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Authors alone are responsible for the statements made and the opinions expressed in their papers. [2100-1.4.21].

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#### MONTGOMERIE PRIZE.

ATTENTION is invited to the conditions under which this prize, in value about  $\pounds_{10}$ , is offered for competition each year.

1. The Prize shall be awarded by the R.E. Institute Council in the manner considered best for the encouragement of contributions on professional subjects, by R.E. Officers, to the Corps publications. From the beginning of 1920 it has been decided that the Prize shall be confined to Officers on the Active List not above the rank of Substantive Major.

2. The Prize shall consist of (a) a book on Survey, Exploration, Travel, Geography, Topography, or Astronomy; the book to be wholebound in leather, and to have the Montgomerie book-plate with inscription inside; (b) the remainder of the year's income of the Fund in cash.

3. The name of the recipient of the Prize shall be notified in the Corps publications; and copies of the contribution for which the Prize was awarded shall be presented to the representatives of the donors.

The following are suggested as subjects for contributions :-

- (a). Descriptions of works actually carried out in peace or war.
- (b). Inventions.
- (c). Design (excluding works of defence).
- (d). Labour organization on work.
- (e). Scientific investigations generally.
- (f). Accounts of exploration work and surveys.

#### MILITARY WIDOWS' FUND, BRITISH SERVICE, INDIA.

THE Military Widows' Fund, British Service, was established in India in 1820 to alleviate the distress of families of officers of the British Service serving in India, and to enable them to return to England without unnecessary delay. Whenever an officer of the British Service, who is a subscriber to the Fund, dies, his family receives at once the following assistance, namely, six months maintenance allowance ranging from Rs 2,400 to Rs 3,600 according to the rate subscribed, plus Rs 1,500 as a donation for the widow, plus Rs 500 or Rs 300 as a donation for each child according to whether the child is over 12 and under 21 years of age or under 12 years of age. These benefits are secured by a small subscription of Rs 4, 3 or 2 per mensem, which is regulated by the amount of pay an officer draws. An officer, on becoming a subscriber, secures for his wife and children quite irrespective of his length of service in India, the full benefits of the Fund in case of his death after having subscribed for fully three months. In the event of an officer dving within that period, his case is specially considered by the Committee of General Management. Copies of the regulations of the Fund and other particulars relating thereto can be obtained from the Secretary at Simla.

#### REPORT ON THE EXPEDITION TO KAMET, 1920.

By MAJOR H. T. MORSHEAD, D.S.O., R.E. (Survey of India.)

THE mountain known in India as Kamet and to the Tibetans as Kangmed<sup>\*</sup> or Abi Gamin—the 30th in order of magnitude of the known high peaks of Asia and of the world—is situated in latitude  $30^{\circ}$  55' and longitude 79° 36' in the Garhwal district of the United Provinces just south of the Tibetan border. Rising to a height of 25,445 feet, it forms the culminating point of the Zaskar Range—a northern bifurcation of the Great Himalaya—and, though forming a conspicuous landmark from the Tibetan province of Ngari Kohrsum on the north, yet from the south, owing to its position behind the Great Himalayan Range, its appearance is so modest that till 1849 it remained unnoticed and unmeasured, though but 250 feet lower than the King of the Kumaon Himalaya, Nanda Devi.†

The earliest attempted ascent of Kamet was made in June, 1855, by the brothers A. and R. Schlagintweit who reached a height of 22,240 ft. on a mountain which they called Ibi Gamin, and believed to be identical with Kamet. Subsequent investigation has however tended to the belief that the mountain on which they actually climbed must have been the satellite known as E. Abi Gamin or Strachey's peak (24,180 ft.).

During the succeeding half century, the only recorded adventurers on the mountain were the members of the Great Trigonometrical Survey who triangulated and mapped the area in the years 1872-75. It was near here in the latter year that the late Mr. I. S. Pocock made what remains to this day one of the world's highest planetable fixings—setting up his board at 22,040 ft.<sup>‡</sup>

In recent times, numerous attempts have been made on the

\* Kangmed = "the lower snows," as distinguished from the higher snows of the Kailas Range, culminating in Mt. Gurla Mandhata 100 miles to the E.S.E. The name has, I think erroneously, been spelled Kangmen in N. Frontier {in. Sheet No. 9 N.E. and on the R.G.S. map of Tibet.

† Burrard and Hayden, A skelch of the Geography, etc., of the Himalaya mountains. Kamet now shares the 30th place in the world's list of high peaks with Namcha Barfra, the mountain of identical height overlooking the big bend of the Tsangpo River in the Assam Himilaya, which was discovered during the Abor and Mishmi Expeditions of 1912-13.

<sup>‡</sup> General Report on the Operations of the G.T. Survey of India during 1874-75. I have searched the original planetable sections of this area in vain in the hope of discovering the exact site of this fixing.

[April]

mountain. The approaches both from the east and the west were reconnoitred in July and August, 1907, by Messrs. Bruce Longstaff and Mumm, but serious climbing was prevented by the onset of an unusually violent monsoon. C. F. Meade, accompanied by Alpine guides made three strenuous efforts to conquer the mountain, in 1910, 1912, and 1913. On the latter occasion, approaching *via* the Raikane Valley; he succeeded in reaching the col ("Meade's saddle," 23,500 ft.) between Kamet and E. Abi Gamin, when his party succumbed to mountain sickness just as success seemed within its grasp.

The late Capt. A. L. Slingsby twice attacked the mountain unsuccessfully from the western side, while Dr. A. M. Kellas, of Aberdeen, the well-known mountaineer, also reconnoitred the western approaches in 1911 and again in 1914—the expedition in the latter year, which had for its special object the scientific investigation of the effects of high altitude on the human body, being summarily cut short by the outbreak of war.

On the conclusion of peace the Royal Geographical Society, recognizing the desirability of collecting further data regarding the physiological effects of high altitude, persuaded Dr. Kellas to resume the experiments cut short in 1914. The Society also arranged for the loan of oxygen cylinders and other scientific apparatus from the Medical Research Committee in England, for its despatch to Bombay through the agency of the India Office Stores Department, and for the assistance of the Survey of India in taking delivery of the apparatus in Bombay and transporting it by rail and coolie, *via* Kathgodam, to the base of the mountain beyond the extreme Himalayan village of Niti. I was fortunate enough to be deputed for the latter task, together with Mr. Laltan Khan of the Survey of India Upper Subordinate Service.

The objects of the expedition may thus briefly be summarized :---

(1).—To study the physiological effects of high altitude on the human body, with special reference to the problem of acclimatization.

(2).—To obtain further information regarding the altitude to which ascent is possible without resort to artificial means of respiration, and to record the temperatures, wind velocities, etc., prevailing at extreme altitudes.

(3).—To experiment with the use of different forms of oxygen apparatus.

(4).—To make as complete a revision as possible of the I'' to I mile reconnaissance survey of 1872-75 in the Kamet area.

The scientific observations contemplated by Dr. Kellas fall under five main heads, viz. :---

(i).—Comparative records at different altitudes of the pulse-rate respirations, lung-pressure, etc., of a number of selected subjects

on similar lines to the tests for physical fitness devised by Col. Flack for use in the R.A.F.

(2).—Comparative measurements of the haemoglobin content of a measured quantity (20 c.mm.) of peripheral blood at different altitudes.

(3).—Microscopic estimation of the number of red corpuscles in a measured quantity (5 c.mm.) of peripheral blood at different altitudes.

(4).--Estimation of the amount of skin-evaporation by means of Hill's apparatus, known as the "kata-thermometer."

(5).—Analysis of the alveolar air (*i.e.*, air from the ultimate ramifications of the lungs) for oxygen and  $CO_2$  content, by means of Haldane's apparatus for gas-analysis.

These observations, if commenced near the level of the plains at Kathgodam and continued as far as the highest point reached, might, it was hoped, yield valuable information regarding the rate and degree of acclimatization to altitude.

(1).—Three sets of oxylith portable breathing apparatus manufactured by Messrs. Siebe Gorman and Co.; these each consisted of a large rubber bag holding a sufficient supply of oxygen for 15 or 20 minutes consumption—the oxygen being generated on the spot by the chemical combination of oxylith and water.

(2).—60 steel cylinders of compressed oxygen, each weighing 15 lbs. when charged, and holding 280 litres of gas at  $0^{\circ}$  and 760 mm. Web belts and straps were provided for enabling these cylinders to be carried on the back, also a flow-meter for regulating the flow of gas to the face-mask at 1, 2, or 3 litres per minute as desired.

It was hoped that the apparatus might have arrived from England by the end of June, so as to enable Niti to be reached by easy stages on about 7th August. This would allow of the remainder of the month of August being devoted to laying out advanced depôts of oxygen cylinders, firewood, etc., as far forward as climatic conditions admitted, with a view to utilizing the first fine weather after the monsoon for the final climb, before the arrival of the winter snow. These plans were unfortunately frustrated by a very serious delay in the shipping of the oxygen cylinders—due, apparently, to the unexpected decision of the shipping authorities in England to classify the cargo as "high explosives." Consequently it was not until early August that the kit reached Kathgodam—whence, after hastily repacking the cylinders into loads suitable for coolie transport, the expedition started in pouring rain on 8th August.

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This unfortunate delay at the start involved the complete abandonment of Dr. Kellas' plans for comparative observations on acclimatization *en route*, and the paramount consideration now became that of pushing forward with all possible speed in the endeavour to reach the high ground before the onset of winter conditions; leaving the comparative observations for the return journey. Travelling *via* the rolling hills and fertile stuffy valleys of Kumaon, we reached Joshimath on 22nd August, and Niti five days later. Here we halted for a day to arrange for food supplies and for permanent coolies and yaks for our further progress.

Resuming our journey on 29th with a retinue of 24 yaks and 40 coolies, we encountered our first obstacle on the following day in the shape of the unfordable Dhauli River which separated us from the Raikane valley, at the confluence of the latter river. This necessitated a day's halt while the coolies constructed a cantilever bridge, the timbers for which came from the tree-zone below Niti.

The foot of the Raikane glacier was reached on 1st September. Dwarf juniper scrub (*bhilaru*) grows plentifully in this neighbourhood and forms an excellent fuel, which can be pulled up by hand by the roots without the use of an axe, and burns with a pleasant aromatic odour. Above this point no further fuel occurs, nor is the valley passable for yaks. We accordingly made this our base camp (15,380 ft.) and determined on a brief halt, in which survey operations and scientific observations could be carried on, while the coolies collected a reserve of fuel for our needs on the mountain. The yaks meantime returned to Niti for fresh supplies of provisions.

Marmots abound in the Raikane valley, and some excitement was caused on our first arrival at the base camp by one of my khalasis catching a tailless "mouse-hare" in his hat. The alpine flowers on the hillsides made a striking and memorable display in their brief autumn glory,—cdelweiss, fleshy-leaved saxifrages, blue cranesbill, yellow and orange ranunculus, and dwarf primula being among the commonest and most conspicuous.

The thermometer at this altitude usually registered 6 or 8 degrees of frost each night, while the morning spectacle of a powdering of fresh snow covering the hillsides down to 16,000 or 17,000 ft. served to remind us that winter was at hand, and that our sojourn on the higher slopes must perforce be brief.

From the Raikane base camp our route was identical with that of C. F. Meade in 1913, and led over the moraines and crevasses of the E. Kamet glacier for a distance of 10 miles. Frequent and terrific avalanches from the steep S. and W. faces of the valley are a feature of this portion of the route, and form a danger to incautious travellers; safe camping sites may be found however here and there on the opposite side of the valley. We were fortunate in having with us some of Meade's old coolies whose knowledge of previous camping grounds etc., proved invaluable, and I am glad to take this opportunity of acknowledging our indebtedness to his gallant pioneering. Profiting, however, by Meade's experiences of mountain sickness after a series of long and rapid marches, we decided on adopting a programme of short and easy stages with frequent days of halting for acclimatization, which latter incidentally enabled the coolies to return for further supplies of much-needed fuel and provisions. Advancing in this manner, on 10th September we reached a camping ground at 18,460 ft., beyond which the route leaves the main glacier and ascends a steep side-valley.

The only incident worthy of mention in this portion of the trip was the loss of two live sheep by slipping through the thin mantle of snow which concealed one of the numerous large crevasses of the glacier. Two-and-a-half days later we managed to lower a coolie by a rope 40 feet into the crevasse, whence he succeeded after half an hour's work with an ice-axe in releasing the two sheep, which were hauled to the surface—one alive, and one reduced to frozen mutton.

