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COAGULANTS VERSUS SAND FILTERS AS AIDS TO WATER PURIFICATION IN THE FIELD.

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THIS Paper is an attempt to dispel the popular idea that filtration through sand is invariably necessary to the production of potable water. With this object in view, the usual methods of water treatment will be very briefly indicated, followed by a description, based on actual practice, of the "Alum precipitation—Chlorination process," or, more shortly, the "Alum Process."

The reduction of crude to potable water may involve :—

(*a*). Removal of suspended matter.
(*b*). Dealing with Bacteria injurious to the human system.
(*c*). Removal of Chemical poisons such as lead, arsenic, etc.

Processes designed for the removal of chemical poisons must be adapted to the particular agent to be eliminated, but are so rarely required that they will not be referred to in this paper. In general, therefore, processes must be provided whereby a clear water can be obtained from a muddy source, and injurious bacteria can be rendered innocuous.

"Purification" of water is usually understood to imply both the above processes, although it is not always realized that a perfectly clear water *may* be loaded with harmful bacteria, and conversely that a turbid water *may* be fit to drink. The means by which Purification, as thus defined, is effected are to a greater or less extent provided by Nature. When such natural processes are insufficient to produce water of the quality desired, the Water Engineer, by methods which are but imitations of natural processes, completes the work. The Table on next page gives the more important natural processes tending to purify water, and the corresponding methods adopted in Waterworks Engineering.

Direct Anti-Bacterial treatment by means of Chlorine or other Chemical agents on a large scale has not been to any great extent applied in England, though it is well understood in America. English practice relies almost entirely for Bacterial treatment on the action of the scum forming on the surface of the sand filter beds.

Processes provided by Nature.	*Processes adopted by the Water Engineer.*
Sedimentation of suspended matter by prolonged standing in Lakes or large ponds.	*Sedimentation* of suspended matter in Tanks or Reservoirs constructed for the purpose. This process is sometimes hastened by means of a coagulant such as Alumino-Ferric.
Filtration through pervious strata.	*Filtration* through sand beds either under a small head of water in which case the rate of filtration is slow, or under a mechanically-produced pressure, when the rate of filtration is greatly increased. In both cases the sand bed is intended to act as a support for a layer of scum, which is in itself the effective filtering medium.
Oxidation of bacteria by sunshine, exposure to the atmosphere—such as occurs in the case of swift rivers or brooks—and the action of certain salts in contact with the water.	*Oxidation of bacteria* by agents such as Chlorine, Potassium permanganate, etc., exposure to sunlight in clear water reservoirs—and arrangements by which the water may be aerated.

The Alum Process.—In this process the water is treated as follows :—

(*a*). The suspended matter is precipitated by the addition of an Alum solution.

(*b*). The clear water is drawn off and harmful Bacteria are dealt with by Chlorination.

The following is a description of an installation embodying the Alum process which has now been at work for some months. The Waterworks in question are situated in Flanders on a river highly charged with organic matter, and also, especially after rain, with very finely divided clayey material partly of a colloidal nature.

The Waterworks originally comprised a large settling tank, gravel prefilters, sand filters of the ordinary pattern, and a clear water reservoir. As soon as the construction of the works was completed, it was evident that the amount of water demanded would be largely in excess of that allowed for by the original design. It was also found that owing to the large amount of suspended matter in the water the sand beds speedily became choked, if the water was passed through at any other than a very slow rate. The length of time required for the sand filters to become "ripe" was also a drawback. It was therefore decided to clear the water as much as possible before

delivery to the sand beds by precipitating the suspended matter with Alum.

This process involves the addition of a solution of Alum (Commercial Alumino-Ferric) to the water to be treated. Provided that the alkalinity of the water be sufficient, the addition of Alum produces a white gelatinous precipitate of aluminium hydroxide, and this, mechanically, and by absorption, carries down with it not only the fine suspended matter, but also the colloidal matter, organic and inorganic.

The reactions taking place are probably as follows :—

1. Double decomposition between the soluble bicarbonates in the water and aluminium sulphate, giving soluble sulphates and aluminium carbonate.
2. Aluminium carbonate cannot exist in the presence of water and is immediately hydrolized giving aluminium hydroxide and carbon dioxide.

The former carries down the suspended matter mechanically, and the organic matter by absorption, while the latter remains in solution. The alkalinity of the treated water differs from that of the crude water by an amount agreeing with reaction (1).

Experiments of both a large and small scale having proved the efficacy of the process, four Alum Sedimentation tanks, each of some 40,000 gallons capacity, were constructed. These tanks were made by lining an excavation in the ground with Tarpaulins, and were found perfectly satisfactory. Arrangements were made whereby the crude water could be discharged as required, into either of the four Sedimentation tanks. The crude water discharge was led into a sloping wooden trough fixed at one side of each tank ; into this trough was taken a feed pipe conveying the Alum Solution, the flow of which could be regulated by means of a stopcock.

A connection from the clean water main from the main pump-house gave a supply of pressure water which was used for making up the Alum solution in the raised tank and also for flushing through the alum feed pipes when necessary. A hose connection for washing out the sedimentation tanks was also provided.

The outlets from the sedimentation tanks were fixed a few inches above the bottom of the tanks and floating intakes have since been added. The Alum treated water discharges were led to the original gravel prefilters, with connections to the clear water reservoir so that the gravel and sand filters could be cut out of the system if required.

The bottom of each of the Sedimentation tanks had a fall from the outlet end to a sump at the other end. When cleaning out was necessary the sludge was swilled down with a little water to the sump, and thence pumped out with a Merryweather to a drain.

The amount of alum used varied from 7½ to 15 or even 20 grains

per gallon. This large proportion, as compared with that used in civil practice, was rendered necessary both from the excessively foul character of the crude water and also from the necessity of reducing as much as possible the time of sedimentation. The amount of Alum required varied from time to time according to the turbidity of the water and atmospheric conditions. No precise rule could be found, and frequent experiment was therefore necessary.

The rule was stated some years ago (reference not at hand) that the quantity of alum to be used should be one half the chemical equivalent of the alkalinity of the water (expressed as $CaCO_3$). This, with most Flanders waters, is in the neighbourhood of 20 grains per gallon. In many cases, however, smaller quantities have been found quite satisfactory. The alkalinity of the water is an important factor in the process, and in cases where the alkalinity is below about 15 parts of $CaCO_3$ per 100,000 it is necessary to increase the alkalinity by adding a solution of lime to the crude water at the same time as the alum solution.

The Sedimentation process in the installation described above was eminently satisfactory. The suspended matter was deposited in from eight to twelve hours, leaving a perfectly clear supernatant water.

The Alum sedimentation was found to reduce the chlorine absorption in the subsequent chlorinating process, and the B.Coli content of the water was also to some extent reduced.

Water passed through the sand filters prior to the introduction of the alum process, although free from suspended matter, had a decidedly brownish appearance (the crude water was rich brown in colour), and an objectionable musty or earthy taste. These characteristics appear to be due to organic substances of the nature of the "Albuminoid Ammonias." If such a water be chlorinated according to the requirements of the "Horrocks" test, although it may be safe, it is very unpalatable, and tastes strongly of chlorine. This taste persists even if there be absolutely no free chlorine present, and a great deal of trouble has been experienced from this cause in the case of water filtered through sand. It is believed that the objectionable taste is due to the products of the reaction between the organic substances in the water and the chlorine—to chloramines.

The water passing from the sedimentation tanks possessed none of the objectionable characteristics just described. It was clear, colourless and its taste was good. Further, it could be efficiently chlorinated without a residual taste of chlorine remaining.

The alum-treated water, in the plant under consideration, was as a general rule passed through the sand beds to remove any solid matter that might have come over from the Alum tanks, but this procedure was for all practical purposes unnecessary, and in effect has frequently been dispensed with.

The Alum tanks described have been working well for some months past, with an output which has on occasions reached 300,000 gallons per day.

The precautions necessary for the successful working of the Alum process may be summarized as follows :—

(1). The proper quantity of alum must be added in the form of a solution.

(2). A very thorough admixture of the alum solution with the water must be ensured. This admixture must be continuous and uniform during the filling of the sedimentation tank.

(3). The mixture of crude water and alum solution must be kept in motion during the filling of the tank. This can be done by causing the mixed water to enter and flow along one side of the tank with a certain degree of momentum.

(4). A warning must be given against confusion between the terms "Alumino Ferric" and "Iron Alum." Although the latter substance has a certain action as a coagulant, it is totally unfitted for the purpose. On one occasion a consignment of "Iron Alum" was in error supplied to the Waterworks described, and "Alumino Ferric" not being available, had to be used, but with disastrous results.

Alumino Ferric is the trade name of the substance which should be employed.

It must not be supposed from what has been said, that precipitation of the suspended matter by Alum is, in itself, sufficient for the production of a potable water. Whereas with the sand filter beds of civil waterworks practice, the removal of suspended matter and elimination of bacteria are effected at the same time, the Alum process can only and should only be relied on to produce a clear water from a muddy source—although in the process the B.Coli content is appreciably reduced.

Further treatment is necessary to deal with the Bacteria.

The best agent for the purpose is chlorine, introduced either as a gas or in the form of a solution of Calcium Hypochlorite (Bleaching powder).

Chlorine gas as an oxydizing agent appears to offer the following advantages over a solution of Bleaching powder :—

(*a*). A more delicate adjustment of quantities can be made.

(*b*). It is possible to add a larger excess of available Chlorine without the taste becoming pronounced.

(*c*). Successive samples of bleaching powder are found to vary in their available Chlorine content, whereas in the gas process pure Chlorine and nothing else is introduced.

(*d*). The labour of making up the bleaching powder solution is avoided.

(*e*). Cylinders of liquid Chlorine are more conveniently handled than corresponding quantities of Bleaching powder and are less liable to deterioration.

The main difficulty in introducing the Chlorine into the water is one of accurately measuring the dose. There are several varieties of apparatus constructed for the purpose but even the best require an expert operator, are difficult to repair, and are extremely expensive. The system by which a Bleaching powder solution is introduced into the water to be chlorinated, will probably meet all requirements in the field. In whatever way the Chlorine is added, the admixture must be uniform and the Chlorine should be in contact with the water for at least 30 minutes before test samples are taken. The longer the Chlorine is in contact with the water before the latter is pumped into the mains the better, since there is thus less chance of an excess of Chlorine remaining to impart an objectionable taste to the water, and the very small quantities of Chlorine admissible only effect sterilization when the contact period is relatively long.

The following are in the writers' opinion, the advantages of the Alum process over Sand filtration plants, whether these be of the mechanical Filter type, the large open sand bed type of Civil practice, or the smaller quick filter of coarse sand such as have been installed in some instances.

1. *Economy of Labour in Construction.*—Alum Sedimentation tanks are easily made of excavations in the ground lined with tarpaulins. The bulk of this work is unskilled. Sand filters of the usual type must be made of brick or concrete and require an enormous amount of work in proportion to the results attained. Mechanical filters require special machinery and plant and a good deal of skilled labour in erection. Heavy and substantial foundations must be provided. Quick filters of coarse sand cannot deal efficiently with a really dirty water.

2. *Economy of Labour in Maintenance.*—All filters require a large amount of labour to be expended from time to time in cleaning the sand beds and washing and renewing the sand, compared with the labour in removing sludge from the Alum tanks.

3. *Economy in Wash Water.*—Alum sedimentation tanks require in proportion much less water for cleaning out than is required for washing the sand of sand filter beds, and dirty water can be used for the purpose if desired.

4. *Character of the Water Produced.*—As already stated, certain waters retain objectionable qualities even after passing through sand beds. Alum treatment will remove such characteristics.

EFFICIENCY.

By ROBINSON SMITH.

