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SOME FAMOUS ENGINEER OFFICERS OF THE NINETEENTH CENTURY.

Lecture delivered at the S.M.E. on 24. 11, 21, by MAJOR-GENERAL SIR GEORGE SCOTT-MONCRIEFF, K.C.B., K.C.M.G., C.I.E.

Ir will, I think, be agreed that, within the limits of one lecture, and especially in this place and with this audience, I have no need to apologise for confining our attention to engineer officers of our own nation only. I omit, therefore, at once, all reference to those of other nations, however famous. Even in our own country, however, the list of famous men is so great that some system of selection is necessary. I would therefore say that the principle which I have endeavoured to follow is the selection of those great men whose influence on the Corps, as it now exists, has been most marked, and whom I have, in some degree, known personally. In endeavouring to place before you some account of their personalities, my desire is not so much to tell of their works, as of their worth, not what they did so much as what they were.

Admittedly such a selection is open to criticism. There are names of famous soldiers, engineers, administrators, etc., of whom I can say nothing, and who, conceivably, in the opinion of my contemporaries, ought to have been put before you rather than those of whom I shall speak. Be it so, I am not concerned to argue the point, nor to claim any right to decide which are the greatest among the many great men of the past. My desire is simply to tell to my younger brother officers how some at least of the great men I knew helped to build up a splendid heritage, so that the account of their worth may help the present generation of officers to maintain the same lofty traditions.

It is generally admitted, however, that among the engineers of the XIXth century there are three names which are pre-eminent, and of whom necessarily some brief mention should be made, the brevity of the allusion being due solely to the fact that I cannot speak of them from personal knowledge, and therefore cannot in any degree supplement what has been written of them in our Corps History. I allude to Field-Marshal Sir John Burgoyne and Lord Napier, and to General Gordon. Burgoyne, who entered the Corps in 1798, became I.G.F. in 1845 when he had passed the age when, by modern rules, he would have had to retire. Yet such was his bodily and mental vigour that he kept going for 23 years more, including the Crimean War in which he took part. Were I to attempt to tell

the story of his early campaigning in Egypt, Sicily, Sweden, the whole of the Peninsular War, N. America, and later in Flanders at the time of Waterloo, it would mean the military history of our country for the first fifteen years of the century, and I can only refer you to the very interesting biography written by his son-in-law Colonel Wrottesley. What I think, however, is apposite to our special purpose, is that in the long period between Waterloo and the Crimea he was by no means content to rest on the laurels he had already gained, but was ever seeking how to keep abreast of modern engineering and use that science for national defence and national welfare. He was for 13 years employed on civil works in Ireland* at a time when railway enterprise was rapidly developing, and it was in recognition of his services in this respect that he received the honour of being selected an honorary member of the Institution of Civil Engineers, being one of four R.E. officers to be so distinguished in the century, the others being Sir Lintorn Simmons, Sir Andrew Clarke and Lord Kitchener.

In Lord Napier's case, active service came comparatively late, after he had been for 10 years on civil works-valuable years of experience on canals, roads, barracks, etc., but so much had this occupied his energies that I have been told that when in 1845 he was appointed to command the engineers in the first Sikh War, he expressed diffidence in his own military capacity. Yet he must have been what Stevenson calls "a bonny fighter." He had two horses shot under him at Mudki and Ferozeshah, and in the latter battlesometimes called " the Waterloo of India," where the issue of the fight was for a while very doubtful, and where both the Governor-General and the Commander-in-Chief were present-Napier charged on foot with the infantry and was severely wounded. I may be pardoned if I allude to an incident of personal interest. My father, who was an infantry subaltern and took part in this assault on the Sikh entrenchments, rendered some triffing aid to Napier, who afterwards was kind enough to acknowledge the service in generous terms. In the second Sikh War Napier was again wounded at the siege of Multan, and later, in the Mutiny, he was wounded for the third time at the siege of Lucknow. But apart from all this personal exposure he was both a skilled military engineer and a daring leader of men. For it was not only in the capture of strongholds and the crossing of rivers that he became famous, but perhaps most of all in the relentless pursuit of the rebel leaders in the Central India campaign,

* In 1835 Colonel Burgoyne (as he then was), with some other eminent engineers in Ireland, founded the Institution of Civil Engineers of Ireland. Some of the principles which he laid down in his inaugural address were quoted recently (in November, 1919) by Sir John Griffith, the then President of the Institution of Civil Engineers in London, as being of universal application. the defeat of 12,000 men (and 25 guns) with a mere handful of 700, and the final blows which ended the campaign. Later he commanded a division in the China War of 1860, and was the Commanderin-Chief of the Abyssinian Expedition in 1867–68. Yet I venture to think that not the least of his valuable services to his country was the work he did as Chief Engineer of the Punjab from 1848 to 1856, for the broad scheme of works, roads, canals, etc., which he then formulated, and for the fine spirit of devoted service which he seems to have inculcated in men like Sir A. Taylor and Sir J. Browne of whom I shall say something presently The "Nelson touch" has something analogous to it on our Frontier works.

Charles George Gordon was one of the most heroic men of the century, and while his fame is dear to all the nation, it is specially precious to us. Free from petty prejudice of caste of colour, he had sympathy with his fellow men as such, and his whole life was devoted to their service. The description of his character on his effigy in St. Paul's, reproduced in the replica here, is in the stateliness of its diction, and the truth of its description, incomparable, and I feel that to comment on it would be an impertinence. The nobility of his character, the purity of his motives, and the absolute unselfishness of his actions have gained for him a nation's deepest reverence and admiration. While some have criticised his actions, themselves perhaps of a school of thought hardly capable of estimating his character at its true worth, the strongest evidence in the attractive nature of the man lies in the fact that those who knew him best loved him most. I need hardly tell you of his great services first as a subaltern in the Crimea, then as a leader of victorious armies in China, then of his great work as an administrator in the Soudan, and his subsequent return there to clear up the terrible tangle of events at Khartum, resulting in his practical abandonment by our Government and his heroic death. One little incident I may tell, as it is illuminating. As you are aware, there are three statues of him, one in Trafalgar Square, one here, and a replica of the same at Khartum. When Li Hung Chang, the great Chinese statesman, was in London, he not only went to see the Trafalgar Square statue, but made the most profound obeisance to it.

In Khartum I was told that an old Soudanese woman, when she saw Gordon's statue, was convinced that he had really come back, and she spent some days waiting to receive from it the nod and smile she remembered he had always given her when he lived among them years before. What manner of man must he have been who thus elicited such devotion from a worldly old Chinese millionaire, and a poor old African woman?

I have thus touched very briefly on the three greatest of our engineers in the XIXth century. There is one other whom I should like to have included in the list, and possibly there are those who

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consider him the greatest of all :- Sir Arthur Cotton. Of him I shall speak presently, in connection with a great change in our Indian policy, but for the present I would wish to speak about one whom I knew at the outset of my career-Major General, afterwards Field-Marshal, Sir Lintorn Simmons. He began his career in the Corps in 1837 and after being employed for some years in Canada, returned to England in the forties, and was employed as one of the Government engineers in connection with the railway development then taking place. He was the first Secretary to the Railway Department at the Board of Trade. In 1853 he got leave to travel in the East of Europe, where the political atmosphere was then cloudy, and where shortly afterwards war was declared between Russia and Turkey. He placed himself at the disposal of the British ambassador at Constantinople, who requested him to go to the Danube and report on the defences there and on the Turkish army under Omar Pasha. Simmons, who resigned his appointment on the Board of Trade, became military attaché to the Turkish army, and when in 1854 England declared war, he was placed in command of Turkish troops, taking part in the defence of Silistria and other operations in Bulgaria. He proceeded subsequently to the Crimea, and later with Omar Pasha to the east of the Black Sea to relieve the pressure on the Turks in Asia Minor. There he commanded a column which took the Russians in rear, and compelled them to retire with great loss. After the Crimean War he was the British representative on the Asia Minor Boundary Commission and later on he was Consul-General at Warsaw. Returning home in the early sixties, he was for some five years C.R.E. at Aldershot, one of our most important commands at all times, but especially then, when the mounted branches of the Corps were coming into being. Thence he came to the S.M.E. for some three years, and after that went to Woolwich as Governor of the R.M.A. There he remained for six years and thence he went to the War Office as I.G.F. At the time of the Treaty of Berlin he was military adviser to the British representation. Later he became Governor of Malta, and later on Special Envoy to the Pope.

This is a very brief outline of his career. I first came into contact with him—if I may use the expression without prejudice to the immense difference between us—when I joined the R.M.A. as a cadet nearly 50 years ago. He was then in the prime of life, a vigorous, active man, with bushy eyebrows, bushy whiskers and huge red moustache, and a strong, kindly face. I think we all knew that, though he was evidently a man to be feared, he was thoroughly in sympathy with high-spirited lads, and had no wish to force discipline to the point of harshness. Discipline he certainly put first, and we learnt that if we learnt nothing else. But in all essentials he kept his hand on the helm, he did not interfere with the instructors, but he was often in the class rooms to see what we were doing. I remember too, he advised us all to go up for the Staff College as early as possible, and to get to know about other arms. To some of us he was more than the distant functionary who ruled over our lives. I was privileged to dine with him one night, accompanied by another cadet, and we got him after dinner to tell us some yarns about his experiences with the Turks. It was all intensely interesting and told without any personal swagger and yet with some very human touches which very definitely thrilled our enthusiasm.

There were two important occurrences—as they were very dissimilar, I can hardly call them anything else—at that time at Woolwich in which the Governor was concerned. One was the great fire which destroyed the fine central buildings. I remember him distinctly directing the salvage and fire extinction operations, and I think it cost him some self-denial to refrain from actually working a fire hose himself. The discipline of the cadets was good, and for that I think he certainly deserves the credit. The other event was the death of the ex-Emperor Napoleon at Chislehurst. The Prince Imperial was one of the cadets and naturally Sir. L. Simmons was a somewhat prominent figure in the ceremonial which followed.

When he became I.G.F. the influence of the Corps was very high. He was the valued counsellor of successive Secretaries of State and of the Commander-in-Chief, with whom, however, he did not always agree, stating his opinions very freely. On one occasion, when as a subaltern I was in charge of the Lower Thames defences at Gravecend, the Duke and all the Headquarters Staff came for inspection, and as I accompanied them round the works I could not help overhearing a good deal of controversy. But I also remember how on that occasion the I.G.F. took me aside and asked me a lot of shrewd technical questions, not so much, as I think, to test my knowledge as to show in a kindly way, his appreciation of a young man's duty and his interest in it.

Sir Lintorn passed away in 1903, aged 82. A mural tablet was unveiled to his memory in the crypt of St. Paul's Cathedral by the Duke of Connaught in 1906, and in so doing H. R. H. described him as "one who has added lustre to the name and to the history of the Corps—a man of great force of character and great power. of imparting it to those under lim. I am convinced that the name of Sir John Lintorn Simmon's, with his great individuality, his warm sympathy, and his high sense of duty, will ever be cherished in the annals of the R.E., and that all who follow in that distinguished Corps will always look up to him as a great example to the British Army."

Not very long after Sir Lintorn Simmons left the War Office, another great soldier statesman became I.G.F., Lieut.-General Sir Andrew Clarke. He spent the early years of his service in Tasmania, New Zealand and Victoria, making roads, wharves, public buildings, etc. He

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was Surveyor-General of Victoria, and a member of the Legislative Council of that Colony while still a subaltern. Coming home in 1859 after this long colonial experience, he was, after some ordinary Corps duty, made Director of Works at the Admiralty in 1864, largely owing to the influence of Mr. Childers, who had been one of his colleagues in Australia, and who had taken up a political career at home. This appointment Clarke held for nine years, discharging his duties with great success, both as regards technicalities and the policy of the works. It was a valuable appointment for one who, knowing so well the colonial and imperial needs of the country. had then to provide for naval bases, and afterwards as I.G.F. had to provide for their defence. In 1873 he was made Governor of the Straits Settlements, but shortly afterwards was selected to be Public Works Minister in India, the first person to be appointed to such a position, and, I think, the only R.E. officer who has ever held it. He had many important questions to consider and many difficulties to contend with, as indeed was inevitable. Railway policy was a pressing question. There were huge famines during his tenure of office. The Afghan War of 1878-80 must have absorbed much of his attention, for vast engineering demands were made and for these he had to provide. In 1880 he returned home, was made Commandant S.M.E., and in 1882 became I.G.F. There again war preparation had to be made for the operations in Egypt, and the engineering policy to be adopted there were matters of urgent importance. He left the War Office in 1886.

He was a far-seeing statesman and I think the following measures he adopted are worthy of note. As Commandant, S.M.E., I think it was he who initiated the training of selected officers in mechanical engineering at large workshops, such as Elswick and Derby, also the Railway Traffic work at the headquarters of our large companies. This policy has borne splendid fruit both in peace and war. Then Clarke's colonial experience led him to get sanction to open the doors of the Corps to young men from Canada and other colonies, and also at one time when large numbers of officers were required, from Cooper's Hill College, and the English universities. These various avenues of supply were excellent and the splendid work done by the officers who thus entered the Corps is the best justification for the policy. Then I think it was Sir Andrew who first foresaw the importance of the Firth of Forth as a naval base. Up to this day, practically nothing had been done to occupy or fortify it. It was certainly he who initiated the Inchkeith experiments which were of such value in coast defence work. Had he lived to the Great War, he would have seen Inchkeith bristling with guns and the Forth the greatest naval fortress in the Empire.

