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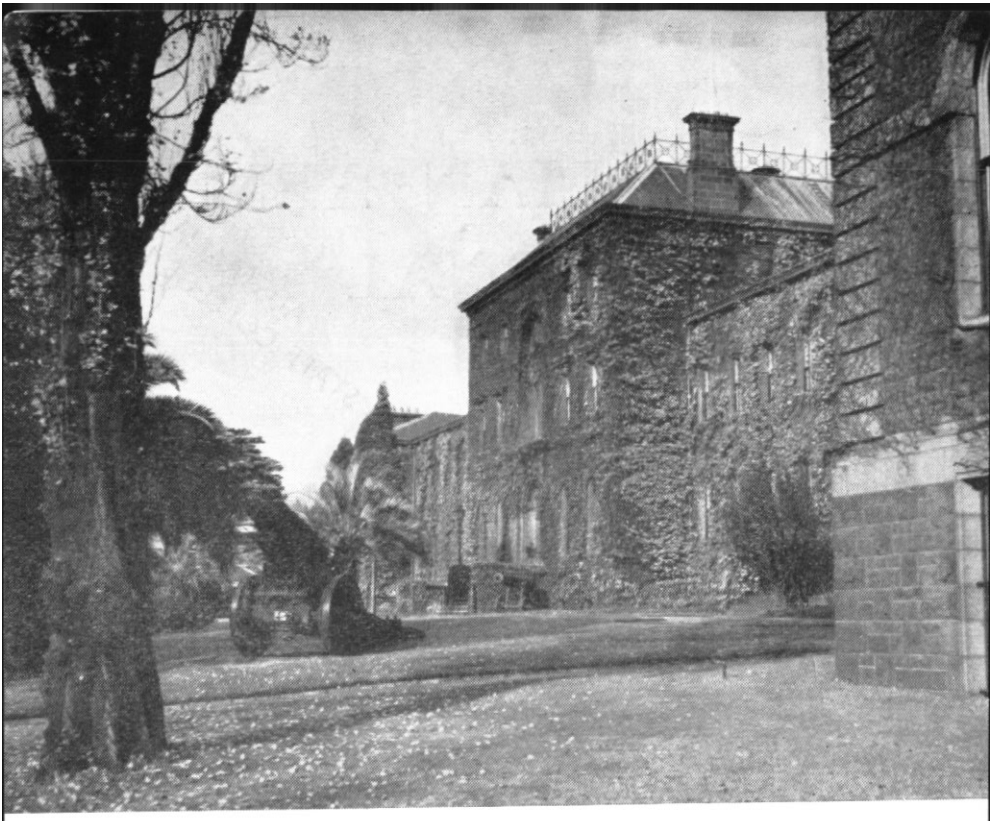

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WATER SUPPLY
in
NUCLEAR, BACTERIAL and CHEMICAL WARFARE

Lieutenant J. B. K. Ley, BCE,
Royal Australian Engineers

SYNOPSIS

Aim

To maintain the supply of water to an Army in the field for drinking and cooking in an area subjected to nuclear, bacterial and chemical contamination.

Considerations

Radioactivity is a natural phenomenon which exists to a greater or lesser extent in all matter. It is harmful only when the body is exposed to too much of it for a sufficient length of time. Therefore the problem is not to eliminate radioactivity from a water but to reduce it to a safe level.

Failure to take precautions with a water supply would have a military effect only in the case of an atomic bomb attack on a large scale with ground bursts or a hydrogen bomb.

The water itself is not affected, but only the matter suspended or dissolved in it. Water protected from "fall out" in a covered service reservoir or in covered tanks or tins is therefore unlikely to be affected.

Chemically, a radioactive material is the same as a non-radioactive one. Its radioactivity is not affected by heat or other chemicals. The problem therefore is reduced to the removal of suspended and dissolved matter from water and the ordinary water treatment

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methods apply except that as the harmful amounts of certain radioactive materials are so very small the degree of purity to be aimed at is very much higher.

No field method of determining the amounts of individual radioactive elements has yet been devised, but this difficulty has been partially overcome by adopting detection equipment which measures the total radioactivity and assuming that the proportions of the various radioactive elements occur in a fixed ratio in any "fall out." In the event of a bomb being disintegrated before exploding or of a ground burst, the actual proportion of the radioactive materials may be very different from that assumed, and values of the gross radiation as detected in this manner, although within the assumed safe limits, may still be dangerous. Therefore, there is a need for a simple, quick means for determining in the field the proportion of the more important elements responsible for the radioactivity in a water.

Much of the "fall out" from an atomic explosion is absorbed by the top inch or so of soil or by porous sands, gravels and rocks; but water flowing off a rocky or snow-clad catchment or underground through fissured rocks can be expected to contain a high proportion of this "fall out." Therefore, natural means of extraction should not be relied on unless shown by test to be safe.

Bearing in mind that an army in the field needs simplicity but can exist on a relatively small quantity of water, no known method other than distillation is likely to give the very high standard of treatment required from any sort of water without highly skilled supervision and complicated control apparatus.

Existing army equipment will give some measure of protection, and there is a need to investigate thoroughly just how much. It should therefore be retained, and in addition distillation equipment could be added at the rate of three 350 gallon an hour "vapour compression" stills to each division, with an additional three such units in reserve.

Distillation also removes bacteria, but in the case of war gases further information as to their complete removal is required.

Plan

To keep informed about developments overseas, to test the effectiveness of existing army equipment, and to obtain details of vapour compression stills, select one, purchase it, and test it in the field.

Aim

To maintain the supply of water to an Army in the field for drinking and cooking in an area subjected to nuclear, bacterial and chemical contamination.

Responsibility

It is the responsibility of the Royal Engineers to maintain the supply of water, which is one of the basic needs of a soldier, at specific points within each divisional area where

units can obtain their supplies in their own vehicles.

It is the responsibility of the Royal Medical Corps to see that the supply is wholesome, and to direct the Engineers as to what steps, if any, are necessary to ensure this.

General Considerations

Water catchments are often very large, and ample opportunity exists for a source of water to be contaminated even in peace time, unless very severe precautions are taken. Often, as far as bacterial infection is concerned, contamination is accepted as inevitable, and the water is sterilized apart from being treated before being put into supply.

Underground water percolating through fine sand and rocks is less likely to be polluted. But many waters flow from the surface through underground channels and rock fissures, and although the chances are much better, the fact that at the drawing point the water is underground is no guarantee of its purity.

In peace time, although the main risk is of bacterial infection, there is also the possibility of contamination by radioactive materials or by poisonous chemicals. In some parts of the world, where there are large industries situated on the water catchments, these risks have to be considered very seriously.

In wartime the chances of contamination by all means are much greater. A water can be polluted directly by enemy agents, from aircraft, or by missiles. It can also happen, incidentally, as the result of nuclear or gas attack.

An army in the field requires comparatively simple methods of detection and standard means of treatment. Fortunately a soldier can fight with only a small fraction of the water required by a civilian, therefore methods of treatment which may be economically practical to an army may be too expensive for a town.

Radioactive Considerations

Fundamentals

Radioactivity is not a new thing; it has existed since the world began. Although some natural radioactive substances such as radium and uranium may possibly occur in dangerous concentrations, most natural radioactive substances are harmless and all living creatures contain minute amounts of them. One of the most universal is radioactive carbon.

Radioactivity is therefore not a harmful thing in itself. It becomes harmful only when the body is exposed to too much for too long.

The damaging effect of radioactive particles is increased when they are ingested or taken into the body. A water whose radioactivity may be quite harmless externally may be dangerous to drink.

It is not the radioactivity of water itself which matters but of the materials suspended and dissolved in it. The problem is therefore to remove these materials to within safe limits.

It is useful to remember that water stored in covered reservoirs, tanks or tins which are protected from the "fall out" of an atomic explosion should be safe to drink; but it is always wise to test the water

in case some dust may have got in by some unexpected means.

It follows therefore that the danger to water supplies increases with the amount of this dust. The amount will depend on the power of the bomb and its distance from the ground at the time of the explosion.

It is interesting to note that no casualties were reported due to the ingestion of radioactive materials after the atomic air bursts in Japan, and although various effects were observed in subsequent atomic tests it was not until the "hydrogen bomb" was tested that the effect of radioactive "fall out" in direct contact with the body, externally or internally, became an important consideration.

When radioactive material falls on to any catchment area there is a tendency for the radioactive elements to be retained on the ground over or through which the water flows. In fact, it has been determined that only some three per centum of the total amount finds its way into the main watercourses. However, although this may be expected on sandy or loamy ground, snow-clad or steep rock ground is likely to retain little of the "fall out," and in any case the danger will depend on the amount of "fall out" as well as the type of ground.

Therefore failure to take precautions with a water supply is likely to have a military effect only in the case of atomic attack on a large scale with ground bursts or of a hydrogen bomb.

Units

The unit of radioactivity is called the "curie," which is defined as the quantity of any radioactive nuclide (or species of atom having a specific mass number, atomic number and energy state), in which the number of disintegrations a second is 3.700×10^{10}. For water supply purposes it is convenient to use one-millionth of this or a micro curie (written μc/cc).

Although there are only some 98 elements, there are about 800 isotopes or elements which are chemically identical but differ slightly in weight from the fundamental elements. For example, there are five isotopes (or kinds) of carbon of atomic weight 10, 11, 12, 13, 14, usually written C^{10}, C^{11}, C^{12}, C^{13}, C^{14}.

As a radioactive substance is chemically the same as a non-radioactive one, the treatment problem therefore is the removal of matter in suspension and solution from water. That matter may or may not be radioactive.

In waterworks practice the amount of material in water is expressed by weight as so many parts in a million parts of water (written ppm). On the assumption that a particular isotope is fully radioactive, $7.66 \times 10^{-9} \times A \times T \times y$ ppm is equivalent to y μc/cc, where A is the atomic number and T days the radioactive half-life (the time for the intensity to fall to half its value).

Tolerable Quantities of Radioactivity

The following maximum quantities expressed in ppm have been tentatively adopted as standard by the International Commission on

Radiological Protection for a Drinking Water. The very smallness of these figures emphasizes the potency of certain radioactive elements:

	PPM
Radium (Ra^{226})	4×10^{-8}
Calcium (Ca^{45})	5×10^{-9}

It should be noted that of the calcium present in a water only a proportion in any practical case would be the isotope Ca^{45}, and so the figures for the total calcium would be greater than that quoted, but still very small indeed.

These quantities are conservative and assume a lifetime of consumption, and are of the same order as the concentrations in certain naturally radioactive waters which have been consumed without any observed ill-effect for many years. The tolerances to be permitted under the stress of war are likely to be of the same order of smallness as those listed by the International Commission as safe for consumption over short periods of time, of, say, 10 days. But even if the wartime consumption tolerance be a 1000 times as great as the lifetime figures the standard of purity is still extremely high, much higher than has ever been faced in water supply practice before, and it would still require a trained chemist with special apparatus to detect such minute quantities.