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1. *Shop Management.* By F. Winslow Taylor. Harpers, 1911.
2. *The Principles of Scientific Management.* By F. Winslow Taylor. Harpers, 1911.
3. *Work, Wages and Profits.* By H. L. Gantt. New York: Engineering Magazine Co., 1913.
4. *Psychology and Industrial Efficiency.* By Hugo Münsterberg.
5. *Scientific Management.* By Clarence B. Thompson. Milford, 1914.

In taking their way westward, European habits and fashions follow what has been said to be the course of Empire. All the flotsam and jetsam of European life—Russian dancing, German scholarship, Hungarian musical comedy, Parisian fashions, and English literature—are borne on the tide and spread over the American continent. The American manufacturer is ever alert for the latest European inventions; the American scientist, whether he work in the laboratory or in the operating-room, is in touch with the literature of his speciality coming every month from abroad; and American scholars, reformers and preachers are alive to the latest discoveries in scholarship, the newest movements in social reform, and the most modern trend in religious ideas.

All this is as it should be; but what puzzles one is that the tide rarely sets the other way. It is only with the greatest difficulty and after many years that American books, customs, movements, reputations, arts, take root either in England or on the Continent. A few notable exceptions blind us to the truth of this fact. These exceptions are so pronounced, so American, that they create an impression of Europe's becoming Americanised quite rapidly enough; for, though perhaps excellent in themselves, they often are incidentally suggestive of those things in American life and ways that are distinctly alien to the European mind. The cinema has become an almost exclusively American enterprise; ninety-one per cent. of the films shown in the British Isles come from overseas. But

this is an exception. Again, Americans, after forty years of insistence, have brought certain comforts, such as central heating, into European hotels, but how long and painful the process has been! And such reforms end at the hotels; the average English or French country-house, to say nothing of more modest dwellings, is still cold and uncomfortable in winter, at least for certain portions of the day and certain portions of the house.

This sluggishness of adoption is due to several reasons. It is due partly, as we have indicated, to a distinct liking for one's own way and a distrust of the ways of others; it is due partly to climatic conditions, which are so influential in forming the character of a race, and which in Northern Europe leave men deliberate and incurious, in Southern Europe emotional and easy-going; but it is also due very largely to the fact, merely psychological one might think, yet very real, that any idea coming to Europe from America must fight its way against a strong current that always sets the other way. Naturally, the European, from his superior historical position and his sense of what Europe has recently achieved in thought, art, and invention, finds this removal from American influences quite a natural if not beneficial detachment. Better fifty years of Europe than, if not a cycle, at least several hundred years of America.

And yet, while admitting the reasons for this imperviousness, while granting that it carries with it a certain protection against whatever is excessive in Western civilisation, one may doubt whether the balance does not represent a loss rather than a gain; the unprejudiced mind, conversant with both civilisations, may feel strongly that Europe would be a better Europe if she permitted herself more easily and quickly to be permeated by Western ideals and achievement. An entirely different social order exists there, an amazing activity in all departments of life; and it could not but give a wider and therefore a truer horizon to our own outlook upon life if Europeans were at least aware of this order and activity, even if these were found not quite fit to appropriate in their entirety. Again and again, on this side of the Atlantic, we are told that certain changes in the body politic and social are quite impossible, when the other side of the Atlantic has proved them quite possible years ago. Conditions differ, but, in general, society advances much more slowly than it might, simply because we are so ignorant of the advances made elsewhere. Content to say that human nature cannot be changed or that the British public would not put up with such and such a reform, it hangs back, rather proud of its conservatism. As a matter of fact, human nature is far more adaptable than we allow, and soon accommodates itself to new conditions, forgetting the old. And, essentially, in our reforms, it is not human nature that we wish to change; rather we are striving to effect certain benefits to society as a whole, let human nature remain or change as it will.

The two forces in America that in recent years have done most to put the American house in order and of which next to nothing is known in Europe are Efficiency and Prohibition, both of which undoubtedly interfere with individual freedom, but have come into play in the States without any of that wholesale injustice with which we are always ready to brand any reform. Prohibition has disappointed its opponents, both in the facility with which it has been introduced and established, and in the number and magnitude of the blessings it has conferred. Totally unsuspected benefits have developed, including commercial benefits which have won over the most unbelieving adversaries.

But the question of prohibition is too controversial a matter to be discussed here and now. The subject to which I wish to call attention is the other movement, also widespread in the States—that of 'Efficiency,' or 'Scientific Management,' as it was termed by its founder. I prefer the simpler term 'Efficiency,' since I wish to treat of this force in its general, philosophic aspect, rather than in its application to industrial management. I speak of Efficiency as a force, since its discovery was precisely like the discovery of some hitherto unsuspected force in nature, in that it completely revolutionised old ways of doing things and opened up new fields of achievement. Efficiency was not unknown—it is, indeed, as old as the hills; but only toward the end of the last century, and in America, was it discovered that it could be applied scientifically to all walks of life, and particularly to the output of labour and the management of business. Some scoffed, and continue to scoff, at its (to them) exaggerated claims, pointing out that every big business must have studied Efficiency in its own particular line—it was, in fact, the very air that big businesses breathed. But the unprejudiced observer will, I think, confess that Efficiency or Scientific Management, as it has been preached and practised the last score of years in America, is a great and new idea in the world.

It developed in this way. In 1878 a young American, Frederick Winslow Taylor, whose training had been that of a pattern-maker and machinist, entered the machine-shop of a steel company at Midvale, Pennsylvania. He quickly rose from the position of a day-labourer to a clerkship; next he became a machinist running one of the lathes; then, after several months, as he turned out more work than other machinists on similar lathes, he was made 'gang-boss' over all the lathes. After about three years, during which time he had been promoted to be foreman of the machine-shop, it was found that the output of the machines had been materially increased, in many cases doubled. What was the secret of this increased output Taylor had scarcely told himself, much less the world, although he had his wild surmises, as do all those who make a

real discovery. To obtain this result he had changed the movements of men and machines, and had adopted many new devices for speeding-up, probably to a greater degree than is usual where any increase of production takes place without increase of labour or plant; but as yet he had hit upon no new laws of maximum results, he had not converted his ideas into a science. He was confident, however, that scientific laws existed and could be translated into formulæ that would, with determinable modifications, be applicable for all work.

Taylor was now joined by others, as enthusiastic and convinced as himself; and in the years that followed, chiefly in the steel-works of Western Pennsylvania, countless experiments were carried out, countless data tabulated, as to the maximum amount of heavy labour that could reasonably be expected of a first-class man in a day—that is, how many foot-pounds of work a man best suited to a particular job could do. The number of foot-pounds varied considerably with the different kinds of heavy labour that were under inspection; in fact, it was soon discovered that there is no direct relation between the horse-power which a man exerts and the tiring effect of the work upon the man. On some kinds of work the man would be tired out when doing only one-eighth of a horse-power, while in others he would feel no greater fatigue after having done half a horse-power. After three long series of experiments, Taylor and his colleagues, by plotting the curves of their data, discovered the central law of heavy-labour maximum, namely, that to obtain the maximum output of a heavy labourer before he is tired out, he must be under load only for a percentage of the day. This percentage varies inversely with the strain caused by each given pull and push on the man's arms; the greater the strain, the smaller the percentage of the day that he should work, if the maximum result is to be obtained from his labour. Thus, when pig-iron is being handled, a first-class workman can be under load only 43 per cent. of the day when each pig weighs 92 pounds, but 58 per cent. of the day when each pig weighs 46 pounds.

Taylor got his data by timing men at work with a stop-watch. He experimented with them, noting which men did the most work, and why; seeing whether these men could do more work if they omitted certain movements or rested periodically; and timing the movements and output of these first-class men, so as to know just when these periods of rest should come and how long they should last. In the case of loading pig-iron on to a freight-car, Taylor's data pointed to the conclusion that a man suited to the job ought to be able to load between 47 and 48 tons per day, when the pigs weighed 92 pounds each. As one of the managers at the Bethlehem Steel Company, he then undertook to see whether his experimental data would hold good in practice and on a large scale. The pig-iron gang

at these works at this time consisted of seventy-five men, who were lifting pig-iron from a ground-pile, walking up an inclined plank and dropping it into a car at the rate of 12½ long tons a day. Taylor's first step was to single out one of these men, a Dutchman called Schmidt, of the ox-type of man, and on this first day and all day long Schmidt was told by the man who stood over him with a watch: 'Now pick up a pig and walk'; 'Now sit down and rest,' and at half-past five in the afternoon Schmidt had loaded 47½ tons of pig-iron on to the car. It was then merely a question of picking out other men of the Schmidt type. Only eight were found in this particular gang, but enough of the ox-type were found either in the yard or outside; and more suitable work was found for the sixty-seven men who were not the right men in the right place when loading pig-iron. By the end of the third year in which Taylor's methods had been applied at the Bethlehem Steel Company, the number of yard-labourers was reduced from between 600 and 400 to about 140 (of whom only two were drinking men), while the average number of tons handled was increased from 16 to 59 per man per day, the average daily wage raised from $1.15 to $1.88, and the average cost of handling a long ton lowered from 7⅓ cents to 3⅓ cents. In this reduced cost are included the office and tool-room expenses as required by the new system of management, and all the wages of labour-superintendents, foremen, clerks, time-study men, and others.

There is the whole story. It all points one way; there is no other side to it. The men were better paid, happier, and soberer, and they worked fewer hours; the Company increased the quantity and quality of its output at a reduced cost per unit, and experienced no labour troubles. In fact, wherever the Taylor system has been applied, there have been no strikes or labour troubles; and the system has been applied to every form of industry and office management during a period of thirty-five years.

The illustration given above tells the whole story as regards increasing the production of man, but the science of efficiency has been applied with equally remarkable results to the production of machines. In one case, the gain in time made through running metal-cutting machines according to scientific principles ranged from two and a half times the speed in the lowest instance to nine times the speed in the highest. The new theory, however, meets perhaps with its greatest triumphs in those trades and occupations where the saving comes not alone from the observance of the laws of fatigue, nor alone from the speeding-up of the machines or contrivances involved, but thirdly and perhaps chiefly, from the imposition of system and order, and the proper relation of the workman to his tools. One of Taylor's followers, Mr. Frank B. Gilbreth, experimented with bricklaying, a trade thousands of years old, but one in which there has been little or no improvement in the imple-

ments or materials used or in the method of their employment. Mr. Gilbreth, having made an intense study and analysis of each movement of the bricklayer, eliminated, one after another, all unnecessary movements, and substituted fast for slow movements. He studied the best height for the mortar-box and the brick-pile, and then designed an adjustable scaffold, with a table on it, upon which all of the materials were placed, so as to keep the bricks, the mortar, the man, and the wall in their proper relative positions. By this means the bricklayer is saved the exertion of stooping down to the level of his feet for each brick and each trowelful of mortar and then straightening up again. Under Mr. Gilbreth's system there is no need for the bricklayer to turn the brick over, or end to end, to examine it before laying, since the sorting is done by cheap labour on the ground, and the bricks, all good ones, have their best edge uppermost in the hod, which has its proper position on the adjustable scaffold. The mortar is mixed to such a consistency that there is no need for tapping the brick after it is in place. By these simple means the art of laying a brick was reduced from eighteen movements to five, and the capacity of skilful workmen raised from 120 bricks per man per hour to 350, attended, of course, by a very considerable increase in pay.

Another classic instance of this general type of increased efficiency was in the inspection of bicycle ball-bearings, in which, by eliminating the girls unsuited to the work, by resting the girls for ten minutes every hour and a half, and by other changes, thirty-five girls came to do the work formerly done by one hundred and twenty. The accuracy at the higher speed was two-thirds greater than at the lower speed; the girls' wages were increased by from 80 to 100 per cent.; and, in addition to the four periods of recreation during the day, their hours of labour were shortened from ten and a half to eight and a half hours.

