterranean.

Marco Polo informs us that the Emperor of China sent ships to the southern part of Africa.

Emigration was, however, prohibited by Chinese law, but in spite of this large numbers of Chinese left their native country, either temporarily or permanently. To some countries, such as Malaya, there was for many years a constant emigration of contract coolie labourers, almost all from two or three of the south China provinces. Schemes for emigration to various other countries, generally speaking, did not prove successful.

An early intercourse between China and Malaysia and the surrounding islands is known to have existed. One work ascribes the beginning of this to the fifth century of the Christian era, and this intercourse was afterwards renewed in the 10th century. When the Portuguese first arrived in this part of the world in the 16th century, they found Chinese junks lying at Malacca, and what was evidently a prosperous trade being carried on by the Chinese. From all that can be gathered, they seem in these early days to have been birds of passage. At all events there is no evidence to show that they settled down amongst their new surroundings and became inhabitants of the land.

The following quotation relates to the early years of the 20th century:—

"The emigrants from China generally are all from the four maritime provinces of the empire — Kwangtung, Fukien, Chekiang and Kiangnan. Nearly all the emigrants consist of the labouring classes — fishermen, artisans and common day-labourers. They usually arrive at their places of destination in great poverty and are obliged to mortgage their labour to their resident countrymen in consideration of their passage money.

"From the nature of the emigration, the proportion of males to females is always great. The result of course, is that the increase of the Chinese population by natural means is very slow".

This paucity of women was one of the peculiar features of Chinese emigration. Naturally, children were also absent for, if those going to try their fortunes abroad had wives and children with them, they would be yet another economic burden. No doubt the abject poverty of most of the emigrants was one cause for all home ties being sundered, and almost none of the middle or upper classes were to be found amongst them.

Chinese in Malaya, the Straits Settlements and Singapore

In 1795 there were 3000 Chinese in Penang; in 1826, 6000 or more were in Singapore. By 1918 the Chinese in Malaya numbered a little over 1,000,000. Today the Chinese population of Singapore is about two-thirds the total population of the city. There are more Chinese in Singapore than in any other city outside of China.

The efforts of the Chinese have succeeded in producing more than half the world's tin supply. Their energy and enterprise have made Malaya what it is today and it would be impossible to overstate the obligation which the Malayan government and people are under to these hard working capable citizens.

Chinese furnish nearly all the miners, as well as the operators, in the tin mining and associated industries. They succeeded, employing primitive methods, where the Europeans failed, hence the tin mining is almost one hundred per cent Chinese owned and controlled.

The appointment of British residents to advise the Malay rulers dates from about 1874. During the following thirty years it was Chinese capital and Chinese effort, employed in working the rich alluvial tin deposits, that brought into the country its large Chinese population, and enabled the government to raise from them a revenue more than sufficient to pay the costs of administration and to construct all necessary public works, including thousands of miles of excellent roads and a thousand miles of railway.

Though tin mining and rubber production give employment to the great bulk of the Chinese population, these industrious people are the principal shopkeepers and contractors. Some sons of these early emigrants have filled many subordinate posts in the government service, and many rendered sterling service during World War II.

Chinese in Indonesia

The majority of the Chinese emigrants to the islands known now as the Republic of Indonesia came there during the period 1860 to 1918. Of those in Java, most of them live in the main cities and towns, a result of early Dutch laws restricting their dwelling places.

The Chinese are settled chiefly in Java, Borneo, Banka, and the east coast of Sumatra. In Java, the Chinese, through their control of the revenue farming system, had a wide field for extortion and "squeezing" among the people. The danger in Java arises not from their number but from the power they wield in the economic and financial spheres.

Chinese in Indonesia earn their living by cultivation, mining and trade. Without Chinese labour and resourcefulness the Indonesian tobacco, tin mining and spice industries would never have reached the standard they are today.

The Chinese seem destined to be the future inhabitants of this part of the world. They land as coolies, but their industry and superior qualities to those of the natives raise them speedily to the position of planters, shopkeepers and merchants.

Chinese in New Guinea

According to world population census figures, there were three Chinese in Australian New Guinea (then known as British New Guinea) in 1890-91.

In New Guinea at the turn of the century, experience proved that for plantation work no other labourers can compete with the Chinese and by the end of the First World War their numbers had increased considerably. Here the story is the same as in Malaya and Indonesia, a type of "From Rags to Riches" story.