On 11th September we advanced a further two miles and pitched a light camp on rock at a height of 20,620 ft. The majority of the coolies showed signs of distress and complained of violent headaches on arrival at this altitude; we accordingly sent them back to the last camp, keeping only two as guides for the 600 ft. of rock climbing which lay ahead. After a day's halt for acclimatization we successfully reconnoitred the rock-face on 13th, finally emerging at the top on to a smooth dome of glassy ice up which we had time to cut 45 large steps before returning to camp—a delightful day of real mountaineering.

Next morning the thermometer recorded 28 degrees of frost, while the small patch of rock around our tents was white with freshly fallen snow. Both Kellas' and my own servants were at this period completely *hors de combat* from the effects of the cold, and we had the greatest difficulty in preparing ourselves any cooked food. The daily convoy of provisions and firewood ceased to function in the absence of responsible superintendence at the various posts on our line of communications, and this in turn re-acted on the spirits of our coolie guides who became extremely despondent regarding the prospects of any further progress at this late season of the year.

Our position was manifestly too precarious to warrant any further advance pending an overhaul of the line of communication, and this I accordingly undertook at once. Retracing my steps down the valley on 15th., I installed my own private servant who now showed signs of convalescence as commander of the Raikane base camp, with orders to institute a regular system of *chālāns* or invoices notifying the daily number of loads of fuel and stores despatched; Dr. Kellas' Lepcha servant took charge of the forwarding arrangements at No. 1 camp (16,914 ft.) and Mr. Laltan Khan at No. 2 (18,460 ft.).

This accomplished, I rejoined Dr. Kellas at No. 3 camp on September 17th, and found that he had meanwhile got his two coolies to complete the 35 more ice-steps required to negotiate the difficult ice at the head of the rock-cliff. After waiting one day, to ensure the arrival of the minimum necessary reserves of supplies, we advanced with very light kit and pitched our small single-fly tent on snow at 22,000 ft. Owing to sickness the number of coolies was now reduced to eight, who subsequently had to descend again for the night to camp No. 3, returning next day with a second tent (for themselves) and a small supply of ready-cooked food. It was impossible to get firewood carried up the difficult rock-face which separated us from the camp below; both we and our coolies were dependent on food sent up ready cooked from below, aided by such cooking as could be done by a spirit stove in the shelter of the tent. The thermometer next morning registered a minimum night temperature 15° below zero (47° of frost) on the surface of the snow, and our blankets were as stiff as boards where one's breath had congealed on them. Rising from our beds on the snow was consequently more than the work of a moment. However, after heating a tin of soup on the spirit stove and thawing sufficient snow to fill the thermos flask with bovril, we started forward at 9 a.m.-our two selves and three coolies being on the rope. Taking the lead in turns, and steering a winding course to avoid the giant crevasses, we gradually emerged on to the wide flat valley which separates Kamet from E. Abi Gamin. On our left the summit of Kamet showed clearly 2,000 ft. above us, connecting with the valley by means of two well-defined arctes of easy slope, either of which must have been easily climbable had time permitted. It was now 3 p.m., however, and our coolies were dead beat, so after a brief halt for food and a round of photographs, we had to turn regretfully homewards from Meade's col, in order to avoid being benighted. The view from this col is magnificent-comprising the whole Tibetan portion of the Sutley valley to the north, while 100 miles to the E.S.E. the stupendous massif of Gurla Mandhāta towered head and shoulders above the intervening army of lesser ranges.

Had we been able to induce the coolies to carry our camp one march further forward to the flat open  $n\acute{e}v\acute{e}$  near Meade's col, it is hard to believe that anything could have prevented our reaching the summit. Lack of properly cooked food, combined with the intense cold, had however undermined the stamina of the coolies, who absolutely refused to carry forward any further loads. My period of deputation had nearly expired, and realizing with regret that the season was now too far advanced for further efforts, I reluctantly bade good-bye to Dr. Kellas on September 22nd and turned my steps towards home, reaching Dehra Dun by double marches on October 15th—precisely two months from my date of departure. Dr. Kellas, with Mr. Laltan Khan, remained a further

#### 1921.] REPORT ON THE EXPEDITION TO KAMET, 1920.

month in Garhwal, and succeeded in completing the essentials of his scientific work, which will form the subject of a separate report.

A few remarks may not be amiss in conclusion regarding the results of the expedition from the purely layman's point of view.

(a) Physiological.—The fact that neither Dr. Kellas nor myself suffered the slightest discomfort at any time from mountain sickness, seems to indicate that our method of attack by a process of gradual acclimatization is correct. That it is essential also to avoid undue fatigue is shown by the fact that our coolies who were carrying daily loads suffered considerable discomfort from the effects of altitude. The reasons for this it is beyond my province to discuss, I am merely concerned with observed results.

(b) Mountaincering and practical.—Under this heading, it may be profitable to discuss briefly the reasons of our failure to reach the summit of the mountain. Undoubtedly the first and foremost cause was the lateness in the year, due to the unfortunate and unforceen delay in the arrival of the oxygen cylinders from England.

A second cause lay in the failure of the Survey khalasis recruited from the middle Himalayas to stand the climate and altitude of the higher ranges. I had enlisted a dozen strong Garhwali khalasis, with the double object of forming a *corpus vile* for the scientific observations of Dr. Kellas, and of providing a *corps d'élite* of porters for the higher altitudes. With the latter object in view they had been lavishly equipped with warm clothing on the "arctic" scale. Unfortunately, one half of their number succumbed to mountain sickness at 15,000 ft. while the other half proved so extravagant of our precious firewood that they had to be sent back to the base camp as "hewers of wood and drawers of water," and their places taken by the hardier "Bhotia" men of Niti and the neighbouring villages. The provision of boots and warm clothing for the latter on the spur of the moment was however a matter of difficulty, and proved a direct contributory cause of our failure.

A third cause of failure must be traced to the inadequacy of our arrangements for cooking at the higher altitudes. I was unaware until too late that the large Primus stove, on which I had been relying, would not work in the rarified atmosphere of 20,000 ft., beyond which point methylated spirit is the only possible fuel; while Dr. Kellas had only one small spirit stove which took an hour to thaw sufficient snow to fill a teapot. Had our equipment included a dozen large spirit stoves, and two or three 2-gallon petrol-cans full of methylated spirit, both our own and the coolies' cooking would have been assured.

I have nothing but praise for the Bhotia coolies of the higher Himalaya. On rock they can climb like goats, while on ice they readily learn step-cutting. It appears very doubtful if the presentday expense of importing Alpine guides can ever justify their employment in future Himalayan exploration.

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The following table shows the highest few climbs recorded :--

Duke of Abruzzi		1909	Karakoram	24,600					
W. W. Graham	•••	1886	Kabru	23,970?					
W. H. Johnson		1865	Pk.i/61a	23,890?					
Rubensen and Monrad									
Aas		1908	Kabru	23,800					
C. F. Mcade	•••	1913	Kamet	23,500					
A. M. Kellas and H	, T.			- •					
Morshead		1920	Ditto	23,500					
	-								

Nos. 2 and 3 on the list are doubtful.

(c) Oxygen apparatus.—This will form the subject of a separate detailed report by Dr. Kellas. Neither of us felt the slightest need for artificial stimulants in the form either of oxygen or alcohol up to the highest point reached, and my impression is that one could have gone several thousand feet higher without distress of breathing, had other conditions admitted.

On the other hand the handicap of 15lbs. additional weight on one's back, supported by a system of tight belts and straps, proved more than I for one could cope with.

(d) Surveys.—I obtained a special blue print on drawing paper on the old I'' = I mile Sheet No. 19. This was mounted on a light 20" by 20" planetable for Laltan Khan's use. 115 sq. miles of country were revised and contoured in modern style, disclosing considerable discrepancies in the old reconnaissance surveys. Roads, streams and watersheds were found sometimes as much as  $\frac{2}{3}$  mile in error, while the original surveyors had evidently never visited the upper portions of the Raikane and Kamet glaciers.

It only remains to express my gratitude at being privileged to serve my apprenticeship in mountaineering under so experienced a hand as Dr. Kellas. Failure is often more instructive than success, and I can only hope that this expedition, on which I shall always look back with feelings of pleasure, may be the prelude to other more successful future efforts in the same genial company.



Kamet, from E. Kamet Glacier.



Rescuing sheep from crevasse on E. Kamet Glacier.



Bridging the Dhauli River,





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#### A SCIENCE OF INFANTRY TACTICS.

#### A lecture delivered at the S.M.E. on 6th Jan., 1921, by CAPTAIN B. H. LIDDELL HART., K.O.Y.L.I.

"SIMPLICITY is the key to victory." This vital truth has scarcely been fully valued in the tactical teaching of the infantry leader. Too many text-books on tactics dealt with war in a series of watertight compartments, explaining the points of difference rather than the points of similarity. The junior Infantry Commander was taught many excellent precepts dealing with each phase of action, but his path was not smoothed for him by any framework of fundamental principles, upon which he could build as he acquired practical experience of ground and weapons. To simplify the task of the junior commander we require to establish the essential principles of tactics and their relation to the varying phases of battle. We must then fit them into their correct place, both in chronological and tactical sequence, in order to form a simple and truly scientific theory.

The family tree is an ancient institution and yet graphically clear as a chart of the various degrees of kinship. Let us endeavour to establish a simple and scientific tactical tree which will clearly convey to the military student the essential principles and their broad application to the phases of war. To understand these principles of tactics we must simplify and reduce it to the essential elements which are true of any fighting whether between two individual men, two platoons, or two armies. We will examine the simplest form of combat, that between two individuals. From their correct course of action, we can deduce the essential principles, and can then apply them to the conduct of war.

But it may be argued that the conditions of war are entirely different from those of a straightforward fight between two men; that in war the enemy's movements and location are hidden from us until we are actually at grips with him.

Certainly, we agree, but the situation in war will resemble that of two men fighting under similar conditions, such as in the dark wherein a man can only locate and reconnoitre his enemy by actually touching and feeling him. Thus the man in the dark resembles the commander in modern war. Let us examine the correct principles of action which a man seeking to attack an enemy in the dark would naturally adopt.

#### " THE MAN FIGHTING IN THE DARK."

I.—In the first place he must seek his enemy. Therefore the man stretches out one arm to grope for his enemy, keeping it supple and ready to guard himself from surprise.

This may be termed the principle of " protective formation."

II.—When his outstretched arm touches his enemy, he would rapidly feel his way to a highly vulnerable spot such as the latter's throat.

This is the principle of "reconnaissance."

III.—The man will then seize his adversary firmly by the throat, holding him at arm's length so that the latter can neither strike back effectively, nor wriggle away to avoid or parry the decisive blow.

This is the principle of "fixing."

IV.—Then while his enemy's whole attention is absorbed by the menacing hand at his throat, with his other fist the man strikes his opponent from an unexpected direction in an unguarded spot, delivering out of the dark a decisive knock-out blow.

This is the principle of "decisive manœuvre."

V.—Before his enemy can recover the man instantly follows up his advantage by taking steps to render him finally powerless.

This is the principle of full and immediate "exploitation" of success.

To follow these principles is the only sure path to victory. We can only neglect the fixing phase, if our enemy commits some mistake, such as the neglect of his own security, by which he fixes himself without our intervention and so exposes himself to our decisive blow.

Now the whole action of our man-in-the-dark can be simplified into two categories :---

Guarding and Hitting.—The man guards against two dangers. Firstly that of personal injury from the enemy's blows; secondly that the enemy may avoid his knock-out blow and thus cause him to overbalance. The man guards against these two dangers by extending one arm in front of him ready to parry and take the sting out of the blow aimed at his body; by using this arm to grope for and feel the enemy; and finally when he has located the enemy by seizing the enemy so firmly at a spot (the throat) so vital that he will be forced to concentrate all his energy on its defence.

All these objects have a common object, and therefore may be grouped under one principle termed "security."

When the man has fixed his enemy, he delivers a decisive knock-out blow. It will be obvious that the harder this blow, the more likely it is to be decisive. Hence the man must put his maximum possible force into it, while he only uses the necessary minimum of strength to carry out the preparatory operations. This is the principle of "Economy of Force."