It is instinctive to every man, and perhaps particularly to Englishmen, to look askance at innovations. They have a constitutional dislike of being jerked out of their ancient ways, and they protect themselves by advancing a host of objections. Thus Taylor's ideas met with a cold reception in this country. One argument advanced was that, after all, they did not make a new man of the labourer and did not solve our social and industrial problems. No one can read the history of the movement without seeing that, among other benefits, this is precisely what it does tend to achieve. Taylor's great hope from his new type of management was that it would largely eliminate the wage question as a source of dispute. 'What constitutes a fair day's work will be a question for scientific investigation, instead of a subject to be bargained and haggled over. Soldiering will cease to exist because the object for soldiering will no longer exist.' 'The close intimate cooperation, the constant personal contact between

the two sides, will tend to diminish friction and discontent. It is difficult for two people whose interests are the same, and who work side by side in accomplishing the same object, all day long, to keep up a quarrel.'

Moreover, scientific management tends to solve our social problems, because it takes care of the individual. It is far from being merely a trick for dealing with men *en masse* for the sake of increased output. It does not lend itself to 'driving,' to pushing-through a piece of work at high speed regardless of the workman. As we have indicated, it not only finds out what work the individual can best perform, but it keeps the individual fit and happy in that work. With women-workers each is made to feel that she is the object of especial care and interest on the part of the management, and that, if anything goes wrong with her, she can always have a helper and teacher in the management to lean upon. One of the regulations is that all young women are to be given two consecutive days of rest (with pay) each month, to be taken whenever they choose. Still further, outside of the factory, all large undertakings in America now have Welfare Centres for their employees, with cost-price restaurants, club-rooms and recreation-grounds. Hartford, in Connecticut, practically guarantees all its skilled labourers continuous employment; the manufacturers, through their own labour bureau, notify one another a week in advance whom they are to lay off and whom they wish to take on.

There are no statistics to show the extent of the Taylor movement and what its total result has been. That result cannot be measured by figures, since efficiency is a spiritual force. Moreover, not all the manifestations of the new spirit owe their birth directly or indirectly to Taylor. It is a wide-spread, national movement. Although there is still much misgovernment and political corruption in the cities, efficiency is the great cry, in all parts of the land and in all departments of life. It may become nauseating where it is used merely to vaunt material wealth and the growth of 'big business,' but it is a welcome slogan if it means, as it should mean, that through efficiency the material things of life are to be made less material, are to consume less of our time and patience, are to sink to their proper place. The average wage of the members of the Typographical Union of New York City, including the periods when they are out of work, is over a pound a day of eight hours, whereas the average wage of compositors in London has been less than eight shillings a day of nine hours or over. According to the last report on comparative prices of H.M. Board of Trade, the cost of living in America is only 50 per cent. more than here.

The time has gone by when a nation can afford to neglect any proved reform, whatever its origin. England is forced to change and improve, whether she will or no, if she is to compete with other

nations and bear the burden imposed by the war. The day of rule-of-thumb methods and dry-rot conditions must come to an end. Trade overleaps all prejudices and former hatreds, and follows where most money is made; and most money is made where there is the greatest efficiency.

Already the efficiency, *i.e.* the output, of the Canadian workman is appreciably higher than that of the English or Scottish workman; and the difference is bound to increase, ruinously for these Islands, unless there is a general awakening. Strips of moulding that cost 9*d.* each delivered from Germany before the war, still cost four shillings and sixpence made in England after three years of war. Those strips, and a host of other things, will climb any tariff wall that can be set up after the war, unless England is better organised. The sole protection, the sole preparedness, consists in a highly trained and intelligently educated democracy. Every English man, woman, and child must come to realize what efficiency means, and must insist with himself and all those with whom he comes in contact that it shall be attained. There is no walk in life, even as there is no action of our daily existence, where efficiency, both a general sense of it and its constant application, would not help to make both our own and the nation's task lighter and nobler. The man reading a story aloud to the cigar-rollers in a Cuban factory, the feat of washing the clothes of fifty thousand workers on the Panama canal over a period of seven years with scarcely the loss of a handkerchief, the stopping of trains 'at the crack' as is done in New York subways, the taking of order-tickets for Paris omnibuses in order to avoid disgraceful scrambling, the feeding of 25,000 people from one bread-depôt without crowding, as has been done for nearly three years in Belgium—these are instances of what can be done when some one man has a sense of causes and consequences.

One might think that a reform of this nature could be left to fight its own way, as a commercial reform, if the savings are as great as represented. It *has* made its way, and that rapidly, in the States; but the estranging sea lies between us, and here the cause of efficiency or scientific management needs preaching from the house-tops if it is to win attention. Taylor's books are more and more in demand, but as yet no school has been founded, as in America, to train efficiency superintendents, and neither the Government nor the Borough Councils have shown any anxiety to put the new idea into practice. The recently issued report (March 1917) of the special committee on munitions-output emphasises the need of Government action, showing how much might be saved if only the commonest laws of fatigue were observed. One factory, continually experimenting on its own initiative, has found its output distinctly larger when its operatives work five and a half days a week than when they work six or seven days a week.

But we cannot wait for the manufacturers to adopt the better ways, and so gradually indoctrinate the people. It is for Government first of all to set the example; the public corporations should follow; lastly, the methods should be taught in the schools. There is nothing, from the opening of our mail in the morning to arranging for fresh air at night, in which a little extra care and thought will not avail. If we have not given it extra thought and care, we may be employing eight typists in our office when, if we listen to Taylor, five would do more and better work, and be better off themselves, while the other three would be really contributing something of sweetness and light to the general hive, where now they are no better than drones. 'Why labour at the dull mechanic oar,' why pile up burdens unnecessarily for ourselves and our children, when, almost by the turning of a hand and a little will, conditions can be made so much better? Let us talk less of the impossibility of changing human nature, let us study less the frequently meaningless will of the people, let us worry less about labour troubles and the relations between employer and employee. Let us, instead, aim at that greater all-round efficiency, by which alone wages can be safely increased and our labour problems solved. To the old virtues of industry and thrift, we need to add the new ones of scientific efficiency and daring change. We need a new spirit that forms and reforms, that leads and is not pushed; a new conscience, that will not let us rest until conditions are far better than they are. Incompetence, slackness, ignorant neglect, are the cause of half our woes. Let us be informed, let us be determined, and we shall not fail. The world is strong, very strong, but man is stronger.

Colonel J. F. Lewis, R.E.

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MEMOIRS.

COLONEL J. F. LEWIS.

BY the passing away, in February last, of Colonel James Frederick Lewis, the Corps lost one of its greatest authorities on fortification and one who was perhaps its greatest expert in the design and construction of all types of recent works of defence.

The founder of his branch of the family, James Lewis, who said he was a Welshman of Glamorganshire, was born about 1723 and went to Jamaica for some years, where he acquired the estate of Lewisburg; returning later, he lived near Brisfol and died about 1790. He was a lawyer and so were many of his descendants, who retained their connection with the West Indies. One of them, also a James Lewis, was, at the request of the West India body in London, appointed one of the three Commissioners for paying off the 20 millions compensation voted on the abolition of slavery. He drew up the rules for the allotment of the money and himself paid away the Jamaica portion (£6,800,000). The father of the subject of this Memoir was the Rev. Philip Lewis, who was born on the 4th December, 1812, and was in the Eleven at Eton in 1830–31; he married Lucy, daughter of Hugh Myddelton Ellicombe, in 1845. He was the first Vicar of Bursledon, Hants, going there in 1850 and remaining till 1879, when he retired, owing to failing health, and died at Brighton on the 9th August, 1886, and was buried at Bursledon.

J. F. Lewis was born on the 14th May, 1846, at Culverlands Cottage, near Exeter, the residence of his grandfather, H. M. Ellicombe. Among his earliest recollections were seeing the Exhibition Building of 1851 being dismantled, the funeral of the Duke of Wellington on the 18th November, 1852, also going part of the way from Devonshire to Southampton by coach, the railway not having been made at that time. He first went to a small school at Titchfield, Hants, in 1855; after that, to various others and lastly to Mr. Wilson, of old Charlton, Kent, where he stayed till he passed for the Royal Military Academy, Woolwich, 4th on the list, at the summer examination of 1864.

After the usual 2½ years, he passed out 6th on the list, obtaining a commission in the R.E., dated the 15th January, 1867. He joined the R.E. Establishment—as it was then called—at Chatham, when

Colonel Simmons was Commandant. After leaving the Establishment, he returned to Chatham for a time to finish the Catalogue of the R.E. Library there, which was published in 1871. During his time there, he was attached to the 10th Co., R.E., under the command of Major Pritchard.

On the 9th November, 1870, he was elected a member of the Geological Society of London; he had taken to geology with great enthusiasm, under the training of Mr. Green, of the Geological Survey.

In August, 1870, he went to Portsmouth, where he was attached to the 32nd Co., R.E., under Capt. Keith, and employed on alterations to the Battery in Southsea Castle and the Southsea Beach sea wall. On the 15th May, 1871, soon after the end of the Franco-Prussian War, when Paris was in a state of upheaval, he went on leave to France, and joined by Lieut. R. C. Hart, R.E., at Boulogne, proceeded to Versailles. Later he witnessed the batteries of both sides—the Communists in Paris and the Troops outside—pounding each other, and he came under fire, having some rather narrow escapes. On the 21st May, while looking through a telescope, he was unexpectedly the witness of the entry of some of the Troops into the Point du Jour, who had been admitted by some one inside. On the 22nd May, he and Hart suddenly came across men in R.E. uniform and found that Fraser, Noel, Chermside, Wilkinson, and his brother in the 40th, and two or three more had come over from Chatham and also Hart's brother Horatio.

They managed to enter Paris on the 26th May, being able to get about fairly well, seeing dead, wounded, prisoners, barricades, damaged buildings, etc. They were allowed to attend a court-martial—which they found to consist of one member only—during the four hours they were there about 150 persons were disposed of, only six being set at liberty. Only a preliminary sifting was made. The duty was done fairly on the whole, though quickly; it was found a very interesting experience. They made various unsuccessful attempts to leave Paris; but on the 3rd June they were permitted to do so; and, stopping the next day with Colonel Hart (R. C. Hart's father), at Boulogne, Lewis returned to England the following day.

On the 22nd July, 1871, Lewis left England for Malta, arriving there on the 3rd August, being posted to the 26th Co., R.E., under Capt. Hime; Colonel G. F. Mann being C.R.E.

He designed a fort for Tarxien Hill, which was approved, and a line of Works between the two harbours across Ta Samra Hill; on the completion of the latter, he set to work on fortification details for Tarxien, "thus acquiring," he records, "an amount of information that proved of immense value to him afterwards." Next winter

was mainly occupied with fortification work on the new extended scheme for the defence of Malta. He drew up on his own account a report as to the Works to be built on the East of Valletta, which was sent home and the sites were adopted. In the summer of 1874, he was put in charge of the Works at Fort Benjemma, which he nearly completed before leaving the station. In 1874-75, he prepared a project for the complete fortification of the Nadur-Benjemma position, 8 miles across from sea to sea (which involved the preparation of over 60 plans). While at Malta, Lewis visited Constantinople and the Danube, Athens, Rome, and several of the large cities of Italy.

In May, 1875, Lieut. Lewis married Amelia, daughter of the late Edward Carey, M.D., of Guernsey.

Lewis returned to England and reported at the W.O. on the 1st July, 1876, where he was employed in the Fortification Branch under Major E. Harding Steward, Colonel Nugent being D.W.F. and General Sir Lintorn Simmons I.G.F. In March, 1878, he was sent to Edinburgh, on special duty, to design batteries for six 10-in. R.M.L. guns, for the defence of the Firth of Forth, which were afterwards constructed.

In February, 1879, he was appointed a member of the Machine Gun Committee just formed, which Committee eventually recommended the introduction of the Gardner gun. At the end of the same month, he was also appointed a member of the Committee on Working Heavy Guns and also of the Committee on Range Finders.