Chinese in Australia

The first settlers from China seem to have been those who entered Queensland between 1840 and 1859, encouraged by white settlers who needed shepherds, convict labour being insufficient to meet the demand. It was the discovery of gold that led to the influx of Chinese and by the end of 1859 it was estimated that there were some 42,000 Chinese on the goldfields, a considerable part of this population, however, being transient.

If it had not been for Chinese industry and Chinese labour and enterprise, many parts of Australia would have remained worthless.

As a point of interest, a genuine Chinese newspaper printed in Australia was started in Sydney in 1895 under the title of "The Chinese Australian Herald".

Since those days, the Chinese population in Australia has been decreasing, until today it is only a few thousand, living in their own particular sections of our capital cities.

Conclusion

With its congested areas and wide empty spaces, Asia thus affords glaring contrasts as a whole and in its parts. While the mass of the population in the more densely populated agricultural areas has been static, historically some groups have been remarkably mobile — nomads from Central Asia ever intruding into the agricultural plains of China, Indians and Chinese voyaging into Indonesia and the Pacific Islands, Slavs trekking into Siberia — so much so that in some cases so-called aboriginal peoples hold no ancient title to their lands. The Sino-Japanese War caused even more large scale shifts of population.

Population has reached or exceeded food producing capacity in certain areas — particularly China and Japan. Although China's industrial potential and possibilities may be considerable, they have been little exploited and, under the existing living conditions, the widespread poverty reflects a condition of over-population. One of the possible remedies, or perhaps reliefs, would be internal migration and emigration. It is estimated that there are some 10,000,000 Chinese nationals abroad today. This figure, compared with the population of China, reputed to be "somewhere between 450 millions and 500 millions" is but a pinprick.

Peoples like the Chinese, with their fierce "nationalistic" spirit, migrate only reluctantly when compelling circumstances — unemployment and the threat of starvation — force them to move. Exclusion from countries of immigration on grounds of race and colour creates a sense of injustice and resentment and a powerful feeling of national unity.

Will the present day leaders of China use this attitude as an excuse to start a "hot war" in the already troubled Pacific area? Will they, when the time is ripe, when their military forces are strong enough, start a mass migration to the islands of the Pacific?

A Military Approach To Child Delinquency

Lieutenant-Colonel H. Fairclough, ED
Australian Staff Corps

THE world-wide problem of child delinquency appears to have most nations, including the USSR, baffled. Probably the reason for this is wrong thinking on the subject because, in my opinion, child delinquency should be re-christened "Parental Dereliction" or "Civic Confusion". Just as nations or countries are supposed to get the Governments they deserve, so do organized communities get the delinquency they deserve.

In Syria during the war I once caused the Baalbeck Gendarmerie to arrest a young lad, after repeated warnings, for stealing army property in the shape of tins of jam. He was taken away and lodged in the appropriate place. The following morning I was visited by two women in deepest black and heavily veiled. One of them was the mother of the lad in gaol. The purpose of the visit was to get me to release the boy because under Syrian law the moment he was arrested the police put his father in gaol for not having brought his son up better. Perhaps there is a moral but it is quite certain that young people do not become delinquent without cause.

However, the purpose of this article is to describe an experiment undertaken in Western Command, which, as far as can be ascertained, is unique in the world. Strangely enough, a few weeks after the start of this scheme a retired General in the USA suggested, in a letter to "Time", that delinquents should be handed over to the Army.

It is necessary to give readers a little background as to what happens to a young lad in Western Australia apprehended in committing an offence. He is brought up before the magistrate in the Children's Court and sentenced to whatever period of detention is decided upon and it may, of course, be anything from a month to two years. The detention is served in the Stoneville Reformatory for boys, an unfenced institution from which many abscond. Depending on their behaviour there they can graduate to Point Walter, an intermediate Department of Child Welfare institution, and eventually get their discharge when the sentence has been completed.

During their detention at Her Majesty's pleasure the boys are under the control of the Child Welfare Department which has certain authority to release them on parole and to check up later by means of probation officers.

To take a young lad out of the community and confine him in detention and then return him to the conditions and circumstances in which he committed his offence in the first place is to invite him to repeat the performance, and many of them are only too willing to oblige.

Basically, it is the lad's environment and conditions at home with the overriding consideration of no parents or disinterested parents which send him on his way of misdemeanour/offence/crime. What to do to correct this state of affairs and to fill in the vacuum in their lives caused the Director of Child Welfare in Western Australia to approach the Army for the use of Training Depots, and so the scheme developed.

I will not weary you with the preliminary details, but it was finally arranged that a training depot would be made available for 2½ hours on Monday, Wednesday, and Friday evenings. 40 Warrant and Non-commissioned Officers from Western Command volunteered to give up their own time, as required, to give instruction to the lads.