But the man can increase the effect of his available strength by surprising the enemy, by his speed, by the momentum or "follow through" behind his blows; by striking his opponent's most vulnerable spots; by full exploitation of every opening or advantage; by husbanding his energy; and by moving his limbs and muscles in

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harmony like the parts of a well oiled machine. All these are means to promote economy of force, and therefore can be grouped under that principle.

Thus we see that there are two, and only two, supreme governing principles—Security and Economy of Force. These two principles govern the execution of the five battle principles, and may be said to cut laterally across them.

A diagram may simplify the idea.



Application to Infantry Tactics of the Two Governing Principles Deduced from the "Man Fighting in the Dark."

A. Security.—In war, as in individual combat there are two kinds of security:—Material and Tactical. The former is security against direct loss, such as casualties inflicted by the actual blows of the enemy; the latter is security against the indirect damage which we suffer if the enemy is able to avoid or parry our decisive blow, so that we weaken and expose ourselves to his counter-blow.

How does one obtain security? Exactly as did the man-in-thedark. He pushed out one arm, which in war means adopting a formation of security. He used his outstretched arm to grope for and feel the enemy, which in war means reconnaissance. When the enemy is located, we fix him so firmly by an attack from one direction that he is unable to avoid or turn to meet our decisive attack delivered from another direction—usually a flank.

It will be seen that these three means to security correspond to the first three battle principles. Hence for convenience we will consider them in detail when we discuss the phase of preparation which comprises the three battle principles. The commander of any unit entrusted with the *rôle* of decisive manceuvre or exploitation must however remember that it is equally necessary for him to carry out these three "security" principles in the course of his own action.

B. Economy of Force.—Now let us consider the principle of economy of force as applied to Infantry. One must use the minimum strength for the phase of preparation, essential though it is. One

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must devote the maximum possible force to the decisive blow and its exploitation. In strategy or grand tactics the distribution of our available forces is a complex problem, but in infantry tactics it is comparatively simple. Each infantry commander, platoon, company, battalion or brigade, has only four fighting sub-units under his command, apart from certain auxiliary fire weapons such as machine guns or mortars.

Hence he has only three possible ways in which he can distribute them, and these are :---

i.—One sub-unit forward for reconnaissance and fixing and three for decisive manœuvre. This distribution will normally be best when advancing against an unlocated enemy as in the approach march or encounter attack. Thus he retains the bulk of his strength in hand until the position of the enemy has been discovered, so ensuring better results when the decisive manœuvre is carried out.

ii.—Two sub-units forward and two for manœuvre. This distribution will usually be advisable in a definite attack against an enemy whose positions have been located, in order to secure that the whole front of the enemy position in his sector is tested thoroughly so that a soft spot may be found. Moreover it is imperative that the forward body shall not be held up before it has firmly fixed the main resistance of the enemy, otherwise the manœuvre body may have to be used before the decisive moment —which would be the antithesis of economy of force.

iii.—*Three sub-units forward and one for manœuvre*. This distribution may be advisable when following a creeping barrage which reduces the need or possibility of manœuvre. This will ensure that the whole frontage is cleared directly the barrage lifts and so enable the forward sub-units to keep close behind the barrage. Further reasons for this distribution are that in such a case the strongest opposition will probably come early, and that a counter-barrage is likely, in which event the bulk of the unit will escape it.

It may also be advisable to adopt this distribution when allotted an unusually broad frontage, in order to cover it with fire. It entails the risk, however, of limiting the force of your manœuvre.

It must be remembered that while the decisive attack is made by the maximum force, its success depends upon the enemy being really fixed. Manœuvre is useless unless the enemy is first fixed in another direction. Hence the manœuvre body is not necessarily the largest. The "last straw which breaks the camel's back" is a great truth in battle tactics.

It will be noticed that the author uses the words " forward body " and " manœuvre body," instead of the recognized terms " firing line " and "supports." This is because these terms are no longer applicable to modern infantry tactics. In order to instil a correct doctrine into the minds of the average officer and N.C.O. it is advisable to eschew misleading terms, and not to try to reconcile modern ideas with out-of-date phraseology.

The term "firing line" does not convey the idea of the outstretched arm or of distribution in depth. It suggests a broad frontal attack with no attempt to make use of covered ways of approach or to find the soft spots.

In the case of "supports" both the word and the idea are dangerous. It does not inculcate the essential idea of manœuvre, but rather the obsolete and unsound idea of reinforcing frontally troops who are held up, which means piling the dead in front of the enemy's strongest points.

Reinforcement of units which are held up causes confusion owing to the mixing of units, nor does it produce so great a moral effect as a diversion from a flank, either on the enemy or on the troops reinforced. As long as obsolete terms persist, there is a danger of a wrong idea lingering in the mind of the average leader. It is contended on the other hand that the terms "forward body" and "manœuvre body" instinctively suggest the true principles. Even if we retain the old terms, however, the action of these respective bodies still holds good.

When one speaks of weight or force in modern war it is essential to remember that it is weight of fire and not of mere numbers of men. An army composed of highly trained fire units capable of manœuvre can defeat far larger armies who rely on mere masses of men. Thus highly fortified enemy defences must be countered by an increase of mechanical fire power, and not by reducing the intervals, and so increasing the casualties, of the infantry.

The infantry commander must not however delude himself with the idea that he has fulfilled the principle of economy of force when he has correctly distibuted his sub-units.

He must use every means to increase the effect of his available numbers. How? By following the same sub-principles as did the man in the dark, which were :---

i.—Surprise. Striking the enemy from an unexpected direction, at an unexpected moment, in an unguarded spot. It is the duty of every commander before and during the attack to use instinctively this, and the following, means to economy of force. He should ask himself subconsciously at every stage of the fight:—How can I surprise the enemy? Is there a covered approach by which I can get closer to the enemy or round his flank? Is the smoke or fire of other units or arms affording me a momentary chance to get forward or to assault the enemy?

ii.—Speed of movement, fire, and eye. Opportunities in battle are fleeting and must be constantly noticed and seized.

iii.—Momentum. How can I keep up the pace of the advance? Is this a suitable moment to use the expanding torrent system? We will discuss this matter later. 2

iv.—Soft Spot, seeking and striking the enemy's weakest spots, instead of dashing out the lives of one's men in front of his strongest points.

Where does there appear to be a weak spot or where is the enemy beginning to give way?

v.—Husbanding one's men by the aid of correct factics and covered approaches instead of massed frontal attacks in line.

How can I get my men over that exposed stretch with the least loss ?

vi.—Mutual support, whether of brigades or sections, all working together like the muscles of the body or the members of a football team.

Can I help the units on my flanks to get forward by bringing cross-fire to bear on the enemy opposing them?

vii.-Exploitation to the full of every advantage gained.

How can I best exploit the soft spot which I have found or the fire position which I have gained ?

Before going on to deal with the execution of the five battle principles, let us consider certain

#### NEW CHARACTERISTICS OF THE INFANTRY FIGHT.

Infantry tactics have been thrown into the melting pot by the realization, which has been forced upon us, that our former methods are inapplicable and wasteful of force under modern conditions. The outstanding change has been the realization that the weight, or force, of an attack does not increase in proportion to the numbers of men thrown in; that progress can only be made by intelligent manœuvre of fire power.

Increasing numbers beyond a certain density adds nothing to the effectiveness of the attack or defence, but only results in greater casualties. Instead of dense lines of bayonet men in attack, or crowded position, in defence, one must use widely dispersed combat groups containing comparatively few men, but well equipped with fire and smoke weapons. These must be allowed ample frontage to manœuvre and find the enemy's soft spots. Thus the exact intervals will depend on whether the ground is open or close.

It is necessary at this point to remember that, in any large action, each of the infantry units will be restricted to a definite sector of the front. At first sight therefore, it will be confined to a purely frontal attack. But modern destructive weapons have enforced a wide dispersion of the combatants on the battlefield. This dispersion has rendered possible penetration by the fire units—the sections—between the enemy defence posts. It is the *rôle* of the section, platoon, and company commander in turn by exploiting this penetration to change their sector of the battle from a mere bludgeon fight into a manœuvre combat, thus fulfilling the principle of economy of force by striking "from an unexpected direction against an unguarded spot."



FIG. 3.-A Battalion in the Approach March against unlocated Enemy.

#### INFANTRY IN ATTACK.

We now turn to consider the application of our man-in-the-dark theory to practical tactics. The ideal infantry battalion, company, or platoon, should resemble a human tank, comprising both offensive power and protective armour. Its offensive power rests in its arms and legs, or in other words its weapons and manœuvring power. The protective armour is represented by an open formation, such as a diamond or square, which prevents more than one of the sub-units being surprised by the enemy, and so affords time for the remainder to manœuvre to take the enemy in flank.

#### A. PREPARATION (SECURITY).

"The man extends one arm to grope for, feel, and seize his enemy by the throat."

#### I. PROTECTIVE FORMATION.

We deduce from our study of the man-in-the-dark that each unit should move with an advanced guard or forward body—the outstretched arm—pushed out in the probable direction of the enemy, whilst the main, or manœuvre body, follows in rear. The latter will thus be ready to manœuvre against any enemy which the forward body encounters, and by its mere presence will protect the flanks of the forward body. In modern war the defenders can only be definitely located bit by bit by actual attack. Hence the danger of a surprise counter-attack is ever present.

An open formation of security is therefore just as vital during the attack as during the approach.

a.-The Advance or Attack against an unlocated enemy.

Maxim i. The best formation for any body advancing against an unlocated enemy will usually be that of the diamond (see Figs. 2 and 3). Whichever point of the diamond encounters the enemy first has the duty of fixing him whilst the other three manœuvre to take the enemy in flank.

Maxim ii. Until a unit is committed to attack on a definite point its commander should move with his forward body in order best to direct the movements of his unit and keep in touch with the situation in front. The diamond, with its solitary leading point, facilitates this direction by the commander, and enables him to make the best use of any covered approaches.

Maxim iii. Hence it should also be used for all manœuvre bodies and units in rear until they are committed to a definite role.

Maxim iv. Security is the first essential. Hence each unit should move by bounds. In this method each body advances alternately, while the other is halted in a position from which it can cover with fire the moving body. The manœuvre body, in an advance, will only bound as tar as a position in rear of the forward body, from which it can cover the next advance of the latter. When not in the neighbourhood of the enemy speed is more important than security. Therefore units should move in column of route along roads, with only the actual head of the forward body deployed. Thus in the case of a company serving as advanced guard or forward body to a battalion, only the forward platoon would be deployed in diamond formation, whilst the three manœuvre platoons move in fours along the road, until in the neighbourhood of the enemy.

#### b.-The attack against a located enemy.

Maxim i. You will normally have two sub-units forward and two for manœuvre. The formation will usually be a modified square (see Fig. 4). The two forward sub-units should be well apart in order to cover the whole extent of your frontage with fire and to thoroughly explore it for soft spots. The two manœuvre sub-units should move as close together as the enemy's fire allows, in order to be under quicker control for manœuvre.

Maxim ii. Speed is the first essential, and therefore continuous progress must be aimed at, instead of movement by bounds.



FIG. 4.-Square Formation.

#### SECTION FORMATIONS.

We now turn to consider the formation of the actual fire, or fighting, units which are the sections. The extended line is not a formation of security; it is not under the instant control and direction of the section commander and thus it prevents full advantage being taken of covered approaches and reduces the power of manœuvre.

The very idea of a line presupposes a wasteful frontal attack instead of a man $\infty$ uvre combat. Hence it should be abandoned in favour of a formation such as arrowhead (see Fig. 5), with the section



FIG. 5.-Arrowhead Formation.

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commander as the point of the arrow. Arrowhead is no more vulnerable to frontal fire than an extended line, whilst against enfilade fire it is even less vulnerable. It gives the section commander far greater powers of control and manœuvre, and is capable of firing in any direction. Thus it forms our ideal of a human tank or moving strong point.

When advancing through defiles or through woods and thick bush, the arrowhead can be closed in to form worm formation, in file or single file.

Maxim i. Arrowhead will therefore be the usual formation for both fire and movement.

Maxim ii. Worm will be the alternative formation for movement. Maxim iii. During the advance the section commander must use his intelligence and change from one formation to the other as the ground dictates.

#### II.-RECONNAISSANCE.

Reconnaissance may be divided into two classes, " previous to battle " and " during battle."