On the 31st March, 1881, all the Committees of the Director of Artillery were dissolved and a single Ordnance Committee appointed in their place. Capt. Lewis was appointed an Associate Member for the subjects of Machine Guns and Range Finders. In the spring of 1881, he gave a series of lectures on Permanent Fortification at the R.E. Institute, Chatham.

On the 11th April, 1883, Capt. Lewis left for Aden and India, for employment under the Indian Government on the design of the Defences of Aden. After three weeks at Aden, he went, *viâ* Bombay, to Simla, remaining there till the end of September, returning then, *viâ* Karachi, to Aden and thence to England, arriving on the 19th December, where he was employed under the India Office (but working at the W.O.), completing the designs for Aden. He worked under the Indian Government for about five years in all.

In February and March, 1884, Capt. Lewis again delivered a course of seven lectures on Permanent Fortification at the R.E. Institute, Chatham. On the 15th January, 1887, he was promoted Major, at the end of 20 years' service; this was afterwards antedated to 11th December, 1886.

In November and December, 1888, Major Lewis, accompanied by

Major Watkin, R.A., went to Gibraltar and Malta to choose sites for Position-Finding instruments, invented by the latter officer, returning *viâ* Italy.

During this winter, Major Lewis began to re-write the Text Book of Fortification, at the request of the I.G.F., General Sir L. Nicholson. This work, *Permanent Fortification for English Engineers*, came out in September, 1890, published by the R.E. Institute, and has been the approved authority on the subject ever since.

While working at the W.O., in addition to directing work regarding defence works and problems in many parts of the Empire, Lewis joined in drawing up a report on the defence of London and visited many parts of the United Kingdom, in connection with proposals for sites of batteries, etc., and experiments with the mounting and firing of guns and for Position-Finding instruments, etc.

He was promoted Lieut.-Colonel on the 22nd May, 1893, and in the following March joined at Portsmouth as C.R.E., Portsea Sub-District, in succession to Lieut.-Colonel A. de V. Brooke, Colonel Durnford being C.R.E., Southern District.

On the 24th June, 1896, Lieut.-Colonel Lewis left for the Island of Ascension, on behalf of the Admiralty, to design new batteries and overhaul engineering works generally; he went *viâ* St. Helena, and arrived there on the 16th July, remained till the 12th September, and reached England again on 28th September. Those who knew him will not be surprised to learn that when, later on, he saw Sir F. Richards, First Sea Lord, he "was very complimentary about the Ascension Reports." There is also an interesting entry as to having "arranged about disposal of turtle from Ascension with Gunter, of Berkeley Square"!

On the 26th October, 1896, Lieut.-Colonel Lewis handed over the duties of C.R.E., Portsea Sub-District, to Lieut.-Colonel Wilkinson, R.E., and on the 1st November again came under the Admiralty, being required to go to the Falkland Islands, for which he embarked at Liverpool, on the *Orcana* on the 5th November, Mr. Cole, of the Admiralty Office of Works Department, going with him. Among the places to which they went, and at most of which they landed were La Pallice, Corunna, Lisbon, Las Palmas, St. Vincent, Rio de Janeiro, Monte Video, Punta, Arenas, where they transhipped, and reached Port Stanley on the 10th December, where the Governor, Sir Roger Goldsworthy, kindly put them up during all their time on the Island.

Here their time was fully occupied preparing designs for a Naval Depôt, including pier, stores, dock, fortifications, barracks, etc. After coming through the tropics the weather must have been trying at times; of the 21st December it is recorded:—"*Longest* day. Temp. 49°!" But they worked with a will, and every assistance was readily given. The night before they left he says that the

Governor proposed his health at dinner, and adds :—" He noted that we had been three months together and had not quarrelled ! "

They left on the 6th March, 1897, returning by the same route as they came. Reaching Monte Video on the afternoon of the 11th March, they were informed that a revolution was going on in the town, and that " the Government did not guarantee life after 8 p.m. ! " They were advised not to land till the morning, and they accordingly very wisely waited till the next day. On the 17th March they landed at Rio and went up the Corcovado, which is about 2,400 ft. high and nearly vertical, by a narrow-gauge railway, with central rack, winding up " through most beautiful tropic forest with flowering trees and shrubs and with distant views of wooded valleys and sea " ; he calls it " one of the most delightful trips " he had ever taken. He was evidently much struck by Rio ; on the way out, when entering, he calls it " one of the most lovely views on earth " ; but it was considered very unhealthy. Some years later, he was informed that many sanitary improvements had been made and he says that he was " glad to hear that the most beautiful place on earth has ceased to be the death trap that it used to be not long ago." They landed at Liverpool on the 4th April and he continued to work under the Admiralty until the end of the month.

He reported at the W.O. on the 1st May, 1897, and was put in charge of the Rifle Range Section of the Military Works Loan and became a Brevet Colonel, on the 22nd May, by seniority. During the winter of 1897–98, Colonel Lewis went to Switzerland with his family, spending two to three months there.

It was announced in Parliament on the 7th April, 1898, that Wei-hai-wei, in North China, was going to be taken over by Great Britain after being evacuated by Japan in the middle of May. Colonel Lewis was selected to go out and make a report on the proposed Defences. He accordingly embarked on the P. & O. s.s. *India* on the 3rd June ; with him there went Major Penrose, R.E., and Capt. W. A. Harrison, R.E., who were to carry out the survey of the newly-acquired land. They stopped at Gibraltar and Colonel Lewis went round the new Dockyard Extension Works, and, after giving a summary of what he saw, remarks : " It is an enormous work and a great deal is done." He little knew, presumably, that he would be stationed on the Rock before the end of the year. Of Malta, he says, " It seems almost unchanged," thinking probably chiefly of the years he was there as a subaltern. The ship called at Brindisi. He was, of course, much interested in the Defences of Aden and remarks on the Works being " delightfully invisible " and that he was " curious to notice how the details of the Forts had worked out." " Generally satisfactory," being the verdict ! At Colombo such a lover of nature was, like others going out to the East for the first time, much im-

pressed by the tropical vegetation, the cocoa-nut palms, etc., the varied races of people and their dresses, the wonderful picturesqueness of the whole. They transhipped to the *Coromandel*, and called at Penang, where the Botanical Gardens in a beautiful valley with the waterfall at the head naturally attracted special notice, and then at Singapore, reaching Hong Kong on the 7th July, where they disembarked. He was met by his eldest son, then in the R.G.A., who was stationed there and had taken a room for him at the Hong Kong Hotel; Penrose and Harrison went to the R.E. Mess, where they all met at dinner that evening. He interviewed various local authorities, Major-General Black being in command and Colonel Elsdale the C.R.E.

On the 12th, they left in the s.s. *Kweiyang*, reaching Wei-hai-wei on the 19th, called on the Naval C.-in-C., Admiral Sir E. Seymour, and were assigned quarters in "Queen's House" (the old Yamen), where, with the kind assistance of the Navy and a "No. 1 Boy," who was an old R.N. Steward, they soon made themselves comfortable. One of the first things in connection with the Survey was, of course, the measurement of a Base, and he records the purchase of the site of one end for the Government for $8 and of having "paid cash down to the great delight of the whole village!" Major F. M. Close, R.A., came up from Hong Kong and they worked on the proposals for the Defences, and went together to Peking to report to the British Minister, Sir Claude MacDonald, leaving Wei-hai-wei in the s.s. *Lienshing* on the 23rd August, by Chefoo, past the Taku Forts, part of the way up the river, and thence, by rail, through Tientsin, to Peking, which was reached on the 25th. They called at the British Legation the next day, saw the Minister and showed him a summary of the proposals.

While there, they visited some of the principal buildings, etc., but the state of the roads, the mud, ruts and filth impressed themselves upon him most forcibly; on arrival they went from the station to their hotel "packed each into a sort of ekka" and found it so bad that he says "The drive into Peking is unforgettable and indescribble. No lady should take it!" When leaving they went on donkeys, which they found "much better!" But this was in "the good old days" before the Siege of the Legations; since then, things have much improved, and, although there are plenty of ruts and much mud in many of the roads, the railway terminus has been brought inside the city and all the area of the Foreign Legations has been cleared, and is well kept.

They left Peking on the 29th August, returning by the same route as they had come; Close left Colonel Lewis at Chefoo, on his return to Hong Kong, and the latter went thence to Wei-hai-wei in H.M. T.B.D. *Whiting*, arriving on the 2nd September. Then he busied

himself in making designs, plans, etc., and finally left on the 16th September in the *Higo Maru*, going by Chemulpo and Fusan to Nagasaki, Moji and through the Inland Sea to Kobe, landing there and visiting Kyoto and Osaka. At the latter when visiting the Castle, for which special permission was obtained, he says :—" One of the sentries called my attention to the fact that my trousers were turned up!" Going back to Kobe, he left on the 28th September for Yokohama, arriving the next day; landed, paid a visit to Tokyo, came back to Yokohama, went for the day to Kamakura, and embarked on the C.P.R. s.s. *Empress of Japan* on the 7th October, having seen Fuji—" a wonderful cone "—both with and without snow on it.

He reached Vancouver on the 18th October, and Victoria the same day and visited Esquimault; went across by Montreal and Quebec to Halifax, where he saw the G.O.C. and also various R.E. officers and, as was his wont, visited batteries, etc., left on the 3rd November and reached London on the 15th and, in due course, reported himself and handed in his report.

Colonel Lewis was made a Substantive Colonel on the 22nd December, 1898; and on that day embarked at Southampton on the hired transport *Jelunga*, with his wife and two daughters, to become C.R.E. and Colonel on the Staff at Gibraltar, relieving Colonel Rathborne; they arrived there on the 27th. General Sir Robert Biddulph was the Governor, Lieut.-Colonel E. J. Dewing was O.C. Cos., R.E., and C.R.E., North Sub-District, and Lieut.-Colonel J. E. Blackburn, C.R.E., South Sub-District; after some time, the former was relieved by Lieut-Colonel Middlemass, but the latter remained until within a few weeks of Colonel Lewis's departure. His predecessor was appointed by the Governor Chairman of the Sanitary Commissioners, a civil body which is responsible for the duties usually carried out at home by municipal authorities, and Colonel Lewis succeeded him in those duties also, an arrangement which had very good practical results.

The various problems, especially in connection with defence, which arose in a first-class Fortress, like Gibraltar, were such as suited the particular experience Colonel Lewis had during his Service. The big Dockyard Extension, to which allusion has already been made, was carried on and nearly completed in his time, modifying to some extent the conditions of defence, etc. The Boer War took place during his time; two of the four companies, R.E., went to S. Africa, being replaced, after an interval, by two others, and the Infantry Garrison was changed more than once. After the War, General Sir George White relieved Sir R. Biddulph, as Governor, and during his time the Duke and Duchess of Cornwall and York visited the Rock, the first stopping place in their tour of the Empire; and

at Easter time, in April, 1903, King Edward VII. also paid a visit to Gibraltar, where Colonel Lewis accompanied him to O'Hara's Battery, on the S. end of the Ridge, where he spoke about the Defences.

During his tenure of office at Gibraltar Colonel Lewis was called home to advise the Colonial Office regarding the future government of Wei-hai-wei. On the 4th May, 1903, he left the Rock, having handed over to Colonel Wilkinson, reached England on the 9th, went on half-pay on the 10th and retired on the 14th, under the age clause.

Like many retired officers, Colonel Lewis found a difficulty in deciding where to settle; towards the end of 1904, he and his family went to Winchester and finally made up their minds to stay there; not being able to get a suitable house, but finding a desirable site in Christchurch Road, he built one there, calling it Myddelton, after one of his ancestors, Sir Hugh Myddelton, and they moved into the house on the 9th December, 1905.