Radioactivity in a water is reduced not only by ageing, which is quite marked for those isotopes of short half-life, but also by settlement, by removal biologically, and by the natural replacement of the contaminated by fresh water.

In this latter respect care needs to be exercised in interpreting allowances for exposure to contamination for short periods. In particular, it should be noted that in England the water is commonly replaced in storage reservoirs every 30 days, and rivers discharge their total contents to the sea within 10 days. This does not necessarily apply in other countries. In Australia the water in storage reservoirs and in some rivers may not be replaced by natural flow for more than a year.

Detection of Radioactivity Simple, Identification of the Elements Responsible Difficult

The special skill and special apparatus needed to detect the presence of dangerous quantities for specific radioactive materials in water make it impractical for such determinations to be made by actively engaged troops. Also from a water supply point of view, as water catchments are often large, the dangerous area is likely to be large. Some radioactive dust is liable to travel a long way either by wind or by flowing water. Therefore, either some simple means of detection should be devised without the need to identify the elements causing the radiation, or else the decision as to when precautions against radioactive material should

be taken and as to when they are no longer required should be taken at the highest level acting on information from units in the field.

In this respect it should be noted that instruments are readily available which indicate the presence of radioactive materials.

On the assumption that a bomb will produce from an air burst a mixture of radioactive isotopes in definite proportion, such an instrument can be used to measure the dangerous proportions of the elements that matter.

However, if the bomb instead of being an air burst hits the ground before exploding, the mixture of isotopes will not be that assumed, but will depend on the mineral contents of the ground at that particular place.

Also, in the event of a bomb being disintegrated, say by gun fire, without exploding, the mixture of isotopes again will not be that assumed but will be the material of the bomb. In this latter respect, however, the danger will depend upon whether that material is wholly radioactive, whether or not it is finely dispersed, and on its solubility.

Therefore, although such instruments are useful, their limitations should be borne in mind, and there is a need for a simple quick means of determining the proportions of the more important isotopes responsible for the radioactivity in a water.

Not Many Radioactive Isotopes are Likely to be Dangerous in Water

Radioactivity not only persists in some isotopes much longer than in others but the intensity varies from one isotope to another. The activity of the isotopes of many elements is of such short duration or of such low intensity as to be harmless from a military water supply viewpoint. Although many of the 800 isotopes can be radioactive, only a few are of importance.

It would appear that from a water supply point of view the isotopes which matter most are:—

Strontium	Sr^{89} and Sr^{90}
Iodine	I^{131}
Barium	Ba^{140}

Substances do not lose their radioactivity by combining chemically with other elements or when subjected to electric fields or to heat. The activity is maintained despite outside influences, other than nuclear bombardment, and gradually becomes less and less potent.

Each element has its own characteristic rate of decay, which for some is rapid and for others very slow. Rate of decay is expressed by what is termed the radioactive half-life.

The only practical means of dealing with radioactive substances, therefore, is to remove them or to store them until the intensity is of no consequence.

The effect of radioactive material on the body depends on the type of radiation, its intensity, its concentration in any part of the body, and its duration.

A quantity useful in assessing some of these considerations is the "biological half-life." This is defined as the period of time during which the amount of a particular radio-isotope deposited in the body is reduced to half its initial value. It depends on the ordinary radioactive half-life of the isotope which determines the natural rate of decay, and also on the rate of its excretion from the body.

An example of a substance with a long radioactive but a short biological half-life is Cesium "137." Although its radioactivity persists for a long time and takes 37 years to halve its intensity, since the body ejects this element quickly, its biological half-life is only about 15 days.

In this respect an element which is not absorbed by the digestive tract but is excreted quickly can be regarded as a source of external radiation only.

An example of a substance which is dangerous is plutonium. One reason for this is that in addition to having a long biological half-life, it expels alpha particles which have serious biological effects, and although of short range are capable of causing severe local damage.

It may be argued that plutonium is too valuable to be of consequence, and if it is used in a bomb it will be destroyed. However, only a proportion of the plutonium is disintegrated in the blast, and should a bomb be disintegrated before being exploded a large amount of plutonium may be distributed on a catchment.

One factor which makes plutonium of less importance is its high density. The coarser particles would not remain suspended in water and the finer ones should be the easiest to remove in any treatment process.

As this subject is so complex, and as the determination of what radioactive elements are present in any particular water would require a specially trained chemist with special apparatus, any method of extracting radioactive material from water should therefore be a routine process, not requiring special adjustment for whatever substances are present in any particular water.

Sabotage Not a Great Risk

Although at first glance it would appear a simple matter to plant radioactive materials in a source of water, it may not be so simple to do this with effect. If an isotope of high intensity but short half-life be chosen, it may be difficult to build up sufficient stocks to make the idea worth while. Isotopes of longer life and sufficient intensity are more expensive.

Another difficulty for the enemy is to place enough of the material at the point of attack to enable lethal amounts to be conveyed in suspension or solution throughout the supply, without rapid detection. Therefore, although direct contamination of a supply with radioactivity should not be overlooked, it does not appear to be as likely as incidental contamination, due to, say, nuclear attack.

Bacterial Considerations

In water supply practice, the word "treatment" is used to describe those processes which improve the qualities of a water

mainly by removing matter, and "sterilization" is reserved to describe methods of killing "germs."

The most general method of sterilizing water is by chlorination. In the army the method of testing as to the need for sterilization by chlorine, though rough by civilian standards, is safe and simply administered.

Organisms which thrive under conditions away from oxygen, called aerobic conditions, are rapidly killed by chlorine. However, organisms which thrive in the presence of oxygen, or aerobically, are more resistant to the chlorine.

It so happens that aerobic bacteria are not of great consequence. A prominent exception, however, is anthrax. It is not normally transmitted by water but as a weapon of war it may be practicable to make it so.

Anthrax in the spore form is resistant to heat, and survival depends on the time of boiling.

All methods of water treatment reduce the number of harmful organisms in a water. This is especially so with distillation. Should any organism survive the high temperature it is most unlikely that it would be carried over with the steam. Distillation, therefore, is a method of treatment which will also produce a water free of bacteria. In this latter respect it is already used in civilian practice.

Other methods of sterilization, such as high frequency sound waves, ultra-violet rays, and other chemicals are more complicated to use than chlorination or distillation, and are therefore not considered suitable for army purposes.

Chemical Considerations

That poisons of a purely chemical nature have not been more popular in recent wars is perhaps due to the difficulty in choosing a poison which is effective enough to inflict a worth-while number of casualties before it is detected and countered by the enemy.

The possibility of the use of chemical poison, especially of new or little known organic compounds, should always be borne in mind, but there is a much greater likelihood of an enemy using a substance which will inflict casualties anyhow and which incidentally will poison a water supply.

In this latter respect the greater scope is given by "gas," and more information is needed as to what hazards are known to exist.

War gases may possibly be carried by water in suspension or in solution. They may also hydrolyze and disintegrate into other substances which may or may not be harmful.

Even if it is difficult to detect in itself the number and type of casualties in the neighbourhood should indicate the presence of a war gas. As such a gas is likely to be detected, it should therefore be possible to devise treatment possibly by chemical means, then settlement followed by distillation. More information in this respect is needed.

Method of Treatment Available

Although water treatment does reduce the number of harmful organisms in a water, that effect is not usually relied upon. To ensure

freedom from infection, a water from a polluted source is sterilized after whatever treatment it may have been given.

Undesirable substances can be removed by methods of treatment which include:—

1. Chemical dosing and settlement.
2. Filtration.
3. Ion exchange.
4. Electro-ion-migration.
5. Distillation.

Chemical Dosing and Settlement: Filtration

Chemical dosing and settlement, and/or filtration, are excellent means of treating dirty water. Although much of the activity in the form of solid particles in suspension would be removed, the degree to which it is practicable to remove soluble particles is not sufficiently great to give the very high standard of purity under all conditions for complete safety against all radioactive substances. Until the standard of safe concentration of all substances is specified for wartime conditions, this cannot be stated with certainty, but it does appear to be most unlikely. A characteristic of these types of treatment is that chemical adjustments may be necessary to make a water suitable for treatment. In this respect certain natural clays and kieselguhr have been proved to extract a high percentage of radioactive matter from water. Unfortunately the data available is difficult to interpret because a percentage even as high as 99.9 does not give a guarantee of protection unless the initial or final quantities are also given.

Full protection will not be guaranteed by percentage removal, but only when a method of treatment extracts radioactivity from all types of water for all possible initial concentrations to within a safe residual concentration.

This does indicate that the existing army type kieselguhr filters may give a fair measure of protection, and therefore this method of treatment should be checked thoroughly.

Ion Exchange

In the ion exchange method any substance which dissociates on solution into positive and negative ions can be removed by passing the water successively through two groups of resin-like materials. The first exchanges its positive ion for the positive ion in solution in the water, and the second exchanges its negative ion.

This method is unsuitable for removing substances which do not dissolve. In particular, it is most unsuitable for a dirty water, as the exchange resins would quickly be blocked by the dirt.

Another disadvantage is that ion exchange gives variable performance which introduces the need to check the resulting supply, a difficult undertaking in the field. Initially, maximum extraction is obtained, but gradually the resins become "used up" and have to be "recharged."

To get over these difficulties it may be practicable to replace the batch process of ion exchange by the continuous process now to be introduced for the extraction of uranium from ore slurry.

In this new process the resins, by suitable vibration, are kept in suspension so that they behave as a fluid flowing in the opposite direction to the water to be treated. Regeneration can be arranged separately also in a continuous "counter-flow" manner.

The ion exchange process is of proved value in water supply practice for improving a supply which is already of a high standard, such as a municipal supply for "boiler feed."

It may be possible therefore to apply this continuous method in conjunction with other methods, but it is more likely to be suitable for civil defence rather than for army needs. In any case, the process is not as yet proved in practice, and it would therefore seem wise for the army to wait developments, while in the meantime to adopt a more practical method.

Electro-ion-migration

Electro-ion-migration or electro-dialysis is another method which is suitable for soluble substances, but which does not give a high degree of purity, and its field is likely to be where a high degree of purity is not required, such as irrigation. In any case, it is not yet proved of practical value.

A characteristic of the ion exchange and electro-ion-migration methods is that the amount of energy required is directly proportional to the amount of matter removed.

Distillation

Distillation is the one method which is suitable for all waters. The condensate is largely independent of the initial dirtiness of the water, and is the purest water obtainable. Stills are made as a matter of everyday practice which will supply water whose total impurities are less than half a part in a million.

All the heavier elements are eliminated beyond trace. Gaseous solutes are more difficult to remove, and therefore a careful check as to the danger in this respect should be made. However, bearing in mind that a natural water does not absorb much gaseous material, and only a proportion of what is absorbed is likely to be radioactive, the hazard in this respect should be negligible.