#### a.-Previous Reconnaissance.

This is carried out by three methods ;---

i.—The commander of each infantry unit studies all information regarding the enemy and the ground, which his superiors or the other arms such as cavalry and aircraft, have been able to obtain.

ii.—He carries out a personal survey of the ground ahead before committing his unit to an attack on a definite objective or to the defence of a definite position. In this survey he should be accompanied by his sub-unit commanders and any *liaison* officers.

iii.—Sending forward specially trained company scouts to carry out long distance reconnaissance to obtain information on definite points.

#### b.-Battle Reconnaissance.

This is carried out by observation and fighting :---

i.—Observation is achieved mainly by section scouts or patrols moving ahead of, but in touch with, the sections or higher units respectively which they are covering.

Maxim i. Each section when it has shaken out from the platoon should send a pair of scouts ahead to ensure protection. Section scouts should move ahead of, but within view of their sections. It is their role to discover the most covered ways of approach and to give warning of defence posts or parties of the enemy, and thus prevent the section coming under heavy surprise fire. They should move by bounds and at the end of each bound one scout should signal back for the section to come on or the reverse, whilst the other remains observing. When held up by the enemy's fire the section scouts should take up a position from which they can cover the section, as it moves up. The section should always move to rejoin its scouts in order that it may become an intact fighting organization once more.

Maxim ii. Patrols, which should consist of a complete section, or platoon, will be used to afford close protection to larger units. They should move in touch with the unit which they are covering, but considerably beyond the radius of action of the section scouts. Like larger units also they should move in a formation of security such as the diamond.

ii.—Reconnaissance by fighting will be carried out by the advance of the forward bodies which by actually attacking the enemy's position will feel and test it at all points, and so endeavour to discover or make a breach at some weak spot. Hence it may be best considered as part of the phase of fixing.

#### III.—FIXING.

Each forward body should advance direct on the enemy in order to reconnoitre him by fighting, discover and penetrate his weak spots and so continue its advance until it has gained the objective. If no soft spots can be found in the frontage allotted to it, it should fix him firmly, so that the manœuvre body can work round his flank and deliver a decisive surprise blow.

Maxim i. Thus when the fire of the enemy holds up a forward body, its duty will be to keep the enemy immediately opposing it fixed to his ground and to absorb his attention by maintaining a vigorous fire and working its way closer at every opportunity provided by the fire or smoke of neighbouring units or of the auxiliary arms.

Any slackening of pressure by the forward body will only result in the defence being able to turn and meet the flanking attack. There is a danger that during this flanking movement, the manœuvre body may be exposed to cross fire or counter attack from other enemy posts. This can only be averted by the neighbouring forward bodies really fixing their own immediate enemy. To ensure this mutual support every forward body must be determined to close with, and fix the whole attention of, the enemy opposed to them.

Maxim ii. The leading sections must not delay the advance by halting to fire until no further progress can be made without beating down the hostile fire.

Maxim iii. The action of the forward infantry in attack must consist of a constant pressing forward to close with the enemy in order to find the weak spots in his defences.

Maxim iv. To this end they must seize every available cover afforded by the ground, fire, or smoke.

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Maxim v. The speed of advance will be vastly quickened if tanks working with the infantry are used to carry the equipment and extra ammunition of the infantry.

Maxim vi. The forward sections can often fix the enemy defence posts opposed to them far more effectively by firing smoke to windward of them, than by rifle or Lewis gun fire. The smoke drifting down over the enemy blinds them and so enables the manœuvre sections to work round their flank unseen to assault them. Moreover this method economizes ammunition.

Maxim vii. To enable him to take instant advantage of any soft spots which are found by the forward companies or platoons, every battalion and company commander should detail an officer or specially selected N.C.O. with runners to move with each of the torward companies or platoons, and to send back word to him the instant a gap is found or made.

Maxim viii. Commanders should keep touch with the units on their flanks by observation or by sending out a patrol or special scout when the necessity for information or communication arises.

#### B (IV.)-DECISIVE MANŒUVRE.

"The man delivers a decisive blow from an unexpected direction against an unguarded spot."

Each manœuvrc body will move close behind. Its normal purpose will be to assist, by means of manœuvre, the forward body to advance and gain the objective. If the fire of the enemy holds up the former body it will be the rôle of the manœuvre body to turn the flank of and enfilade, the enemy resistance which is opposing the forward body.

Maxim i. To achieve this a manœuvre body may have to quit its own sector and follow in the wake of a neighbouring unit which is still advancing. It will pass through the gap thus made, and come in on the flank of the enemy against which it will deliver an immediate blow.

As soon as this manœuvre has achieved its aim the forward and manœuvre bodies will mop up, reorganize and continue the advance until the objective has been gained. They will then consolidate the ground won in the most suitable tactical positions in the vicinity.

Maxim ii. If the enemy counter-attack during the advance the manœuvre body will be at hand and ready to counter-manœuvre against them.

Maxim iii. The commander of the unit must not however hold back or hesitate to throw in his manœuvre body to turn the enemy's flank directly it is clear that the forward body has fixed him.

Maxim iv. To guard against the danger of counter attack during its flanking movement, the manœuvre body must itself be distributed in depth. Maxim v. Company and platoon commanders should always move with their manœuvre platoons, or sections, directly they have committed their forward body to a definite attack.

Maxim vi. Battalion and brigade commanders should also move with their manœuvre companies, or battalions, but only until they commit them to a definite *role*. They should subsequently move with their reserve. Thus every infantry commander will be able to keep control of the course of the attack and influence it without delay at the decisive moments.

Maxim vii. It must be clearly understood that the assault is not necessarily carried out by the manœuvre body. If the enemy turn to meet the latter, it will be the duty of the forward body to seize the opportunity to rush in and assault the enemy.

Maxim viii. In the case of the platoon the Lewis gun sections may often be used for manœuvre. They are less mobile and present a larger target than the rifle sections, but if covered approaches are available, they are more valuable for manœuvre, because of the greater surprise and enfilade effect of Lewis gun fire.

It is highly desirable that infantry should be systematically trained in deployment and changing direction by signal. These will not only be of great advantage during the approach march, but could be used on many occasions during the actual attack to quicken manœuvre and direct sub-units to take advantage of covered ways of approach. If thoroughly ingrained in the troops, signals can be used **at suitable moments** instead of the slower method of messages.

#### C (V.). EXPLOITATION.

"The man instantly follows up his advantage and renders his enemy finally powerless."

#### .a.—The limited or unlimited objective in attack?

In battle the only true objective is the enemy. But his actual strength and dispositions can only be ascertained by fighting. Hence certain topographical objectives must be allotted beforehand in order to serve as stepping stones by means of which the artillery can co-operate with and support the infantry advance. On the other hand it is a direct violation of economy of force to limit the advance of unexhausted units which find soft spots and can press on with little opposition. One should only replace those units whose momentum is checked by fatigue and severe opposition. Therefore these stepping stones—termed objectives—should be restricted to the battalion or higher formations. The companies, platoons, and sections of each battalion should press on to gain the battalion objective, their objective being the only true one the enemy, wherever they find him in their path.

Hence the battalion will be the smallest unit which needs to carry out pursuit beyond the objective.

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#### b.-The Pursuit.

Companies and platoons need only be distributed into two bodies, forward and manœuvre, but battalions when carrying out a definite attack should be divided into three bodies: forward, manœuvre, and reserve. (See Fig. 6).



FIG. 6. -Battalion in a Definite Attack.

The reserve body is the means whereby the battalion or higher commander exploits success or retrieves failure. At the moment the battalion objective is taken, the enemy will be disorganized and probably demoralized, but if the attacking unit halts on the objective and is content to send out a few patrols only, the golden opportunity of exploiting the enemy's local reverse will be lost. If the troops which carried out the assault have to be reorganized for pursuit precious minutes will be lost. If a separate unit under a different commander is used for pursuit, delay is bound to occur, and the pressure on the enemy be relaxed, thus affording him a chance to recover.

Hence a fresh body, but one which is under the control of the commander who has taken the objective should be used for pursuit.

Maxim i. The normal purpose of the battalion reserve therefore will be to exploit the success and continue pursuit until such time as fast-moving tanks or other mobile troops have caught up and passed through them. In this way a relentless pressure on the yielding enemy will be maintained, so that his retreat may rapidly spread and gain momentum, thus resembling a snowball rolling downhill.

Maxim ii. If the forward and manœuvre companies fail to gain the objective, the battalion commander may use his reserve to relieve them or to meet counter attacks.

(To be continued).

#### PROFESSIONAL NOTES.

# THE WAR DEPARTMENT SCHEDULE OF BUILDING PRICES.

#### By COLONEL T. E. COLEMAN, O.B.E., Chief Inspector of Works.

PROBABLY every experienced Engineer and Contractor has some knowledge of this well known price book. For many years it has formed the basis for estimating the cost of War Department buildings and engineering works, and it is interesting to trace its development up to the present time.

So far as can be ascertained, the first War Department schedule was compiled about 1855. The earliest copy which can now be traced is dated 1865. It was divided into 10 trades, with 3,000 items and 7,000 prices. From time to time the schedule has undergone considerable expansion, but it is gratifying to find that the original arrangement for a series of building prices was based on sound lines, and this at a time when the measurement and pricing of building and engineering works had not been reduced to a uniform and standardized system. The general plan still remains on the same lines as in the original work.

Flattering evidence of the value of this book of building prices is afforded by the fact that other public departments practically adopted it as their model, adapting the various items to suit their own particular requirements. The Works schedules of the Admiralty, the Office of Works, the London School Board, and the London County Council, are all similar in arrangement and design to that of the War Department.

Further references to previous editions of the War Department schedule show that in 1874, it had increased to 6,000 items and 14,000 prices. In 1903, each sub-district had its own schedule of items and prices, with the result that there were 31 different War Department schedules then in use for the United Kingdom only. This involved a heavy expense in printing and revising so large a number of schedules, and keeping such a mass of matter permanently in type.

About 1908, an attempt was made to reduce the number of schedules, and also the number of items and prices. The number of schedules was accordingly reduced to nine. This comprised one for each of the eight Commands, and one for the Channel Islands. Another schedule was provided for Woolwich Arsenal, but this was prepared locally and not at the War Office. By a system of grouping,

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the items were diminished from 6,000 to 3,000, but still the number of different prices rose from 14,000 to 15,000.

In 1906 and 1911, a series of Addenda (one for each Command) was issued for use in making corrections and additions to the existing printed items and prices.

In 1914 the W.D. schedule was re-printed, the Addenda being embodied therein, but no other changes were made.

The present position, therefore, is that (including Woolwich) there are 10 different War Department schedules for building work used in the various Military districts of this country, each of which contain 3,000 items and 15,000 prices.

Even before 1914, it was realized that a thorough reconstruction and complete revision of the War Department schedule was a pressing necessity. In addition to the Addenda already mentioned, numerous corrections had been made from time to time, and in many cases new items had been interpolated without due consideration of the existing items and prices. Many discrepancies and inconsistencies therefore crept in. The introduction of new materials and new methods of construction had also not received sufficient consideration.

Then came the Great War, when all ideas of an improved schedule were perforce abandoned, but a few essential corrections were embodied in Addenda published in 1917. Now that the war is over, the necessity for a new schedule has become imperative. Compared with pre-war prices, all building values for labour and materials have been revolutionized. Roughly speaking, the cost of building is now about three times that of 1914.

The general principles laid down for the construction of the new schedule are as follows :--

(1).-The preparation of one standard schedule for the United Kingdom. Any modifications or variations in the local cost of labour and materials, as compared with the standard schedule prices, to be automatically adjusted by the Contractors themselves in their tenders. by adding to or deducting from the standard schedule prices the necessary contract percentage. Amongst other advantages, this proposal will reduce the number of schedules to be separately set up and printed, thus effecting a substantial economy in printing and stationery, whilst the work of future revisions will be simplified. It will also be possible to obtain a direct comparison as to the relative cost of similar works and repairs in all parts of the country. Another advantage is that Division Officers, Foremen of Works, and the Works Staff generally, having become accustomed to one standard schedule. will be in a position to take up their estimating and detailing duties in any part of the country on changes of Station, without having to get accustomed to a new arrangement of schedule items and prices. Detailed estimates made in one part of the country will be applicable

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to any other part of the country by an adjustment of the local Contract rate.