On the 15th December, 1904, he started for Hong Kong, on a special mission to adjust a land dispute there, between the W.O. and the Colonial Authorities. He went through France and caught the P. & O. s.s. *Britannia*, at Marseilles, the next day; transhipped to the s.s. *Simla*, at Colombo, on the 1st January, 1905; at Singapore, he was entertained by Major-General Sir Arthur Dorward, and reached Hong Kong, on the 14th January, and was invited by Sir Matthew Nathan to stay with him, at Government House. The G.O.C. was Major-General V. Hatton. Colonel Darling had arrived recently to take over the duties of C.R.E. from Colonel L. F. Brown, who was retained to go into the land question.

Colonel Lewis went into the matter and his report was agreed to by both parties; the "Lewis Agreement" being still referred to when questions arise. In addition he made a report on the Defences. While there, he went with the Governor for a short trip to the New Territory (a portion of the adjacent mainland leased from China), and also paid a visit to Canton.

He got instructions by cable to report on the Defences of Port Arthur, which had just been taken from the Russians by the Japanese, and to first report himself personally to the British Minister, at Tokyo; this last pleased him much, and he left Hong Kong on the 8th March, in the C.P.R. s.s. *Empress of Japan*, reaching Tokyo on the 16th, where he saw the British Minister, Sir C. MacDonald, and also met Capt. Sir A. Bannerman, R.E., who had recently come from Port Arthur. There was much rejoicing at Tokyo at the time, the Battle of Mukden having just been gained by the Japanese.

After communication with the Japanese authorities, permission was granted for Colonel Lewis to go to Port Arthur, accompanied

by Bannerman, and they went, on the 2nd April, by rail to Shimonoseki and there embarked on the *Aki-Maru*, which was being used as a transport, reaching Dalny (now called Dairen by the Japanese), on the 8th and going by rail to Port Arthur the next day. Here they were assigned a little one-storeyed wooden house which was that used by General Kondrachenko, the Engineer hero of the siege; everything was very plain as he left it. Later they were moved into the house which had belonged to General Bailui, the Russian Artillery Commander, which was more comfortable. General Ijichi, who was in command, gave them full facilities for visiting the various parts of the Fortress and taking photographs.

They left Port Arthur on the 19th April, returning to Shimonoseki whence Bannerman went back to Tokyo and Colonel Lewis left, on the 23rd, in the s.s. *Anhui, viâ* Nagasaki, for Shanghai, where he transhipped to the French s.s. *Armand Béhic*, reaching Hong Kong on the 1st May, where he related his experiences of Port Arthur, and left in the P. & O. s.s. *Coromandel*, on the 6th. The Captain took the ship near the coast of Cochin China to try and sight the Russian Fleet; in this they were successful, as, on the 8th May, they passed some guardships, evidently on the look-out, and, later on, saw the Fleet at anchor, in Vanfong Bay! Colonel Lewis changed into the P. & O. s.s. *Victoria* at Colombo, disembarked at Marseilles and reached England on the 5th June, 1905.

He records that "this was a most interesting trip" and his appreciation at being chosen for the work as "a compliment to a retired officer."

He was, as might be expected, much in request for information regarding Port Arthur and, on the 13th July, he lectured to officers of the War Office, at the R.U.S. Institution; on the 20th, at the R.E. Institute, Chatham; and, on the 26th September, at the R.M.A., Woolwich; and again on the 15th March, 1906, to the officers at Portsmouth.

In 1910, Colonel Lewis went for a trip to the West Indies, starting from Southampton, on the 2nd February, in the R.M.S.P. s.s. *Tagus*, on board he found Colonel and Mrs. Rochfort-Boyd. He called at Barbados, Grenada, and other places, finally reaching Jamaica.

Shortly after his return from the trip, he sent in a Report on the Defence of the Panama Canal to the W.O. and received the thanks of the Chief of the Imperial General Staff for his "valuable and interesting report."

On 14th May, 1911, his 65th birthday, Colonel Lewis received an offer from the Coventry Ordnance Works, Ltd., to act as adviser to the Firm for Foreign Governments requiring designs for batteries; this offer he accepted; the work lasted for a year.

While at Winchester he was by no means idle, but assisted

various organizations connected with the Church and schools, and in philanthropic work. He represented the Church Schools on the City Education Committee for some years. When a Church Institute was opened in one of the local Camps he assisted those responsible for its management. He was for some years on the Committee of the Church of England Soldiers' and Sailors' Institutes Association, in London. Although living at Winchester, he joined the local Committee of "The Trafalgar" Church of England Institute at Portsmouth, helping in its reconstruction and becoming Vice-Chairman and Chairman of the House Committee; when he resigned these positions, the Committee named one of the "cabins" after him, placing an inscription on the door.

Colonel Lewis was a member of the R.E. Institute Council at his death, having held office for the allotted periods from time to time. He was also for years a member of the R.E. Institute Publications Committee.

Colonel Lewis had three sons and three daughters; he is survived by Mrs. Lewis, two sons and two daughters, the eldest girl died in infancy. The three sons all married, and it is interesting to note that though Colonel Lewis would have been the last of his family had he been without children, he has now left 10 grandsons, and, therefore, deserves well of his country at this crisis!

When the War broke out in 1914, Colonel Lewis offered his services to the W.D., to enable a younger man to go to the Front; but, owing to his age, his offer was not accepted. But he has been well represented by his sons, all of whom made the Army their profession; the eldest was for a time on the Staff of one of the Divisions in France, and for the rest of the time at the W.O.; the second is serving in France; and the third made "the supreme sacrifice" in France, in October, 1914.

Colonel Lewis was always fond of taking plenty of walking exercise, but towards the end he had to be careful; he records:—"I was told that the mitral valve of my heart had more than it could do and that I must go easy in future," and he frequently found that his energies had to be curbed, and although near the end he made some surprising rallies he finally succumbed to heart failure on the 7th February, 1918, at his house, at Winchester. He was buried in Compton Churchyard, near Winchester, on the 12th February.

Colonel Lewis will be greatly missed by all who knew him; in his domestic relationships, he was not to be surpassed; as a friend, always staunch and true; it is impossible to think that he could ever make an enemy, being always full of consideration for others, ever ready to help any one, he did much to assist those in need in an unobtrusive manner, ever prepared to expend himself. He was very fond of travelling and studying nature and took a great interest in

botany, geology and architecture. He was much liked by all the officers serving under him, being just as courteous in his dealings with a subaltern as with a senior officer.

It seems strange that one who was so frequently selected for special services, which he carried out so satisfactorily, should have received so little special recognition ; but this may perhaps partly be attributed to his retiring disposition and his dislike to advancing his personal interests.

He was of a strongly religious character and, as was said recently of an officer who fell in France :—" He was a real noble and Christian English gentleman; than which no more can be said of any one."

C.W.R.St.J.

COLONEL G. F. O. BOUGHEY, C.S.I., R.E.

COLONEL BOUGHEY received his commission in the Royal Engineers in June, 1862. After the usual training at Chatham he arrived in India on January 5th, 1865, and spent the whole of his service there. He served in the Bhootan Expedition, 1865–6 (Medal and Clasp). In 1869 he joined the Public Works Department as Assistant Engineer, Railway Branch, North-West Provinces, was appointed Executive Engineer, Rajputana Railway, in September, 1870, Deputy Consulting Engineer for Guaranteed Railways, Lucknow, in May, 1877, and Assistant Secretary, Railway Branch, North-West Provinces and Oude, in 1879. He saw service again in the Afghan War, 1878–80 (Medal). He was appointed Manager of the Indus Valley and Kandahar Railway in January, 1882, and Manager of the Eastern Bengal State Railway in November, 1885. He took charge of this latter line at a critical time, a year after it had been acquired by the State, and neither the Calcutta public nor the late Company's staff welcomed the change with enthusiasm. The task of consolidating and amplifying the necessary alterations in procedure and working was no easy one and there were many difficulties to be overcome, but the new Manager soon earned the confidence and respect of the commercial public of Calcutta and the regard of his subordinates.

He was the first in recent years to put forward the project of a bridge over the Ganges at Sara and took great interest in the scheme in the late eighties. In the spring of 1891 he induced Sir John Fowler, the eminent engineer, to visit Sara, and consider the question of the suitability of a bridge or a tunnel to make the necessary connection. The project remained for a long time pigeon-holed amongst the records of the Government of India, but Colonel Boughey lived to see the completion of the bridge.

Colonel Boughey became Manager of the North-Western Railway in October, 1892, and his house at Lahore became a centre at which all his staff could look for a hospitable welcome from himself and Mrs. Boughey, while his personal interest in each individual and his appreciation of honest work had far-reaching effects on the future of the many assistants who had the privilege of serving with him. He was appointed Honorary A.D.C. to the Viceroy for valuable services in connection with the Volunteer Movement in India, and was mentioned in the Commander-in-Chief's despatches of the Chitral Expedition, 1895, and was rewarded with the C.S.I. in January, 1896.

Colonel Boughey was a man of strong character and varied experience, with a sound knowledge of Railway Engineering and a very complete grasp of the economics of Railway Administration. He had a strong belief in his own opinion, but the results generally proved that his confidence was not misplaced, and his disinterestedness and lack of self-seeking were never open to question; all who worked with him had great faith in him and felt that their interests were safe in his hands.

Colonel Boughey returned home in 1896, and held the appointment of Light Railways Commissioner in England from that year till the end of 1917.

NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

No. 2.—February, 1918.

THE PRESENT SITUATION RELATING TO OUR INFANTRY MACHINE GUNNERS.

I. *Organization.*—The author of the original article states that the organization of the 120 companies of machine gunners which the Swiss Infantry have had to provide since the summer of 1915 has been completed and that the *personnel* of these companies finished their preliminary course of instruction on the 24th November, 1917. The introduction of a machine-gun organization in the *landwehr* similar to that provided for the *élite*, namely, one M.-G. company per battalion of every regiment, has yet to be carried out to complete the full scheme which has been projected.

Attention is called to an article by Colonel Egli, which appeared in the *Basler Nachrichten* for the 24th November, 1917, entitled *On the German Front in Flanders, III. New Infantry Formations*, in which it is stated, *inter alia*, that "Progress in the employment of machine-guns keeps pace with that effected in the technique of hand grenades. The weight of the machine-guns militating as it did against its mobility, the large numbers of the *personnel* composing the gun detachment and the size of the teams were all obstacles to the efficient employment of this arm. The adoption, however, of a lighter gun has solved the difficulties referred to; and the provision of a simpler mounting for the gun has now made it possible for one man to transport the gun and its mounting. The other numbers of the detachment carry the ammunition and help in manning the gun. The light machine-gun is not the same weapon as the automatic rifle with which it must not be confounded; the former is practically the ordinary Maxim gun, that is to say, it is provided, as is the Maxim gun, with a water-cooling jacket. On the other hand, the mounting is different, as it is fired from the shoulder by the gunlayer. The light machine-gun is less rigidly fixed on its present mounting than has been the case with the mountings hitherto in use; in consequence, a wider angle of dispersion can be obtained. This consideration, however, is not of very great importance in the case of the short ranges involved in trench warfare. To-day, every German infantry company is provided with several light machine-guns. In addition, the numbers of machine-guns of the heavy model with the battalions and regiments have been very considerably increased, so that the troops employed on the front held by a regiment are able to sweep the field before them with a dense band of bullets, even where all the machine-guns are not simultaneously brought into action and even if several of these guns are knocked out."

The author of the original article is of opinion that the Swiss Army should not be provided with two types of machine-guns, a heavy and a light one. In a small army great care requires to be exercised to avoid multiplicity in the types of the armament parts, since this not only creates difficulties as regards manufacture but also brings about complications in connection with the training of specialists. It is stated that the machine-gun now in possession of the Swiss Army is not too cumbersome but exactly meets the requirements of the situation. The same, however, cannot be said of the mounting for the Swiss machine-gun. The Swiss tripod mounting, although much lighter than the German heavy tripod, is not considered suitable for universal use. It does not lend itself to the requirements of trench warfare. The most cannot be made of the protection of the parapet; considerable time is required to get the tripod into position. And if the weight of a shield —the adoption of which is imminent—be taken into account, the total weight involved will be quite equal to that of the German heavy machine-gun. Under these circumstances, the author of the *Revue* article is of opinion that whereas the Swiss Army should possess but *a single type of machine-gun*, it should be provided with *two types of mountings*: one for long-range fighting and the other for short-range combats.