One other measure he adopted was not a success, though to all logical reasoning it ought to have been. When he was P. W. Minister

in India, the flow of students from Cooper's Hill C. E. College had to be provided for, and Sir Andrew decided that irrigation and railways (with a small reservation) should be entirely officered by civil engineers, and that R.E. officers should henceforth be employed only on military works. The subalterns who were there on canals and railways were transferred to the Military Works branch. As most of these—myself among the number—were then on active service, there was no inconvenience, indeed it was a very favourable opportunity for making the transfer. At that time the Irrigation Department was officered mainly by a very notable group of R.E. officers, men whose enthusiasm for the work was as conspicuous as their technical skill, and with our young officers there was keenness and zeal, the service was popular and several bade fair to become good hydraulic engineers. But the supply of R.E. officers was cut off summarily.

Well, twenty years later, I went to India for a second tour of service and volunteered for any public works duty in the Punjab, expecting I would be employed on frontier railways, on which I had had experience. To my surprise I was sent to Irrigation-of which I knew next to nothing. Then I found that the department was in a bad way, utterly unpopular with young civil engineers, with a poor standard of efficiency because it was with the greatest difficulty anybody could be induced to go into it. I was kindly welcomed, though it was evidently a matter of surprise that I volunteered for it. Discussing the matter with some of the senior civil engineers whose experience went back prior to Sir A. Clarke's day, I was interested, but very sorry, to learn that they all deplored the step he had then taken-natural though it was-for they said that the loyalty and co-operation which was a matter of service tradition with the R.E. officers had gone, and apparently no new bond of union had taken its place. The soul of the department had somehow departed. The withdrawal of the R.E. from the canals was therefore a loss to the country. And this fact is one among other proofs that the R.E. are too valuable to the nation at large to be entirely utilized in peace time on purely military services. The usefulness in war of men employed, during peace, on civil works has been proved again and again, while the cramped and limited nature of most military works tends to dwarf and discourage energies which might be and which ought to be used to national advantage in a wider degree.

I would like to tell one anecdote about Sir Andrew Clarke before leaving the subject of his character. I had at the beginning of the Afghan War got into a pretty serious scrape—I need not tell you what it was, except to say that I am not in the least ashamed of it, though it nearly involved a court-martial—and I was severely reprimanded. I met Sir Andrew here after the war was over, and he

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told me that though he had to join in the reprimand he would have acted, had he been in my shoes, exactly as I did. I mention this for it was a kind act on the part of a General to a subaltern and also it shows how he recognized that at times the letter of the law is at variance with the conclusions of equity.

Mention of irrigation now leads me to consider the career and character of one who was the father of that scientific branch of the Corps activities-General Sir Arthur Cotton, one of the greatest hydraulic engineers of this or any other country. Indeed, so great were his achievements, whether we consider the colossal character of the works he built, or the number of lives he saved from famine. or the riches which his skill secured for the country, that we might. well, as I have already said, include him in the list of the greatest of our Corps. In character he was a man like Gordon, with whom I understand he was in correspondence when the latter was in the Soudan. Like Gordon he was noble, unselfish, self-denying, he sought neither riches nor honours, but the welfare of the poor, the raising of the fallen, the glory of God. Like Gordon, he was not beloved by the politicians, who treated him, even after he had achieved startling success, with the gravest discourtesy, because his views did not accord with their policy. So little indeed was he known in this country that in the brief obituary notice of him in The Times, all that was said of his marvellously beneficent career was that "he was employed by the P. W. D. on the making of roads, the construction of bridges and other engineering works." These last words are truly delicious. The "other engineering works " included a dam or weir across a huge river four miles wide ! His life was a long one, for he died in 1899 at the age of 96, and that, too, in spite of the fact that he seems to have been in delicate health in his early career and frequently obliged to leave his work to recruit. His. first essay in irrigation works was the construction of weirs across the Cauvery river in Tunjore in the extreme south of India. There by his skill in adapting old and constructing new works, he transformed a poverty-stricken district into a fertile and prosperous land, which in the days of subsequent famines was always beyond all fear of scarcity. But his greatest work was some years later, in the forties, when he built a barrage or anicut across the Godaveri river at the apex of its delta. The river here is four miles wide, the bed is sand of unknown depth, the volume of water three times that of the Nile at Cairo. By utilizing certain islands, Cotton reduced the length to 21 miles-long enough in all conscience-and he so spread his foundations that they rested on the sand, with perfect success. The cost of the work was ludicrously small, only £50,000 approximately, and of course the benefits to the people in the delta of this great river were and are enormous. Moreover, it was the precursor of other great irrigation works, which in spite of some errors in

alignment, etc., are now an asset of stupendous value. When I left India, one of the largest of these canals, in the Punjab, was paying a clear revenue of 20 per cent. i.e., the difference between the revenue of the irrigated land and of the same land unirrigated, while the value of the crops in one year alone on that canal exceeded the entire capital outlay. In all India generally the net revenue gained was IT per cent., and I think is greater now. But of course the gain to the country lies in protection from famine, and that, according to Cotton, was never done properly as it ought to have been. He was a tremendous advocate for navigation canals as against railways. Most people think he carried his views to excess, and that railway development was at least as important as inland water transport. On such a subject there must be great differences of opinion, but it is at least questionable whether the views of so successful an engineer as Cotton received anything like the consideration his eminent services entitled him to receive. In 1874 he came to lecture here, and I remember well his dignified appearance and the eloquence of his appeal to us young officers. The mass of statistics which he gave us was far above us, but he did give us some food for thought which I have never forgotten. He said the prosperity of a country depends on production and distribution, that one is of little use without the other, and that if you have large rivers you can use them to both accelerate production, and effect distribution. Railways cannot produce, they are a means, and that a costly one as compared with navigable rivers, of distribution. (We have seen in the Great War how in Mesopotamia the inland water transport was far more important than railways.) Talking of transport, he spoke of the bicycle which was then the plaything of the comparatively rich, and he prophesied that before long it would be the useful machine of the working man who would use it in going to and from his work, an idea which at the time seemed absurd, and yet came true in a very few years after. It is interesting to remember all this at a time when motor transport is introducing new factors into the problem and making our old roads, which fifty years ago were little used, now once more of increased importance. I also remember that at the close of his lecture, the old man spoke somewhat as follows :---" Some of you are going to India and will be employed on irrigation work. You will find it, though arduous, intensely interesting, and you will have the great satisfaction of knowing that the work you are doing will benefit tens of thousands of your fellow creatures, who will bless the unknown Englishman who has brought food and comfort into their lives. What nobler career can any man desire?" In after life I had a little opportunity of testing the truth of these words and I realized their nobility, pathos and priceless value.

Sir Arthur Cotton was the precursor of many noble officers of our Corps who devoted their lives to the service. Of them I shall only

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mention one who, so to speak, transferred the splendid traditions of this school of work to another country at a most critical moment in its history and thereby turned the scale in a national problem of exceeding difficulty. This officer, Colonel Sir Colin Scott-Moncrieff. was a very near relative of my own, and I feel a good deal of difficulty in speaking about his services impartially, for the family ties which associated us may lead me to take a biassed view of his worth. He was, like Cotton and Gordon, a most enthusiastic champion of the poor man, the rvot of Madras, for whom he toiled night and day during the great famine of 1877-78, and the fellah of Egypt, whom he redeemed from the slavery of the corvée. I think, too, that most officers who served under him would agree with me (who never served under him) that he was one of the kindest and most unselfish men they ever met. His association with Egypt was, humanly speaking, a matter of chance. He had retired from the service after some 25 years of useful and honourable work in India, and he happened to be going home by the usual Red Sea route, instead of by America. "at a loose end," as we say colloquially. At Suez he got a telegram from Lord Dufferin, who was then at Cairo, asking him to come and see him. It was just after the 1882 campaign and Britain had to reduce order out of chaos. Lord Dufferin, who was the British representative, asked Colonel Moncrieff to tackle the irrigation problem there, and he thought he might as well do that as go home and take up some other philanthropic work which he then contemplated.

So he took the job in hand and in the teeth of much professional opposition made the shaky old French barrage at the Nile delta do its duty—which it had never done—brought a chosen band of officers from India who made corruption and tyranny flee away, and finally in the teeth of tremendous international obstruction he abolished the *corvée* or forced labour, an iniquity which had ground down the poor since the days of Pharaoh. He then left Egypt and for several years was U. S. for Scotland.

Later on in 1901-02 he was the head of a Commission which enquired into the whole possibilities of irrigation in India—a most exhaustive task, but one which meant a sound and settled policy for future guidance—a magnificent monument to leave behind him.

I now come to speak of two officers whose lives, whose characters and whose work were very similar—General Sir Alexander Taylor and Major-General Sir James Browne, commonly known on the frontier and in the Corps as "Buster Browne." In fact there is a rather amusing story told about this nickname. He was dining at Simla with the Viceroy, and before dinner the wife of that distinguished official was told by the Military Secretary that "Buster Browne" was going to take her in to dinner. She thought it was his name, the Military Secretary never for a moment imagining that she did not know a man so famous. She addressed him throughout the evening as "Sir Buster" to his huge delight.

Both Taylor and Browne were educated abroad, the former at a very remarkable school in Switzerland where the lads were taught rather like modern boy scouts—to seek for opportunities to do service to their fellows. Browne was the son of a Scotch father by a Dutch mother, and his early education was almost entirely in France and Germany. Both these great engineers learnt the chief lessons of their life on the N.W. Frontier, developing Lord Napier's great schemes, for Taylor was the disciple of Napier, and Browne that of Taylor.

I only knew Taylor slightly, and can therefore only give you an account of him at second hand, but as I used to hear much of him from Browne, who was my chief officially, and a great friend personally, I got to know about him fairly intimately.

He went to India in 1845, and served in the two Punjab campaigns with great distinction, including the conveying of the siege train some 250 miles by pontoon rafts down the flooded Sutlej to Multan, and then being one of the most prominent leaders of the attack on that fortress. In these campaigns he came into close touch with Napier, who appointed him, after the war was finished, to take on the important work of constructing the Grand Trunk Road from Lahore to Peshawar, over 200 miles of exceedingly difficult country. It was a very responsible task for so young an officer as he then was, but Napier knew his man. For something like eight years Taylor was employed on this huge and intensely interesting task. Then came the crash of the Mutiny. That period of our history still awaits some Homer to describe it in epic poetry, and to depict the heroes of the tremendous drama. John Lawrence ruled the land from Rawalpindi, stamping out sporadic cases of rebellion, with Herbert Edwardes at Peshawar guarding the frontier from Afghan intrigue and hostile Yet all the time Lawrence had his gaze on Delhi, the tribesmen. nerve centre of the whole rebellion. He sent off every soldier he could spare under John Nicholson, but he knew (what was apparently forgotten in 1914) that in a war of positions you must have engineers of the best, and as Napier was at home on leave, he sent off Taylor, in the hottest of a Punjab summer, to go to Delhi and there supplement the efforts of the Chief Engineer, Richard Baird Smith. This capable and resolute officer was the backbone of the attack, but he was utterly prostrate with sickness. The General in command was a nonentity, but his A.A.G. was Neville Chamberlain, a great soldier, and Nicholson had by that time arrived to strengthen the brains and heart of our army. The power of this little force lay mainly in its resolute leaders, and their daring policy. The enemy, vastly superior in numbers, ammunition, equipment and position, had no leaders, and was therefore weak. It is a little difficult, without going into

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long details, to show how daring and clever was the scheme which Baird Smith and Taylor evolved. Broadly speaking, they had before them a strong front of a bastioned system held by superior numbers, who also occupied outposts and advanced positions beyond the permanent works. We had a secure flank on the left, furnished by the river Jumna, and we had a fairly good position held by our troops on the right. But anything like a formal attack with parallels and trenches was quite out of the question. The only chance of success was the construction and arming of siege batteries very rapidly in absolute secrecy and with complete surprise. To do this demanded careful reconnaissance, the fullest detail of preparation, and the absence of any movement that would rouse an enemy's suspicion. In collaboration with Chamberlain, Nicholson and his bed-ridden chief. Taylor worked out the whole plan. Alone and at night he penetrated the hostile outposts, fixed the position of the batteries. brought up the guns for the false attack, and then the assaulting columns for the real blow. How brilliantly successful it was-albeit the victory was dimmed with the loss of John Nicholson-is a matter of history. It was the turning-point of the war and the restoration of British rule. After the capture of Delhi, Taylor went on to Lucknow, where he found himself once more under Napier, to their mutual pleasure. Once more he led an assaulting column in the tremendous fighting which took place there, and once more he was wounded very severely this time. He returned to England after the campaign, after 13 years absence, with a splendid record as a soldier, even in those days when war had brought many fine men to the front.

He was offered several important military commands, and if he had been actuated by selfish motives, he might certainly have risen to a very high position in the purely military line of our profession. But it is characteristic of the man that he went back to his great road, saying that to leave it was like deserting his wife for a richer woman. He knew so well what had been done and what was still remaining that he felt no other officer could take his place adequately and bring this vitally important work to completion. So for many years after the Mutiny he was back at the great work, which he finally completed. During these years the Umbeyla campaign took place, and he was C.R.E. in the thick of the fighting again, and again wounded. Later in his career he acted as Chief Engineer of the Punjab, later on he was employed at Headquarters on Defence work, leaving India about 1880. Later on he was Principal of Cooper's Hill College.