In recent years the old process of boiling water and condensing steam has been greatly improved. This has been accomplished firstly by multiple effect evaporators, which are really a succession of evaporating chambers, each at a lower pressure than the last; secondly, by flash distillation; and thirdly, by vapour compression distillation. In flash distillation the hot water in the boiler is kept at a pressure sufficient to prevent the formation of steam, and therefore of boiler scale, which, being a good insulator, reduces the efficiency. After leaving the boiler the superheated water is then allowed to evaporate in a special chamber. In vapour compression distillation, after evaporation in the boiler the steam passes through a compressor before reaching the condenser, which serves both to reduce the pressure in the boiler and to raise it in the condenser.

The incoming boiler feed water is used as the condensing water, so that the latent heat of evaporation is recovered in the condenser. Once

the unit is started up the only energy required is that necessary to run the compressor, and no further heating is required. The number of pounds of distilled water produced by each pound of fuel at 18,500 British Thermal Units a pound for each type of still is:—

	Pounds of Water	Gallons of Water
Multiple effect Evaporators	25 to 65	2½ to 6½
Flash Distillation	25 to 85	2½ to 8½
Vapour Compression	150 to 200	15 to 20

A characteristic of distillation is that it is suitable for all waters, and the amount of energy required is independent of the amount of matter removed.

Is Distillation Practical?

Bearing in mind that water is required to be practically free from radioactivity for internal consumption, that is for drinking and cooking, but that radioactive contamination does not preclude its use for other purposes, it would appear wise to allow for a liberal quantity for drinking and cooking, but not to supply drinking water for washing men or vehicles or for vehicle radiators.

A man can exist in an emergency on a third of a gallon a day, and as a minimum for cooking and drinking this is increased to one gallon.

The water vehicle capacities of the various units in a division vary from about 1-1/3 to 3¾ gallons a man. This variation may well be according to the need of water for other purposes and to the likelihood of some units being better situated than others with regard to the divisional water points.

From an administrative point of view there may be some advantage in continuing with the existing water vehicles whose capacities have been determined after considerable thought and experience, and that the overall allowance should at least provide for filling them once a day. This would also have the advantage that the existing methods of treating and sterilizing water could be retained until such time as war on a large scale occurs, when it would be relatively simple to introduce the distillation units at the divisional water points.

Therefore, although distillation could be organised on a unit basis, it would appear suitable to leave the existing system of water supply intact and to provide for distillation when necessary at the water points.

This method will relieve units of the need to carry and maintain equipment which may only be needed rarely.

Distillation of a water supply for a division could therefore be introduced at the divisional points without any great practical difficulty.

Fuel Requirements

The performance of a vapour compression still depends on the quality of the fuel and the initial temperature of the water as well as on the efficiency of plant. Between 150 and 200 pounds of water is delivered to each pound of fuel, of

18,500 British Thermal units a pound, consumed; so that all the divisional water vehicles could be filled once daily with distilled water using less than 200 gallons of fuel oil a day.

The Capacity of Plant Required

If it be decided to distil, the choice of size of distillation unit cannot very well be made until some information is obtained about the variation of overall dimensions and weight in relation to output.

Until this is known, it would appear likely that six 350-gallon-an-hour units to each division would be needed.

This size unit probably could be mounted in a lorry, and any three of them could supply the divisional requirements in 24 hours.

Cost of Plant

Vapour compression units are expensive. It should be borne in mind that at present the greatest use of this equipment is in ships where space is very valuable. Distillation saves water storage space, and therefore ship owners can afford to pay handsomely for efficient units.

If production be increased for standard units to fulfil service and civil defence needs, no doubt the cost could be reduced greatly.

The cost of a single 350-gallon-an-hour unit landed in Australia or made in Australia is likely to be about £25,000.

Courses Open

1. To do nothing but to await developments overseas. In any case, it would be wise to watch developmen's elsewhere; but in the meantime some practical means of tackling the problem should be adopted.

2. To experiment with existing army equipment to ascertain what degree of protection is given thereby and to try to improve that equipment. Although the existing equipment is not likely to give a sufficiently high degree of protection at present standards, in the event of these standards being much lower for short term emergencies a knowledge of the degree of protection afforded by this means may be well worth while.

3. To find out what is being done to safeguard water supplies at various test centres throughout the world. In particular, inquiry should be directed to the neighbourhood of hydrogen bomb explosions or small scale ground bursts rather than of smaller atomic weapons tested as air bursts. In this respect it is very likely that no water is being consumed from contaminated catchments, but that water is being carried in or else underground supplies whose source is outside the contaminated catchment are being drawn upon. In any case it should not be difficult to arrange for the collection of contaminated water to test the effectiveness of the various treatment processes.

4. To try and adapt the ion exchange method to army requirements. In this connection it may be possible to combine with the civil defence organization. This may well take perhaps some years of research, and in any case is more likely to be suitable for civil defence rather than army requirements.

5. To obtain details of vapour compression stills so as to select the best type and size for army purposes and try it out in the field. This has the advantage of immediately providing a way by which the objective can be attained.

Plan

To keep informed about developments overseas, to test the effectiveness of existing army equipment and to obtain details of vapour compression stills, select one, purchase it and test it in the field.

References

1. "The Effects of Atomic Weapons" prepared for and in cooperation with the US Department of Defence and the US Atomic Energy Commission—revised September, 1950.

2. "Recommendations of the International Commission on Radiological Protection," Supplement Number 6, British Journal of Radiology, London 1955.

3. "Limitations of Water Treatment Methods for Removing Radioactive Contaminants," by Conrad P. Stanb, Ph.D., US Public Health Reports, Volume 70 Number 9, September 1955.

The most vital quality a soldier can possess is self-confidence, utter and complete. You can have doubts about your good looks, about your intelligence, about your self-control, but to win a war you must have no doubts about your ability as a soldier.

—General George Patton, USA

The Army Great Britain Needs

Extracted and digested by the Military Review, USA, from Report of the British Army League Sub-Committee 1955 entitled "The Army in the Nuclear Age"

The British Army League is a group of eminent private citizens with political, military and business experience. Its membership includes members of Parliament, officers of the armed services and business executives. The report from which this article was extracted concerns itself with the changes in structure and organization of the British Army necessitated by the advent of nuclear and thermonuclear weapons into military consideration.

THE kind of army Great Britain needs depends on the kind of war that army is intended to fight. Throughout history, the major problem confronting military planners has been to decide what the next war would be like and to prepare for it in time. This problem of preparation has been complicated in the present period by the fact that our army has to discharge four major functions at the same time:

1. The conduct of cold war, involving operations against terrorism, sabotage and riots such as we have experienced in Kenya, Malaya and, last year, in the Suez Canal Zone.

2. The waging of regular but localized military operations such as the conflict in Korea.

3. The maintenance of preparations against the continuing danger of an immediate and general war.

4. The adaptation of our forces to the new industrial revolution which is transforming contemporary strategic and tactical conceptions, and already confronts the military planners with an entirely new situation.

These four aspects of our military effort are, inevitably, to some extent in conflict with one another.

Localized campaigns, such as the recent Korean and Indo-Chinese conflicts, have followed, more or less, the pattern of operations in the last war. Much the same weapons have been used, and many of the assumptions of 1944 have tended

to persist, thanks to the fact that, in both campaigns, the Western forces have enjoyed almost complete air superiority.

If a major war were to break out in the immediate future, operations would be altogether different from those of 1944-45. For one thing, we should almost certainly be on the defensive, not the offensive, on the ground at any rate, in Europe. For another, we might not even enjoy air parity, let alone air superiority. Beyond these there is now the probability of the strategic bombing of ports, bases and industrial centres with atom and hydrogen bombs. "Tactical" atomic weapons and guided missiles, moreover, are likely to be in general production well before the end of the present decade.

Let us consider what the effect of these new weapons is likely to be on the organization and handling of the army. It is, of course, possible that the hydrogen or atom bombs may never be used. The arguments for and against the use of these potentially decisive weapons go beyond the scope of this discussion. Many of them, indeed, are predicated upon very wide political and psychological assumptions. It must, however, be said that there is at any rate a probability that they will be used and that such a probability would become a certainty if one of the two contending groups of powers failed to adapt its defence planning to the new weapons.

The radius of destruction of the atom bomb is from 3 to 10 miles; that of the hydrogen bomb may exceed 50 miles. Both, moreover, have radioactive properties which give them a continuing destructive value for days or weeks after their immediate explosive power has been spent. The radius of action of nuclear weapons means that they need to be delivered much less accurately than high-explosive bombs. They are, therefore, better suited to being dropped from a great height or to being delivered by a guided missile.

It is arguable that the best defence against these weapons will ultimately lie in building so strong a system of radar, fighter aircraft and guided missile defence that the losses the attacker would have to sustain in the process of "getting through" to the target would outweigh the advantages of an eventual direct hit. Deep shelters for troops, essential industries, aircraft and other key installations may also provide effective protection outside the area of the direct hit. The development of the bomber and guided missile, however, suggests that, at the present time, the advantage is so much in the attacker's favour that dispersal offers the only hope of defence. Even so the term "defence" can only be used in a very relative sense.

Strategic nuclear and thermonuclear bombing is likely to interfere first of all with communications. Harbours, airfields, railway junctions and roads may be put out of action altogether. It will be essential to disperse the means of transport as much as possible. Ships must embark troops or supplies from barges. Aircraft must fly from a widespread network of airstrips rather than from major airfields. Such attempts at dispersion must greatly increase problems of supply

for the armed forces as well as for industry and the consumer.

It will, therefore, scarcely be possible to nourish large armies such as were supplied in the last war through main harbours and by long railway lines. On the contrary, the premium will now be on the force which is as fully self-supporting as possible; in which every man is a skilled mechanic capable of repairing as well as using his vehicle or weapon; in which there are no superfluous mouths to feed; and which will use its ammunition as sparingly as possible.

The trend to dispersal and smaller, more self-supporting armies will be intensified by the "tactical" use of atomic power. Atomic shells and other tactical atomic weapons will lead to still greater dispersal on the field of battle. Troop concentrations will be more vulnerable than ever. Movements will have to be undertaken across country rather than along roads. The swift-moving wheeled convoy will have to give way, at least in the front line, to the tracked troop carrier. Supply will have to be undertaken as much as possible by air, and more particularly by helicopter and other aircraft equipped with vertical lift and landing mechanism.

How will the development of tactical atomic weapons as well as the bazooka affect the use of armour? (Will it spell the end of the heavy tank, just as gunpowder spelled the end of the knight in armour?) This is by no means certain. The tank is a device to enable direct accurate fire to be delivered in the most effective way—that is, in the midst of the enemy or from his rear or flanks. In addition, modern improvements have given it speed and endurance, and with these the possibility of surprise. There is much to be said in favour of fleets of small swift tanks, each with a crew of 2 or 3—packs of destroyers, in fact, rather than capital ships. On the other hand, attempts to reduce size must be limited by considerations of speed, endurance, cross-country performance and the power of the weapons mounted, all of which are in favour of the large tank. Only a large tank, for instance, could mount atomic cannon.