To meet the requirements of Woolwich Arsenal and of Scotland, (where certain special forms of building construction, or measurement, are sometimes required), it is proposed that a set of Addenda shall be prepared and attached to the standard schedule for use in these cases.

2.-The labour of measuring, squaring, abstracting, and moneying out the items of building work generally, to be reduced as far as Many of the present schedule refinements (consisting of possible. small variations in labour and workmanship) will be omitted. For instance, it is proposed that the prices for mouldings, etc., as fixed under average conditions will include the labour of forming mitres. instead of the latter being separately measured and billed. Prices at "per foot super" or "per foot run" will be adopted when practicable, in lieu of prices by weight. In the case of lead pipes, etc., convenient items, priced at per foot run instead of cwts., will be introduced. Under this arrangement, the work of reducing the measured quantities to weights will be avoided. To minimize clerical labour, farthings and halfpennies will be omitted, and round figure values substituted. Thus an analytical value of 7<sup>1</sup>/<sub>1</sub>d. will be shown as a schedule price of 7d.; 11<sup>3</sup>d. as 1s., etc.

3.—It is proposed to provide a complete series of items for "labour only" in order to meet the requirements of those stations where building materials are bought in bulk by the War Department, and direct labour is employed. By this means, it will be possible to prepare the necessary "labour only" estimates on a uniform basis of prices, as well as to obtain some recognized standard of comparison of cost in different parts of the country. This extension of measured labour values, will, however, involve a very large number of new items and prices being added to the schedule.

4.—The descriptions and items of workmanship, etc., to be simplified where practicable. The principle of using one combined item, instead of adding two or three together, will be extended. "Flat rates" for small items of general repairs will be introduced in order to save clerical labour in the preparation of incidental requisitions.

5.—Many items for materials and workmanship now obsolete, or rarely used, will be omitted. Other items and prices for new methods and materials will be provided. In this connection, the reinforced concrete section will be entirely remodelled and extended.

6.—A new section—the "Electrician "—will be introduced. These items and prices will embrace ordinary repairs to electric lighting, electric bells, etc.

7.—The specifications for materials and workmanship in each trade will receive careful consideration, so as to bring them into line

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with the best modern practice, and secure uniformity and standardization in all parts of the country. For this purpose the British standard specifications for cement, drain pipes, steel joists, wrought iron and steel tubes, pipes, etc., as laid down by the Engineering Standards Committee will be adopted as far as possible. A suggestion to introduce a decimal system of measurements and prices was carefully considered. Under present conditions, however, the practical difficulties were found to be too great to warrant its adoption.

8.—Taking the principal trades in their order, some of the salient modifications to be made in the new schedule are briefly mentioned :—

In the *Excavators' Work*, the items of excavating in various soils, etc., will be reduced. The measuring and pricing of trenches will also be simplified.

The *Concretor* section will be considerably extended, and, it is hoped, improved. Concrete is now a much more scientifically prepared material than in the old days when contractors apparently considered that any miscellaneous collection of gravel, brick, or stone *debris*, roughly broken, and containing a variable proportion of fine stuff, mixed with water, and a minimum quantity of inferior cement, might be dignified by the name of concrete. Such a material is far removed from the concrete which satisfies the requirements of the trained engineer of to-day. The proportions of coarse aggregate, fine aggregate, and cement, will be specified in detail. A number of items and prices for Reinforced Concrete will be introduced.

The *Drainlayer* section will be rc-modelled, and additional items and prices for 'labour only' provided for the use of stations where direct labour is employed.

For *Bricklayers' Work* it is proposed to adopt a mode of measurement more in accordance with the London Quantity Surveyors' practice. At present brickwork is measured in the War Department schedule at ' per foot cube ' and involves the squaring out of three dimensions for each measurement. The general practice is to measure and price brickwork on a superficial basis, except for heavy engineering works. In the latter case, brickwork in thick walls and large masses (as arches, dockwork, etc.), is measured by the yard cube.

For ordinary building works in London and the south of England, brickwork is almost universally measured at per rod of 272 feet superficial, reduced to a standard thickness of  $1\frac{1}{2}$  bricks. In the north of England, it is generally measured by the yard superficial reduced to the standard thickness of  $1\frac{1}{2}$  bricks, or else in accordance with the London standard rod of 272 feet super of reduced brickwork. Both the rod and the yard super units are, however, too large for adoption in a general repair schedule for small works. It is accordingly proposed to introduce a unit of 1 foot super of brickwork reduced to a standard thickness of  $r_2^1$  bricks. The adoption of this principle will not only harmonize War Department measurements with the London and the northern practice of superficial measurements for brickwork, but it is also anticipated that Division Officers, Foremen of Works, and others will be saved considerable labour in squaring dimensions, etc.

Hollow walls will be measured net at per foot superficial of standard thickness, and a further item provided for forming cavity walls including the provision of bonding ties, etc., complete. This method is also similar to that adopted by London Quantity Surveyors.

In the general arrangement of the Carpenters' and Joiners' work, several alterations will be made. To facilitate reference, all items of carpentry—such as floors, roofs, etc.—will be grouped together in a more comprehensive form, and the Joiners' work similarly dealt with.

A suggestion that timbers, etc., in Carpenters' work should be reduced to a uniform thickness of 1 inch—instead of being calculated at per foot cube—has been considered. In the former case all timbers are reduced to a uniform thickness of 1 inch, and priced at per foot super of 1" standard thickness. This system is extensively adopted in Canada and the United States. Whilst the method may possess some advantages, yet on the whole they do not appear sufficient to justify a departure from the fixed practice amongst building surveyors, contractors, etc., in this country, of pricing such work at per foot cube.

The Slaters' end Tilers' work will be remodelled with a view to securing simplicity in measuring repairs, etc., to roofs. In the existing editions of the schedule, the items and prices for tiling are included with the Bricklayers' work, instead of in the Slating section, where they will be found in future.

Similarly, the items and prices for lime-whiting, colouring, etc., will be transferred from the "Plasterer" section to the "Painter and Decorator" section, where they properly belong.

As regards the remaining trades, no important modifications will be introduced beyond a thorough revision, consolidation, and grouping of the items and prices.

There are many difficulties to be overcome in preparing a standard schedule which shall apply generally to all parts of the country. The prices of materials and labour vary in some degree in each district. Its accomplishment will, however, be advantageous in many ways, as already mentioned. The ideal to be aimed at in providing a good standard schedule of prices for building works and repairs, is a price book in which contracts for London and large cities average about 10 per cent *above* the schedule prices, whilst contracts for Country districts average about 10 per cent. *below* the schedule prices. In other words, the schedule prices should represent the mean average cost of ordinary works and repairs throughout the various home military commands.

It will be seen that a re-construction of the War Department schedule in accordance with the broad principles laid down—including analysing and formulating thousands of prices to suit present conditions necessarily involves an enormous amount of labour. The fact that at the present time, rates of labour, and prices for materials, are not yet stabilized, introduces further complications which are not present under normal conditions. These variations will, however, be corrected from time to time as they occur.

From one point of view, the preparation of a schedule which should provide for all building operations and for all variations of conditions and materials, is an absolute impossibility, the processes being so numerous, and the variations of the material factors, to say nothing of the human, being infinite.

A schedule of building values is therefore rendered practicable only by the adoption of average prices, and this must be remembered when criticizing or using them. It is quite likely that taking a particular piece of work, the schedule price may appear too high or too low, but it has been calculated with the idea of its being an average price over a series of jobs to be met with under that particular description in War Department work, and it is intended that both parties to the contract should interpret the schedule in that light.

It is hoped that Division Officers, Foremen of Works, and others who may be called upon to supervise, measure, and price building work executed by measurement contracts based on the new schedule will find it a somewhat easier task than at present.

It may be added that during the revision the opportunity will be taken of consulting experienced Division Officers and Foremen of Works, who are the persons most closely concerned with the applica tion in practice of the book to estimating and billing, and who know where the shoe pinches most. It is hoped that their co-operation will be of the greatest value.

#### THE ART OF TEACHING.

#### A lecture delivered at the S.M.E., Chatham, on the 27th January, 1921, by PROFESSOR FRANK J. ADKINS, M.A.

An art is the expression of one's ideas and personality through some medium or other : hence there must be as many varieties as there are personalities; i e, art is individual and the rules of an art are therefore only observed uniformities, not imperatives. Moreover, an art is acquired not from talk but from practice under skilled supervision and from self criticism. All I can attempt therefore is to offer the result of nearly thirty years' teaching experience, in the hope that it may stimulate self criticism. If anything I say is taken as fixed, final, and absolute, I shall have failed in my object, which is not to prevent thought by the delivery of a sealed pattern system to be worked in its entirety, but to promote self criticism.

There will be many platitudes in this paper, but I do not apologize for them, since Truth is none the less true for being well-worn; and, as we shall see presently, the most hopeful of educational methods is the re-discovery by the student for himself of truths already known to the initiated.

My first platitude, then, will be this: Be sure you know your subject before you venture to teach it; and by knowing a subject I mean more than appears on the surface. For practical purposes a man may know his subject in a perfectly inarticulate way. His knowledge enables him to *act* correctly, but there it stops. But the teacher's knowledge must be articulate; he must be able to express it in words, and to this end he must reach the *rationale* of his subject, using the word Why? as the probe in his exploration of its foundations. Frequently I have found that people who have a difficulty in expressing themselves are by no means deficient in the power of expression; but they have no clear idear as to the thing they want to express.

Understand a subject and the words to make it clear to others are most likely to come.

The second point about a teacher's knowledge must be its flexibility. It must be part of himself, completely under control, not merely a track traced through text books from which one fears to depart. One does not get one's flying certificate until one can perform all manner of stunts : one cannot ride till one can take one's own line across country and enjoy jumps.

Lastly, a teacher's knowledge must be question-proof; and question-proof in this sense. He need not necessarily have every detail in his text books in mind, but he must be so master of his subject that any question from a pupil, put, perhaps, in the course of a lesson, which suggests a different angle of vision or a new line of argument, is seized upon by the teacher as a means of a fresh handling of the subject, not dreaded by him as an obstruction threatening derailment.

So much for the teacher's knowledge. Now, what is the first step in preparing this knowledge for teaching purposes?

In the first place we need to arrange that the essentials are all dealt with in the time at our disposal. To find oneself only half way through one's subject at the end of one's period is obviously to have failed as a teacher. Secondly, we need to arrange our facts in such a way that they are all linked and woven together; none left isolated and alone, as unsupported "points to be remembered," but all braced and held together in a chain of continuing cause and effect, each fact arising out of a previous fact and leading on to another. Facts so marshalled become significant-more than Memorandalinks, rather, in a chain of argument ; and students who have grasped facts thus, who have realized that they are the points which give the curve its direction, will remember them because they have digested them with the pepsin of the intelligence and so made them part of the brain structure itself ; whereas facts obtained by a process of merely mechanical repetition remain alien bodies in the mind, liable to drop out in course of time. A further reward of this organizing of facts is that the structure so built up will bear a greater weight of detail than a loosely put together scheme.

Having finished our general preparation, we come now to the question of the detailed preparation of the various sections, lectures or lessons. In other words, we come to the vital question of the teacher's notes. Now, notes are a nuisance, because they come as a sort of paper barrage between the teacher and his objective. The teacher ought to have his eye fixed continuously on the class. Every time he looks at his notes he drops a certain amount of control and power to stimulate. If he reads his lecture from a manuscript he might as well have it printed and handed round in pamphlet form. What sort of notes then at once avoid these defects and help the teacher? Obviously not notes on subject matter, since by hypothesis the teacher is thoroughly master of his subject; but notes rather which enable him to handle his masses of knowledge effectively. To get lost in the tangles of one's own knowledge is no uncommon experience of the teacher, and his notes should be the guide-posts which enable him to keep to the path he has mapped out or to get back to it if for any reason he has strayed.

Notes then must be brief; and if their brevity is such that at intervals during the lesson they can be written up on a blackboard, they form, as a blackboard summary, the backbone of the whole subject. Nay, more, the key to the whole teaching position.

Our preparations are now complete and we are ready for the attack. (I am purposely leaving aside the preparation of experiments, illustrations, examples, extracts from books and so forth, although success in teaching depends largely on attention to such details, as it depends also upon skill in using the blackboard).