"Buster" Browne joined him on the Grand Trunk road in the early sixties. He had arrived in India in '59, went straight to the frontier on one of the many Waziri expeditions, and at once took to the frontier life with natural zest. He was a man of herculean

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strength, boyish humour and a rich talent for adventure, so he soon became the leader in all sorts of exploits among the frontier tribes. Just to mention one of his exploits, when with the outposts in the Umbeyla campaign he used to imitate with singular success the voice of one of the enemy's mullahs or priests who called the faithful to prayer at the orthodox hours. Browne mimicked him with such accuracy that the enemy were aroused to their devotions with such frequency and irregularity that the exasperated priest challenged him to single combat. He had more than one such combat in the hot fighting of that campaign, he was severely wounded twice, but he ended with a fine reputation as "a bonny fighter" even among the frontier regiments where that sort of fame is common.

About 1864 he went as professor of mathematics and assistant principal to the Thomason College at Roorkee, where he found that teaching others is by far the best way of teaching oneself, and that (for a short time, anyhow) a period of instructional work in-the course of a practical career is of extraordinary value. But he only stayed on this work for a short time, going on to the construction of an important hill road in the Punjab, where he was for about five years. There he designed and built some very remarkable bridges-some of them indeed the largest of their kind in the worldbrick arches of 140-ft. span from bricks made in his own kilns, and a concrete arch of 80-ft. span, and some remarkable timber and suspension bridges. On return to England (where he was awarded one of the medals of the Institution of C. E. for his road work), he went on a long tour of examining works abroad, in Holland, among some of his relatives, investigating river training and coast protection, and in America for a year and more, studying bridge design and construction. On return to India he was detailed to prepare designs for a railway bridge over the Indus at Sukkur. He worked out an elaborated suspension bridge, but, much to his disgust, his plans were superseded by the hideous cantilever which now spans the river. Later on he was sent to investigate the possibilities of roads on the Baluchistan frontier, then little known, and to start work at Quetta. Here he had more choice adventures. He was a clever linguist, and went among the tribes often in native dress. He had a wonderful influence among them, largely due to the extraordinary fact, which he found out some years later, that he had a double, a mullah of great celebrity. Even so it is marvellous that he escaped being murdered.

The intimate knowledge he thus acquired of this frontier and people led to his being appointed to be political officer with the first troops that went that way in the Afghan War of 1878-9. In this duty he was very successful, his most notable feat being the capture, single handed, of the Afghan fort of Khelat-i-Ghilzai by a piece of sheer audacity. After the first part of the campaign he

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guided a column back to India by an unknown route and then, thinking as we all did that the war was over, he returned home and thus missed all the big fighting in the second part. On return to India he was for a while on special duty at Simla where I first met him. Then the Egyptian campaign of '82 broke out and he went as C.R.E. of the Indian contingent, with more amusing adventures at Tel-el-Kebir and elsewhere.

Then came the biggest task, even of his eventful life-the construction of the Sind Peshin railway, in which I had the privilege of being his personal assistant and staff officer. It is 36 years since, in this theatre. I gave three lectures about this railway-crude lectures they were, but they were the first I ever delivered. I have, of course, no intention of going over the story again, but I think I may quote what others have said about the work, as the mere description of the difficulties and results show what manner of man he was who overcame them. The length of the line is 215 miles, rising from Sibi on the edge of the Sind desert at 400 ft, height to a summit. level of 6,600 ft. in 112 miles. The ruling gradient is 1 in 45, limiting curvature 600 ft., gauge, 5 ft. 6 in. This is longer than any two. of the Swiss Alpine railways put together, and among them the highest summit level is 4,400 ft. Moreover, they cost on an average \$30,000 per mile exclusive of special tunnels, while the Sind Peshin line cost under £20,000 a mile, all told. Moreover, the latter took only three years to construct as against far longer periods in the others. The Ceylon mountain line, about 120 miles, I think, took 11 years. As regards the country, the following is an extract from Engineering :---"It traverses a region of arid rock without a tree or bush, and with scarcely a blade of grass; a country on which nature has poured. out all the climatic curses at her command. In summer the lowlands are literally the hottest corner of the earth's surface, in winter the upper passes are filled with snow. The few inhabitants are thieves by nature and cut-throats by profession and regard a stranger asa gamekepeer does a hawk, something to be bagged at all costs. Food there is none, and water is often absent for miles, timber and. fuel are unknown and desolation writ large is graven on the face of the land." Then there were difficulties of cholera and other sicknesses, floods and landslips, but above all the pestilent worry from the petty jacks-in-office in Simla. Then another rival line was started. up the Bolan Pass, and for months and even years the daily presskept on carping at the R.E. who were said to be extravagant and. inefficient, as compared with the civilians who were running the other. "Buster" Browne never said a word in his own defence, and, in. fact, when my lectures were published and I came in for my share of abuse and asked him whether I should reply, his reply was brief---"Let the pi-dogs howl." Twenty years later I went up one passand down the other. The Bolan line had been absolutely wiped.

out, there was practically no vestige of it. Of the other, all, certainly 95 per cent., remained as my chief had built it.* It was of thrilling interest to go over the line again and see all the marks of his mighty genius graven in the rocks and gorges of that grim country where I had known tens of thousands of busy men blasting and building, and where now all is silent as the grave save when each day a train goes thundering past.

"Buster" Browne and I lived in tents together, and naturally got to know one another very intimately, an intimacy which warmed into very great friendship. He was a most amusing companion, full of humorous yarns, and with a very varied amount of useful information. Personally one of the most generous and unselfish of men, with deep religious feeling underlying his practical exterior, he was ever mindful of the honour and dignity of the Corps and the respect due to all ranks. Especially was he interested in the young officers sent to us, in considerable numbers, from home. He called them his "young bears learning to dance; the hotter the plates, the sooner they learn," and certainly the plates were hot enough ! When I think of these officers and remember how many have distinguished themselves since-Sir Fenton Aylmer, Sir John Capper, Sir Ronald Macdonald, and many others-I realize the soundness of his forecast as to their future. One of his favourite mottoes was Ex arduis ardor, which he translated "Harder by hammering," and certainly it was one which was then put to a crucial test.

One of the schemes which we often discussed was the placing of all works on the frontier under the R.E., which actually came into being five years after his death, and I feel sure he would have been interested and pleased that his old staff officer was the first head of the new organization.

After a period of leave at home, Browne went, at Lord Roberts' request, to be Q.M.G. in India, the first R.E. to be so appointed. It was a strenuous time, for there were numerous frontier wars and much re-organization. After a few years in that post he went to Quetta as Chief Commissioner in Baluchistan, to an arduous and difficult task, and I think the work was too heavy for him. At all events I was much distressed at the tone of his letters; he appeared to be so overwhelmed with the iniquities of the unruly chieftains of that wild land, and the failure of support from Government to his proposals. And there he died, suddenly, in June, 1896.

* It is only fair to state that the Bolan line was not intended to be in all respects permanent. To the best of my recollection, a phenomenal rainfall had just occurred, and the line was constructed with the experience gained, so as to be above the *normal* level. But apparently in subsequent years this did not prevent its entire destruction.

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The picture of him in the Mess is quite inadequate in giving an idea of the man, although it was painted (from a photo) by a very good artist. On the other hand, that of Sir Alick Taylor is excellent, giving a charming idea of the courteous and modest gentleman he was. There is at Delhi a bronze statue, erected by a Committee, of which Lord Roberts was president, and I had the honour of representing the Corps. It is right that there, of all places, there should be a statue of him who played so conspicuous a part in the capture. In Rochester Cathedral there is a tablet to Sir James Browne, the inscription on which, at Lady Browne's request, was composed by two of his friends, General Henry Brownlow and myself. But his best monument is carved on rocks and tunnels, on the great frontier railway which he built so successfully.

I have now come to the end of my task. Had time allowed, I should like to have said a little about another great engineer, Sir John Ardagh, whom I knew and deeply admired. He was Commandant here at one time, the best I ever served under. He and "Buster" Browne were men of very different types, but they knew and appreciated each other well, and they were imbued with the same chivalrous spirit. More I am afraid I have not time to say.

I would, however, conclude by saying that great as are the examples of the past, I am not the least apprehensive of the future. I used, in the days when I was an instructor here, 25 years ago, to hold that the young officers of that day were splendid, the very cream of our nation's manhood, and all we seniors had to do—and it was a huge and difficult task—was to use this material wisely and to train it properly. The records of the Boer War show how gallantly and well our young officers behaved, and the Great War has still further confirmed the good opinion that I held of their value. It is in the firm confidence that you will uphold the great traditions of the Corps that I commend to you the fuller study of the biographies of the men whose careers I have briefly touched upon, and of others of similar calibre, and I am sure that you in your turn will add lustre to the great reputation of your ancestors, and will pass on to your successors an enhanced heritage of noble deeds and high example.

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THE INFLUENCE OF COLOUR ON THE HEAT-ABSORPTION OF PAINTS AND BRICKS.

By MAJOR C. R. SATTERTHWAITE, O.B.E., R.E.

SOME interesting experiments on the influence of colour on the amount of heat-absorption of various materials in hot sunlight were carried out in the Soudan during the period 1915-1918, by G. W. Grabham, Esq., M.A., F.G.S., and are described in an article in the *Journal of Hygiene*, Vol. XIX., No. 3, January, 1921. The experimenter's attention was particularly concentrated on the properties of various materials and fabrics used for clothing; but he also carried out tests on painted surfaces and bricks.

The experiments on paints are described as follows :---

"For the purposes of experiments, cylindrical tin flasks $12\frac{1}{2}$ cm. long and $7\frac{1}{2}$ cm. in diameter were adopted. They were provided with necks to accommodate corks, through which thermometers were inserted so that the bulbs were placed freely at about the centre of the flasks. The flasks were laid on their sides, and in order to give them stability a four-ounce volume of clean sand was measured into each. The amount of sand was not enough to come in contact with the thermometer bulb, and, as the quantities were similar, it can hardly have influenced comparison of the temperature effects due to the paints.

"The principal experiments were conducted at Halfa in 1916. The flasks were laid out on a white sheet resting on a doubled woollen blanket to eliminate as far as possible disturbing factors due to heat absorption by the surroundings. They were set out at intervals of about 30 cm. between them, and arranged in order of their apparent tints so that the lighter-coloured flasks were next each other and distant from the darker ones. These precautions were taken to reduce effects due to radiation from one flask to another, such as might have interfered had a black flask been near a light-coloured one. Both the Soudan Railway Department and the Public Works Department kindly undertook the painting of sets of flasks with colours in common use. Besides the immediate interest of testing such colours, there was the advantage of having them applied by the very workmen and in the same way as in ordinary practice.

"Standards of reference were provided by other flasks, the white being coated with a lime-wash which gave a dead-white surface, while the other was coated with a mixture of lamp-black and varnish which dried with a dull black surface." The results of the tests are given in tabular form, showing the temperatures at intervals during the hot period of the day. It is sufficient here to give the mean temperatures.

P. W. D. Paints, Halfa, 15. 5. .16. Maximum temperature in official screen, 44° C.

Paint.				Mean	Temperature °C.
Black standard				•••	69.5
Cement wash	1		. • • •.	:	65.3
Bright red	•-•	•••	•••	•••	62.2
Dull red	• • •	•••	• • • •	•	61.9
White enamel		•••			54'7
White standard		•••	•••		52.0

Soudan Government Railways Paints, Halfa, 2. 6. 16. Maximum temperature in official screen, 40° C.

Paint.			Mean Temperature °C.		
Black standard	•••	•••		62.9	
Black paint		•••		62.2	
Brown paint			•••	61.4	
Green paint		•••	•••	60'4	
Grey paint	• • •	•••	•••	58.7	
Khaki paint				57'3	
Scarlet paint		•••	· •••	54'4	
Straw paint		•••	•••	52.7	
Cream paint		•••		51.0	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Cream enamel	•••			50.8	
White enamel		•••		49 ' I	
White standard			•••	45'3	
		•			

From the mean of several observations a further table is compiled, the most interesting facts in which are that with the "White Standard" (lime-wash) at 46.6° C. or 115.9° F. the following colours showed an excess temperature over the white standard as under :—

					Excess °F.
Cream paint	•••			• • •	11.2
Khaki paint			··· ·	••••	22.3
Cement wash	•••	•-•	••••	•••	26.8
Black paint	•••				35-2

Technical descriptions of the paints are not given, but the section dealing with paints concludes as follows :---

"By the kindness of the late Mr. E. W. Buckley, of the Irrigation Service, a practical test was made by whitewashing the half of the galvanized corrugated iron roof of a barge, the other half remaining in the usual condition and presenting the ordinary, rather dull appearance of the weathered metal. In the sunshine of the middle hours of the day the difference between the temperatures of the two halves was very striking. The plain metal became so hot that the

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hand could hardly bear it, while the whitewashed part remained cool and could be handled with comfort. The roof was low and in moving about under it, the radiant heat from the plain half was immediately felt as oppressive and showed the need of a helmet. Beneath the whitewashed part, on the other hand, it was possible to remain bare-headed with comfort. An attempt on one occasion to measure the temperature gave $45\frac{1}{3}^{\circ}$ C. and $33\frac{1}{2}^{\circ}$ C. respectively for the plain and whitewashed parts, but little importance is to be attached to these figures, as that relating to the plain part is almost certainly too low. They indicate, however, the magnitude of the difference. Owing to the oppressive temperature, the iron roofs of a number of similar barges have been lined with wood, but as efficient a result might have been attained by means of a coat of white paint, or even whitewash, so long as the latter withstood the rains."