In the case of long-range fighting a machine-gun requires telescopic sights, a tripod mounting and a shield. In the case of short-range combats, telescopic sights and the tripod mounting must be dispensed with and the shield should be so constructed as to provide a support for the gun. In the latter case a greater dispersion of fire can be obtained than where tripod mountings are in use; this is all to the good. The principal consideration, to be borne in mind, however, is that the ground, within a certain range, over which the enemy has to advance must be capable of being brought under fire up to the full height of a man.

In the case of a further increase in the number of machine-guns in the Swiss Army questions relating to the possibilities of recruiting the additional *personnel* for manning these guns and of providing the necessary transport, including animals, call for attention. It is said that so far as the Swiss infantry is concerned no difficulty is apprehended. Experiments have proved that the Swiss mountain wagons are capable of transporting eight machine guns, together with their tripods and shields and also the ammunition for immediate use. If, therefore, in addition to the guns with the machine-gun companies—intended principally for long-range fighting—each company of an infantry battalion were later to be equipped with eight machine-guns apiece for short-range combats, four 4-horse mountain wagons and four 1-horse carts would be sufficient for the transport of the 32 machine-guns of a battalion, including their ammunition and all accessories.

So far as the transport question is concerned the foregoing proposal does not exhaust all the possibilities. By a trifling alteration in the machine-gun cart now in use in Switzerland, it can be adapted for the transport of two guns, with their tripods and shields, instead of one only. On good roads and for short distances arrangements can also be made to carry a small quantity of ammunition.

In difficult country and in proximity to the enemy, when the carts can no longer be used, the gun and its tripod and shield must be carried by the gun detachment, and similar arrangements must naturally be made for the transport of the ammunition.

In the event of an increase of machine-guns, by the issue of these weapons to infantry companies, it is recommended that an increase of armourers should take place, so that each infantry company may have two men specially skilled in the repair of machine-guns. Further, each section of an infantry company should have two N.C.O.'s and eight men trained in handling a machine-gun in short-range fighting—a month's instruction it is suggested would be quite sufficient for the purpose.

II. *Training.*—The author of the original article justly remarks: Organization and *matériel* provide in themselves alone an insufficient preparation for war. There is required in addition sufficient military training and the development of a tactical instinct in troops to fit them for the realities of a soldier's calling. The opinion is expressed that sufficient progress has not been made in the training of the machine-gun *personnel* of the Swiss Army.

Attention is called to the issue of the *Allgemeine Militär Zeitung* of 24th November, 1917, in which an article entitled *Beiträge zur Gefechtausbildung der M.G.* (Points in connection with the battle training of machine-gunners) by H.C. Capt. Herbert Constant, a Professor at the Swiss School of Musketry, is thought to be the author of the article referred to; the views expressed therein meet with hearty approval, the suggestion being made that every infantry machine-gun officer should make a thorough study of H.C.'s article and apply the lessons contained therein.

The rules laid down relating to the fire of several machine guns against a single target and in the preparatory stages of an engagement deserve the closest attention. The opinion is expressed that the training of Swiss machine-gunners in the matter of fire discipline is based too rigidly on the teachings of the Artillery School and not sufficiently on that of the Cavalry School. There appears to be a tendency to attempt to treat machine-guns as if they formed units of a battery of artillery. It is pointed out that a control of this nature is not possible and not desirable in the case of machine-guns. Another fault in the handling of this arm, which has been noticed, is the attempt to bunch the guns on an exceedingly narrow front—the Swiss provisional regulations lay down that machine-guns when in action shall be spaced about 30 paces apart—and to have too many men in the immediate vicinity of the weapon.

Where machine-guns are served by two men and are properly brought into action in masked positions, it will rarely be necessary for them to open fire at a longer range than 600 yards.

Range practice with machine-guns should, it is urged, always be carried out as a tactical exercise. The method of forwarding ammunition to machine-guns as at present practised in Switzerland is said to be faulty, as it tends to cause damage to the ammunition. It is recommended that a small ammunition dump should be formed in rear of each section of machine-guns and the ammunition passed carefully forward thence.

The object to be aimed at in the training of machine-gun detachments should be to develop the initiative of every individual member so that he may be able to carry out his duties and to act independently without spoon feeding on the part of the Section Commander. Naturally, everything should be done to create *esprit de corps* of the proper kind in machine gunners; every man should be encouraged to aim at being able to handle his gun without assistance. Machine-gun officers should never forget that they belong to the infantry arm and that it is in that arm that they must seek their career.

The original article is illustrated with a number of photographic reproductions showing machine-guns in action under various conditions.

THE ITALO-AUSTRIAN THEATRE OF OPERATIONS (*continued*).

The text of the original article is accompanied by a sketch-map showing the lines of advance from Austria into Italy. In preceding articles on the above subject the operations of the Italian Army, which brought Cadorna's troops to within a few thousands of yards of one of the objectives of the War, Trieste, have been briefly described. It would be premature to discuss, at the present time, the causes which led to the Italian retreat from the Isonzo. History will, no doubt, deal with this point as well as with the reasons which have made it impossible for the Austrians to hold the Italians in check without German assistance. One fact, however, clearly stands out, namely, that the fighting efficiency of an army cannot be kept at concert pitch without the *moral support of the whole nation* to which it belongs. Without this support an army suffers in its fibre as well as in its discipline.

Cadorna's was a two-fold task: that of directing military operations, whilst at the same time countering the intrigues of those opposed to the War, a war held by Italian patriots to be the crowning effort in a national work begun half a century ago.

The *Revue* article deals with the difficulties of the military operations connected with the Italian retreat and the possibilities connected with an Italian offensive after the Austro-Germans had broken their front.

The Italians had for some time recognized the importance of the Isonzo front, and the necessity of providing the maximum artillery force and other troops on that front had been urged from time to time. Their victories on the Isonzo had caused a heavy drain on their resources. It was realized that there were weak points on the Isonzo front, and that if the enemy succeeded in piercing it at one of these points a dangerous situation was likely to arise, owing particularly to the mountainous character of this region.

The importance which the Italians attached to this front is indicated in the following extract from an article which appeared in the *Esercito italiano* of the 6th September, 1917:—"We must always bear in mind that the *decisive front* of the War, the *front of victory*, is that one on which the Entente are able, within the shortest possible time, to bring the Central Powers to terms promising a permanent peace. This front is still to-day the Italo-Austrian front, where our Army has been able, thanks to its enormous sacrifices, to inflict a real and great defeat on the hereditary enemy."

In an Austro-German offensive against Italy an attempt, it may be accepted, would naturally be made by the Central Powers to advance by several routes converging towards the same point on Italian soil, railways being utilized to as great an extent as possible and care being taken not to trust to this means of transport at those altitudes at which their use might be problematic at certain seasons of the year.

An inspection of a map shows that the lines of advance *viâ* the Stelvio, Tonale and Judicaria Passes, and the Adige from the Tyrol into Lombardy form divergent routes; these routes can be easily defended on the Italian side of the frontier. Valtellina, Brescia and Verona constitute strong centres of manœuvre where invading columns could with ease be held up and checked. It is for this reason that the Austrians have made no attempt to advance in this region in the present War.

The other routes into Italy form two groups; one converging on Padua, the other on Udine. The first group consists of the roads *viâ* the Fugazza, Sugana, and Cadora Passes. They present the disadvantage that, if used, long marches in the mountains are involved and, further, that no railways are near at hand. The second group consists of the Tarvis-Pontafel-Udine and the Tarvis-Caporetto-Cividale-Udine roads; these roads form the most advantageous lines of invasion for the Central Powers, affording as they do the most ready means of access between Austria and the plains of Venetia and the use of the most direct railway. A subsidiary advantage in connection with the use of the roads of the second group lies in the fact that a simultaneous use can be made by the Austrians of the routes from the Carniola *viâ* Tolmino and Gorizia and from Trieste along the coast.

It is evident then that in the event of the Italian front being pierced in the upper reaches of the Tagliamento, the Carso front becomes untenable by them. Further, the situation is such that owing to the paucity in the number of roads remaining available and the obstacle of the Isonzo in rear of the Italian positions an offensive stroke for the purpose of re-establishing their front becomes, under the circumstances, an extremely hazardous, if not impossible, operation.

The Italian front being so pierced Palmanova loses its value; the Tagliamento is itself too vulnerable and the bridgeheads at Sacile and Motta, on the Livenza, can then serve merely as points to be held by rear-guards to cover the Italian retreat.

The real menace to Austrian columns invading Italy in this region lies in the possibility of a flank attack from the sea, S. of the Piave.

The mountain region about the Cadora affords excellent protection on the Italian left flank.

In the operations now in progress on the Italian frontier, the Tyrol is once more playing a preponderating *rôle*; its configuration renders it eminently suitable for defensive warfare. The nature of the country is such as to preclude all possibility of a surprise of any kind.

The most easterly point of access between the Tyrol and the Cadora is *viâ* the M. Croce Pass (about 5,355 ft.), leading to the upper Tagliamento; further west lies the main Landro road giving access to Belluna. An offensive which succeeds in giving a belligerent possession of these two roads not only places the Cadora in his grasp but also one of the lines of

advance on the front Conegliano-Bassano, whence routes converge on Treviso and Padua. In the event of a successful invasion *viâ* the Sugana Pass taking place in combination with one *viâ* the Landro road, the invader of Italy secures the very important line Trent-Feltre-Belluno. For this reason the road *viâ* the Sugana Pass possesses special interest.

There are many positions along the route through the Seven Communes which can easily be prepared for defence by the Italians, such for example as that at the Val d'Arsa, where the Austrian attacks were so heroically met and driven off in 1916. The culminating point on this route is the Fugazza Col (4,590 ft.), and barely 30 miles of the route lies in mountainous country. It connects Vicenza and Rovereto by almost a straight line and possesses the great advantage for an invader that it skirts the plains of Padua and turns the entrenched Camp of Verona. Nevertheless, the defenders, by holding the line M. Lessini-Lake Garda, place themselves in a position from which a counter-thrust can be delivered with some possibility of success.

The line of the Adige, from Rovereto to Castelnuovo, forms a long defile hemmed in on the E. by the Monts Lessini and on the W. by M. Baldo and Lake Garda. This configuration lends itself to the creation of defensive positions, specially in view of the fact that the Adige, which is from 65 to 90 yards wide, can only be crossed at few points on this part of its course. South of M. Baldo, the Rivoli plateau affords further opportunities for barring the approaches *viâ* the Adige to Verona and Mantua. Napoleon considered the Rivoli plateau the key position in this region.

The Judicaria Pass line of advance from Trent to Brescia is not so much hemmed in as the Adige route between Mori and Rivoli. Its narrowest part is at Lake Idro, where it contracts to a width of about six miles, being barred by the fortifications of Rocca D'Anfo. Many improved roads now diverge from Storo in a S.W. direction, which permit this defile to be turned and give access to Bergamo and Brescia.

Riva, to the N. of Lake Garda, is the great road junction in this region; its possession is necessary for an offensive campaign directed towards the plains of Lombardy.

At the present time defensive positions have been constructed across all these routes, and, therefore, a rapid advance along them is hardly possible. The Judicaria Pass route possesses practically the same advantages and disadvantages whether viewed from an Italian or an Austrian standpoint. Perhaps, by forcing this route the Austrians might gain slightly more than would the Italians.

The route *viâ* the Tonale Pass connects S. Tyrol to the plains of Lombardy by the Sole and Camonica Valleys. The Tonale Col (6,168 ft.) is easily defended, in spite of the existence of the secondary line of the Montezzo to its north.