What is the weapon the teacher uses most in the actual conflict? Eye and manner of course to a great extent, but voice most of all, And so we come to the important question of language. Now, a man's language is his own, no two people express themselves in exactly the same way. Nevertheless certain general considerations arise. And here I shall have to distinguish between the lecturer and the teacher. Lecturing is a one-man show. The lecturer does the work and the audience does the rest-sometimes a very real rest too. Between him and his hearers there is a great gulf fixed. But the teacher's case is very different. His business is emphatically not to do the work and save his class the trouble. Quite the reverse. His success as a teacher is to be measured by the amount of work he gets out of his class; by the amount of mental energy he can develop among his pupils. He must make them teach themselves ; and his language is his instrument. Let him then speak easily and colloquially, not slangily, ungrammatically or provincially, but chattily and informally, as one does in fireside talk. Let him speak also simply; always remembering that what may be simple to him may not be by any means simple to his class. A schoolmaster once began a lesson on King John thus: "The darkest passage in the reign of King John was the murder of Arthur," which one of the boys rendered thus, "King John murdered Prince Arthur in a dark passage in the rain." Which innocent little story brings me to the subject of jokes and laughter-perhaps the most effective ally the teacher has.

When a joke is made—or rather, when it is seen—a flood of energy is liberated and has to be worked off somehow. Now Nature's recoil mechanism is laughter, tears, and violent limb wagging in the excessively young. But all the energy is not thus taken up. What happens to the equivalent of the energy which propels the shell; the useful energy in a gun explosion? That flushes and refreshes the brain and nerve centres and so helps on our work like a shower upon a thirsty land. But obviously the jokes we need are only those which underline and emphasize our subject—a joke dragged in for the sake of the explosion is an impertinence, it does not belong

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to the scheme-we need those also which promote the thoughtful chuckle rather than the loud laugh which speaks the vacant mind. Nor must our jokes be too frequent. The outline of our subject must never be blurred by too great a flood of laughter. And lastly, our jokes must be properly constructed. A misfire is always a tragedy, and if there is any doubt as to the exact wording of a joke, I should not hesitate about writing down the joke in full in my lecture notes (but I should not copy those words on to the blackboard). Thus prepared and armed, the teacher moves towards his objective, the development of mental power among his pupils. And the dumbells of the mind which he has at his disposal are the facts of his subject, facts to be used obviously not as points to be remembered but rather as questions to be answered, problems to be solved, matters to be discovered. Let the student be placed in the position of those who were the first to find out the next truth in the subject, re-discovery of this sort (the Henristic method) is the natural process of education, and the truth found out in this way is sure to be remembered because the mental energy developed in the discovering of it has already assimilated it with the rest of the brain. Thus the teacher aims primarily at mental activity; but since that has to be exercised on a given subject, the reward his pupils reap is not only increased mental fitness, but also a valuable residuum of intelligently acquired and therefore applicable knowledge.

Nevertheless the knowledge is essentially nothing but the byproduct, however vital and valuable, of the gymnastic process which is the teacher's real concern. The process may seem—and is—slow at first, but it is subject to acceleration and in any case the teacher should delay giving his help as long as he can. "The child's extremity is the teacher's opportunity :" a very sound old maxim provided one is quite clear as to which extremity the saying applies.

In this work the teacher is obviously only the leader of a group. Progress is the result of team work and the effectiveness of the team work will depend largely on the extent to which the teacher can, by manner, language and so forth, indicate that he is only *primus inter parcs*, a captain in the games sense of the word. Indeed, if a member of the class happens to know more about a given section than the teacher, it is his obvious duty to carry on for the public benefit and for the teacher to leave him to do so. Thus frequently also the best brains in a group get the opportunities for exercise to which they are entitled, but which they are denied if the subject is taken by the teacher as a series of explanations suited to the dullest, a fatal form of waste, too prevalent in many educational circles. The student also who feels moved to ask a question in the course of the lesson finds himself encouraged to do so, because he, too, is helping on the joint effort towards discovery ; whereas frequently the interrupter finds himself snubbed and subdued (if not ejected) in classes where teaching is a monologue by the teacher.

And so the lesson proceeds by a process of give and take dialogue, question and answer, co-operation; and at the end there ought not to be any real need for the formula, "Any questions?" Nevertheless that formula may bring forth an odd question or two, and, if so, how can these also best be used for still further developing the mental powers of the class? Obviously not by the teacher answering the question; but rather by the teacher turning it back upon the class, a sort of mental ju-jitsu. If different members of the class have differing answers to the question which the teacher has repeated to them then, maybe, a division is caused in its ranks and each faction, to prove itself right, marshals all its facts and powers of argument against the other side. A debate thus started represents a maximum of mental energy and should be welcomed by the teacher.

Thus the lesson ends, but there are still one or two points deserving of a word or two. First : recapitulation. If I am right in my main thesis that, understanding once secured, the knowledge so obtained is registered automatically in the memory, then aids to memory like recapitulation and note taking become relatively unimportant. Nevertheless one aspect of recapitulation is worth a few words, not that by the teacher at the end of the lesson, but that by the class at the beginning of the next to consolidate. If each student has a paper and pencil and the teacher has his last lesson boiled down into a list of twenty or so questions, he can read out the questions one at a time. Each student writes the answer and so covers the whole ground in less than five minutes, each student having tested and corrected his own knowledge from the teacher's answers given at the end of the test.

Note taking is a more complex business because it results in a division of energy between listening and writing which is often fatal to both. Never measure the success of your teaching by the amount of note taking among your students. Some can make notes, of course and those may as well; but many are better employed in just following and understanding. Never go so slowly that your every word can be taken down and your lessons become merely dictation exercises. There are few mental jerks about dictation. If while you are putting your summary on the blackboard your students are copying it into their notebooks, no division of energy results; and if their notebooks contain ample blank space for the recording of their own reading, experience and thought in amplification of your lecture blackboard skeleton, you will find the notebook to be the key of the whole position. Its blackboard skeleton has not only kept you straight in your course, but it also connects you with your pupil's own efforts. His use of the blank pages reveals his character and progress to you: and the notebook itself is small enough to carry about yet elastic enough to add to throughout the rest of the student's connexion with the subject. If, in addition, you can give him during the first days of the course some idea of reading his text books pencil in hand, for underlining, marginal comments, cross references and the like, you will have done a great deal in helping him towards a successful career.

#### "THE BRITISH SOLDIER AND THE EMPIRE." By Colonel B. R. Ward, C.M.G.

THIS pamphlet,\* published for the British Academy, is a report of the Raleigh Lecture on History delivered by Mr. Fortescue on the 27th October, 1920. The Annual Lecture was founded by Sir Charles C. Wakefield, Bart., on the occasion of the Raleigh Tercentenary, October 29th, 1918. No living man is a greater authority on the British Army than the brilliant historian who has recently placed all soldiers in his debt by adding two more volumes to the greatest work on the deeds of the Army that has appeared since Sir William Napier's "History of the Peninsular War" was published in 1828.

In a pamphlet of 23 pages Mr. Fortescue here gives us his considered opinion as to the rôle and influence in the development of the Empire of the British soldier from the days of Queen Elizabeth to those of the Mediterranean Expeditionary Force and the occupation of Salonica. Taking Sir Walter Raleigh as his point of departure, he says that, although of course Raleigh was a soldier, it is not primarily as a soldier that we think of him at all. "We know him better," he says, "as a seer of great visions, a thinker of great thoughts, and a projector, in actual practice, of great enterprises for the widening of his country's power and influence." Not only so, but we think of him also as a poet and man of letters. "Here," he goes on to say, " is a soldier of whom surely it can be said that his sound has gone out into all lands and his words unto the ends of the earth. . . . Have there been any soldiers like unto him since his head fell upon Tower Hill on October 29th, 1618? That is the subject which I propose to discuss this evening."

In Raleigh's day the soldier was an amateur. The professional soldier came into his own during our civil war. The most lasting work for the army was, however, done by Cromwell, an amateur who was greater than any professional. His great work was to abolish the old tradition of war as a mere matter of money-making, and to raise the whole calling of the British soldier to a higher plane. The recruits he sought were "men who make some conscience of what they do." When these recruits had been turned into trained soldiers he describes them as "men who know what they are fighting for, and love what they know." "Are not these rugged words," says Fortescue, "a possession to our race for ever?"

\* The British Soldier and the Empire, by THE HON. JOHN FORTESCUE, LL.D., Oxford University Press, Amen Corner, E.C. 25. 196

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Taking these words as his text he follows up the influences of the great instructors of the British Army who carried on the work initiated by Cromwell—Marlborough, Wolfe, Moore, Wellington, Charles Napier, and "a certain taciturn inarticulate Scot who has held the very highest command and controlled the most tremendous issues, but is still to us little more than a name."

But it is not only the great names that Fortescue gives us in his study of the influence of the British Army. Colonel Mark Wilkes, author of the *History of Southern India*, Lieut.-Colonel Colin Mackenzie, collector of Southern Indian antiquities, Henry Rawlinson, the Assyriologist, William Martin Leake, the Gunner Colonel, "one of our great authorities upon classical antiquities, and a positive genius in the matter of topographical research," are amongst the less known names that he brings before us.

James Kempt and Benjamin D'Urban were two of Wellington's generals who became successful colonial governors; Harry Smith and . Lord Seaton, admirable colonial administrators, had been trained in the Light Division by Sir John Moore.

As authors, beginning with Sir William Napier, historian of the Peninsular War, Fortescue gives us William Cobbett, author of *Rural Rides*, and of an English grammar "which for long was considered—and perhaps may still be considered—the best that ever was written." This is tollowed by "a devout wish" that the military profession would study this grammar, an aspiration not difficult to understand, coming as it does from a military historian who has in the course of his work had to read, compare and collate more military reports and literature than perhaps any man living !

After an interesting and inspiring summary of the character and influence of the British soldier from the days of Cromwell to those of Wellington and the early campaigns of the nineteenth century, he closes his lecture with the following words : "Since then the soldier has gone from strength to strength. Now he is anxious to go abroad and see the world, and wherever he goes, he takes order and good-nature with him. It matters not whether he hails from my own garrulous and affable Devon, or from the more taciturn and suspicious North country, he is the same. It is true that, when he is thoroughly comfortable, he can only find vent for his feelings in incessant grumbling, but that is simply the defect of his supreme qualities of cheerful patience in discomfort, and of charity towards all men. Whence this charity arises it is difficult to say; but I think that it has its true source in the feeling that he comes of a victorious stock, that he is very strong, irresistibly strong, and that therefore he can afford to be very gentle. An officer of very wide experience told me after the South African War that it was the most difficult thing in the world to make the British soldier kill a man; and the readiness to accept treacherous signs of surrender is a proof of this. However, the good nature-the charity-is there; and we do not realize what it has done for us. To give but one instance, our Allies at Salonica sent forth, quite legitimately, emissaries in every direction to gain the hearts of the people, and to lay a foundation for future commercial enterprise. We did nothing of the kind; and yet the people everywhere turned to us and wished to deal above all others with us. Why? Because the name of a British soldier was not to be found on the criminal chargesheets of that polyglot army. The British soldier, though employed on a duty which subjected him to much hardship and sickness with no compensating chance of distinction, had always been not only well-behaved, but honest, gentle, and considerate. And so it was that quite unconsciously he outdid, by sheer force of character, the efforts of all other nations to commend themselves to the Balkan peoples. And this work, be very sure, he does wherever he goes, He is a silent missionary, but of power untold. Better than most of us, he has assimilated the precept, 'Be pitiful; be courtcous;' more truly than most of us has he learned the difficult lesson of self-respect without self-consciousness. Such is the fine flower of the tree that was planted by Cromwell and watered not only by Marlborough and Wolfe and Moore and Wellington and Charles Napier, but by thousands of humble and carnest officers whose names have perished but whose works do follow them. The British soldier, supposed to represent physical force only, is a great moral force within and without the Empire. It is not with physical weapons only, nor even chiefly, that he contends all the world over for the honour, in the higher sense, of his regiment, of the Army, and of the nation. And he prevails because he makes some conscience of what he does. He knows what he is fighting for, and loves what he knows."