The experiments on bricks are thus described :---

"In February, 1915, some building bricks were tested on the same lines as adopted with the cloths and paints.

"Both sun-dried and burnt bricks are in use in the Nile Valley, and the coolness of mud houses as compared with those of burnt brick is common experience. For the purpose of the experiment a hole was drilled from the end so that when a thermometer was inserted it was placed about the centre of the brick. The thermometers were packed round with fine soil to keep them in place and preserve the records from disturbances due to convection. A pair of burnt bricks and a pair of sun-dried ones were used and one of each pair was left plain while the other was whitewashed. They were laid out on a board at 9 a.m. on February 9th, 1915, and not disturbed until after the readings on the next day. The following are the readings at 2 p.m. on the two days :—

			9. 2. 15.	10. 2. 15.
Plain burnt brick		•••	57'8	53'3
Plain sun-dried brick			54'3	50'4
Mud brick, whitewashed	•••		49'5	46.9
Burnt brick, whitewashed	• • •	•••	48.3	46'3
Official maximum	•••		33'4	31.1

"Possibly the hotness of the burnt brick as compared with the sun-dried structure is not due to the greater absorption alone, but also to its texture. The firing must result in the grains being in more intimate connection than is the case with the sun-dried one, with the result that the burnt brick takes up more heat during the hotter parts of the day and radiates it more freely in the evening. The same kind of effect is experienced in the open country. Where the desert surface is formed of loose sand, the surface cools quickly and the nights are comparatively cool even in the hottest seasons. Where, on the other hand, crystalline rock predominates, the solid stone absorbs a large amount of heat and appears to be able to radiate it

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during most of the night so that these are sultry and oppressive. No figures have been obtained for these conditions, but if the hand is thrust into an exposed sand dune on the afternoon of a sunny day, the heated surface layer will be found to be only about 10 or 15 cm. thick and quite cool sand will be found just underneath."

The experiments conducted on cloths were exhaustive, and gave results indicating a pronounced superiority for white linen or cotton fabrics over all types of khaki. In general it was found that the temperature of khaki fabrics, when exposed to sunlight, exceeded that of white drill by $10^{\circ}-20^{\circ}$ C.; while thin black fabric showed an excess of over 30° C. over white drill.

ANTI-AIRCRAFT SEARCHLIGHT DEFENCE.

A SUGGESTED SCHEME FOR RAPID TACTICAL SEARCHING.

By MAJOR H. J. HUMPHREYS, R.G.A.

IN Field Service Regulations, Volume II. (Operations), 1920, Chapter XI, Section 140, para. 2, we are told that "Units of Anti-Aircraft Artillery, Engineers with Searchlight Signal Troops . . . will be organized to deal with air attacks on communications, rear concentrations, and dumps."

Considering the general form of warfare as seen in France in 1914-18 the organization of this A.A. defence, facilitated by siege warfare, was slowly and methodically built up.

In a war of movement a hasty defence is not so easy to arrange. "Every body of troops, when halted, will be protected by outposts, in order that it may rest undisturbed." These words are to be found in Section 90, but they do not refer to attack from the air. It is not too much to expect in future warfare that, in addition to outposts, some form of A.A. defence will be necessary for troops, parks of ordnance, food, and other stores, even when such troops and parks remain halted for a very short period. Time to organize such defence will be short, consequently it cannot be expected that an elaborate organization can be accomplished. The A.A. units of Artillery, Lights and Signals will have to be employed tactically and a hasty protection organization devised.

The posting of Artillery and Lights with the corresponding signal communication to suit the topographical surroundings, is a tactical problem, which can be quickly solved by the anti-aircraft defence Commander, but the question of fighting control is a much more difficult problem.

With fixed A.A. defences as existed in many places during the war, fighting control can be maintained with the aid of mechanical devices —but all mechanical devices require time to instal, and to test, and generally special cable to work from the controlling centre. Mechanical devices are not applicable to temporary and hasty defences. The control of lights offers a difficulty.

The following rapid tactical scheme for controlling lights is submitted for consideration, and to facilitate explanation an imaginary tactical situation is briefly described.

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A force is marching towards the enemy northward from X to Z and halts for the night at Y—usual outposts are put out and the Anti-Aircraft Defence Commander proceeds to organize a defence. Assume he considers 8 guns and 12 lights sufficient.



He makes his reconnaissance and decides on the positions of his guns and lights and his own controlling station.

He issues orders accordingly, but before the R.E. officers proceed to their stations they receive instructions on the following lines :----

Each R.E. officer produces his map—an arbitrary circle is described enclosing the electric light stations, and arbitrary areas such as A B C are marked on its circumference. Very little time is required to do this.

Each officer marks his map in exactly the same manner as that of the A.A. Commander is marked.

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At each searchlight station the base of the projector is marked with chalk to agree with the orientation of the areas A B C, etc., as seen from the post.

Each searchlight has its name or number, such as 1, 2, 3.

Field telephonic communication is therefore required between the controlling officer and his guns and lights, but visual signalling is equally effective where the topography admits, as messages to be sent are short.

ACTION OF CONTROL.

Let us now consider what form the control takes in action.

> No. 1 search C. No. 3 search H. No. 2 search F.

If, at the order "search," it is understood a methodical search is carried out a definite number of degrees right and left, up and down, there should be no position which could not be searched instantaneously at the will of the Controller.

A further example:—Suppose the Controller is suspicious of enemy aircraft in the direction of "N," he can order with an almost mechanical mind :—

No. 4 search B. No. 2 search A.

It will be seen that this method of control is almost instantaneous and, above all, admits of concentration of lights.

Such orders as north, south, north-east, etc., could not be so easily worked—to commence with, the Controller would have to make a mental calculation, a troublesome thing in the excitement of action.

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HILSEA ORDNANCE DEPOT.

By COLONEL J. C. MATHESON.

OWING to an agreement, arrived at between the War Office and the Admiralty, the Ordnance Depôt at the Gunwharf, Portsmouth, is being handed over to the latter for the purpose of forming a shore establishment, to take the place of H.M.S. *Vernon* (naval mining and torpedo school).

The Depôt thus displaced is being re-provided at Hilsea, just south of the Hilsea Lines, and is rapidly approaching completion. It is really an expansion of certain Ordnance establishments which have been erected there previously, most of them being constructed between 1914 and 1918.

The principal constructions in the Reprovision Works at Hilsea which may provide points of interest are :---

- (a) The equipment sheds.
- (b) The workshops.
- (c) Drainage.
- (d) The married quarters for officers, other ranks and police.
- (c) Main office.

(a) Equipment Sheds.—Three of these have been erected, each 400 ft. by 120 ft. The walls are of $4\frac{1}{2}$ -in. brick, strengthened every 12 ft. by buttresses which carry the steel roof trusses. The roof is of slate, and is in three spans of 40 ft. each, the trusses being supported by the buttresses in the walls and by brick columns. There are loading platforms, running the entire length of the sheds on each side, with railway sidings. The photo shows the interior of one shed. The floors consist of $3\frac{1}{2}$ inches of tarmac rolled in three layers of different grades. This gives a warmer and drier floor than concrete, and is about 30 per cent. cheaper. The cost of these sheds has worked out at 4.17 pence per foot-cube, exclusive of overhead charges.

(b) Workshops.—These are of the latest factory type in brick with the usual north light, and have floors of either concrete or wood block, according to the nature of the work to be carried on. They are sited on three sides of a rectangle, with the administrative block at one end of the rectangle and the shops on the two sides with a large open space in the middle. They are equipped with the most modern plant, and power is supplied at 550 volts D.C. from the Portsmouth Corporation mains. The cost per foot-cube comes to



HILLSEA ORDNANCE DEPOT.

Interior of Equipment Sheds.



Workshops. Part East Elevation of West Block.

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SECTION A.A





9.76 pence. This includes all machinery, power, light, roads, drainage and making up the quadrangle between the East and West blocks. The photo shows part of the West Block.

(c) Drainage.—Owing to the fact that the site is very flat and low-lying it has been necessary to instal compressed air ejectors to lift the sewage at two different places. One lifts 12 ft., and the other 14 ft. The ejectors are of the same type as the Shone. There are two electric motors of 2 B.H.P. each for working compressors, and these are brought into action automatically when the pressure in the reservoir falls below $10\frac{1}{2}$ lb. per square inch. The maximum pressure of one compressor is $15\frac{1}{2}$ lb., and the other $16\frac{1}{2}$ lb. The longest length of pipe $(1\frac{1}{2}$ in.) is 1,900 ft. At each lift 25 gallons are raised. The ejectors are duplicated to avoid trouble in case of breakdown. Considerable difficulty was experienced in constructing the ejector pits owing to the infiltration of tide water. The work was finally accomplished by excavating a deeper pit close to the ejector pit to act as a sump for a pump by which the water was kept down.

(d) Married Quarters.—The quarters provided under the scheme are :--

- (a) 3 officers (one Group 3, one Group 4 and one Group 5) ;
 - 24 married soldiers ;
 - 5 warrant officers ;
 - I police inspector, practically a Group 5 quarter ;
 - 23 police, similar to warrant officers.

All these quarters, except the Group 3, are constructed in concrete hollow walls, the outer wall being made of hard concrete blocks, 18 in. by 9 in. by $3\frac{1}{2}$ in., and the inner wall of breeze blocks, 18 in. by 9 in. by 3 in., with a 3 in. space between; the two walls being bonded with the usual iron ties. The roofs are the ordinary wooden gable type, covered with eternit slates.

Both classes of block have a composition of 6 to 1, and were made in two ways, either in Winget machines or by hand in a locally made frame with partitions for 36 blocks. The Winget blocks were what may be called dry concrete; while those made in the frame were wet. Owing to the great dryness of the past summer on the South Coast the dry process blocks were not so satisfactory as the wet, and had to be watered daily while setting. This method of making blocks in a frame, although somewhat slower than the Winget process, may often prove of use in a large job, as it can be done at odd hours by men for whom it might be difficult otherwise to find profitable employment. The cost of these hand-made blocks at Hilsea at the present time is $6\frac{1}{2}d$. each. Here they have been used in the officers' quarters, and in the main office block. The Winget blocks have been used for the other quarters. All the married soldiers' quarters are of the single-storied type, as illustrated on Plans I. and II. The cost of these, which were the first constructed, varies according to the type of quarter, of which there are two in each block. The cost of a block containing one "A" and one "C" quarter was $\pounds g14$.

One feature of these quarters is that the floorboards consist of converted "bed-boards" nailed direct into breeze concrete filling. This has the composition of $4\frac{1}{2}$ to I, no sand being used. The exact proportions require experiment for their determination, as they have to vary with the quality of the cement. The result of these floors appears to be satisfactory.

The warrant officers' quarters, and the police quarters are twostoried and have two quarters in each block as shown on Plan No. III. The cost of these has, so far, worked out at £815 per quarter. (£1630 per block.)

(e) Main Office.—This building, which measures 77 ft. 6 in. by 73 ft. 3 in., is of a special design, with a large central office, 41 ft. by 40 ft.; for all the clerks, and small offices all round for the officers' offices, typists, etc. The whole is central-heated. This building is also of the concrete and breeze block construction with a ruberoid covered roof over the side offices and eternit slates over the central one.

The overhead charges on these Re-provision Works have amounted to 64 per cent. This includes :---

Pay of superintending officer, foremen, clerks, etc. Rental of office buildings.

Stationery, postage and telephone charges. Fuel and light.

PROFESSIONAL NOTE.

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THE RAYMOND PILE.

(COMMUNICATED BY THE R.E. BOARD.).

A DEMONSTRATION of the driving of one of these piles was recently shown in the neighbourhood of London, and it is thought that the advantages of the system are such as to merit description in the R.E. Journal.

The Raymond system of pile driving offers a certain method of producing a concrete pile cast *in situ* without any risk of the concrete being polluted by contact with infiltration from the surrounding soil. This is effected by driving an expanding mandrel covered by a sheet metal shell into the ground. On a suitable depth being reached the mandrel is contracted and withdrawn and the steel shell is left in the ground of the shape of the required pile.

Visual inspection of the shell can be made before pouring the concrete.

The four accompanying plates explain the process of forming and driving the pile. *Plate* I shows the tapered component parts of the pile shell before assembly The sections of the shell are made of 22 to 24 gauge sheet steel reinforced with a helix of $\frac{1}{4}$ in. steel rod spot welded to the shell at the ends. The rod helix itself fits into a shaped helix formed in the shell.

Plate II. gives the view looking down into a driven shell before pouring the concrete.

Plate III. shows the shell assembled on the mandrel and ready for driving.

Plate IV. shows the shell driven and the mandrel in process of withdrawal.

It is stated for this system of piling that, owing to its taper form its holding powers are great; a 20-ft. tapered pile has been found superior to a 35-ft. straight pile. Standard Raymond piles have an 8-in tip and are at top 16-in., and 23-in. diameter for 20-ft. and 37-ft. 6-in. lengths of pile respectively.