There are many defensive positions between Tonale and Edolo along the upper reaches of the Camonica, these reaches are also covered by the stiff slopes of M. Adamello, a region ill-provided with roads. The Upper Camonica is connected with the Valtellina by the Mortirolo and Aprica roads, which are so situated as to admit of the movement of troops in the region most threatened.

A seizure of Aprica by the Austrians, by laying open the Valtellina, would seriously threaten the Italian defensive positions on the Mincio.

Attention is called to the Austrian plan of campaign in this region in 1859. The Austrian VI. Corps consisted, in the year in question, of 25,000 men and was opposed by Garibaldi who had a detachment about 6,000 strong at the Stelvio Pass and another about 5,000 strong at Rocca D'Anfo. The Austrians faced the Garibaldians at the Stelvio Pass with equal numbers and kept a strong reserve at Trent. This reserve was utilized for an attack against Rocca D'Anfo with a view to a march on Solferino, while the main body of the Austrian Army was forcing the passage of the Mincio. The Franco-Italians were, under these circumstances, compelled to detach a strong force for the protection of their left flank at the time that they had to meet the Austrian main army.

The above example is of interest at the present day, for a similar situation might arise in the event of the Entente forces being compelled to give way before an Austro-German push against the front Verona-Asiago-Arsiero. It is evident that an Austro-German advance by the routes *viâ* Tonale and Aprica, through leading to dispersion, would play a characteristic *rôle* if carried out in combination with a general plan of attack in the plains of Lombardy.

The line of advance *viâ* the Stelvio Pass, the culminating point of which is near the Dreisprachenspitze (9,000 ft.) is of particular interest to the Swiss people. It connects the Val Venosta with the upper reaches of the Adda. The Col is easily defended. The Austrians are firmly established there and hold the heights both N. and S. of the Col; they thus possess the advantage here and command the valley.

The route which descends towards Bormio can be easily barred; it is covered on the N. by Switzerland, and it is difficult to turn on the S. by reason of the existence of the Cristallo and Tresero glaciers. At Tirano the valley widens and does not contract again until the Lake Como is reached. Fuentes, the position held by the Spaniards in the XVII. Century and constituting the gateway in the Grisons into Italy, consists of a rocky eminence which affords an extended view and a commanding position over the valley, on the N. as well as on the E. The approach to Milan along the banks of Lake Como is difficult; by using the roads S. of the Valtellina the Austrians might mass large numbers of troops in the Italian plains. But the Valtellina does not offer many advantages to the Austrians.

The foregoing brief sketch relating to the *lines of invasion* into Italy shows that the difficulties connected with their use increase the further westward of the Carso that an invader attempts to penetrate into Italy. It is in the E. that the most vulnerable points are to be sought for, whilst in the Trentino and in the region nearest the Swiss frontier the mountainous character of the country is such as to put many serious obstacles in the way of an Austro-German invasion.

Music in the Swiss Army.

So many reforms have been carried out in the Swiss Army since it was mobilized in the Autumn of 1914, that there is an inclination not to allow anything, however small a part it may play in the fighting machine, to

escape revision now that an opportunity has presented itself for putting the Swiss military house in order. The author of the *Revue* article deals with certain defects in the training of musicians, buglers and trumpeters and puts forward certain suggestions with the object of removing the short-comings in the musical training of the Swiss Army to which attention is called.

NOTES AND NEWS.

Switzerland.—The *Comité de la Section vaudoise de Zofingue* has taken exception to some of the remarks published in the Notes and News in the January number of the *Revue*, in which attention was called to the wave of pacifism passing over and through Switzerland. The President of the *Comité* in question has, in consequence, addressed a letter to the Editor of the *Revue* contesting the accuracy of the statements contained in the contribution complained of.

The Editor takes the complaints made against him seriatim and demolishes the charges of the President of the *Comité* by quoting the latter's own words to prove the correctness of the remarks to which exception has been taken.

Regret is expressed that there should exist a coterie, however small, addicted to "pacifism" in the ranks of the intellectuals of Switzerland, and particularly so when the disciples of this cult belong to the *élite* of the youth of Helvetia, as do the Zofingiens.

The Editor states that he has received a second letter from a Zofingien, who takes up a stand on different ground to that taken by the President of the *Comité* in his letter. It is proposed to deal with this communication in the March number of the *Revue*.

Belgium.—A special correspondent contributes some notes dealing with the War. He reminds us that in the wars of distant ages great generals, Kings, and Emperors were accompanied in the field by their favourite actors and actresses. It is as necessary in these days of trench warfare, as was the case in the older wars of movement, to keep up the spirits of the fighting men by healthy forms of amusement. So apparently think the Belgian Higher Command. A programme of entertainments for the Belgian soldiers has been drawn up which goes far to meet the needs of the moment. The Belgian King and Queen have in this matter, as in all others affecting the welfare of the Belgian soldier, done their share in promoting the success of the scheme.

A travelling theatre has been constructed and it moves from camp to camp. The performers are the leading Stars of the theatrical profession and some of the classical masterpieces have been staged by them for the edification of King Albert's fighting men, who have much appreciated the efforts made to relieve the tedium of their existence.

Another direction in which provision is being made to cater for the amusements of the Belgian Army is in the encouragement which the Belgian G.H.Q. is giving to the "Société Symphonique Militaire." There is no country in the world richer than Belgium in musical institutions of high standing, such for example as those of Brussels, Liège, Ghent, Mons, etc. Official recognition has been given to the "Société Symphonique Militaire" and assistance rendered in connection with

the procuring of the musical outfit. Facilities are provided for concerts, practice and instruction in the musical art, etc.

Attention is called to a steel helmet, invented by Dr. Weekers, which is under trial on the Yser front. The helmet has been designed more particularly with a view to providing greater protection to the soldier's forehead and eyes than that obtained by the use of other types of steel helmets; it can be worn with the gas helmet, and it is claimed that it in no way prevents the soldier from using his gun and other weapons of offence and defence. Whether the helmet meets all practical requirements has yet to be determined. A thousand of these new helmets have been ordered and have been issued to the troops in the trenches. The expenses of the experiment are being borne by Queen Elisabeth; she has been playing the part of the fairy godmother of the nursery tales to the soldiers of her unhappy land, where she passes under the name of the " petite reine."

It has been known for some time that the Germans have been compelling civilian prisoners to work in the operation zone. Not satisfied with the numerous breaches of the written and unwritten codes of war of which they have been guilty and concerning which so much has already been published, it would appear that they are now systematically employing not only men, but also women and children, in the construction of military works in the operation zone. It is stated that many dead bodies of women and children have already been found at the front in this zone.

The decision of the German Government to effect the administrative separation of the Flemish and Walloon Districts of Belgium is touched upon. The spirit of resistance is abroad and the Germans may find the Belgian people as intractable in this matter as they have found them so in many another direction.

INFORMATION.

Cavalry.—A great part of the Swiss Cavalry has been collected together at a camp of instruction at Porrentruy, in connection with the training of the recently-formed Machine-Gun Squadrons. A very complete programme of instruction seems to have been prepared and carried through. Satisfaction is expressed at the progress made.

Utilization of Grease Tins.—Attention is called to the fact that Serbian soldiers have been using their empty grease tins as tea-infusers. It is suggested that Swiss soldiers might care to take advantage of the idea.

This number of the *Revue* concludes with a list of works of military interest received for review.

No. 3.—March, 1918.

THE HORSED-MACHINE-GUN GROUP OF THE SWISS DIVISION.

I. *Organization and Mobility.*

In the ordinary and mountain machine-gun companies of the Swiss Army animals in single-draught carts, pack-horses and mules are led by men on foot, but in the case of two-horsed vehicles drivers are employed, who drive with long reins from box-seats. With the exception of the Company Commanders, the other officers and the N.C.O.'s of these

units are not mounted and recruit-drivers, probationary N.C.O.'s and N.C.O.'s receive no instruction in equitation.

In addition to the machine-gun company with each battalion, a horsed-machine-gun group, consisting of three companies, forms part of every Swiss Division. The officers, sergt.-majors, sergeants, and driver-corporals of the latter units are mounted and its wagons (four-horse) are driven postilion fashion; their recruit-drivers and probationary N.C.O.'s are, in consequence, taught to ride.

The horsed-machine-gun companies with the Swiss Divisions were brought into existence by a recent Law passed for the express purpose. One of these horsed-machine-gun companies is attached to each infantry brigade of the division; these companies have been provided with mobility superior to that of the machine-gun companies at present with infantry battalions, in order to facilitate their employment in open country, *i.e.* for tactical reasons.

Sub-para. (1) of para. 314 of the *Instruction provisoire pour les mitrailleurs d'infanterie* states: "The horsed-machine gun group of three companies forming part of the division may be held by the Divisional Commander at his own disposal or placed as a whole or by companies under the brigades or regiments."

It is pointed out that this instruction gives an indication to Divisional, Brigade and Regimental Commanders as to the actual value of this special organization of machine-guns.

The horsed-machine-gun companies have only six guns, and in this respect do not differ from ordinary machine-gun units. On the other hand, the former possess 73 riding and draught horses as compared with the 36 with the latter. The larger number of animals, it is thought, are not justified for six guns only. On the occasion of the increase from 4 to 6 in the number of guns with horsed units alterations were made to the wagons so as to permit of two machine-guns with their shields being carried on the rearmost part of the wagons; this meant a reduction of their ammunition-carrying capacity by from 9,600 to 8,000 rounds.

The new horsed units are to be provided with six wagons, each capable of carrying two machine-guns with their shields and 8,000 rounds for short-range fighting, in addition to the six gun-wagons each carrying one machine-gun with its tripod and 8,000 rounds for long range fighting.

In future each section of a horsed-machine-gun company will possess two guns for long-range and four guns for short-range fighting, *i.e.*, six of the former and 12 of the latter per company. This organization allows of a section being detached with both kinds of guns, or of the employment of a company as five separate sections, *i.e.*, two long-range with three guns apiece on tripods and three short-range with four guns apiece.

The view is expressed that even the contemplated increase in the number of guns to 18 in the horsed units does not justify the retention of 73 animals in the company. In the article *The Present Situation Relating to our Infantry Machine Gunners* published in the February number of the *Revue* it was shown that the number of guns with an ordinary machine-gun company from 6 to 38 would only involve an increase in the number of animals from 35 to 48.

The great mobility of the horsed-machine-gun units was clearly demonstrated in the autumn of 1916, when from 11 to 16 machine-gun squadrons carried out exercises with their new equipment under Major Heer. The following facts were established :—

(1). That horsed machine-guns can move at the same pace (200 to 220 metres per min.) and can cover the same distances per hour ($3\frac{3}{4}$ to 5 miles per hour) as artillery—this is but $1\frac{1}{4}$ miles per hour less than that covered by dragoon regiments.

(2). That horsed machine-guns cannot keep up with the cavalry brigade to which they may be attached, but can follow close on its heels. In this respect the machine-guns are in no different a position than the artillery attached to the cavalry brigade.

3. That it is inadvisable to move at the trot with machine-guns across rough fields, ditches and along broken roads as the wagon wheels and the springs are not built strongly enough for this purpose. The result is that the horsed machine-guns are not so mobile as the cavalry machine-guns.

It must not be supposed that machine-guns can be brought into action in a manner similar to that in which field artillery comes into action ; the process is more laborious than that of merely unlimbering. When orders are given for machine-guns to come into action, the company or section is halted under cover and arrangements are there made for carrying the guns, their mountings and ammunition forward, meanwhile suitable positions are reconnoitred. And when everything is ready the positions selected should be occupied *quickly, silently, and by covered approaches.*

Capt. von Normann, of the Austrian Army, who has been in command of a machine-gun squadron for three and a-half years during the present War, has recently published a work entitled *Winke für die Ausbildung mit dem M.G. und dessen Verwendung* (Hints for training in M.G. and for their employment), wherein he states : "When M.G.'s have to be brought into action on open ground, in proximity to the enemy, I prefer to move forward after having unloaded. My reason for adopting this course is that I never have liked to incur the risk of arriving at my destination with men and ammunition, but after having lost one or several animals *en route*."