#### CORRESPONDENCE.

#### THE TIBET MISSION OF 1903-04.

#### To the Editor, R.E. JOURNAL.

Sir,

It seems to be quite clear from the Blue Books that neither Major Morshead nor General Ferrier is quite accurate in his reference to the Tibet Mission of 1903-04. The former speaks of "the military and political expedition to Lhasa under Colonel Younghusband in 1904-05." The latter protests that "Colonel Younghusband was head of the political mission that accompanied the military expedition to Lhasa under the command of Brigadier-General J. R. Macdonald." Both writers are wrong in calling it a military expedition; it was a political mission with a military escort. Colonel Younghusband was the British Commissioner, and Brigadier-General Macdonald commanded the escort. The Blue Books are : Papers relating to Tibet, 1904, Cd. 1920; Further Papers relating to Tibet, 1904, Cd. 2054; and Further Papers relating to Tibet, No. III., 1905. Cd. 2370. It should be sufficient to quote from these the following phrases :—

Cd. 1920 No. 99. Secretary to the Government of India in the Foreign Department to Major Younghusband, 20 July, 1903. "Instructions have issued for the deputation of an escort of 200 men to accompany your Commission."

No. 112. Viceroy to Secretary of State, 16 September, 1903. "Colonel Younghusband is strengthening his escort."

No. 170. Viceroy to Secretary of State, 12 January, 1904. "Tibet Mission left Phari . . . accompanied by the escort."

Cd. 2370. No. 115. Secretary of State to Government of India, 5 August, 1904. "I desire to express the appreciation of His Majesty's Government of the courage and endurance of the troops attached to the Mission."

The language used throughout is consistent with these passages. Though the escort was increased until it became a considerable force, and though after the attack on the Mission at Gyantse the Foreign Sccretary, Simla, telegraphed to the British Commissioner that "preponderance for the present must be given to military considerations, and General Macdonald has been authorized to take all measures necessary to secure safety of Mission" (Enclosure No. 77 in No. 97, Government of India to Secretary of State, 30 June, 1904) it is clear that the Mission retained its political status throughout, and was never regarded as a military expedition.

Yours very faithfully,

ARTHUR R. HINKS.

Royal Geographical Society, 19 February, 1921. NARRATIVE OF THE 502 (WESSEX) FIELD CO., R.E., 1915-19. By MAJOR C. L. FOX, M.C., R.E. (Hugh Rees, Ltd., 1920).

This is another publication in the interesting series of R.E. Company records which have begun to appear. It is the story of the experiences of the 502nd Field Co., R.E., from its formation in 1915 to its disbandment in 1919.

The unit was originally the 1/3 Wessex Field Co. and was formed under the late Major W. Jane. Major Jane was a Territorial officer of long standing, whom I knew personally as 2nd in Command of the 2nd Wessex Field Co. in the 27th Division, with which unit he was wounded at Armentières in the summer of 1915. We had the 1st and 2nd Wessex in the 27th Division in Armentières then and it is curious to note that the 502nd Fd Co., seems to have done a great deal of work on the same ground. I notice the name Rolanderie Farm particularly. In 1915 the 2nd Wessex (Jane's Company) built an advanced Div'l. H.Q. at this place and at the time it was one of the star jobs in that part of the world, with its reinforced concrete roof which 502 seemed to think was not thick enough and which they in their turn improved. Another item of interest is the account of "dowsing" or water divining having been resorted to during the great advance in 1918. The only other time that I know of this having been done by a Royal Engineer Unit was at Glen Imaal near the Curragh in 1912, when Captain Buckle, R.F.A., who was attached to the 59th Field Co., gave us great assistance in locating water by this method, which he had the power to use. The book is a faithful record of the work of a Royal Engineer Field Unit, written as a souvenir for the personnel of the unit and its friends. It shows throughout the cheerful optimism that carried the Sapper so far in the war and the kindly feeling between all ranks that kept us all together. The unit was in the field from February, 1917, to the Armistice, and during this period lost 2 officers and 74 other ranks killed and wounded, a light list I imagine, considering all they went through, pointing clearly to good leadership. There are two good maps and lists of *personnel*, on proceeding overseas and at the Armistice.

Now that these company records are beginning to appear, it seems desirable that some move should be made to collect the records of the regular field and other companies that served during the war.

G. WALKER, Colonel Commandant.

#### WIRELESS TELEGRAPHY AND TELEPHONY. AN OUTLINE FOR ELEC. ENGINEERS AND OTHERS.

By L. B. TURNER, M.A., M.I.E.E. (Cambridge University Press. £1).

This is not a book for the "Wireless Amateur," or for the beginner in electricity who wishes to take up wireless. It is written for the Electrical Engineer who is at home in his alternating current theory and practice,

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and wishes to extend his knowledge to include the principles of wireless. It aims at showing how the new art is based on laws with which he is already familiar, extended to the region of high frequencies, and it should help to dispel the too prevalent idea that the subject is the thing apart, sacred to the initiated and to be regarded with awe by ordinary men. A peculiarity of wireless is its fascination for the amateur who has not been through the mill of a general electrical training, and the extent to which such a man can do really good work in it; a large number of text books have been written for his benefit but he reaches his limit where he is passed by the engineer with the broader grounding for whom this Outline is intended.

The arrangement of the book is unusual, but effective for the object After a short introduction, pointing out among other things in view. the order of frequency employed (commonly between 5  $\times$  10<sup>6</sup>, and 5  $\times$ 10<sup>4</sup> periods per second), the author proceeds to a simple analytical explanation of the fact that energy is radiated from any circuit when the current in it changes, negligibly in the case of ordinary A.C. practice but very appreciably in the case of wireless aerials. He claims that his aim is to convince of this fact rather than prove it, but the explanation given should satisfy any but the most hardened mathematician. Then, still before making any mention of the apparatus used, he discusses the wave nature of the energy thus liberated from a wireless sending aerial, traces its fate in surrounding space, and shows what portion of it may reach that speck on the earth's surface, the receiving station, concealed from the transmitter by the curve of the world. He then, in Chap. III examines the behaviour of oscillatory circuits in general, with the effects of inductance, capacity and resistance; he discusses decrement and methods of coupling and finally shows that a wireless antenna is an oscillatory circuit obeying the laws he has sketched out. Chapters IV to X explain the apparatus in general use for the production of oscillatory current of the sending aerial, and for the detection at the receiver of the ether waves set up. Most wireless text books dwell principally on the spark systems, which comprise perhaps 90 per cent. of the world's existing stations, describe fairly fully the arc and high frequency generator, and finally discuss the thermionic tube or triode as a new oscillation generator of great promise. Mr. Turner, on the other hand, gets his account of the first three systems behind him as soon as possible, as of great temporary importance but almost certainly obsolescent, and settles down to a very full description of the many applications of the triode in both sending and receiving. This arrangement, and the fact that he dwells on principles of action and avoids the detailed specification of apparatus should keep the book up to date for a number of years to come. The author goes on to a chapter on telephony, and finishes up with a discussion of miscellaneous subjects including his interpretation of the modern trend of development, with which no one in touch with events is likely to guarrel.

The book pays the reader the compliment of assuming he is as well up in the theory of his own work as the author in his, and many of the arguments in the analytical portions are condensed and by no means easy to follow. The author sets the pace over a country he knows well, but the reader may find himself forced to stop and think hard at many passages that he is evidently expected to take in his stride. This is perhaps no drawback, but rather the reverse, and the book well repays the close attention it demands; it contains less than two hundred pages, and in such a short outline the question of what to leave out becomes a very difficult one, on which no two writers are likely to agree; it is hardly a point for the reviewer to criticize, since if many obvious omissions were included the book would no longer be an Outline. It is admirably produced with excellent plates and clear diagrams, and is a valuable addition to the technical library both of the electrical engincer and the more specialized wireless expert.

R. CHENEVIX-TRENCH.

#### TALKS ON LEADERSHIP ADDRESSED TO YOUNG ARTILLERY OFFICERS. By Basilisk.

(London, Hugh Rees, Ltd., 5, Regent Street, S.W.I., 1921. Price IS.).

Although addressed to young artillery officers these " Talks on Leadership " are eminently suited to interest and benefit young officers of all arms. The subject of leadership is dealt with in a concise, practical and thoroughly attractive manner.

#### NOTICES OF MAGAZINES.

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#### REVUE DU GÉNIE MILITAIRE.

THE R.E. Journal has much pleasure in announcing the re-appearance of the *Revue du Génie Militaire*, the publication of which was suspended during the war, but has recommenced since January, 1921. It is published by the Librairie Berger-Lebrault, 18 rue des Glacis, Nancy, at the price of 4 francs per copy, or 48 francs post free (postal union), per annum. In an Introduction to the January number, it is stated that during the suspension of the *Revue* its place has been taken by 12 numbers of the *Bulletin de Renseignements du Génie*, published under the direction of the *Inspection Générale des Travaux et Organisations aux Armées*.

The present number contains the first part of a comparative study by General Benoit of the fortifications of Verdun and Metz. The General gives a detailed description of the latest development of the German *Feste* and traces its evolution towards a defensive function from a purely offensive one in 1899. It is hoped that the *R.E. Journal* will be able shortly to publish extracts from this instructive study. There are also a lecture on flame projectors and several interesting reviews, including one on the timber reinforcement of concrete, and a memoir on General Roques, the distinguished Commander of the 12 C.A. at the Meuse and the Marne, and later of the 1st and 4th Armies, and Minister of War, who died at Saint Cloud on 26th February, 1920.

F. E. G. S.

#### MILITÄR WOCHENBLATT.

No. 27.—Review of military and political events in 1920.—The leading article, after the usual references to Germany's unconquered army, Wilson's hypocrisy, and the futility of the League of Nations, attributes all Germany's troubles to her defencelessness. It says that all that can now be done, is to use every effort to make the Reichswehr an efficient and trustworthy force.

France's measures to reconstitute her army are looked on with envy. She is considered a fortunate country to have been able, in these days of outcries against German militarism, to continue and enlarge her system of universal service; while Germany is an unhappy land, being unable to make use of this best of schools for her young manhood, in spite of having been the first to institute it.

Belgium's close connection with France is said to find but little favour in England, while France is said to consider Belgium's short six months training for her recruits, hardly enough to enable the latter country to fulfil her obligations.

The anxious moments which Poland caused France in 1920 are noted and it is expected that 1921 will see more of them, when the Bolsheviks find the country dry enough for campaigning. The Riga negotiations are considered a mere pastime for the winter months; no result is expected from them.

Serbia's sympathies are said to be as much for Russia now, as they were in the days of the Czar—another source of anxiety for France, who must learn that there is no room for gratitude, but only for self-interest, in politics.

The return of Constantine to Greece and the fall of the "Cretan adventurer" Venizelos is about the only bright spot the writer sees in 1920, though he still has hopes that the question of Cilicia and Syria, Ireland, and the Pacific will cause the thieves of the Entente to fall out so that honest Germany may, in 1921, come by her own.

The Black Plague.—The M.W.B. calls on all nations to stop France using coloured troops in the army of occupation. It says that she only does it to hide her real weakness, that it makes the lower races lose their respect for Europeans, and that the consequences for the whole civilization of the white races will be terrible.

No. 28.—The revolutionizing of Germany in the world-war.—Under this heading the M.W.B. discusses a recently published book called Subterranean literature in revolutionary Germany written by two members of the 3rd International.

The book recounts events from the 4th August, 1914, the day when the 2nd International died, and describes how pamphlets were secretly circulated, sometimes from hand to hand, sometimes pushed under doors or left in factories; this literature, which is extensive enough to fill a whole library, forms a complete picture of modern revolutionary propaganda. It is based on the principles laid down by Marx and will have nothing to do with a democratic revolution; this is described as an out-of-date relic of the French revolution, forgotten since the days of 1848. A socialistic revolution is the only thing for the up-to-date strifemonger. The defeatist ideas which were circulated, were not directed so much against war as such, as against a state of affairs which threatened to settle the bourgeoisie still more firmly in power. The leaders were Liebknecht, Rosa Luxemburg and Franz Mehring. To the first named much credit is given for the way in which he influenced the young recruits, and succeeded in rendering the two last called-up classes almost useless to the Army. In December, 1914, the English comrades were addressed, according to the book with success, though the M.W.B is sceptical! In 1915 the German government took a hand in the game, called Liebknecht to the colours, put Rosa in gaol and suppressed Mehring's publications. In spite of this they managed to carry on their work and the organization for printing and circulating "Spartacus letters" was much improved. In March, 1916, some 18 social-democratic deputies formed a party of their own and thereby greatly strengthened the revolutionaries. May, 1916, saw Liebknecht imprisoned, but the organization was now strong enough to survive even this blow, and at the end of June it succeeded in getting the Berlin and Brunswick munition workers out on strike. Further strikes followed in April, 1017, and the work which had been devoted to demoralizing the Navy began to show results. The Russian revolution gave a great impetus to the revolutionaries, who now began to come out into the open. Enormous numbers of pamphlets were circulated among the troops at home and at the front, great emphasis being laid on the large American forces which were landing, and special efforts were made to counteract any effects which the German victories on the Chemin des Dames might be expected to have.