The following points of superiority and advantage over wooden piles are claimed for the Raymond pile in the firm's publications, and can be relied on :---

1. Absolute permanency; not being subject to decay or to the attacks of wood-borers and destroyers—a point which does not admit of argument.

- 2. Economy, because of greater carrying capacity-meaning less number of piles for a given load.
- 3. Smaller and lighter footings, because of decreased number of piles.
- 4. Decrease in total load to be carried, because of decreased weight of footings.
- 5. Practical elimination of shoring, underpinning, sheeting, pumping and deep excavation and the reduction of masonry.
- 6. Important saving of time.

The claim to greater carrying capacity rests upon several points :---

- (a) Greater size, therefore greater displacement.
- (b) Greater taper, therefore greater frictional value per square foot.
- (c) Perfect shape, therefore perfect contact with the ground at every point.
- (d) Possibility of inspection after driving, hence the ability to load to full capacity, instead of making a large allowance for inefficiency, as in the case of wood piles subject to injury by over-driving, telescoping, departing from the vertical and like defects, none of which are discernible at the moment when correction is possible.
- (e) Decreased length of pile as a natural consequence of greater size and taper.

In addition, the following important advantage can be guaranteed by the use of this system, *viz.*, increased speed without increase of cost at the present time, as compared to pre-cast concrete piles. Further experience may result in a decrease in cost of the Raymond system. It is claimed that a piled foundation job can be completed in two-thirds of the time as compared with other systems. Twentyfive piles, up to 40 ft. long, can easily be driven with one piledriver *per diem*.

The above saving of time should result in a considerable general saving of cost over a contract.

The sole licensees of the Raymond Concrete Pile in Great Britain are Messrs. J. & W. Stewart, to whom we are indebted for the loan of the blocks of the plates which accompany this article.



Plate L





Plate III.



LECTURE NOTES ON THE PRINCIPLES OF THE FIELD SERVICE REGULATIONS.*

By Br. LT-Col. L. V. BOND, R.E.

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I. We are constantly told, we constantly tell others, to base instruction on *principles*, to enforce the *principles*, to practise the *principles* of Field Service Regulations.

2. "The fundamental principles of War," say the F.S.R., "are neither numerous nor in themselves very abstruse." Yet we know that the maxims, the rules, call them what you will, laid down in the F.S.R. *are* very numerous, that they are difficult to understand, to learn and to remember. How then can we reconcile the apparent contradiction? What are these few and simple principles of war?

3. Let us begin at the beginning. What is our object in war? To beat the enemy. When is the enemy beaten? Is it only when he is physically or financially incapable of continuing to fight? No. When then is an Army beaten? Prince Kraft has given us the answer in a phrase which Marshal Foch has so convincingly illustrated. "Those troops only are beaten who believe themselves beaten." "A battle lost is a battle one thinks one has lost."

Our whole aim in war is, then, to create on our own side a feeling of confidence, of certainty in success; to create on the side of the enemy, in the heart either of the Commander, of the soldier, of the nation, in any one or in all of these, despair, hopelessness.

"The secret of victory lies in the hearts of men."

4. This is the one, the only, elemental principle of war. All our teaching, all our system, all our regulations are built up on the foundation of this one principle; the one, the only great principle of war, to which all others are secondary, from which all others are derived.

5. At the bottom of all the theory and practice of war is man, the heart of man. On the one side its enthusiasms, its determination, its ideals, its hopes; on the other its weakness, its instincts of selfpreservation, its fears, its terrors; above all anxiety, fear, terror in all its manifestations, at its worst panic, that wild unreasoning terror which grips the multitude and sweeps it headlong away.

6. This then is the instrument with which, on which, against which, we have to work. All that we do in peace, our every action in war,

^{*} Author's Note.—The following Notes were compiled in September, 1920, before the receipt in India of the new F.S. Regulations, Vol. II. They refer, therefore, to the F.S.R. Part I (1914 reprint) in which the principles of war were not specifically enumerated.
must be directed towards one object, and one object only; to create on our own side a confidence of winning: to create in the enemy a hopelessness, a despair of winning.

- 7. We must create on our own side :---
- (a) In all ranks—(i) Confidence in themselves; due to physical fitness, freshness, the result of youth, physique, physical training; the result in war of good food, good clothing and equipment, good arrangements for billeting, camping, marching, for the advance to the battle; the result of protecting our men from discomfort, and danger.
 - (ii) Confidence in themselves; due to a consciousness of superiority over the enemy in armament, in training, in skill in the use of weapons, in education, in cunning.
 - (iii) Confidence in their leaders; due to admiration of their courage, their coolness, their knowledge, the excellence of their arrangements, their care and sympathy.
 - (iv) Confidence in themselves, their leaders, their comrades, in the army as a whole, due to success in resisting the enemy's attack, but above all to success in attacking the enemy.
 - (v) Courage; due to all that produces confidence, to national characteristics, to high ideals, to tradition, honour, self-respect.
 - (vi) Determination to win, determination not to be beaten; due to all that produces courage, to a good cause, *esprit-de-corps*, patriotism, to the team spirit; when all else fails, to that part of discipline which consists of a habit of obedience.
- We must create—(b) In our subordinate leaders and staffs,
 - (i) All those qualities enumerated above, and in addition;
 - (ii) Confidence in those under their command; due to knowledge of their high military qualitics, knowledge based on peace training and administration, and on a study of the astonishing tenacity and high spirit of our soldiers as recorded in the history of past wars.
 - (iii) Confidence in themselves; due to knowledge, above all, of the human heart, of how it reacts to all the influences of war, knowledge based on personal experience of war, on observation of men in peace, on the experience of others in war; that is to say, on a study of the behaviour of troops and of their leaders as recorded in military history, in the records of eye-witnesses of past wars.
 - (iv) Confidence in themselves; due to a knowledge of their profession, to experience in the handling of troops; to the knowledge that their own dispositions are such that they themselves have nothing to fear from the enemy, that they cannot be surprised, that they will not "let down" others.

Finally we must create-

- (c) In the supreme command in addition to all the above :---
 - (i) Confidence; due to complete knowledge of the enemy, due to the excellence of our intelligence service.
 - (ii) Confidence in the army, due to a knowledge that it possesses those qualities which we have already enumerated, that it will carry out his wishes exactly, owing to its intelligent discipline, to its excellent organization, to a common system of acting, to a common system of thinking, the result of a common doctrine ingrained in all ranks by a uniform system of training.

Finally :---

(iii) Confidence in the Government and in the nation, that they will not fail in good or evil fortune.

- 8. We must create on the enemy's side :---
- (i) Among all ranks, (a) Physical fear; by killing him, wounding him, destroying him by the use of arms more numerous, more destructive, more skilfully handled, more irresistible than his own.
 - (b) Mental fear; by continually threatening destruction, by attacking by means which he cannot parry, from directions from which he is unable or unprepared to resist us.
- We must endeavour to create, (c) The fear of the unseen, the terror of the unknown, by surprise, by acting secretly, swiftly, unexpectedly.
 - (d) Misery, despondency; due to hunger, thirst, fear, cold, fatigue, lack of sleep, by continually firing at him, threatening him, destroying his communications, his organization, his rearward services.
 - (e) Hopelessness, distrust in his leaders, his comrades and himself as a result of continual reverses, defeats, miscarriages.
- We must destroy by propaganda, (f) his determination to win, to fight on, by destroying his belief in the justness of his cause, in the good faith of his leaders.
- We must create, (ii) In the enemy commander,
 - (a) Crushing anxiety, hopelessness, lack of confidence in himself and in his army, by keeping him in ignorance of our circumstances, of our intentions, by striking suddenly, unexpectedly, overwhelmingly at the point and in the direction which he least expects or wishes, by continual activity spoiling his plans, breaking up his preparations before they have time to mature.
 - (b) A belief in the irresistible superiority of our arms, of our skill, our numbers, our efficiency.
- We must create also, (iii) In the enemy nation by victories, by blockade, by propaganda, a feeling of hopelessness, of distrust, a desire to stop the war at all costs.

9. To strike at the soul of the enemy, to establish a moral superiority, this must be our one object in war. Our reason affirms it. All history proves it. The records of war teem with examples of armies defeated only by their own terrors, of victory turned to defeat because the heart of the Commander failed him. The history of the British Army is full of instances of victory won against overwhelming superiority of men and material because the British soldier refused to believe himself beaten

10. This then is the single foundation from which all other principles are derived,

"The secret of victory lies in the hearts of men."

"That army only is beaten which thinks itself beaten."

" In war man is everything, the rest nothing."

II. Next in importance, yet secondary to this first principle, since derived from it, equally universal in time and place since it is based solely on the unchanging nature of the human soul, secondary, yet itself the basis of all others, comes this principle.

" Decisive success in war can be gained only by a vigorous offensive."

Why is this? Because by adopting a defensive attitude we can, at the best, do no more than convince our enemy that he cannot beat us. It is only by dealing him blows, violent, staggering, repeated blows, blows which he finds he cannot parry, that we can convince him that we are indeed the better men, that he cannot hope to win, that he himself must be beaten. This is true for the individual man, it is therefore true for armies which are but collections of individual men.

12. There is indeed another great principle, elementary in so far as it is derived directly from our first principle, but universal only if we conceive of war in its usual meaning, that is to say, as the struggle of two armed communities each determined to defend itself and, if possible, to defeat its enemy.

The principle is this "that victory can only be gained by defeating in battle the armed forces of the enemy."

The truth of this is evident, since by hypothesis the loser nation starts with hope based on the success of its armed forces; until these are beaten in battle it can still hope for success, it is still unbeaten. But once its armed forces are beaten, unless it can create more or revive their belief in possible victory, it cannot hope to resist longer, it is, in fact, beaten.

This principle, however, is for the use of the supreme Command alone; it is a purely strategical principle.

13. The subordinate leader and the man in the ranks are concerned only with the application against the armed forces of the enemy of the principle of "the vigorous offensive," and from this principle we now find a group of principles derived.

14. First, it is evident that our "vigorous offensive" will have the greatest possible chance of success if we strike the enemy at the most favourable time and place and in the most favourable direction. Which will be the most favourable time, place, and direction? That at and in which a blow will be most irresistible, will most shake our enemy's confidence, disturb his plans, break up his organization.

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To discover which is the most favourable spot, how best to strike, how best to exploit success, we must evidently ascertain as correctly as possible the enemy's strength, his dispositions, his armament, his morale, his organization, in fact all about him. We must also know all about the ground and about our own troops, how they are distributed, what is the state of their strength, their morale, their armament; we must also know what they are doing. That is the next principle: "To inform oneself as fully as possible about the enemy, about the ground and about one's own side." This involves "intelligence" in all its forms, secret service, maps, air reconnaissance, patrols, observers, raids, even preliminary attacks. As regards our own troops, it involves liaison, intercommunication, report centres, contact aeroplanes, reports and returns. It calls for control, strict obedience to orders, movement by bounds and so on.

15. Having decided where to strike and how, we must now prepare the attack. This requires time, it requires space. While we are preparing the encmy may move, may take the initiative, may attack and upset all our preparations. We must prevent this. How? It may be done in various ways. We may prepare the attack out of striking distance and trust to the secrecy and intense speed of our approach to save us from interruption. This method is rarely possible by itself in land warfare. On land, where at present we are still comparatively slow moving, we must watch the enemy so as to divine his intentions, to have timely notice of his moves (protective reconnaissance). We must detail detachments, advance guards, flank guards, rear guards, to stop him, to fix him. We may occupy with these detachments a defensive front; or we may gain time by manœuvre; or we may make a holding or fixing attack. In any case we must invariably take measures to gain sufficient time, and to keep sufficient space for our attacks to develop under favourable conditions. We must take measures of Security of Protection. .

And since in war our information can never be perfect, we must always keep something in hand to counter unexpected action by the enemy, to reinforce a detachment, to re-establish a broken front, to furnish a fresh detachment. We must, in fact, *keep a reserve* (distinct from our striking force), we must organize in depth. All these measures are, however, only consequent on the principle itself, which is "to secure for ourselves freedom of action."

16. We have now in all probability used up a large portion of our force in these detachments, defensive fronts, local reserves. If we use too large a portion, the decisive attack, up to which all our preparations are leading, will fail through being too weak. This gives us the principle of "*Economy of force*;" to use as few troops as possible in these subsidiary duties, and with this in view to increase the holding or fixing power of these detachments by making them strong in fire-power in proportion to man-power, by manœuvring as in fighting a rearguard action, by using obstacles, field fortifications. The same principle, Economy of Force, requires us finally so to arrange our detachments that, at the psychological moment, all can join, either directly or indirectly, in the decisive act. 17. Having secured time and space to prepare, to choose our time and method, nothing in the way of preparation must be left undone which time and circumstances will permit. That is the next principle, "to prepare for the decisive action as completely as possible," to foresee requirements and to provide for them.

18. We are now ready for the *dénouement*, the decisive blow, the supreme act of that "dreadful and impassioned drama," war. It must not be allowed to fail, if it is humanly possible to prevent failure. It may still require for its preparation preliminary bombardments, preliminary attacks, subsidiary attacks. But in the end we must put into the decisive battle itself, every man, every gun, every round, every ounce of energy of which we are capable. We must deal a blow or series of blows of the most intense and appalling character possible, with all the resources of the army, of the nation. There must be no half-hearted measures; we must stake everything. This is the principle of unlimited war, "to strike the decisive blow with all our forces."