The author of the original article expresses the opinion that it is still more imperative for the Swiss to guard against the risk of heavy losses in animals ; very few horses are bred in Switzerland and for the past $3\frac{1}{2}$ years exportation of horses into the country has been prohibited by the neighbouring Powers.

It is only when horsed machine-guns are marching on roads, at the walk and trot combined, that they move faster than the ordinary machine-guns.

It is suggested that the rate of marching can be speeded up and the animals spared by adopting the system of marching introduced 30 years ago by Colonel Bluntschli (a Bavarian Artillery Officer, at one time Editor of the *Zeitschrift für Artillerie und Genie*). This system consisted in forming up columns on the march with distances between the sections of a battery equal at least to the length of a section in column of route. The change in the pace from the walk to the trot and *vice versâ* did not

take place simultaneously throughout the batteries of an Artillery Brigade, but at the moment that the head of each section reached a given point. This system possesses the advantage that dust trouble is reduced and that the increased pace can be confined to the short stretches of route which are suitable for covering at the trot.

II. *Value of the Horsed-Machine-Gun Group.*

In this section of the original article an examination is made into the nature of the service the horsed-machine-guns can render to their division and the question whether this service is of a kind to justify the retention of these units.

1. *The Advance.*—According as the division marches as a single column or by brigade columns the M.G. group can, as occasion requires, be sent on ahead of the infantry advanced guards at an increased pace, either as a whole or by companies, under cover of the cavalry screen of the Army or the cavalry forming part of the infantry advanced guards. Should the horsed machine-guns come into action under circumstances of this kind the cavalry can lend them assistance by providing *personnel* for replenishing the ammunition supply, loading the bands, etc. The employment of the horsed machine-guns in this manner seems to be called for in Switzerland by reason of the existence of numerous rivers and defiles.

2. *Retreat.*—Para. 172 of the Swiss *Instruction sur le service en campagne* expressly states that "*field artillery, machine guns and cavalry* are eminently suitable for employment with rear guards." It is quite evident that horsed machine-guns and cavalry machine-guns can, during a retreat, be more advantageously handled than the ordinary infantry machine-guns.

3. *Protection of Flanks and in Support.*—In the case of the immense armies employed to-day, which operate on fronts extending from one sea to another, or from the frontiers of one neutral state to that of another, the protection of the flanks of an army can no longer be secured by patrols. There can never be troops sufficient enough in number to fill in the gaps along the fronts of divisions and brigades. As was the case in the German advance towards the Somme and in that of the invasion of Russia by the Armies of the Central Powers, the intervals between the columns marching on a wide front must be filled in by troops of a kind whose lack in numbers is compensated for by their great mobility; cavalry brigades, horsed-machine-gun groups, cyclists, infantry on motor-lorries and other vehicles can all be effectively utilized for this purpose.

The foregoing examination justifies, in the opinion of the author of the original article, the retention of horsed-machine-gun groups in the Swiss Army, even though machine-gun companies have more recently been added to infantry battalions.

III. *Examples in Connection with the Employment of Horsed Machine Guns in an Advance.*

A few schemes are worked out in this section of the original article, in connection with the use of horsed machine-guns in offensive and defensive actions; the section concludes with a few general remarks on the schemes in question.

IV. *Selection of Men and Officers.*

A. *Men.*—Capt. von Normann, in his work mentioned earlier, states: "The greatest care is required in recruiting the *personnel* for cavalry machine-guns. It is necessary to select the men as well from amongst those who volunteer for this branch of the service and exhibit an interest therein, as from those who have to be selected by lot. It must be accepted as a principle, without exceptions, that the best men are only just good enough as machine-gunners." The above remarks apply equally, says the author of the original article, to the *personnel* of the horsed-machine-gun group.

Every machine-gunner and driver in the horsed-machine-gun companies is required to possess such great self-reliance and to bear so considerable a responsibility that only absolutely trustworthy, well-educated, cool-headed and highly disciplined men are alone able to come up to the scratch in this branch of the Service. The above remarks apply equally to the N.C.O.'s. Machine-gunners should be a *troupe d'élite*, since every machine-gunner ought to be capable of effectively handling a weapon which costs 40 to 60 times the price of a rifle and can do 40 to 60 times as great execution.

Swiss machine-gunners must take the place in the infantry which the Carbineers have had to surrender.

B. *The Officers.*—Only those premier-lieutenants who have been noted as being qualified for the command of a company should be posted to the horsed-machine-gun companies. They should, as a rule, be drawn from the officer-instructor class who have been through a course of equitation and horse-management.

It is suggested that cavalry officers, who have successfully commanded machine-gun squadrons, should also be posted to horsed-machine-gun groups. The two arms would thus be brought into closer contact to their mutual advantage.

The original article is accompanied by a number of photographic reproductions showing machine-guns in action.

THE CEREMONIAL STEP.

The author of the original article states that the article dealing with the *morale* of the Swiss Army which appeared in the number of the *Revue* for January, 1918 (*vide R.E. Journal* for May, 1918), describes with frankness and accuracy the uneasiness that prevails at the present day in the Swiss Army. He approves generally of the measures therein recommended to increase the Swiss soldier's interest in his profession by modifying his training so as to conform to the requirements of war as carried on to-day. He points out that it would be wrong to suppose that nothing had been done in this matter; on the contrary, in one division of the Swiss Army, which was mobilized in August last, special attention has been directed to trench warfare and its Commander has announced that in his inspections he will devote his attention exclusively to the training given in this branch of the soldier's education.

It is admitted, however, that the progress made in modifying training to meet the latest requirements is not as great as it might have been and that the discontent in the Swiss Army is increasing. The author of the original article suggests that reform in the Swiss Army should begin by abolishing the *pas cadencé* (the German *paradeschritt*) as the ceremonial step for parade purposes. In making this recommendation, he recognizes that he may be looked upon as a heretic by certain Swiss military enthusiasts. Although he advocates the abolition of the *pas cadencé* as a parade step, nevertheless, he recognizes that it has its value from the point of view of the development of the muscles of the leg and he has no objection to its retention as a gymnastic exercise. He points out that in the march past during inspections the Swiss soldier feels himself the subject of ridicule by being made to adopt a method of marching which is contrary to Swiss instinct. A large part of the Swiss population being mountaineers they cannot readily imitate the Prussian kick and therefore a great deal of time has to be spent at *drill* for the mere purpose of perfecting the men in this method of marching; to this is due in some measure the discontent prevailing in the Swiss Army.

A War Anatomical Museum.

The Inter-Allied Medico-Surgical Conference, to which reference was made in the number of the *Revue* for November, 1917, has already produced useful results; valuable statistical information has been rendered generally available, comparisons have been effected of the various methods employed in treating wounds, dealing with fractures, etc. The superiority of some of the methods over others has thus been definitely established. All this possesses an advantage from the military point of view; it tends to the bringing about of a more rapid recovery of the wounded and also to the cure of those who would otherwise have been lost to the Military Service. But an advantage also accrues from a humanitarian point of view, a matter of immense importance to society at large; those that are crippled in war are, by the utilization of the knowledge gained by the interchange of ideas, rendered more efficient in their capacity as civilians, and consequently their earning powers are thereby correspondingly increased when the time arrives for them to put aside their khaki and don mufti.

Aural instruction is at all times profitable, but visual instruction is often more striking, more impressive and becomes more deeply graven on the human memory. For this reason the "Royal College of Surgeons of England" is to be congratulated on the step taken by it in establishing a permanent collection of things connected with war surgery. Although it has been in existence but a very short time, the exhibits have increased so rapidly that the collection is already considered one of the most useful educative means at the disposal of the medical profession.

A short description of the collection is given in the original article, and it is suggested that in view of their importance and interest the exhibits should become the nucleus of an International Exhibition relating to War Surgery.

Notes and News.

Switzerland.—The discussion on pacifism begun in the number of the *Revue* for January, 1918, is continued. In a letter to the *Editor* from a Zofingien dated Zurich, 29th January, 1918, published in this number of the *Revue*, its writer explains the mentality of the youth of Switzerland concerning which, he alleges, ignorance prevails and there is much misunderstanding. "Pacifism and the Abolition of the Army" is a question which is occupying a prominent position in the minds of Swiss 'Varsity students. It is stated in this letter that "far from aiming at a social revolution, we are seeking by methods of evolution to bring about a new cohesion, and that without lending ourselves to mysticism or any extravagant Utopian ideas. So far as it may be necessary to defend ourselves as a collective whole, an army is, we recognize, a necessity, and we would be the first to lend it our support. What we desire is not that we should give up the right to defend ourselves, but rather that we should render the army useless by getting rid of the possibility of an attack on us by any Power whatsoever. In our capacity as individuals we will always have to fight in order to live, since passions enter into the composition of individuals and they are capable of harbouring hate. A nation as a whole cannot rouse itself into a passion at white heat; it never desires a war; and on the day that a community is able to control its own acts, and is no longer at the mercy of a few individuals, war will no longer be possible and armies can then be suppressed. An Arbitral Tribunal, with or without international police, will suffice to dispose of the differences and disputes between democracies, etc., etc."

The *Editor* examines this remarkable document and points out the self-evident contradictions therein. He asks the writer to furnish him with evidence—not from personal convictions inspired by kindness of heart but from the lessons of history and psychology—to support the following views:—

(1). That a nation, as a whole, cannot rouse itself into a passion at white heat.

(2). That a democracy never desires war.

(3). That a community will be able to control, or at least sufficiently to control, its own acts, so as not to be under the domination of the Government elected by it, in other words that it will no longer be at the mercy of a few individuals.

(4). That the rights of a community, any more than those of individuals, are capable of being maintained without the *sanction* of the gendarme and by the mere award of a few arbitrators.

The writer of the letter in question is referred to publications innumerable issuing from the Press to-day, where he will find facts recorded which prove that abundant evidence exists to demolish every one of his cherished tenets on war and on the psychology of democracies.

It is announced that a third letter has been received on the above subject from the Zofingiens of Neuchatel. It simply gives in its adhesion to the protest from the "Section Vaudoise" published in the number of the *Revue* for February last.

Portugal.—A special correspondent deals with the Portuguese Military Budget for 1917. Reference is made to the Portuguese Division sent to France as a visible and tangible evidence of the loyalty and sympathy of Portugal for France. On the departure of this division, a second division was mobilized at Lisbon.

At the beginning of 1917, the French Government asked the Portuguese Government for support. In consequence, a military convention was entered into between the two countries, whereby Portugal undertook to raise and maintain a Corps of Heavy Artillery, of not less than 15 and not more than 30 batteries. The armament for this corps was supplied by the French Government.

The struggle in Africa has, since the beginning of the War, absorbed from 30,000 to 35,000 men of the Portuguese European Army; including the Colonial and native troops, some 45,000 men have been taking part in the operations in Africa.

The differences which brought into existence two camps in Portugal—the interventionists and the non-interventionists—are subsiding. The importance of the step Portugal took in coming into the War, and its bearing on international politics, are now fully recognized. A small country, such as Portugal, possessing as it does a vast Colonial Empire, must, it is realized, attach itself to one or other of the Allied groups.

INFORMATION.

Switzerland.—A description and particulars are given of a heating device, consisting of impregnated paper, which has been in use in the Serbian Army.

This number of the *Revue* concludes with a Bulletin Bibliographique.

A further part of the *Supplement* containing M. Epuy's translation of Lord Ernest Hamilton's *The First Seven English Divisions* accompanies this number of the *Revue;* the narrative is brought down therein to the events connected with the "Second Advance"—23-26 October, 1914.

W. A. J. O'MEARA.