The second part of the book deals with propaganda which came into Germany from abroad. The M.W.B says that this was mostly worked by the Entente, who found plenty of German traitors to do their dirty work for them. It regrets however that Ireland, India, Egypt and Persia, which would have provided Germany with such promising opportunities, were unattainable by her.

The M.W.B hopes that the history of this important subject will be dealt with by the commission, which is examining the causes of defeat; and says that the monthly reports of G.O.C.s' districts would furnish much material for their consideration. It further recommends that the feelings of men in the reserve formations, in the transport service, the leave trains, the recruit depôts and finally in the units themselves should be carefully examined, so that the true causes of these sad events in German history may be laid bare.

The fear of a gap.—Julius Frontinus says that this fear was unreasonably strong on the German side. The pretty barrage maps, with every possible approach duly blocked by nicely coloured bands and ovals, encouraged this fear, even if they did assist the imagination of commanders. The principle has always been laid down that it is a good thing to surround your enemy. The logical sequel is, that if he is good enough to push his head into a hole so much the better, but this was forgotten. Germany clung too much to Linear strategy, partly through anxiety

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to use all available roads to their full extent, and partly because the difficulty of expanding a gap was underestimated. The writer says, rightly enough, that there is no danger in a gap-provided of course it is not too wide—so long as the flanks are strong and of good moral. He says that all the troubles of 1914 spring from lack of appreciation of this fact. Germany was so anxious not to be weak-anywhere, that she was not strong enough anywhere, and to this weakness of character, for so he correctly names it, all her subsequent troubles were due. He . says that whenever in France the German line was pierced the penetration was incorrectly dealt with. Instead of being attacked from the flanks, it was always pushed back from the front ; this merely served to hasten its withdrawal from a dangerous position. An an instance he mentions the 30th Nov., 1917, at Cambrai , when the reserve of the 2nd Army was directed from Seranvillers via Crevecoeur in a due westerly direction.

On a large scale he says that the 1866 advance into Bohemia was an example of what should be done. This, he says, was due not to any special system of Von Moltke, but to his strength of character.

No. 29.—The break-through on the Macedonian front in September, 1918.—General von Zwchl says this was due to the Bulgarians having lost all heart for further resistance. Before the attack began 15 German battalions had been withdrawn to the Western front, and though they were replaced by more than that number of Bulgarian battalions, the deficiency could not thus be made good. On the 15th September there were, besides the German artillery and machine guns, only 3 German (jager) battalions on the whole Macedonian front.

The condition of the Bulgarians, as regards equipment and supplies, was pitiful; most of the men had no shirts or boots. There was practically no administrative service and each regiment looked after itself. The better condition of the German detachments gave rise to bad feeling, which the Bulgarian officers were at no pains to repress. The latter took little trouble over their men and mutinies were common.

When General von Steuben tried to effect a redistribution of troops, so as to strengthen the threatened front, the Bulgarians put every obstacle in his way, and said it was impossible to do anything because regiments would not leave the areas in which they had cultivated land, fearing that, if they did so, they would starve.

Even the superior officers were not free from distrust and conceit. When a divisional commander was recommended to prepare a defensive position in rear, he indignantly declined to do so, because, he declared, his men would never retire. Similarly an attempt to obtain better cooperation with the artillery was met by the abrupt refusal of a senior gunner to have any interference with his command. After the breakthrough a divisional staff was entirely lost both to its commander and the troops. The Bulgarians were worn out, but General von Zwehl thinks that their exertions before and during the war provide some excuse for them.

No. 30.—The break-through on the Macedonian front in September, 1918 (continued).—General von Zwehl declares that there was no surprise.

The attack was foretold by Serbian deserters as well as by aeroplane reconnaissances.

Increased readiness for action was ordered, from the 7th September, and all possible measures taken, to prepare for the attack. The Bulgarian commanders were very confident that their troops would stand, but Sofia apparently had doubts, and sent many political chiefs and high officials to the front to exhort the troops to resistance. Reserves in the shape of complete divisions, were lacking, but there were several regiments available ; these however could not be used for counterattacks because their morale was so poor. It was unfortunate that the best Bulgarian divisions were not in the front attacked, but further to the West. When the attack came these divisions (of the 62nd Corps) easily repulsed the feints made against their front, but the break-through on the front of the 61st Corps made the situation difficult. However there was no immediate withdrawal of the 62nd because it was not thought possible that the first would go back as fast as it actually did.

On the 21st September (the attack having been launched on the 15th) the left wing of the 62nd Corps began to fall back and was followed by the whole western part of the line. The Corps intended to retreat via Kalkandelen and Uskub, but, delayed by immense baggage trains and bad roads, found the latter place already occupied by the Allied advanced guard. Weak though these were, they sufficed to cut off the Western troops and though the German and Austrian detachments mostly got away north, the Bulgarians had to lay down their arms under the terms of the Armistice. The first reinforcements from Germany and Austria could not reach Uskub, or Kumanov as had been intended, but had to detrain at Vranje. They could do nothing to prevent the catastrophe.

General von Zwehl does not wish to depreciate the value of the Bulgarian Army, which had been through much before the Great War began, but he thinks that the German defeats in France in July and August had made many Bulgarians begin to wonder if they had not backed the wrong horse. This feeling was fostered, he says, by the American ministry which was very foolishly allowed to remain in Sofia, the Bulgarians being unable to bring themselves to break with the United States.

Von Zwehl says that discussion of the collapse on the Macedonian front, raises once more the question as to whether it would not have been better, when the brilliant Serbian campaign brought the central powers to the Greek frontier in 1915, to have pushed on and occupied Salonika.

Von Falkenhayn decided against this on political as well as on military grounds and this decision was in accordance with his general idea of limiting German commitments in the East as much as possible. Von Zwehl thinks he was right and only regrets that similar moderation was not shown elsewhere.

L. CHENEVIX-TRENCH, Major, R.E.

14th March, 1921.

#### REVUE MILITAIRE SUISSE.

#### October, 1920.

#### NOTES AND NEWS.

France.-Two important questions are under consideration by a Commission ; (1) the general organization of the army, and (2) recruiting. It is probable that the Commission will recommend that the present general organization be retained, whereby France is divided into 20 military regions; some slight alterations of the sub-areas may be involved to meet recruiting requirements and the exigencies of a mobilization. It is expected that both the division and the army corps will form a permanent part of the peace organization ; higher formations will only come into existence on mobilization. In a draft law, which has been prepared, provision is made that in future all officers, whether on the active, reserve or territorial list, shall be eligible for promotion to the highest rank in time of war. Provision is made in the draft recruiting law, now under consideration for service with the colours being reduced to 18 months from 1922, provided that (1) the number of professional soldiers (exclusive of officers) can be maintained at 80,000 to 100,000 men in 1923; (2) the number of native soldiers can be raised to 300,000 men (there are only 100,000 at present); and (3) a civilian corps can be recruited to carry on the "services" in the Army.

#### No. 11.—November, 1920.

Ski-ing Competitions.—Colonel Grosselin deals in the original article with a ski-ing competition in which the Swiss 1st Infantry Brigade took part recently at St. Croix. He doubts the military value of competitions of this kind for the purposes of tactical training, which, in his opinion, can be better effected by means of the ordinary tactical schemes carried out against a marked enemy in the open weather of the spring and summer months. On the other hand, he entirely approves of such competitions as a form of gymnastic contests, and expresses the hope that the Swiss War Office may soon lend to military ski-ing competitions the same countenance and encouragement that it does at the present time to rifle shooting and other similar forms of sport.

Indirect Machine-gun Fire.—Captain Monod states, in the original article, that it is now customary to employ machine-guns in large batteries of from 120 to 150 pieces grouped directly under the orders of a Divisional M.G. Commander, and that, in such circumstances, indirect fire has been resorted to with good effect up to ranges of from 3,000 to 3,500 metres, and in exceptionally favourable cases up to a range of 4,000 metres. The gun laying has in such cases been effected by means of maps; and a description of the methods employed, and also a list of the special materials and appliances necessary for the purpose are given in the original article. The tactical employment of machine-guns in large groups in offensive and in defensive Warfare is also briefly touched upon.

#### Notes and News.

Switzerland.—The new Swiss regulations entitled Principes à enseigner dans les écoles et les cours de 1920 pour la préparation au combat, are, it is stated, inspired by the doctrines which prevail in Germany. The contributor of the original notes points out that the French regulations on military training have met with universal approval both in France and abroad, and suggests that the Swiss military authorities should accept the principles worked out in France as the basis for the instruction of the Swiss Army rather than the politico-military tactical principles of Ludendorff, which, even in Germany, have been, to some extent, rejected by serious students of war.

United States of America.- A special correspondent deals with the Military Service Act passed by Congress on June 4th, 1920; this Act, in a general way, modifies and effects improvements in the provisions made in the Act of June 3rd, 1916, which constitutes the organic military law of the United States. By the new Act the peace establishment of the American Army is raised from 175,000 to 280,000 men. The former term of Army service was 7 years-3 with the colours and 4 in the reserve-but to-day men may engaged either for one year or three years, according to their wish, and there is no longer any obligation to serve in the reserve. The reserves now consist of (1) the Reserve of Officers, and (2) the Enlisted Reserve, i.e., men belonging to certain trades who, whilst not willing to serve with the colours are prepared to enter the service as reservists. The Reserve of the National Guard, instituted in 1916, is continued in existence. Among the most important of the changes introduced by the new Act is the creation of chiefs for each arm and for each of the services. The formation of a "Chemical Warfare Service" and of an "Air Service" is also sanctioned. The-General Staff has been reorganized and divided into two branches : the Staff of the Ministry of War and the Staff with formations. In future officers will require to possess the certificate of the newly-created Staff College to be eligible for staff appointments. A new system of promotion has also been introduced : henceforth there is to be a single seniority list. Brigade commanders are to be promoted from a list of Colonels selected each year by a Committee consisting of 5 Divisional Generals.

W. A. J. O'MEARA.

#### PROBLEMS

PROBLEM 22 (Solution).

Sum the series  $\sin 2x - \frac{1}{2} \sin 4x + \frac{1}{3} \sin 6x$  to infinity.

If S be sum of series

$$2 \sqrt{-1} S = e^{2x\sqrt{-1}} - e^{-2x\sqrt{-1}} - \frac{1}{2} (e^{+4x\sqrt{-1}} - e^{-4x\sqrt{-1}}) + \text{etc.}$$

$$= a - \frac{a^{2}}{2} + \frac{a^{3}}{3} - \text{etc.}$$

$$- (b - \frac{b^{2}}{2} + \frac{b^{3}}{3} - \text{etc.}$$

$$a = e^{2x\sqrt{-1}} \text{ and } b = e^{-2x\sqrt{-1}}$$

$$= \log (1 + a) - \log (1 + b)$$

$$= \log \frac{1 + e^{2x\sqrt{-1}}}{1 + e^{-2x\sqrt{-1}}}$$

$$= \log \frac{1 + \cos 2x + \sqrt{-1} \sin 2x}{1 + \cos 2x - \sqrt{-1} \sin 2x}$$

$$= \log \frac{\cos x + \sqrt{-1} \sin x}{\cos x - \sqrt{-1} \sin x}$$

$$= \log \frac{e^{\sqrt{-1}x}}{e^{-\sqrt{-1}x}} = \log e^{2x\sqrt{-1}}$$

#### SOLUTIONS.

A solution to Problem 22 adjudged correct has been received from Major F. C. Westland, and correct solutions without analysis of Problem 23 from "x" and Captain C. J. E. Greenwood, M.C., R.E. Major P. G. H. Hogg, D.S.O., R.E., has sent a correct analysis with 3 numbers correct.

J. M. WADE, LI,-Col.

where

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