Whatever the fate of the tank, the advent of tactical atomic weapons and the increasing tendency to dispersal should mark the end of high-explosive rifled barrel artillery just as the guided missile has already made the anti-aircraft gun virtually obsolete. Atomic cannon against major targets, and bazookas and mortars against vehicles and troops should largely take its place. This may effect some compensating economies in the cost of equipment and make possible some reduction of supply lines.

The loosening of the front, the dispersal of industry, civilian population, and communication centres, and the formation of temporarily radioactive or infectious zones will tend to encourage deep raids into enemy territory against industrial and political as well as against purely military targets. These will be undertaken either across country by armoured units or by airborne formations. Such raiding forces would have to live off the country with the addition of some air supply. They would probably

be kept small because of supply difficulties. Defence against them might consist of static troops guarding vital installations and supported by strategic reserves designed for the counter-attack.

The conception of war which emerges is one of widespread dispersal of economic life behind the front; of a very loosely manned front of cross-country or airborne raids by both sides deep into each other's territory countered by static, local defence forces based on deep shelters for troops and factories and backed by mobile strategic reserves.

It is, at the least, questionable how far the present structure of corps, divisions, and regiments would be suited to such operations. It seems possible that the conception of the task force, built with the battalion as the basic unit, may come to predominate. In any case, there would seem to arise a very clear distinction between the highly equipped, highly trained and highly mobile elite troops, used in the attack or as strategic reserves for the counter-attack, and the general defence in depth, which must be relatively static. The battle would be between task forces of a commando type against a background of strong points guarded by second-line troops and a home guard.

The tactical considerations enhancing the value of the individual fighting man will be still further underlined by the development of air transport. If you are going to fly troops across the world or from one part of the battlefield to another, each man must be worth the trouble and expense involved. Large masses of men, indeed, will still be required for the defence of vital areas behind the lines. This will be the main task of the territorial army. The troops, however, which are to be "dropped" into the attack or which are to be flown out to defend the Middle East or South-East Asia will need to be intensively trained elite formations.

If the above view of the likely evolution of modern war is correct, the army will have three main functions to fulfil.

First, it must supply the elite fighting troops. These will be relatively few in number, highly trained and young. They will form the armoured units, paratroops, commandos, and jungle or mountain task forces.

The second task of the army will be to provide troops organized for static defence in depth, for mopping up operations, and for the occupation of conquered ground behind the front. This second-line army would also be responsible for garrison duties in the different bases and fortresses overseas. Its main cadre would be provided by those officers and non-commissioned officers of the elite army who were no longer young enough or fit enough for commando type exertions or who could expect no further promotion in the elite army.

The army's third task would be the organization of factory, town and communication defences against deep penetration or airborne raids by the enemy. This would call for a home guard, which would be a compulsory service in time of war. Here again the cadre would be mainly drawn from those officers and NCO's of the first or second

line army who had reached the retiring age for their rank. Another aspect of the home guard's duties would be civil defence. Under the conditions of atomic and hydrogen bombing, this will assume a far greater importance than in any previous war. The ability of a nation to continue fighting under atomic and hydrogen bombing will depend as much as anything on the sucessful organization of civil defence.

There would thus emerge a pattern of three distinct services within the army—an elite mobile army, a territorial army for static defence and a home guard. The link binding the three together would be the regular officers, NCO's and other ranks who would automatically pass into the territorial or home guard army as they passed certain age limits for their rank. Anyone joining the regular army could thus look forward to a life career from the age of 18 to 55 or 60.

In theory it would probably be best if the elite army were composed entirely of regulars. Selective service would then be designed solely to train civilians for static defence and might be shortened accordingly. In practice, however, it is very unlikely for some time to come that the army could recruit enough regulars to meet all our different commitments. It might be possible with the help of colonial or other auxiliaries to make the South-East Asian and Middle Eastern strategic reserves largely a regular commitment; but the maintenance of four divisions on the Continent of Europe and the manning of our different overseas garrisons is likely to remain a selective service commitment as far ahead as can be foreseen. Even to make the Middle Eastern and South-East Asian strategic reserves entirely a regular commitment would only be possible if recruitment for the regular army could be very substantially increased.

Our group is of the opinion that three major considerations have to be borne in mind in considering how to increase the regular element in the army:

1. *Pay and Living Conditions.*—Higher pay, better food, and improved accommodation particularly for married personnel can play an important part.

2. *Prospects.*—We have laid stress on the conception of a 3-tiered army —active elite, static garrison, and home guard—whose cadre would be supplied at each stage by regular officers, NCO's and other ranks as they passed certain age limits. Thus a young man joining the regular army at 19 might look forward to 15 years with the active army, 10 years of static defence and garrison service, and a further 10 years in the home guard or administrative departments. The army would thus be his entire life and, on this basis, could provide him with an adequate pension on retirement.

3. *Modern War Demands Elite Formations.*—Such units as airborne and armoured units, and commandos have a glamour of their own which will draw recruits; hence the need to emphasize the distinction between the active army and the static and garrison formations.

The conditions of hydrogen war would make it virtually impossible

to carry out the mobilization of the territorial reserve as at present conceived. Plans should be made so that on the outbreak of war reservists would make their way automatically to assembly areas where they might be flown to safe areas overseas. They would then be available to carry on the struggle and defend the national interest should the British Isles themselves be temporarily put out of action.

COMPETITION FOR AUTHORS

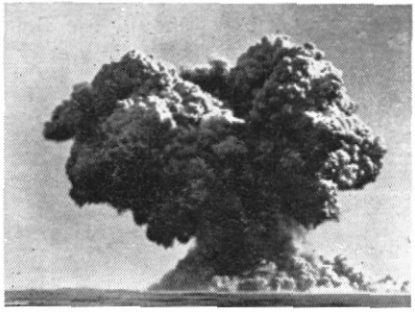
The Board of Review has awarded first place and the prize of £5 for the best original article published in the December issue to "Tibet — Past and Present," by Major G. M. F. Wood, Australian Intelligence Corps.

At the outbreak of war in 1939 Major Wood was a gunner in the Royal Australian Artillery (P) at Queenscliff, Victoria. He later transferred to the Australian Instructional Corps and became an instructor in various AIF and CMF training units. When the School of Military Intelligence was formed in 1942 he became the adjutant. Later he served as an Intelligence Officer in New Guinea and Bougainville.

Since the war Major Wood has filled Intelligence appointments in Southern, Central and Northern Territory Commands, and is at present posted to the Directorate of Military Intelligence, Army Headquarters.

Major Wood has contributed several articles to the Australian Army Journal, one of which has been reprinted in the Military Review, USA.

ORDER or ANARCHY



UNDER the ATOMIC UMBRELLA?

Lieutenant-Colonel A. Green
Royal Australian Army Service Corps

Simplification Through Nuclear Weapons

THE first nuclear attack, on Hiroshima in 1945, brought apparently instantaneous enlightenment to military thinkers. Here, in one device, was the ultimate simplification; destruction in the most concentrated and shattering form. After one hundred and forty years of progress in the art and science of war, during which the division had grown into a complicated serpentine a hundred miles long or a tortoise ten miles broad, depending on whether it was in movement or deployed, the physicists had produced one single effective answer to the intricate conventional organisms of warfare in all three elements.

Adherents of the Strategic Bombing School of thought were probably the most gratified, professionally, by the emergence of the new weapon. Proponents of the Douhet Doctrine—the belief that war should be waged directly upon the focus of modern life, the city—they had hitherto been frustrated during the five years of World War II by a series of indeterminate results. They had argued, logically, that as our modern mechanical and industrial civilization derives its main human and material resources for the prosecution of war from the great urban centres of population and the adjacent factories, the short

cut to victory lay in direct attack upon the moral and material heart of the enemy—his cities. Large-scale trials upon London, Coventry, Hamburg, Berlin, Leningrad and Tokio were still inconclusive. Despite great structural damage, these populations continued to work and produce, and their armies remained intact. Soldiers and sailors were able to contend that bomber attacks were better directed to selected strategic targets such as oil stocks or railways, or even to troop concentrations in the field, as was done at Caen. Since one of the major preoccupations of philosophers and scientists is the progress towards rationalization or simplification, this diversion of the long-range heavy bomber against subordinate targets represented a partial failure to the pure air power school, and postponed the emergence of air forces as the dominant forces in war. The possession of the nuclear weapon by the Allies accomplished the final phase of this military revolution. The mode of its employment immediately and strategically against Japanese cities and the prompt capitulation of Japan is the clearest evidence of that fact. Therefore, since 1945 the continued existence of city civilizations has been conditional upon at first the possession of nuclear weapons by one great and benevolent power and latterly the nuclear stalemate, since both USA and Russia have possessed stocks of these weapons.

The Nuclear Terrain

It has taken ten years of fluctuating post-war policies and strategy to formulate the pattern of war in the so-called Atomic Age. Unfortunately the conclusions derived from this experience are not all of that crystal clarity which the strategist would desire. One simple and indisputable factor has, however, come to be accepted. The nuclear weapon in both its strategic and tactical effects is more topographical than operational. It inhibits the growth, and threatens the existence of urban communities, and although so far tactically untried in the field, it has the power to disperse and canalize land and sea forces just as effectively as mountains or archipelagos did in the past. Moreover, the exertion of these effects is no mere passing phase of opportunity as with conventional weapons. It is by its nature as permanent as geography itself. Nor have the powers, major or minor, yet wholly and fully adapted themselves to this factor, hence much of the current confusion and flux in military and political thought. Statesmen and nations keep trying to avoid the dominant effects of nuclear weapons, and are constantly forced to revert to a position of subordination to them. They cannot be used, but they cannot be ignored.

Nuclear Weapons and Relative Vulnerability

The chances of nuclear warfare supervening, and of subsequent survival, appear to depend broadly on two main factors: the quantity of weapons and their means of delivery possessed by the major powers, and, reciprocally, the suitability of their respective target systems for nuclear destruction. It is almost certain that there are only three nations in possession of the weapons, America, Russia and

Britain, and that, whereas America probably has all the nuclear weapons she needs, Russia is dangerously well stocked, while Britain is apparently producing appreciable numbers of the weapons. Now it is also public knowledge that all three powers possess the thermo-nuclear weapon or hydrogen bomb, a purely strategic weapon of enormous potential. Judged from this positive angle, the USA has a real but probably diminishing lead and superiority in weapons and means of delivery.

In relative vulnerability the situation is quite different. Britain, with her concentrated population and industry in proximity to the European mainland, is far and away the most vulnerable. America, with her great metropolitan centres in the north-east, also presents appreciable targets, but at longer ranges and over a greater area. Russia is most favoured with well-dispersed industries and installations located on a great land mass. This factor considerably offsets any inferiority in Russian weapon stocks, and reduces the practicability of British participation in nuclear warfare to the degree of suicide.