19. Such then are the basic principles of war, whether in large or small operations :---

ist. To direct every action against the soul of the enemy, to make him think that he is going to be beaten, while refusing to believe that we are beaten ourselves.

2nd. With this object, sooner or later, at the most favourable opportunity, to attack, to strike a supreme, a decisive blow.

3rd. In order that the attack may be put in at the right time and place, to find out all we can about the enemy, about the ground and about our own side.

4th. In order that we may prepare the blow, that we may strike how and when we like, "to secure for ourselves freedom of action," preventing interference by detachments, by defensive fronts, by secrecy, by speed, by watching the enemy, stopping him, fixing him, mystifying and misleading him.

5th. To ensure economy of force in subsidiary operations, by using as few troops as possible, and by so arranging our detachments, keeping touch with them, that at the decisive moment, all can act against the enemy in some way or another, that all can " pull their weight" at the supreme instant.

6th. To prepare the blow as completely as possible by a complete organization, by foresight, by mystifying and misleading the enemy, by shaking his morale, by secrecy and surprise creating our opportunity.

Finally at the favourable moment

7th. To strike with all possible violence even to the exhaustion of all our means.

20. These are the principles of war, and they are of universal application, whether to armies of bowmen and spearmen or to armies of tanks, to fleets of ironclads at sea, or to fleets of aeroplanes.

21. In war, these principles govern our action at all times. Thus, when we are halted, we maintain our intelligence service (reconnaissance). We cover ourselves with outposts and with protective reconnaissance (to secure freedom of action). We keep these outposts as weak as

possible (economy of force), while we make our main body as comfortable as possible, to keep it fresh, unshaken, fit for the decisive act (preparation, the blow with all our forces).

22. Similarly, during a march, towards or away from the enemy, we cover ourselves with detachments, so that our striking force may march in a sense of security, so that we may have time and space to prepare the blow which we eventually *must* strike, so that we may strike it with full strength, full courage.

So also even during the progress of the attack itself we must still 23. learn all we can about the enemy, about the ground and about our own troops and report it (observation, reconnaissance, liaison, intercommunication). We must protect ourselves with observers, with detachments detailed for the purpose (such as defensive flanks), by organizing in depth to meet the unexpected. We must also constantly fix the enemy, prevent his counter-action, shake his courage, prepare the way, by covering fire. We must, in fact, continue to ensure for ourselves freedom of action. All the time, also, we must remember our fundamental principle. We must look at things from the enemy's point of view, see . with his eyes the place at which he most fears attack. This will usually be his flank or rear. Why? Because it is a natural instinct of the human heart to fear the danger that comes from the flank or rear especially when one is already engaged in front, to fear the possibility of being surrounded; and because also, in large forces attack from a flank upsets the enemy's arrangements, causes him anxiety, hunger, possibly even starvation, creating despondency, paralyzing his counter-blow.

If the attack comes unexpectedly, fear is intensely magnified. It may become terror, panic. A unit or Commander surprised is already half-beaten.

So also we shall be attacking where the enemy least wishes, if we press our attack at his weak points and waste no force on the strong points. What are his weak points? Those at which we have already penetrated. This is what we call "Soft spot tactics," a most elementary application of the first principle of war.

Finally, we must push the attack with all our forces. This implies fresh troops, kept in hand. It implies organization in depth; first, to encourage those who go ahead, since the human heart fails if, sceing terrors ahead, it sees not also help coming from behind; and second, in order that we may put in *fresh* and yet more *fresh* troops as the leading lines lose their vitality: fresh troops whom we have brought up with all possible care, in good order, under cover, as fresh, as unshaken as possible, so that they may apply the maximum of force, so that they may enter the battle with a maximum of confidence, of courage.

24. But if the enemy seizes the initiative, if he attacks us, do we then still act on the same principles? Most certainly. We still reconnoitre. We still hold him with detachments, with our fighting front which we keep as weak in troops as possible, increasing its resisting power with guns, machine guns, obstacles, field fortifications, using only such reserves as are necessary to close gaps, to make local counter attacks; employing always as few men as possible (economy of force). We secure in this way time and space (freedom of action) to collect, to keep *fresh* the main body, the striking force, to prepare in security the decisive counter-blow which must be made.

25. Let us open the Field Service Regulations at random. We shall find no sentence, no rule of action which does not react to one of these principles.

These then are the fundamental principles of war. They are "neither numerous nor in themselves very abstruse."

26. "But the application of them is difficult and they cannot be made the subject of rules."

Why is the application of them difficult and why cannot they be made the subject of rules? Because the human heart itself is complex; because the circumstances of war, the position of the opposing forces, their characteristics, their armament, their strength, the incidents of the ground, the weather, all these vary to an infinite degree. No two cases in war are ever exactly alike. *Every case in war is a special case* which must be treated on its mcrits.

27. What then are these two hundred and more pages of reading matter in the Field Service Regulations? They do not all contain fundamental principles of war. The fundamental principles of war could be printed on a single page. They cannot contain rules of war, since there can be no rules. How then can we explain them?

In this way. If we are to act on the orders which we receive exactly in the way in which our Commander desires us to act, if the Commander is to be in a position to lay his plans with accuracy and precision, if we are to act in harmony with those around us, if we are to rely on them and they on us, we must have, not only a fixed organization for the whole army, but we must also have a common method, a common system of acting, a common phraseology; so that whoever gives us an order may do so with a general knowledge of how it will be carried out : so that whoever receives an order may understand clearly what is intended.

The Field Service Regulations and our Training Manuals provide us with such a common method of acting in the face of a large variety of circumstances such as may occur in a war against an enemy armed more or less with a certain type of weapon, of a certain degree of organization, in a certain type of country-a method which has been "evolved by experience as generally applicable to the leading of troops " and departure from which "has often been followed by mishap." If circumstances are very different we must, of course, largely revise our method. modifications generally necessary to meet the case of warfare against uncivilized enemies in certain types of country are indeed provided in the Field Service Regulations. But though the method provided in the text books may more or less meet a given case, it can never exactly do so. The method is very elastic, it admits of modifications and it must be modified in every case, since every case is a special case. We can never therefore act entirely from memory, even if memory did not desert us in the stress of the war, nor yet from habit in solving any but the most simple or invariable of problems. We must in every case think. We must consider how the common method fits the special circumstances and modify the method on the basis of the fundamental principles of war.

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28. It is evident then that we must have, in addition to a common method of acting, a common method of thinking, of appreciating a problem; so that all, being faced with the same problem, would act more or less in the same way. Where is this method of thinking laid down? Nowhere in our regulations. We must therefore evolve a method, or, better still, adopt a method which has achieved success. Let us then follow the teachings of Marshal Foch.

29. Let us first realize that, with the exception, perhaps, of the supreme commander every one of us is acting under orders. We have each a task to perform, one definite task and no other, We must therefore be absolutely clear first of all as to what that task is. What is it that we have to do? We must, in fact, answer the question which Marshal Foch has made so familiar to us: "What is the problem?" Having decided this, we may then test our problem with the "principles of war" in the order in which we have enunciated them.

Thus "What do I know of the enemy, of the ground and of our troops? Do I know sufficient to make a plan with certainty?" We can never, of course, know as much as we should like to know, since the enemy also is acting, is always changing his position, etc. We must therefore always arrange to reconnoitre and observe.

We must then ask ourselves: "What is my general plan?" We may decide to march to a certain place by a certain road, to attack more or less in a certain direction, to resist on a certain line. Then, "What must I do to guard against the enemy's counter-measures, that is, to secure for myself freedom of action?" We cannot answer this question without looking at the situation from the enemy's point of view. We must see with his eyes, feel with his heart. This is a most valuable practice, a practice too little followed.

Then, "What is the least force that I can use for the purpose of securing freedom of action?" "How can I arrange so that my detachments may remain under my control?"

In a march, a retirement, a defence, a full answer of the above questions may be all that is necessary for the formation of a plan to carry out our responsibilities.

If, however, our portion of the general task involves attack of any kind we must think also "How must I organize and prepare the attack so that the blow may be as strong, as violent, as unexpected, as terrifying as possible, so that I may be able to employ *all* my forces, if necessary?"

30. We cannot expect, of course, always to have time to review the situation in detail. When in close contact with the enemy a new situation will present itself for solution every moment. In such circumstances practice in the common method of action will save us, for we shall decide subconsciously, as by habit, to act in a manner more or less correct; and a mind well practised in the common method of thinking will then suggest to us, at times almost instantaneously, the modifications necessary to meet the special case. In the same manner, on the football field, although every moment presents a different problem for the solution of which there can be no exact rule, yet we keep a certain general formation and act subconsciously on a certain common method while solving consciously, though more or less instantaneously such highly complicated problems as when and where to pass, how to swerve, and when to shoot.

31. But it is not sufficient for the commander to make a correct plan. The plan must be carried out, and correctly carried out. To achieve this we must issue orders, and our orders must be so concise, so clear, so simple, that there can be no mistake either in understanding or in executing them. Every subordinate must be given a definite task and a perfectly clear idea of his task, so that he can unhesitatingly answer, as regards himself, the question "What is the problem?" We must also give all the information required for solving that problem and carrying it out; that is to say,

(a) news of the enemy; (b) news of our own troops; (c) the intention of the commander; (d) the particular orders for each sub-unit of

the command: (e) the arrangements for control (report centre).

In order that we may forget none of these, our orders, whether written or verbal, should always take this form and sequence. Field Service Regulations again supply us with a common method.

32. Let us remember, however, that in the rapidly changing situations of war orders can only hold good for a certain time. We must therefore so arrange matters that we can modify our orders, or issue fresh orders when necessary. This implies *liaison*, intercommunication, extension postponed till the last moment, close and handy formations, limited objectives, movement by bounds.

33. Our action must follow this order :—(a) clear, correct thinking; (b) clear, simple orders; (c) control retained to the last possible moment.

34. Finally, let us remember again in all we do, in all we think, that one fundamental all-embracing principle that "That nation, that commander, that army is only beaten which thinks itself beaten." Let us keep in mind the knowledge that victory depends on skill, numbers, armaments only in so far as these tend ultimately to raise the confidence of our own side, to create despair in the hearts of the enemy.

There is nothing else in war but this: to frighten the enemy into thinking that he is beaten, to resolutely cast out fear from our own hearts and to refuse to be beaten.

To arrange *everything* with a view to causing the enemy the maximum of discouragement, of fear; while so acting as to create on our own side the maximum of energy, of confidence, of courage. How essential to the leader then, above all things, is a knowledge and understanding of the human heart. "The secret of victory lies in the *hearts* of men."



Colonel R. A. Wauhope, C.B., C.M.G., C.I.E.

MEMOIR.

COLONEL ROBERT ALEXANDER WAUHOPE, C.B., C.M.G., C.I.E. (With Map.)

By COLONEL SIR S. G. BURRARD, K.C.S.I., F.R.S.

THE late Colonel Wauhope won a high reputation in India as an explorer and surveyor of the mountainous trans-frontier regions. Having accompanied many expeditions against warlike races and tribes, he had become a past-master of the art of surveying, as it has to be practised in the midst of an armed and hostile population. A born geographer and linguist, a strong and keen mountaineer, he seemed to have been specially designed for the arduous tasks that were allotted to him through life.

The advance of Russia across Central Asia in the seventies and the Afghan war of 1879 had brought home to the Indian Government that their trans-border areas were not only unmapped but unexplored; after fighting two Afghan campaigns, 1839 and 1879, the army of India was still without a map of the borderland. Wauhope's career opened at a time when the authorities had become impressed with the necessity of building up surveys of that wild frontier zone, concerning which little was known beyond the fact that any attempt at exploration would be forcibly resisted.

Colonel Wauhope was born at Monkstown, Co. Dublin, in 1855, and was the eldest son of Colonel Henry John Wahab, 48th (Northamptonshire) Regiment. His original surname was Wahab, but in middle life he reverted to the older spelling of Wauhope, in accordance with a family agreement. He was educated at Durham School, 1866–1871, and at the Royal Military Academy, and he passed into the Royal Engineers in 1873. He carried away from school not only a solid groundwork of mathematics that enabled him to deal easily with the formulæ of geodesy and astronomy, but also a rare knowledge of the classics, which was a constant help in his studies of the oriental languages.

In 1875 he joined the Madras Sappers and Miners, and two years later he served with the expedition that was sent to suppress the Rumpa rebellion. In 1878 war was declared with Afghanistan, and Wauhope served with the Peshawar Valley field force as an assistant

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field engineer, until the peace of Gandamak was signed in 1879. Under this treaty a British Resident proceeded to Kabul and was honourably received by the Amir, but six weeks later he and his staff were murdered, and a British Indian army again invaded Afghanistan. In this second campaign Wauhope served with the force that advanced on Kabul under General Roberts. Peace with Afghanistan was finally declared in 1880. In 1881 Wauhope served

with a military expedition against the Mahsud-Waziris. It was on these campaigns that he first came into contact with the hardy Mahommedan races whom he subsequently knew so well, and it was on these campaigns that he first witnessed the difficulties of surveying under the eyes of a guerilla enemy.