It will be readily seen that, in fact, there are too many volunteers but it shows how interested members of the Army are in the idea.

The opening night and subsequent nights produced a weird menagerie of no-hopers with duck's bottom haircuts and wearing clothing which would defy description, and that applies also to describing the reaction of tough Army instructors when they first caught sight of them. Nevertheless a valiant effort was made without much luck until it was realised that the boys selected for the initial effort were beyond the pale, or most of them were, anyway.

So a new start was made with a not so hardened class of delinquent but who still wore weird clothing and strange looking haircuts. To encourage these lads, many of whom were on parole, a system of points was devised, and on attaining 2000 the lad was free of his obligation. The 2000 points were given for the usual things like attendance, punctuality, tidiness, keeness, sport and so on, and this points system was the beginning of the success story.

The nightly procedure was, and still is, for the Department of Child Welfare's PT instructor to take them for PT and games, and then the Army instructor weighs in with a periods in instruction ranging from map reading through weapons to underwater swimming. The Army instructor takes the subject in which he is most proficient. The lads have watched coast artillery shoots, films at the Command Library on all kinds of subjects and have been introduced, and allowed to take part in, the activities of the Western Command Skin-Diving Club. One public-spirited civilian has taken them out on his yacht as a special reward for their keeness in sport. The lads have played the Army team basketball and are interested in other sports.

A point to remember is that Army instructors were forbidden to criticise haircuts or clothing. The result today is, that of their own volition, the lads have Army-type haircuts and bodgie clothing has almost completely disappeared. They are contented and reasonably happy, and the scheme has proved an undoubted success, earning the gratitude of the Western Australian Government. The Department of Child Welfare has had enquiries from other States about the scheme and now wishes to enlarge it. Of a total of 91 who passed through the classes, eleven have fallen from grace, but on the other hand some of them have volunteered to keep on with the classes after they have earned their freedom.

The scheme has proved a success because it has filled a vacuum in the boys' lives and the instructors, by not preaching to them but by setting an example, showing kindness and taking an interest, have made them feel they are wanted and are worthwhile members of the community.

What may you ask is in it for the Army. This: Firstly, the Army increases its standing in the community by undertaking a worthwhile task outside its normal functions. This is a great asset in public relations. Secondly, many of these boys have high IQs, initiative and plenty of guts. Because they have been silly enough to pinch a car when there are hundreds to choose from every day of the week when they have no one to control them or when there is nothing else to do, it does not necessarily mean they are criminals or even potential criminals. Many a reader will no doubt recall some episode of his or her youth which would be rather embarrassing now if recorded on their annual confidential report. These boys are a potential source of recruits and so far this year two have enlisted, two more are enlisting, and many others are interested.

Thirdly, it provides the Army instructors with a chance to display their leadership as many of them never see troops — one example, a transport NCO in Command transport office.

There is a very satisfying and rewarding value for anyone in a position to help these lads, and apart from individual successes such as enlistments, there is the tremendous interest the subject invokes whenever it is mentioned, and it is quite stimulating to find everyone so willing and eager to help.

The Department of Child Welfare and the Army can do splendid work in this field with mutual advantage and there should be no bar to its extension throughout Australia. Indeed should it become Australia wide, the very word delinquency could well disappear from the columns of the daily press.

COMPETITION FOR AUTHOR

The Board of Review has awarded first place and the prize of £5 for the best original article published in the May issue to "Nuclear Warfare and Signal Communications" by Major W. H. Walters, Royal Australian Corps of Signals.

OPERATION OF THE AUSTRALIAN TARIFF BOARD

Major R. W. Swartz, MBE, ED, MP
Royal Australian Infantry

SUCCESSIVE Australian Governments have used the Customs tariff to assist Australian industries subject to competition from imports. The Tariff Board was created in 1921 to advise the Government in regard to proposed tariff changes.

The Board is an independent body, the members of which are appointed for fixed terms and can only be removed from office by action in the Parliament. Appointments are made so as to reflect the diverse interests of the community. Its functions are purely advisory and, whilst it has considerable powers of investigation, it has no executive authority.

Tariff Board References

Although the Board is authorized to conduct inquiries into certain subjects on its own initiative, the subject matters of its inquiries are normally those referred to it by the Minister for Trade. The type of questions which the Minister may refer to the Board are set out in Section 15 of the Tariff Board Act 1921 - 1953. In practice, most references are concerned with —

(a) The level of protective duties.
(b) Other methods of assisting Australian industries in competition with imports.
(c) The admission of goods under By-law.
(d) The imposition of dumping duties.