Those nations which do not possess nuclear weapons are faced with a thorny dilemma. They may align themselves with one of the major protagonists, and risk committal to nuclear reprisal in the event of full-scale war, or seek a precarious neutrality, which yet cannot guarantee them immunity from war if their strategic position attracts belligerent interest. This is fundamentally the choice which lies before Australia, India, Indonesia and New Zealand and all the other non-nuclear powers.

The Nuclear Climate

The first use of nuclear weapons was justified by the argument that it shortened the duration of hostilities and, in effect, prevented the sacrifice of the countless soldiers who would have been required to assault Japan. The decision was made in the simplest context, since America alone possessed the weapon, although the Allies approved, and in certain instances encouraged its employment. The subsequent controversy as to whether the attack was necessary, since Japan was probably on the verge of surrender, is irrelevant, as the Allied Intelligence interpretation of Japanese intentions could only be conjecture at that time. Nevertheless the most potent counter-argument, of possible nuclear reprisal, was absent. The reaction of the more radical Asian press was spontaneous and critical. Notably, the Indian contention was that the use of the weapon was unwarranted and that, furthermore, it had been employed in a discriminatory manner, since it was believed that the preponderantly Western Allies, who had atom-bombed an Asian people, would not have used the weapon against European nations, e.g., Germany. This I believe to have been wholly erroneous, as Germany and the Allies tried to develop the bomb in time to use it in Europe.

With the advent of the post-war struggle for world leadership between the USA and USSR, there arose new postulates for the formulation of future strategy. On our own democratic side of the fence

we assumed that no democracy seeks to wage war; indeed, that was a proven article of faith during the Fascist aggressions of 1930-1942. Our main apprehension is now that the expanding forces of World Communism will use any and every weapon to further their bid for domination. Against this theory stands the interesting hypothesis of Arnold Toynbee, the historian, that Communist Russia has a fanatical sense of inner rectitude approximating in its policy effects to that of the early Christians, and that from this conviction there arises a fatalistic type of persecution mania, which assumes that the Non-Communists must inevitably attack Russia even as Hitler did. This, then, presupposes that Russian nuclear weapons would only be used in defence or retaliation, a somewhat specious, unreliable theory. In fact, when Truman and MacArthur disagreed over Korea the Americans obviously believed that Russian involvement there would lead to full-scale nuclear warfare.

Much play has been made since World War II of the need to return to an objective assessment of war aims and the methods of waging war. Unlimited warfare and concepts such as unconditional surrender have led to wholesale destruction and loss to victor and vanquished alike. A return to the limited wars of the eighteenth century is accordingly demanded, in which destruction is limited to that degree of force needed to attain reasonable national aims and advantages. The defensive ferocity of the democracies in World War II, in particular, has since been severely criticized. There is also a general plea to common Christian humanitarianism, that nuclear warfare by unrestricted destruction can only result in the collapse of modern civilization and all its attendant material and cultural benefits. This plea assumes the complete rationality and decency of human nature and omits all the contrary evidence from Genghis Khan to Herr Himmler. History proves that the forces of the spirit and the emotions have constantly dominated those of intellect and even self-interest, and that even a well-meaning, sentimental regard for the world we live in is undependable under the stress of national and personal conflict.

Thus much present discussion of nuclear warfare leads to that military *reductio ad absurdum* of Massive Retaliation. This doctrine has recently been debated during the American Presidential Elections and, in effect, was also voiced by Krushchev in his sinister threat of nuclear retaliation made against France and Britain during the Suez crisis. Massive Retaliation entails the constant readiness of large stocks of thermo-nuclear and fission weapons and their associated delivery vehicles to discourage from the outset any potential aggressor. American opinion was greatly exercised by the prospect of world-wide biological hazards arising as secondary effects from such operations, quite apart from primary destruction, and the defence scientists, whose politics seemed to influence their technical advice, did little to resolve this problem. Since both the major powers now clearly subscribe to this doctrine, as again witness the NATO assumption of nuclear warfare *à l'outrance*, as a basic

premise, the result is a varying but persistent state of political and military tension. This tension, however, has prohibited Russia or America from intervention in specific, tacitly-agreed areas, e.g., Korea, the Persian Gulf, because it has been recognized that any incursion there will most probably be immediately regarded as a *casus belli,* with catastrophic results. To this extent there has therefore existed for the past five years a curious atomic umbrella; not wholly storm-proof, but suspended over the whole field of international relationships—and warding off major cataclysms, paradoxically by constantly threatening one. It is this effect on which such strategists as Air Marshal Sir John Slessor rely when they declare that the prospects of major war have receded, since nuclear warfare will be profitless mutual suicide.

Sub-Nuclear Wars

Because major powers are prevented from waging major wars it does not imply that their political ambitions decay; far from it. War being the subordinate instrument of politics, the effect on great powers is to force them to operate through the agencies and proxies of allies and satellites. Nor is this a simple pattern of activity, because it is complicated by the national and economic interests and jealousies of the smaller nations. Thus, after a series of similar struggles based primarily upon conflicting ideologies, in Greece, Korea and Indo-China, we see a complex but old-fashioned struggle between opposing national interests in the clash of Israel, Egypt, Britain and France, a reversion almost to the type of wars past, albeit heavily imprinted with an additional factor of the all-pervading cold war.

After 1945 there was an idea current that the structure of international relations had crystallized into a rigid settled form for a long time to come, and was changeable only by negotiation. The Allies had won the war, disposed of the vanquished into spheres of influence and occupation, and the nuclear weapon had apparently rendered conventional warfare obsolete as a method of resolving international differences, so that the old methods of changing frontiers were no longer available. Russian intransigence and barefaced political warfare, however, soon dispelled any illusion that the *status quo* would be accepted by them, and during the subsequent interventions in China and in the Berlin blockade the new ideological alignment of great powers was clearly revealed, but war seemed practicable only for great powers, and that only at great risk.

Under this new dispensation the minor powers have perforce gradually evolved their own *modus operandi,* not only as pawns of the major powers but also as principals. Where their interests coincide with East or West they become agents in warfare at secondhand. As independent operators they may seek to create opportunities in which the major powers are so balanced that they will not interfere with the freedom of action required, e.g., Egypt in the Middle East. Such opportunities abound in areas where the decay of the old order has created a power vacuum. Thus the disappearance of the European

colonial powers of Britain, France and Holland, leaving unstable areas in South-East Asia, North Africa and the Middle East, has been followed by a series of small wars. In many cases the major powers, Russia and America, have been forced to abstain from direct intervention by the prior outright declaration of vital spheres of influence, defensible by nuclear warfare if challenged. This factor arose in NATO and checked Russian designs in Western Europe. Nevertheless such defensive barriers, based on the co-operation of buffer states, have proved untenable in the event of deliberate non-co-operation by the satellite, as occurred with Yugoslavia.

The Middle East is the most recent and urgent field for strategic expansion based upon political warfare and limited wars. It contains all the necessary elements for major conflict under pre-nuclear conditions, and the campaign is now being waged piecemeal in a minor key. The existence of vital and valuable oil resources around the Persian Gulf, the location of essential communications in the Mediterranean and Suez, the decay of the old Western hegemony and the rise of nascent nations in Israel, Egypt, Morocco; such factors create a peculiarly delicate problem. Overshadowing this problem is the familiar nuclear factor, in its normal dominant topographical form.

Thus Britain initially and officially evacuated the Canal Zone because it was, in the final strategic analysis, untenable in the thermonuclear age. There may have been additional American State Department reasons, but they were not stated. The subsequent Egyptian negotiations with East and West were typical overtures under the Balance of Nuclear Powers, designed to encourage higher bids from the major powers. Temporary withdrawal of definite Russian and American support from the area created another power vacuum. If neither major power was prepared to take risks over Suez, the way was open for conventional action. The Anglo-French forces therefore sought to re-establish order and their own interests by military operations. Meanwhile the straightout national clash between Egypt and Israel created a favourable opportunity, and thus precipitated the Anglo-French invasion of Suez. Although one of these powers, Britain, was equipped for nuclear warfare, there was never any question of resort to this measure. It was limited war for a specific limited object. Thereupon Russian threats of intervention by "volunteers" raised the possibility of unlimited warfare developing in the area, and America countered with a warning against extension of the hostilities. It is hardly a moot point whether the threat of ultimate nuclear warfare arising from Russian intervention or the pious invocations of UN were the main influence in securing Anglo-French withdrawal. This in brief is the chaotic story of this unfinished imbroglio.

Meanwhile Russia has been experiencing local uprisings in her own buffer areas, with separatist movements in Poland and Hungary and incipient imitations in Rumania and Bulgaria. While these are partly attributable to new policies in the Kremlin and to the

hardships created by doctrinaire Communist economics, they are also considerably affected by the external strategic factor. The satellite states, unwilling collaborators from the beginning, are acutely aware of the risks they run as Soviet buffers in the event of nuclear warfare, and of their importance to Russian strategy in the geographical and the economic spheres. Thus emboldened and desperate, they have taken the enormous risks of armed insurrection. Russian counter-strokes have hardened from hesitancy to bloody repression. Tacit acceptance of the area as a vital Russian sphere of influence and therefore a cause of nuclear warfare has prohibited UN from intervention on Hungarian behalf. The lesson will not be lost on other subservient powers, but the unease must persist so long as the causes continue to be operative.

The Israel-Egypt struggle is on a different and more familiar plane than the other operations. The encirclement of Israel by antagonistic Arab states imposes a continuous threat to her existence. The recent operations in Sinai were a preventive campaign. Although external powers may have assisted on either side, they were in no sense principals. It seems likely that such conventional operations will continue, and that the major powers may become further involved in this internecine struggle, as it suits their own strategic interests. Certainly Israel must align herself with a major power in order to survive.

The most recent American declaration of an Eisenhower Doctrine for the Middle East, based on the declared intention of the USA to deny entry into that area to Russia, and the promise of economic aid for the rehabilitation of Middle Eastern countries is a positive and powerful step towards stability in the area. The details of its implementation have yet to be settled. It fills the power vacuum and at the same time drags the shadow of nuclear warfare and Massive Retaliation over this theatre. It is intended to order the present chaos. The final results remain to be seen. One thing is certain: Russia will not permit American assumption of power to be accomplished without vigorous political and strategic countermeasures, such as are already apparently in train in Syria.

Some Deductions from the Present Anarchy

There appear to be four main possible lines of development in the defence measures of the smaller powers in the future:—

(a) Solid alignment in one of the two main power blocs.

(b) Creation of a third neutral bloc.

(c) Independent and anarchic attempts at self-sufficiency.

(d) Reliance on a wholly federated World Government based on the United Nations concept.