After serving for 18 months in the Military Works Service at Lahore and Meerut, he was appointed to the Survey of India in 1883, and was posted for training to Major Charles Strahan's topographical party in Rajputana.

Western Baluchistan.—Under the treaty of 1880 the Amir of Afghanistan had recognized the suzerainty of the Indian Government over Baluchistan. Sir Robert Sandeman had been the chief political officer in Baluchistan during the Afghan wars, 1878–1880, and on the conclusion of peace he was appointed the first Agent to the Governor-General for Baluchistan. In 1883 Sandeman decided to undertake a mission through West and South Baluchistan for the purposes of exploring the country and of initiating friendly relations with the chiefs. A survey party, under Lieut. the Hon. M. G. Talbot, R.E., was attached to the mission, and Wauhope was selected to be Talbot's assistant.

The vast extent of territory which had lately come under British rule between India and Persia was largely a *terra incognita*; on the best maps then available thousands of square miles were shown as sandy desert, which were afterwards found to be covered with ranges of mountains rising to altitudes of 10,000 feet

On October 5th Talbot assembled his party at Jacobabad, where Wauhope and the two surveyors Ikbaludin and Ata Mahomed joined him. The party met Sir Robert Sandeman at Quetta, and arrived at Kalat on October 30th. Wauhope and the two surveyors and half the Khalassies were now suffering from fever, and Wauhope recorded in his diary that everything was looking bad for the success of their expedition, except that "Talbot kept well, and did everything." After a week's halt the epidemic had abated, and the party were able to move forward. Talbot and Wauhope worked independently of one another towards Persia, the former exploring the southern country, and the latter the northern. They both had to cross mountain ranges and their plan was to effect a junction at Kharan, a Baluchi town, where Sandeman had directed them to meet him. On December 23rd the survey party met the political officers at Kharan, and on Christmas Day, Sir Robert entertained all the members of the mission at a dinner in his tent. After Kharan, Talbot and Wauhope worked together, Talbot taking the triangulation and Wauhope the topographical detail, and jointly they carried the survey over the hills of Western Baluchistan. In January they met Sandeman again at Panjgur, and received directions from him to explore westwards to the Persian boundary, but to avoid entering Persia. Through February and March the operations progressed successfully, but in April observations became difficult. Wauhope recorded in his diary—" This haze is now becoming a constant annoyance, stopping all distant sketching entirely; a month ago when we had clear weather every detail twenty miles away was visible; now we can just see hill tops looming through the mist and nothing in the valleys."

On April 23rd the mission returned to Quetta, and Sir Robert Sandeman, in bidding farewell to the members; expressed himself very pleased with the political and geographical results obtained.

On May 22nd, 1884, Capt. Wauhope was married at Meerut to Miss Catherine Ward, the elder daughter of Colonel David Ward, R.E.

The Zhob Valley .-- In 1884 Sir R. Sandeman obtained permission to explore the Zhob Valley and to take with him a field force with which to punish the Kakar Pathans for their raids. Major Holdich was appointed to the charge of the Zhob survey party and Wauhope was nominated his assistant. It was just at this time that the Russian army, having conquered the Turcoman states, advanced to the northern boundary of Afghanistan and came into collision with the troops of the Amir. Great Britain had guaranteed the integrity of the Amir's dominions and an acute crisis ensued; eventually Russia agreed to-recognize the independence of Afghanistan, and to co-operate with Great Britain in demarcating the northern Afghan boundary. Major Holdich was now selected to be Chief Survey Officer with the Afghan Boundary Commission and an unexpected vacancy thus occurred in the Zhob Valley survey party. There were senior officers who had claims for the Zhob appointment, but they were at distant stations; the matter was urgent, Sandeman wanted Wauhope, and Wauhope, being on the spot, stepped into the vacant charge.

The Zhob valley lies between Baluchistan and the Punjab frontier ; it separates the Quetta plateau from the Sulaiman range, and it stretches northwards to the Gumal river of Waziristan. In neither of the Afghan Wars, 1839 and 1879, had this tract been traversed by British troops, and before the Zhob expedition of 1884 it was geographically unknown. The best map available in 1884 showed the Zhob river cutting across the Sulaiman range into the Punjab, 80 miles south of the Takht-i-Sulaiman Peak, whereas Wauhope discovered that the Zhob flowed northwards into the Gumal and escaped from the mountains 30 miles north of the Takht-i-Sulaiman

Sir R. Sandeman and the field force, under Sir Oriel Tanner, reached Smalan on October 1st, and there the survey party joined them. Wauhope's assistants were Mr. G. B. Scott and Surveyor Yusuf Sharif. On October 20th Wauhope first entered the Zhob Valley, which he described as " a broad alluvial plain, 10 miles across, bordered by mountains, and stretching away as far as the eye can see." As the expedition progressed he carried on a triangulation from the summits of hills, and by computing his results daily he was able to supply the plane-tablers with the positions of the new points, almost as soon as he had fixed them. On October 22nd a survey detachment came under fire from the Zhobis and four of the escort were killed. On the 24th the Zhob chieftain Shah Jahan made a determined attempt to stop the expedition from advancing, but his men were defeated with heavy loss. Two days later the force reached Shah Jahan's fort only to find it abandoned ; the towers were then blown up, the Zhobis watching the demolition from their hills. Sandeman was anxious to get maps made of the lateral valleys, and General Tanner arranged for military escorts to accompany the several exploring detachments. The expedition returned to Quetta in the spring; there was some disappointment that Shah Jahan's opposition to the force had proved so feeble, but the results achieved by the expedition were of lasting value; Sandeman's influence began now to spread from Baluchistan over the Kakar Pathans, and a large blank in the maps of the frontier was filled in.

On his return from Zhob, Wauhope remained in Baluchistan, carrying out surveys of various areas. It was at this time that he designed his "Height Indicator." The introduction of the clinometer in 1876 had enabled plane-tablers to insert contours on their maps, but even with the clinometer a surveyor had to calculate each observation before he could ascertain the height of a surrounding point. In Baluchistan, Wauhope introduced a graphic method by which heights could be read off from a diagram, and he thus relieved his surveyors of the calculations. His Height Indicator has proved an important contribution to surveying, and it is now recognized as an essential article in the equipment of a topographical surveyor.

Campaigns on the Punjab Frontier.—A belt of independent tribal country runs along the Indo-Afghan frontier from the Zhob valley to the Khaibar pass, but beyond the Khaibar it leaves the actual frontier and bends inwards to Buner and Hazara. The river Indus in its submontane course cuts across the eastern end of this tribal belt, and it is for this reason that a considerable length of the great Punjab river has never been systematically explored. There has been a clash of races on the Indus, a clash of the Tibetan and Afghan and Hindu; on its long high-level course above 4,000 feet the Indus

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flows through a peaceable country, where Mongolian blood predominates, and where geographical exploration has been unopposed; but, in its middle course, during its descent from the plateau to the plains, the river passes through lawless tracts where surveys have only been possible on campaigns. In these surveys Wauhope has played a leading part.

In r888 he accompanied an expedition for exploring Southern Waziristan. Later in the same year he went in charge of the survey party on the Black Mountain campaign, and made useful maps of the hills on the east bank of the Indus. The General Officer commanding reported in his dispatches that Wauhope was unremitting in his endeavours to seize every opportunity during the march of the field force to secure extension of his surveys, and that he deserved much credit for the thorough manner in which the new country had been mapped.

In 1889 he went to Chatham to undergo various courses of training, and he returned to India in 1890. Early in 1891 he was selected to accompany the Miranzaifield force, which operated from Kohat against the tribes occupying the outer hills between the Kurram and Khaibar passes. In the summer of 1891 he served as survey officer with the Hazara field force, when he was able to extend the surveys which he had made on the Indus during the Black Mountain expedition of 1888. The annual report of the Surveyor General for 1891 refers to the topographical results of these expeditions as being most creditable to Capt. Wauhope and acknowledges the excellent services which he had rendered on many frontier campaigns and which had so often been brought to notice in Army dispatches.

In 1891 the authorities at Aden were meeting with difficulties in settling the disputes amongst various tribes of South West Arabia which had come under British influence during the preceding half century. In October, 1891, Wauhope took a party to Aden with orders to survey the hinterland. Maps of the country round Aden for a distance inland of 70 miles were completed by the following May, when the work was stopped by the heat and the party returned to India.

In 1892 Wauhope was Survey Officer with the Isazai field force, which was operating against the tribes in Buner on the west bank of the Indus.

The Durand Boundary.—In 1893 a mission under Sir Mortimer Durand proceeded to Kabul and was received by the Amir Abdur Rahman. The negotiations were successful and an agreement was signed by which the boundary between India and Afghanistan was to be settled and demarcated. This agreement was remarkable, not only for the way in which the Amir had been induced to withdraw his known objections, but also for the boldness of the scheme under which lines of pillars were to be erected across the frontier mountains which had for centuries been the homes of India's marauding enemies.

Landi Kotal, at the head of the Khaibar Pass, was one of the pivots of the Durand line, and in 1894 a commission, consisting of Mr. Udny and Mr. Hastings, political officers, and of Colonel Holdich and Lieut. Coldstream, Survey Officers, set out from Peshawar to mark the Indo-Afghan boundary from Landi Kotal northwards to the Hindu Kush range*. To the immediate west of Landi Kotal no demarcation was necessary, as the Durand line followed the crest of the Safed Koh range. But beyond the Kurram came the Waziristan section, and Wauhope was selected as Chief Survey Officer for Waziristan. West of Waziristan was the Balchistan section ending at the Persian border; Capt. MacMahon was the political officer for this last section, and Capt. Mackenzie and Mr. G. P. Tate were the Survey Officers.

The central pivot of the Durand Boundary was to be a pillar erected near Domandi on the river Gumal in Southern Waziristan. Domandi was to be the junction-point of the frontier lines of India and Baluchistan. Wauhope's duties were to survey the Durand line through the Waziri hinterland and to assist the political officer in demarcating it from Domandi to the Kurram.

The Amir had subjugated the tribesmen on his side of the boundary, but on our side the Mahsuds and Waziris were independent, and it was expected that they would endeavour to stop the demarcation by force of arms. The political officer who was deputed to treat with the Amir's representative was Mr. L. W. King, I.C.S.

Wauhope assembled his party at Dera Ismail Khan on September 30th; it consisted of Capt. C. L. Robertson, R.E., and Surveyors Abdul Ghafur, Husen Baksh, Sher Jung, and Jafir Ali; a few days later it was joined by Capt. P. F. J. Macaulay, R.E., who had been fixing boundary pillars in the Kurram. The survey party marching by the Gumal Pass, reached Karkana Kotal on Oct. 14th, and here they commenced their work. It was essential to carry the surveys across Waziristan to the Afghan border, so that the maps of the Durand line should be connected with those of India, On October 19th a brigade of troops marched through the Gumal Pass, and on the 25th reached the plain of Wana. Robertson and Macaulay carried out surveys on both flanks during the march to Wana. The Waziris were firing into the encampments at night and the Mullah Powandah was in their midst preaching the duty of war. On November 3rd a strong force of Waziris made a night attack upon the camp at Wana, and, having overpowered the outposts, a large body broke into the camp. They succeeded in cutting horses loose

* The Indian Borderland, by Sir Thomas Holdich, 1901.

and in causing a certain amount of confusion in the dark, but they were soon driven out by the Indian troops.

Our casualties were heavy, and when daylight came, Capt. Macaulay, R.E., was found to have been killed.

It was not till two months after the fight at Wana that King and Wauhope reached Domandi, a small village on the Gumal. In agreement with Abdul Wahid, the Afghan representative, King selected the site for the Domandi mark-stone ; Wauhope erected the cairn, and determined its latitude and longitude; Husen Baksh sketched the topography of the surrounding country. King and Wauhope then marched across the hinterland, erecting cairns along the boundary. The villagers showed disapproval of the proceedings of the commission, and the political officer was anxious to push on rapidly before the local dissatisfaction could come to a head. But the work of deciding upon the actual boundary line occupied less time than the surveying and hill-sketching, and Wauhope found it impossible to hasten his triangulation and mapping. Snow-storms were of frequent occurrence, and the survey work, being more dependent upon visibility than the demarcation, was retarded. Every day when the sites of the pillars had been settled the surveyors had to climb many thousands of feet in the snow in order to make the necessary observations.

At the last pillar of Southern Waziristan, Wauhope received orders not to cross the watershed between the Gumal and Tochi, but to return to the Punjab by the Gumal route and to make a fresh start up the Tochi into Northern Waziristan. The British and Afghan missions therefore parted company, and Wauhope marched back to Wana and down the Gumal Pass to Bannu.

Robertson and Sher Jung who had been surveying Southern Waziristan also joined at Bannu. Mr. H. A. Anderson, Commissioner of the Derajat, was appointed political officer for the demarcation across the valley of the Tochi. The new mission marched up the Tochi under the protection of General Egerton's brigade, and on March 3rd they arrived at Sheranni*. Here they were met by the Amir's officer Abdul Wahid. On March 6th Anderson and Wauhope, with a small escort, marched 30 miles south of the Tochi to the spot where the Gumal line of pillars had ended, and they erected the first Tochi cairn on the hill of Kharkamar. In the evening some shots were fired into their camp, but these proved to be accidental and merely due to a fight in the camp of the Afghan mission amongst themselves; the Amir's representative sent his excuses. The two missions spent the whole of the next day out on the mountains, and

* An instructive description of the Tochi was published in the R.E.Journal, October, 1921, entitled "A Frontier Motor Road," by Major A. H. Bell.