Numerically at least, questions of protection are the most important.

References relating to the assistance to be accorded Australian industries usually arise out of representations by local manufacturers for the imposition of protective duties or for increases in existing duties. If those representations establish a prima facie case for assistance, the Minister refers the matter to the Board for inquiry and report. However, the Minister may refer such a question to the Board on his own initiative if it appears that the duties on a particular product are no longer appropriate.

Personnel of the Board

The Tariff Board consists of the Chairman and six other members who are appointed by the Governor-General for periods of from one to five years and who are eligible for re-appointment. The Act provides that at least two (but not more than three) members must be, at the time of their first appointments, officers of the Department of Trade. The remaining members are men with wide experience in such fields as commerce, industry, banking and primary production, so that the Board at any time contains a wealth of knowledge and experience covering all facets of the Australian economy.

The members of the Board are assisted in the work of investigation, research and report-writing by a staff of trained officers.

Board Inquiries

The Board is permitted to hold inquiries in any part of the Commonwealth which it deems convenient. In practice this means that the Board sits in those places where the industry concerned is located. Inquiries in most matters are held in Melbourne and Sydney, other centres being added to the list as occasion warrants.

For the purpose of inquiries the full Board of seven members usually divides into two "committees", each consisting of the Chairman and two or three other members. Each "committee" has the full powers of the Board as regards the conduct of a specific inquiry and the submission of a report thereon.

The Board periodically publishes schedules of proposed public hearings, showing the time, place and subject of each hearing. It is obliged by law to advertise every inquiry in two newspapers circulating in each State in which the inquiry is to be held. The Board also has an extensive mailing list for all circulars and makes every effort to ensure that all interested parties know of all hearings.

Most of the Board's hearings take the form of public inquiries with evidence being taken on oath. All interested parties are entitled to appear before the Board, including manufacturers, traders, importers and consumers. The right of United Kingdom producers to appear or be represented at Tariff Board inquiries are specifically stated in Article 9 of the United Kingdom-Australia Trade Agreement. Although not guaranteed by treaty, representatives of producers or other interested persons or organizations in any other country are also accorded full rights of appearance at Board inquiries.

Evidence to be given at a Tariff Board inquiry is submitted in the form of a written statement which is sworn at the public hearing and on which the witness may be questioned. The Board takes evidence of a confidential nature in private and, although it uses this in preparing its report, does not publish such evidence. The Board has power to summon any person to appear as a witness before it and to compel him to produce all relevant books and documents.

Tariff Board Reports

After hearing the evidence presented at the public hearings and obtaining all other relevant information which may be available, the Board prepares a report for the Minister. The report sets out the requests received, a summary of the evidence given and relevant information on the local and overseas industries, including such matters as costs, material supplies, employment and other factors. These are followed by the Board's comments and conclusions and finally by the Board's recommendations.

In arriving at its recommendations the Board endeavours to provide adequate protection for economic and efficient Australian industries. The United Kingdom-Australia Trade Agreement provides that protection by tariffs shall be afforded only to those industries which are reasonably assured of sound opportunities for success, and also that the Australian Customs tariff shall be based on the principle that protective duties shall not exceed such a level as will give United Kingdom producers full opportunity of reasonable competition on the basis of the relative cost of economic and efficient production.

The Board has stated in annual reports that it would be guided by these principles even if they were not written into the trade agreement with the United Kingdom.

Action on Board Reports

All reports containing recommendations for assistance to industry whether by means of duty or bounty are submitted by the Minister to Cabinet for consideration. They are then examined by Cabinet in the light of overall Government policy.

If it is decided that the recommendations should be adopted (as happens in the great majority of cases) it is occasionally necessary to modify by negotiation our international commitments — for example, those which have been entered into under the General Agreement of Tariffs and Trade — before taking action to put the recommendations into effect. Any problems which arise from our international commitments can be overcome, when necessary, by making use of the special provisions of the various agreements for the modification of tariff commitments.

It only remains then for the normal Parliamentary machinery for tariff amendments to be set in motion and the new rates become applicable.

Annual Report

The Board is also obliged to submit an annual report, for tabling in Parliament, on the general operation of the tariff and the development of industries. These reports contain a general review of factors affecting the Australian economy during the year and the problems of Australian industries. The annual report of the Board has come to be regarded as one of the most important general reviews of the Australian economy available and is widely quoted and publicized.