The latter is a distant ideal remote from present practicability; the first and third courses are each likely to be practised in the near future. The renewed cold war must nevertheless tend to harden the main blocs. The Indian design for a neutral bloc fails because it lacks "teeth" and true identity of

aims among the neutralists. It must ultimately side with one of the major belligerent blocs. Yet the presence of the nuclear threat could so undermine international confidence as to cause regression to a mediaeval condition of isolated states, endocentrically preoccupied, militarily, economically and culturally. There are already some clear signs of this trend when small states like Iceland and Burma and large states like India, seeking safety in active neutralism, must find the role of go-between very difficult to sustain, and real security more elusive than ever, and so revert to passive and ostrich-like efforts to ignore the inevitable.

The effect of nuclear war on foreign policy is to make it more analogous than ever before to stud poker, the protagonists more prone to bluff, and the stakes alone, in their gravity and solemnity, distinguish it from other games of chance. Thus nuclear weapon tests, particularly in Russia, have frequently been timed to give them political as well as military significance. National strategy is thus handed over to political gamblers. In such an atmosphere the creation of effective military defence becomes in turn an intense military gamble. Certain main trends can be distinguished such as the following:—

(a) The development of smaller carefully dispersed urban industrial areas better adapted for defence against nuclear attack.

(b) The demand of minor powers for categorical guarantees of their defence and territorial integrity from the major power blocs. This will not always be easy to secure or to enforce, since the major power may thus in turn be automatically exposed to nuclear attack, and even these giants will not be immune to nuclear blackmail.

(c) The creation of economically self-sufficient states, capable of withstanding blockade and siege or weathering out a global war. This will normally be done by intensive internal development coupled with stockpiling.

(d) The ultimate evolution of defensive military forces of the maximum hitting power consistent with high mobility and the ability to draw logistical support and to mobilise from decentralised garrisons constituting unattractive targets for nuclear weapons. These will be used to deter aggression at home rather than as expeditionary forces, and will have to rely on local militia or partisan reinforcement, once committed. Expeditionary forces will tend to become mopping-up elements to follow up after nuclear attacks and to occupy ground, and will be strong in armoured, airborne and air transported formations.

(e) Small nations will need to defend themselves against wars of opportunity waged by conventional forces, with or without assistance from major powers, and probably under an intimidatory threat of nuclear warfare.

(f) There can be no permanent stability in international affairs, hence increased emphasis will be placed on political and furtive military methods of changing existing frontiers and alliances. Small nations seeking to survive through the patronage of major powers will therefore require absolute guarantees, which in turn must entail wholehearted committal to the power bloc.

All in all, defence and survival become more hazardous than ever before in modern history. It imposes military and civil burdens of a greater order upon the population, without any practical alternative, and without the certainty of effective results. Nations are often compelled to adopt defence policies from expediency, not because they are self-evidently right but rather as the lesser of several evils. Their old defence machinery cannot be rejected as obsolete, and the new nuclear weapons make additional demands simultaneously upon aggressors and defenders alike. Thus we find ourselves requiring defences against nuclear war of the first order, and against the minor warfare which still contrives to flourish under the atomic umbrella, despite the good offices of the United Nations. The dictum of Heracleitus stands, that "change is the only reality." Militarily it follows that defence and survival continue to depend essentially on individual and collective human courage. Disarmament trends and promises of universal peace prove illusory, or the fictions of peace-offensive diplomacy. The development of warfare on two planes suggests that unlimited warfare might be avoided by adopting suitable defence organizations. At present the navies, armies and air forces of the world all seek to adapt nuclear weapons within an integrated framework with conventional weapons. Thus inherent dangers arise that any scale of aggression can lead direct to Massive Retaliation. The creation of a fourth Nuclear War Force would ensure that fission weapons were reserved as a last resort, thus diminishing the chances of unlimited warfare. Meanwhile no free nation can contract out of its own defence obligations, however limited or obscure, for by our own will, skill and effort do we still stand or fall.

HOMING A GUIDED MISSILE

Condensed from an article in KOMMANDO, South Africa

HOW is a guided missile guided to its target? That question puts in a nutshell most of the complicated technical problems which are facing the scientists who today are trying to plan a foolproof defensive system against air attack.

Their problem is very different from that of the anti-aircraft gunner, who relies on the accuracy of his gun and his radar prediction equipment, to enable him to hit the target; the problem for the missile experts is to manoeuvre the missile after it has been launched. The object is to design a projectile which can be aimed in the general direction of the target and which will subsequently seek it out and hit it.

Little has been written about these problems, and for security reasons it is not possible to go into detail. The general principles of guidance systems can, however, be described. The missiles can be of several basic types—air to air, air to ground, ground to air, or ground to ground. But the guidance systems used for them all have much in common.

A missile can be homed on to its target either by what is called "passive" homing, where the missile homes on to a source of energy radiated by the target, or by "active" homing, where the missile itself transmits energy which is reflected back from the target, thus locating its position in space.

This source of energy radiated or reflected by the target can be any of the various forms of energy produced by an aircraft in flight—heat, noise, wake, infra-red radiation, static electricity. Some of these can be detected many miles away, others at only quite a short range.

By fitting the missile with a detector or receiver which will pick up responses from the target, amplify them, and pass the information as to their direction and strength to the controls of the missile, the missile will then be automatically guided to the source of energy—and it will ultimately hit the target. This, in the simplest terms, is "passive" homing, and it is usually a relatively short-range technique.

To pick up targets at longer range, "active" homing is used—that is, the missile itself transmits energy and picks up the reflection or echo from the target, which is, in turn, used to steer the missile on to it. The missile has therefore to carry a transmitter as well as a detector or receiver. A radar set

would be an obvious method of using this technique.

The drawback is the weight of equipment necessary, and the size the missile must be if an aerial and a heavy power supply have to be carried. In other words, though the system can be a long-range one, in practice its bulk keeps down the distance over which it can be used.

These limits on the size of the transmitter can be overcome if, instead of carrying it in the missile itself, the transmitter is placed somewhere else—for instance, in a larger aircraft, or on a ship, or on land. In this way the complete guidance system is a remote high-power transmitter, with a smaller receiver in the aircraft capable of directing a missile to the source of reflected energy. This is known as the "semi-active" homing system, and it is at present accurate over ranges of the order of 17 miles.

Another system of guidance which gives about the same results as "semi-active" homing is "beam-riding." A radar beam device in another aircraft or on a ship or on the ground locates the target and locks on to it. The missile is fitted with a rearward-looking receiver which, together with the control system, ensures that the missile flies dead along the centre of the beam. As the beam is locked on to the target, the missile will ultimately hit it.

The disadvantage of these two long-range systems—the "semi-active" and "beam-riding"—is that because the transmitting source of energy is based away from the missile, the further it flies from the transmitter the less accurate is the information which it receives to guide it. But the nearer the missile gets to the target the more it needs accurate navigation. This is overcome by carrying yet another transmitter in the missile itself. This is not switched on until the final phase, because for the greater part of its journey the missile's course is controlled by the information picked up by its receiver from the surface control. The receiver in the missile is common to both the ground and airborne transmitter.

To sum up, the missile works as follows: it is launched and reaches supersonic speed, its booster rockets fall away, and it settles down to controlled flight. At this point, the "mid-course," "semi-active," or "beam-riding" homing devices take over. These transmitters locate the target, and pass the information to a receiver in the missile. This in turn operates the controls and keeps the missile on course over the greater part of its journey. Finally, shortly before reaching the target, when the outside transmitters may be insufficiently accurate, a small transmitter in the missile itself takes over and actively homes on to the target.

If several missiles are being launched from widely separated points, they must all be headed in the approximate direction of the target. For this reason it is necessary to have a "gathering" phase before the active homing begins. A long-range interception by guided missiles would, therefore, consist of a "gathering" phase, when the weapons are headed in the correct direction, followed by mid-course navigation and, last, a "final terminal or homing" phase.

COMMANDOS

Major J. M. Hutcheson, MC,
Royal Australian Engineers

THE word "commando" came into use in the Boer War to describe a small group of men who made raids against the enemy. It was revived by the British in World War II when units of specially selected troops were organized and trained for raiding operations.

Royal Marine Commandos

At present the Royal Marines are responsible for providing the British Commandos. An RM Commando is commanded by a lieutenant-colonel, and is organized as a headquarters troop, a support troop and five fighting troops. For tactical purposes a troop fights as four sub-sections and a support subsection. Sections are not normally used as tactical sub-units. Each fighting troop has officers and other ranks who have been trained as landing craft helmsmen, cliff leaders and guerrilla warfare specialists, in addition to their normal troop duties.

A Royal Marine Commando Brigade consists of a brigade headquarters, two or more commandos and a small boat section. These small boat sections are the Royal Marine frogmen teams trained and equipped for the following tasks:—

(a) *Ship Attacks.*—Sinking or damaging of enemy ships in harbours and anchorages by means of small boats or by swimming on or under the surface of the water.

(b) *Offensive Raids.*—The destruction of enemy positions, disruption of communications

and installations, operations aimed at the capture of prisoners or equipment.

(c) *Reconnaissance Raids.*—The pre-assault reconnaissance of enemy beaches, beach exits, seaward approaches and coastal defences, the provision of markers and guides for assault landings, and for other types of reconnaissance where specific information is required.

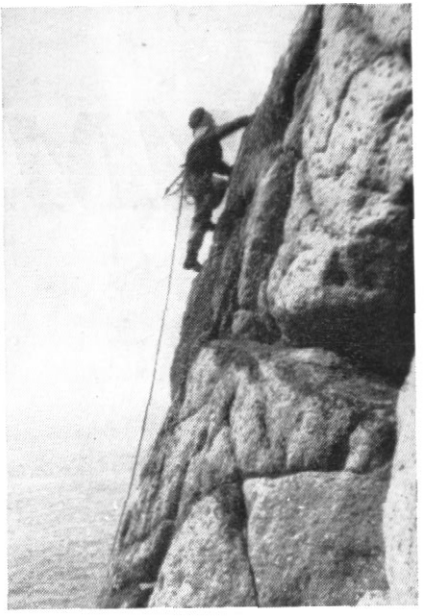
(d) *Landing of Special Personnel.*—The landing of agents, important people, reconnaissance experts, etc., on enemy-held coasts.

Frogmen are known as swimmer-canoeists by the Royal Marines. All swimmer-canoeists are qualified parachutists. This enables them to be dropped near a target area with their under-water breathing apparatus and inflatable craft, and therefore save time in the approach phase of an operation. Each section has a balanced complement of men specialized in different technical subjects., i.e., beach reconnaissance, demolitions or navigation. The organization should be regarded as entirely flexible and the size of any sub-unit should depend on the requirements for any particular task.

Australian Commandos

Australian commando companies at present raised are CMF units of the Royal Australian Infantry Corps. They are commanded by majors and organized as a company headquarters, three platoons, a pioneer section, a signal section and a medical section.

The aim of these units is to produce groups of about one officer and



ten other ranks, each of whom, besides being a thoroughly trained rifleman, is a qualified parachutist and small boat operator, and in addition possesses one other skill from the following:—

Medical orderly
Wireless operator
Driver
Assault engineer
Frogman
Cliff climber.

These groups will be capable of making a small-scale raid deep into enemy territory, carried either by sea or air, performing a task which will normally involve the destruction by demolition of enemy equipment or installations, remaining at all times responsible for its own security and maintenance, and finally extricating itself to a point from which it can be taken out by sea or air.

The Green Beret

The green beret indicates that the wearer is a qualified basic commando. This symbol is used by both British and Australian units. Bearing in mind that feats of physique and nerve, although of value, are chiefly important for the spirit in which they are taken, men are progressively trained to pass a series of commando tests which may vary in detail but include:—

Rope and Balance Work.—Movement on ropes and balance walks at heights up to 20 feet which gauges nerve and personal determination.

Speed Marching.—A test of teamwork, determination and discipline under stress, as a member of a team, by achieving nine miles in 90 minutes without straggling or loss of step.

Speed Scramble.—Determination and self-discipline within a team is tested by movement in very rough country at high speeds.

Cross-country March.—About 30 miles by trainees on their own in small teams, marching by map and compass, taking the weather as it comes.

Comparison

Before comparing the British and Australian units, one must realize that the current organization of the Royal Marines is for non-jungle

warfare, but it can be and actually has been used in the jungle. The main differences are:—

(a) While there is a high percentage of qualified Royal Marine parachutists in commandos, their main mode of assault is from the sea.

(b) The Australian commando raid is about ten men. However, the British aim at using a much larger force. In Europe a large force is necessary, e.g., actions at Dieppe, Vaagso, and St. Nazaire against heavily defended ports, ètc.

(c) Our commando company includes frogmen. Under this system the commander is able to co-ordinate all "cloak and dagger" activities in his area. Frogmen activity by both organizations is the same.

(d) There are no heavy weapons in the Australian commandos. This is because of our aim to produce small teams. However, our Royal Marine colleagues will often require heavy weapons in their large-scale raids.

Conclusion

The Royal Marine and Australian Commandos have four things in common:—

The green beret
Their basic training
The commando spirit
Frogman work.

The difference in roles may be demonstrated from the last war. Here we saw the requirement for units which can attack from the sea and hold or raid an installation in force. This is the role of the Royal Marine Commando. Similarly, small parties were required for harassing and disruptive raids, such as in Yugoslavia (read Fitzroy MacLean in "Eastern Approaches"). This is the role of the Australian commandos who will be capable of fighting in any theatre, but to conform with current requirements the emphasis is on raids against installations in our most likely theatre of operations.

TRI-SERVICE COLLEGES

Major Austin Chapman, BE,
Royal Australian Engineers

ONE of the interesting aspects of service education and training in India is the degree to which she has developed, in a matter of nine years, an inter-service relationship which makes for close co-operation between the three services. This close co-operation is based on personal friendships and a knowledge of inter-service problems, both being provided by tri-service education.

A cadet, whether he is to proceed to Army, Navy or Air Force, undergoes an initial four-year training period. The first three years of this training for all cadets is carried out at Karakavasla, commonly known as the National Defence Academy or NDA. All the cadets wear the same uniform, work to a similar programme and code of discipline.

In the cadet's third year, when service subjects, other than, say, foot-drill and elementary weapon training, are introduced, there is a divergence in this technical training. Naval cadets take up sailing and allied nautical subjects, whilst Air Force cadets commence their detailed study of theory of flight, aeronautical design and the like. However, most of the teaching in the first three years is of an academic nature, and hence is common to all cadets.

The Academy itself is on a lovely site some eleven miles from Poona, and has an adjacent lake and airfield. It is built in a wide, shallow re-entrant, and as all the buildings are in stone and brick, the Academy, even though still incomplete, presents a most imposing appearance. The central administrative building is a fine three-storied masonry structure surmounted by a dome, and is to be flanked by a library building and assembly hall. Both these are in course of construction. The entrance hall or vestibule of the administrative block is directly beneath the dome, and is, as it were,

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Major Austin Chapman graduated from the Royal Military College, Duntroon, in 1944. After war service in the Pacific with 2/12 Infantry Battalion he served with the occupation forces in Japan. He graduated Bachelor of Engineering from Sydney University in 1951, and attended the Staff College at Wellington, India, in 1955.

at the bottom of the dome well. The walls are finely furnished in marble and lend an air of quiet dignity to the building, which is indicative of the standard of construction throughout the College.

After his three years at the NDA the cadet proceeds to his service College to complete his final year of training. In the case of Army cadets it is the Indian Military Academy at Dehra Dun. However, the cadet has made in his first three years of service life intimate friendships with fellow-students who have joined the Navy or Air Force. Thus inter-service co-operation has a very solid base in the Indian Forces.

When, in later years as an experienced officer, he proceeds to Staff College, the Indian officer goes to the Defence Services Staff College at Wellington. The DSSC is organized into three Wings—Army, Navy and Air—and officers work together for one year. Over thirty per cent. of the syllabus at the DSSC is "joint instruction," which culminates in the amphibious exercise. In addition, the whole College goes on a three weeks' land/sea cruise during the course. This "cruise" embraces visits to Air establishments, a sea cruise with the Indian Navy and Army demonstrations by Engineers, Artillery, Armour and Infantry. Thus every officer, no matter what his functional position may be in each of the three Services, gains a very sound insight into the workings and problems of the other branches of the armed forces.

The advantages of this method of training for *all* officers are obvious. An officer does not have to "get to know his opposite number" in the Navy or Air Force—he was probably a fellow-student at NDA or DSSC. At the least, they will have mutual acquaintances. There is also a considerable saving in administrative and accommodation overhead expenses.

In the case of the Australian Armed Forces a combined Cadet College is not outside the realm of possibility. Duntroon could with comparative ease be expanded to cater for all service cadets in their first three years of training. It has, for example, a very convenient airfield at Fairburn and nautical facilities at Lake George and Jervis Bay. A proportion of the staffs of Flinders Naval College and Point Cook would be posted to Duntroon, which would then have a Combined Services Staff. The final year's training for Navy, Army and Air Force Cadets could then be carried out at Flinders, Duntroon and Point Cook respectively.

An Australian Defence Services Staff College is perhaps easier to accomplish. Army and Air Force already have small Staff Colleges, and their combination with the addition of a small Naval Wing would present no great problem. Once again the Army College at Queenscliff offers a suitable site.

In modern techniques of warfare the close co-operation of all three services has been proved over and over again to be an essential requirement for success. No doubt such steps as a National Cadet College and a Defence Staff College would meet with initial opposition from each Service for various reasons. There are Service traditions and College traditions which have

been built up over a number of years, but these can be added to the traditions of the National Colleges when established.

The demand and need for the integration of Armed Services is a matter which is claiming the attention of many nations. We already have a Joint Services Staff College and an Imperial Defence College in the United Kingdom which cater for senior ranks. Surely the time is ripe in Australia to come down the other two rungs in the ladder of service education and combine our Cadet and Staff Colleges.

DISCIPLINE IN MODERN WAR

The more modern war becomes, the more essential appear the basic qualities that from the beginning of history have distinguished armies from mobs. The first of these is discipline. We very soon learnt in Burma that strict discipline in battle and in bivouac was vital, not only for success but for survival. Nothing is easier in jungle or dispersed fighting than for a man to shirk. . . . Only discipline—not punishment—can stop it; the real discipline that a man holds to because it is a refusal to betray his comrades. . . . It is only discipline, too, that can enforce the precautions against disease, irksome as they are, without which an army would shrivel away.

At some stage in all wars armies have let their discipline sag, but they have never won victory until they have made it taut again; nor will they. We found it a great mistake to belittle the importance of smartness in turn-out, alertness of carriage, cleanliness of person, saluting or precision of movement, and to dismiss them as naive, unintelligent parade-ground stuff. I do not believe that troops can have unshakable battle discipline without showing those outward and formal signs which mark the pride men take in themselves and their units, and the mutual confidence and respect between them and their officers.

It was our experience in a tough school that the best fighting units, in the long run, were not necessarily those with the most advertised reputations, but those who, when they came out of battle, at once resumed a more formal discipline and appearance.

Field-Marshal Sir William Slim.

ON WRITING BRIEFLY

Condensed from the Royal Bank of Canada Monthly Letter

ONE important step toward clear and courteous writing is described by Polonius in Shakespeare's Hamlet: "Since brevity is the soul of wit, and tediousness the limbs and outward flourishes, I will be brief." But what is brevity?

If a piece of writing tells the whole story, and only that, it is not too long. Being brief means that you will not use ten pages to tell a one-page story; but neither will you try to tell a ten-page story on one side of a sheet of paper.

A report of three thousand words may be brief, and a 100-word memo may be long: the first, if it comprehends many facts, several points of view, and some choices: the latter if it is devoid of necessary facts, woolly in its thinking, and indeterminate in its conclusion.

To use too many words to communicate one's thoughts is a sign of mediocrity, while to gather much thought into few words, clearly and accurately, stamps the person of executive genius.

Men in management positions have a specal obligation. Sour notes are not sweetened because the writer dictated them from an executive's chair to an exquisite secretary.

What you have written may not be bad writing, but the chances are it is not the most effective plain talk, either.

Have you written it too hastily? When you spend an hour seeking the answer to a correspondent's question or complaint, isn't it good economy to spend ten minutes expressing your answer so that it will be understood and appreciated?

When Churchill was directing Britain's war effort he wrote a memo containing this dictum: It is sheer laziness not compressing thought into a reasonable space.

Why Are You Writing?

Before starting to write, you should know just what you wish to convey. Business men don't ordinarily write with the sole purpose of self-expression. They want to get other people to understand, to believe, to act.

A letter may fail of its purpose because of lack of target definition. The writer scatters his fire. He writes or dictates many words while wandering around in his mind looking for explicit thoughts. So one rule for the writer of letters is: Reach a clear and definite agreement with yourself about the ideas you wish to convey. You are not

writing to be impressive, but to be understood. There is an obligation upon you to deliver your message in such a way that it will have the best possible chance to fulfil its mission.

The thing needed in writing is to have something to pass along, and to use words the reader will understand, put up in packages small enough for him to grasp easily.

Be Precise

This is not a list of rules for letter writing, but no essay can avoid reference to some rules. One necessary prescription is: be precise.

When your writing is definite in its manner and plain in its language it is likely to be vivid, so that your words walk up and down in the mind of your reader. Brevity helps you to give movement to what you write.

The first virtue of a masculine writing style is brevity, and brevity is aided by use of the active verb and the concrete noun. What most appeals to people is life, action, sights and sounds—something happening. Note how carefully those exquisite short stories called the parables speak only of things you can touch and see, and what befalls them.