The Board now has behind it almost forty years of factual reporting and careful and impartial analysis. It has built up an enviable reputation and its reports and recommendations are generally accepted without question by all sectors of the Australian community.

There are obvious advantages in having a tariff advisory body such as the Australian Tariff Board, and several overseas countries, after studying the Australian system, have set up tariff tribunals modelled on similar lines.

BOOK REVIEW

VICTORY IN PAPUA. By Samuel Milner (Office of the Chief of Military History, Department of the Army, Washington, USA).

THIS volume, one of the series THE UNITED STATES ARMY IN WORLD WAR II, is the seventh to be published in the sub-series THE WAR IN THE PACIFIC. It tells the story of the war in the South-West Pacific Area from the Japanese conquest of Indonesia to the Allied victory at Buna.

This book is military history at its best. While presenting an accurate, well-documented account of events, the author invests his narrative with life, colour and dramatic values. Unlike much that passes for military history, no punches are pulled in this volume. The effect on green, half-trained troops of their first encounter with the enemy in tropical jungle, the failure of commanders, the clash of personalities, are all honestly and vividly described.

Australian readers will be particularly interested in the section dealing with the decision to defend Australia on the approaches rather than on the mainland itself. The concept of continental defence was forced upon the Australian Chiefs of Staff, not because anyone liked the idea, but simply because they had nothing like the naval and air forces necessary to protect their sea communications with New Guinea, nor could they at that time see any prospect of Allied assistance on the necessary scale. They estimated that it would take at least 25 divisions to hold Australia against the scale of attack to be expected. And having nothing like that number in hand or in prospect, they were forced to concentrate their attention on the defence of the vital Brisbane-Melbourne-Adelaide triangle. Nevertheless they planned to impose the greatest possible delay on the enemy in his approach to this area.

Quoted documents make it clear that it was General MacArthur who decided to defend Australia on the island approaches rather than on the mainland itself, and that he took this decision immediately after his arrival in this country. He assumed as a matter of course that he would be given sufficient naval and air support to ensure a successful defence of the continent at its approaches, an assumption that the Australian Chiefs of Staff were in no position to make.

Three weeks after MacArthur's arrival the Australian Chiefs of Staff in conjunction with MacArthur's headquarters, prepared a joint appreciation of the situation. The appreciation noted that the enemy had virtually undisputed control of both sea and air in the South and South-West Pacific and could be expected to undertake an offensive in great strength against Australia's supply line and against Australia itself in the very near future. The one part of Australia essential to the prosecution of the war, the appreciation continued, was on the south-east and east coasts in the general area between Melbourne and Brisbane. The "critical point" which controlled this area was Port Moresby, against which a major offensive could

be expected at any time, for the enemy was known to be concentrating heavy forces at Rabaul. If Port Moresby fell to the Japanese, its loss would put in immediate jeopardy the safety of Australia's all-important area — the Brisbane-Melbourne coastal belt. Therefore a maximum effort would have to be made to provide additional air and sea power for the defence of Port Moresby and the other threatened areas. A successful defence would require several aircraft carriers and at least 675 land-based aircraft.

The means for putting this strategy into effect were already coming to hand. 7 Australian Division had reached Adelaide from the Middle East and the main body of the 41 US Division was disembarking in Melbourne. 32 US Division was under orders to move to Australia. The US Air Force in the South-West Pacific was being rapidly brought up to strength and additional warships were arriving for the Allied naval command. That was quite a different situation from the one faced by the Australian Chiefs of Staff a month earlier.

Important points for controversialists to note are that the decision to fight on the approaches was taken by MacArthur as the result of a purely military appreciation, that it was taken immediately after his assumption of command, and that its implementation depended on the provision of adequate naval and air forces.

The strategy of this phase of the war in the South-West Pacific — the phase which ended with the Allied recapture of Buna — is treated in detail and with liberal reference to official documents. In the tactical sphere, since the volume is one of a series dealing with the US Army in the war, the emphasis is on the action of the American troops. That does not lessen its interest or importance to the Australia soldier, nor indeed to anyone concerned with the training of forces for employment in tropical warfare. The outstanding lesson clearly implied in the narrative is that unless these forces are thoroughly prepared, intellectually and physically, for the conditions they will encounter, and unless they are backed with adequate logistic support, very unfortunate results are likely to accrue.

This volume bears all the evidence of an authoritative account of the campaign, and the author appears to have spared no effort to present an accurate, objective and lively story. The text is illustrated with excellent coloured maps and numerous black and white sketches.

— E.G.K.

1 May 58