Your writing will be diffuse and pedestrian so long as you prefer abstract words to concrete words. But most business men are not that way at all by nature, so another rule is: be yourself. Directness and simplicity of expression will contribute mightily toward natural forcefulness. "One must still have chaos in one, to give birth to a dancing star," said Nietzsche, the German philosopher. The business man will resolve his chaotic thoughts into exact, concrete and brief expression.

Be Graceful

Brevity is not to be worshipped in a narrow way. The graces have their place in social correspondence and descriptive narration. Some irrelevancies should make their way into all letters designed to win friends. Brevity should be sought in the spirit of "as briefly as I can, saying what I wish to say, in the spirit I wish to convey."

Let our letters have something in them not common and ordinary. Every letter is entitled to depart from what is dictated by a strict rule of shortness: a departure that adds a personal touch in keeping with the purpose and content of the letter.

Your letters can be meaningful and significant and still be melodious and human and courteous. But it takes art and effort to do all this without rambling.

What is our ideal? All of us would like to write letters and reports and articles that have distinction of expression, brevity, dramatic quality, concreteness, beauty of rhythm and adventurousness of phrase and idea. We can do it. By paying attention and observing a few principles we can improve our writing little by little until one day we awake to the realization that we have achieved the mystery called "art."

Be Clear

Opposed to the grace and concreteness we have been writing

about is what Professor Edgar Dale, of Ohio State University, brightly headlines on two of his essays: "The Art of Confusion" and "Clear Only if Known." It is unwise to send forth your thoughts like so much raw material for your reader to put into shape. The expert writer, the thoughtful writer, the writer who wishes his letter to accomplish something, will not leave to his reader the labour of disentangling the pertinent material and reshaping it in his own mind.

What is the first object of a machine? Effective work. The maker seeks to eliminate friction and tightness and looseness. The machine that runs with perfect smoothness transmits its power in production.

What is the first object of writing? To convey thoughts. The writer seeks to arrange words so that they shall suffer the least possible obstruction from friction in the reader's mind.

In both cases the object is to secure the maximum of disposable force by diminishing the amount absorbed in transmission. "Obviously," said George Henry Lewes in an essay on style more than fifty years ago, "if a reader is engaged in extricating the meaning from a sentence which ought to have reflected its meaning as in a mirror, the mental energy thus employed is abstracted from the amount of force which he has to bestow on the subject."

If your letter deals with products or ideas that are highly technical, take pains to interpret them simply. Remember that you are the specialist on the point you are writing about: your correspondent expects something helpful from you.

This does not mean that you must always write for the 12-year-old mentality. Do avoid ten-dollar words and do build bridges between one section of a topic and another. When "boiling down" your letter, be sure not to demolish the bridges, thus leaving the reader to flounder between two thoughts. Destroy confusing ornamentation; trim away the superfluous; remove images and expressions that are foreign to your train of thought and your purpose.

John Evelyn, the 17th century diary writer, told the story of Monmouth's rebellion in 68 lines, and he included all essentials and colour. Homer condensed ten years of adventure into his epic Odyssey, and Aristotle made a digest of it in 79 words. Lincoln's address at Gettysburg used only 266 words. The Ten Commandments use 297. The United States Declaration of Independence has 300. By contrast, said Walter Winchell, the United States columnist, a U.S.A. order to reduce the price of cabbage uses 26,911 words.

Effects of Lengthiness

People do not like to read a letter that is lazily long. They are likely to exclaim at the end, as an old philosopher did in a great Egyptian temple built for a little black monkey: "What a magnificent palace is here for such a ridiculous inhabitant!"

It is not good business to have that said of something one writes.

Readers are likely to resent it if you take up their time by using superfluous words. Your purpose—selling goods, collecting money, answering criticism, or making friends—will be better served by letters that are concise, dynamic, straight-to-the-point, and tell exactly what your reader wants to know.

Simplicity Pays

Great writers try to tell their thoughts as clearly and shortly as possible. Simplicity has always been a mark of truth, and we believe that it is now accepted as a mark of genius.

Simplicity is the outward sign of depth of thought. You cannot adorn simplicity. You do not achieve it by grammatical artifice. What will move your reader to your way of thinking is your sincerity manifesting itself through words that have human feeling akin to his own, and carry a meaning of interest to him.

Alas! there are many people who think that if they are dull enough and laboured enough they will sound scholarly. They take an ordinary proverb, like "Early to bed and early to rise makes a man healthy, wealthy and wise," and they change it to "Early retirement is a significant factor in one's physical development, pecuniary success and intellectual stature." They take an advertising slogan like "Ask the man who owns one" and turn it into "Make an inquiry of one of our purchasers."

Good style is not reached by such tortuous ways. Confused talk does not drum up business. Ornamentation wearies the eye and deadens the mind. The smooth and luscious in a business communication disgusts us. Every word that can be spared from the purpose and plan of the letter is hurtful if it remains.

Superlatives should be avoided. They are unnecessary and often misleading, deceiving not only the reader but the writer. The latter may be led to think when he writes "I have given the matter my closest attention" that he really has exhausted all avenues of approach.

Exaggeration expresses ignorance. We try to replace poverty of thought or language by the use of bombastic phrases. Our appeal will be more effective if we write gently, supplying facts in easily understood form, presenting our purpose in a charming and eager way.

We must be careful about adjectives, because the evil destiny of many who aspire to good writing abides in their indiscriminate use. Those who misuse or over-use adjectives fill their letters with affectation. They are like the painter who threw sponges soaked with several colours at a wall, expecting a beautiful landscape to result.

It is good practice to reserve adjectives for occasions when they make our meaning more precise, and to reject them when they merely convey emphasis. Concrete nouns, fittingly chosen, and active verbs will usually give the desired strength and movement to what we write.

Words and Sentences

What do you write with? Words, sentences and paragraphs. We should take a delight in calling

forth the right words, in the right environment, to say what is in our minds to say.

The best words call up images with little expenditure of the reader's time and energy. It is a mistake for the business man to chase after a fine word instead of using the simple word that fits his needs. He lays himself open to two dangers: he may be seduced by the charm of some attractive word to write something he did not intend, or he may be tempted to seek a situation into which he may fit the word to which he has taken a liking.

It is obvious by now that brevity in letters does not consist alone in deleting words as one does in composing a telegram, but in choosing ing the right words to convey our meaning clearly and sharply. By using words that give light and shadow to our meaning we help ourselves toward writing pithily. If there are unusual words that express a meaning better than any others, we should use them. We should not fear long words if they are strongly expressive and have a familiar look and sound.

Let us cut sentences into bites we can swallow. The man who wishes to avoid suspicion of being a fuzzy thinker will prune his high-sounding phrases. Instead of adorning one thought about his firm or his product or himself in ten glorious sentences, he will fill ten simple sentences with ten significant thoughts.

The more words there are in a sentence the harder it is to read and understand that sentence. A sentence should, ideally, express only one thought. At the same time, we must try to have some melodious movement in what we write: we cannot have our sentences always leaping and never flowing. Too many very short sentences tire us. We should vary the pattern. Each sentence should tell a situation which is part of a larger one, and move us on to the next.

Building our sentences into good paragraphs is an art not to be despised. We shall not go far wrong if we take for each paragraph one essential truth about our subject, or one point of view. By breaking our letters into short lengths in a thoughtful way we achieve two desirable results: we give our letters an airy and readable look, and we increase our points of emphasis.

Writing a Letter

Your letter will be well written if it fulfils these modest requirements: if it is effortless in appearance, showing no sign of strain in its composition; if it is untheatrical, making its points without needlessly sawing the air; if it is simple in its construction, making intelligible to the reader things that might be obscure; if its words fit your thoughts, not hanging like a giant's clothes on the limbs of a dwarf nor squeezing a man's frame into the clothes of a boy; and if all this is attained in the smallest space commensurate with the clear expression of what you have to say.

Think before writing. Just as perspective is the bridle and rudder of the artist, so a forward look is the guide of the writer. You should know your audience and your subject; you should have a clear con

ception of what you want your audience to learn about your subject.

If you do a little exercise in analysis it will help you to write briefly. Ask yourself: to whom am I writing? What knowledge has he about this matter, knowledge that I need not repeat? What is his feeling about it? On what points do we agree? Disagree? What do I wish to add to his knowledge? What do I wish to influence him to do?

Begin your letter at the point of the reader's interest. It is discourteous to tackle the reader as if he must read what you write, and need not be wooed. No one is so wise or important that he can neglect being urbane.

In the body of your letter, make of the problem or plan an interesting situation to be told about. You must have something specific to say or you would not be writing: don't be coy about saying it. Keep this part of your letter compact, being sure at the same time to cover the subject.

Be correct. Brevity is helped by exactness. There are times for severity of writing, with no frills or puffs, but even then—perhaps, indeed, more then than at other times—you need to be exact in your use of words.

Look It Over

If you have been led to believe that your correspondence, or that of your subordinates, can be improved, beware of seeking neat solutions. We do not know of any way of handling correspondence that is at the same time the quickest way and the best way. Efficiency in results demands some expenditure of time in preparation.

When you are checking a letter, read it with more than the discovery of typographical errors in mind. Does it convey your message to your reader in such a way as to provoke a favourable response along lines you desire? Does it tell as briefly as is consistent with courtesy and your strategy just what you have to say? Have you smothered any important points by loading them with detail? Have you discarded all unnecessary ballast? Is there anything in the letter whose presence or absence makes no discernible difference?

Shakespeare seems to have had a habit of roughing out his plays pretty large, and then cutting them down. He wrote at white heat, once the mood was on him. He did not pause at the end of every passage, to check back on the number of words he was using. But in the outcome his plays hew closely to the line of economy, considering not only the matter in them but the evocation of spirit they were designed to arouse.

Yours may be a similar method: to write at length and then shorten your manuscript.

Read your letter, too, with an eye on its effect on you. The discipline of striving for perfection of expression, your effort to do a good job with an economy of words, will have a beneficial effect. A sloppy way of writing may give rise to self-induced murkiness of thought, but strictness in expression will contribute to a tidy mind.

Appreciate Good Writing

We should esteem good writing, and show our appreciation. There is magic in a word of praise.

Why not write, once in a while, to someone who writes you a letter, just to compliment him? Go into particulars; don't compliment generally. He probably knows that what he wrote was pretty good technically. Instead, tell him what it meant to you, how it gave you a new viewpoint, solve a problem or added to your happiness. As Andre Maurois once remarked: "The general did not thank me when I talked to him of his victories, but his gratitude was unbounded when a lady mentioned the twinkle in his eye."

Out of your evaluation of others' letters will spring a new desire for distinction in your own.

It will be easy, then, to choose which comment shall apply to what you write: Maria's in Love's Labour's Lost—"The letter is too long by half a mile," or Sam Weller's in Pickwick Papers—"She'll vish there wos more, and that's the great art o' letter writin'."