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long discussions over the boundary took place. It was a wild country and the people appeared even less civilized than those of the outer hills. As the missions passed the small village of Atsar, Wauhope heard an uncouth Waziri shout out to the guides, "Are we to be English (Angrez) or Afghan?" and he gesticulated with pleasure when the guide shouted back—"You are to be English."

Heavy rain and mists often obliged Wauhope to sit on the hillside for hours unable to observe; the political officer was averse to halting inside Afghan territory, and the rations of the mission were running short. On March 11th the party descended into the bed of the Tochi, five miles above Sheranni, where they were met by General Egerton and his brigade, and where they were able to replenish their rations—now completely exhausted. On March 12th they ascended the hills on the north side of the Tochi, but failed to come to any agreement with the Afghans. On March 13th they proceeded up the bed of the Tochi, taking Io days' rations; heavy snow-storms occurred and snow lay deep upon the hills, but they were able to fix two pillars near the head waters of a feeder of the Tochi.

On April 4th Anderson and Wauhope reached the peak of Laram, near the Kurram, and here they erected the last cairn of the Waziristan section of the Durand boundary. Whilst Wauhope had been mapping the belt of country through which the line passed, Robertson had been surveying the area round Sheranni, and between them they had produced a valuable map of Northern Waziristan.

The Russian Boundary across the Pamir Plateau .-- Mr. Udny and Colonel Holdich had meanwhile extended the Chitral section of the Durand line to the snow-capped crest of the Hindu Kush. Immediately north of the Hindu Kush a thin strip of country (Wakhan) had been allotted to Afghanistan; it is from 10 to 20 miles wide and it stretches across the Pamir Plateau for over 200 miles, as far as the Chinese frontier. This narrow Afghan buffer, separating India from Russia, has a natural boundary on its south side in the Hindu Kush range, but on the north the Russo-Afghan boundary required to be settled. The Pamir Boundary Commission was therefore formed in 1895 under General Gerard with Colonel Holdich as Chief Survey Officer*. Having recently finished his work in Waziristan, Wauhope was appointed to the new Pamir Commission, and Surveyors Abdul Ghafur, Asmatullah Khan, and Dan Singh were also selected for it. Marching through Kashmir and Gilgit and via the Darkot Pass (15,000 feet), the Commission met the Russians near Lake Victoria (13,400 feet) on July 28th. A pillar near the lake was the principal station of the boundary ; triangulation was carried across the plateau, and maps of the country were made by the

* The Indian Borderland, by Sir T. Holdich.

British and Indian surveyors, and printed off from a field press for the use of the commissioners. The selection of the boundary line gave rise to no serious disputes and the settlement was completed in September. On September 15th, from the summit of Andamin Peak (17,273 feet), Wauhope was able to see the Pamir peak of Mustagh Ata (height exceeding 24,000 feet). It was 60 miles distant to the north, and, unfortunately, it was too faint for accurate observation. This remarkable peak is situated outside the range of the Indian triangulation, and neither its position nor its height are accurately known; an observation by Wauhope from Andamin would have been of great geographical interest, but the haze was so dense that he was unable to get an intersection.

Between 1860 and 1880 some snow peaks of the high Hindu Kush range had been observed from the south from the Gilgit stations of the Indian Survey, and their positions had been fixed. The Pamir surveys of 1895 were north of the Hindu Kush, and Holdich and Wauhope saw these peaks standing on their southern horizon at a distance of 50 miles. By careful observations of the peaks, they were able to connect their Pamir triangulation with the triangulation of India. The method they adopted is known to surveyors as the method of resection ; the positions of the peaks were first fixed from the south, and then the surveys on the north side were based upon the peaks. In this way a geographical connection was made between the survey of India and that of Russia in Asia.

Seventeen years later, in 1912–13, Capts. H. G. Bell and K. Mason, of the Royal Engineers, made a geodetic connection between the triangulations of India and Russia : the Hunza river has cut a deep gorge across the Hindu Kush range, and Bell and Mason succeeded in observing a continuous series of triangles through the gorge. The station of Kizil-Rabat on the Pamir plateau, which had been fixed by Holdich and Wauhope in 1895 was independently fixed again by Bell and Mason in 1913. The results obtained were as follows :--

Date.	Observers.	Resulting Latitude.	Longitude.
1895 1913	Holdich and Wauhope Bell and Mason	37° 27' 27" 37° 27' 23"	74° 44′ 36″ 74° 44′ 35″
	Discrepancies	4″	ĭ″

GEOGRAPHICAL POSITION OF THE KIZIL-RABAT MARK.

The smallness of the discrepancies shows that the Pamir triangulation of 1895 amply fulfilled the requirements of the boundary. The Holdich-Wauhope connection was carried out under service conditions, the time allowed for it was limited, the snow-peaks, which formed points in their triangulation, could not be visited, and the angles at them could not be observed.

The Bell-Mason connection was carried out under scientific conditions, with a superior instrumental equipment, and with no time limit; all its triangulation points were visited and all its angles observed.

The connection of 1913 placed Kizil Rabat 135 yards S.S.W. of the position assigned to it in 1895...On a map of Asia, on the scale of 1,000,000 an error of 135 yards is unplottable, being less than the two-hundredth part of an inch, and is therefore not geographically important. But the scientific precautions taken by Bell and Mason have been justified, for an error of four seconds in latitude is sufficiently large to vitiate an investigation either of the Earth's axes or of the attraction of the Pamir mass.

Sir Thomas Holdich has recorded that—" the success of the Pamir Triangulation of 1895 was due to Wauhope's capacity for climbing great heights rapidly, and to the promptness with which he observed rounds of angles from the summits. No one but a highly experienced surveyor could have made this connection between the triangulations of India and Russia."

The Persian-Baluch Boundary.-In 1895 the Government of India made an agreement with the Shah of Persia to settle the boundary between Persia and Baluchistan, the extreme western boundary of the Indian Empire. A special commission was appointed, Colonel Holdich being selected as Chief Commissioner, and Colonel Wauhope as Survey Officer*. The commission reached the Persian boundary on February 20th, and there met the Persian commissioners. The boundary-line had to be selected and surveyed from the shore of the Arabian Sea to the peak of Koh-i-Malik Siah, the south-west point of Afghanistan. † Over the greater part of the distance the boundary followed the crests of barren ranges, where there were no serious obstacles to a settlement; a considerable difficulty, however, arose at the great lake of Mashkel. Here the commission found abundant water, and it was necessary to survey in detail the lake and its groves of dates. These dates had been the cause of serious disputes between Baluchis and Persians, probably for centuries.

The headquarters of both commissions were encamped by the

* The Indian Borderland, by Sir T. Holdich.

[†] This mountain, the trijunction point of the three countries, Afghanistan, Persia, Baluchistan, was first observed with a theodolite in 1884, when Wauhope intersected it. Its geographical position was first fixed in 1896 by G. P. Tate, Survey Officer with the Durand boundary commission. It was made a principal station of the Great Trigonometrical Survey of India by C. M. Browne, R.E., in 1908.



lake for some weeks. By the end of March the boundary had been demarcated for 300 miles, and the final agreement and maps were signed. The British commission then marched back across Baluchistan to Quetta, where they arrived in May, 1896.

Colonel Wauhope was travelling home by train from Quetta to Simla, when a tragic calamity occurred. His wife with their two children had been staying at a bungalow in the hills a few marches out of Simla, and she was riding back to Simla to meet her husband on his return from Persia. Her horse took fright at a monkey near the road and leapt over the cliff in the presence of her children. She fell thirty feet and was severely injured. She died at Simla a week later. Wauhope took his children to England, and he did not return to India till October, 1897.

The Campaign in Tirah.—As his steamer dropped anchor at Bombay, he received news of the campaign in Tirah, and of the fighting at Dargai, where several of his oldest frontier friends lost their lives. On landing in Bombay he found orders awaiting him to join the army in Tirah, and he left the same day by the Punjab train.

The Tirah campaign was directed against the Afridi and the Orakzai tribes; the army employed was the largest force that had been organized for frontier tribal warfare. It was commanded by Sir William Lockhart, afterwards Commander-in-Chief in India, and the Chief of the Staff was General Nicholson, afterwards Field-Marshal Lord Nicholson. The force marched through the Tirah country, and fought a guerilla war against the tribes. Colonel Holdich was the chief survey officer, and Wauhope became his senior assistant. In February, 1898, before the campaign was over, Colonel Holdich had to retire under the age rule, and he handed over the charge of the several Tirah surveys to Colonel Wauhope in the field. Wauhope served as Chief Survey Officer with the Tirah field force up to the end of the campaign, and he supervised the drawing of the new maps during the following summer. During this campaign surveys were made of valleys and hills in the Afridi and Orakzai countries, which had hitherto been blanks upon the maps.

During the years 1899 and 1900 Wauhope remained in charge of the frontier party, and carried out surveys on both banks of the Indus in the hills above Buner and Hazara.

The Anglo-Turkish Boundary in S. W. Arabia.—The years 1885 to 1896 were remarkable for the number of boundary settlements that were undertaken in Asia; during that period long lines of cairns were erected across mountains and valleys and deserts, which only a few years before had been unexplored. Afghanistan, always hostile to surveys and settlements, was now hedged round with markstones; the Russian advance from the north had been stopped by a line of pillars; there were pillars across the Pamirs, pillars

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through the Waziri hinterland, and pillars round Baluchistan. It seemed as if the boundary problems had been solved and that the era of demarcation had come to an end.

But in 1901 the question of the Anglo-Turkish boundary in South West Arabia was forced upon the attention of the Indian Government by disputes amongst the various Arab tribes. In 1839 Great Britain had taken over the port of Aden with the consent of Turkey, and in the next half-century several tribes of the hinterland had come into direct relationship with the British authorities in Aden. The rule of Turkey in this distant portion of Arabia had never been more than nominal. In order to preserve peace in the interior it became necessary in 1901 to come to an agreement with Turkey as to which tribes were to be governed from Constantinople, and which from Aden. A' line of pillars would therefore have to be erected across S. W. Arabia through a country of which no maps existed.

In the autumn of 1901 a survey party was organized and dispatched to Aden with orders to extend the maps of the hinterland into the interior. Colonel Wauhope was placed in charge, and Capt. M. O'C. Tandy, R.E., was appointed his chief assistant. A strong staff of surveyors was chosen, including some who had served on previous expeditions with Wauhope, notably Lal Singh (now Rai Bahadur) and Sher Jung (now Khan Bahadur). Early in 1902 the British and Turkish Governments appointed special commissions to meet in Arabia and to settle the boundary. Wauhope was now selected to be the Chief British Commissioner, and his duties became political and diplomatic. He handed over charge of the survey operations to Tandy and for the next 23 years he remained in Arabia, patiently endeavouring to settle disputes. It was on February 11th, 1902 that he first met the Turkish commissioners, Mustapha Ramzi Pasha and Ismail Saifi, and it was not till May 30th, 1904 that the boundary settlement was concluded. The first meeting took place at Dhali (height 5,180 feet, 75 miles inland from Aden), when the Turks requested Wauhope to become permanent president of the joint commissions and of the conferences. It was not a simple matter to determine a starting point for the boundary; for the Turkish. claims were warmly opposed by the Arab Shekhs. The country had been governed under a system of tribalism and the several Shekhs were independent chiefs. Wauhope gave interviews to the Shekhs and examined the documents which they submitted as proofs of revenue payments from their villages. He described the chiefs. as "intelligent and eager for a treaty, but very jungly." The negotiations were occasionally hindered by the Arab tribes attacking the Turks, and they were further interrupted by the Shekhs, whowere in favour of British supremacy, fighting strenuously amongst one another. Many villages were bones of contention between Shekhs, and it soon became apparent that no progress would be possible until maps had been completed. Some of the Shekhs helped the surveyors, but others obstructed them. The camel-men of the various survey detachments were continually being stopped, and forced into wrong directions. As soon as survey cairns and pillars and signals had been erected they were pulled down, generally by the local Arabs, but sometimes even by the Turks themselves. In December, 1902 Tandy was attacked and wounded by an Arab, and this delayed the surveys. Surveyor Lal Singh was fired upon more than once, and in January, 1904, Surveyor Abdul Jalil was killed. For two years disturbances were of frequent occurrence, and the Turks were powerless to restore order. Many questions of the boundary line had to be referred to London and Simla and Constantinople, and the periods spent by the commissions when waiting for replies were generally enlivened by local fighting. Wauhope's time was mainly occupied in endeavouring to promote agreements between the Turks and the Arabs, and many of these agreements, though successful for the moment, were subsequently broken. It was not till the commissions had been on the ground for two years that the boundary pillars were finally erected.

The boundary starts from the Arabian coast at the southern end of the Red Sea, opposite to the island of Perim, and from thence it runs in a north-easterly direction to a pillar near Kataba (height 4,400 feet), nearly 100 miles north of Aden. From Kataba the boundary is continued, but not demarcated, in a north-easterly direction across Arabia as far as the Persian Gulf. This delimitation placed the whole of Southern Arabia within the British sphere of influence, which thus includes the Aden hinterland, the Hadramaut, and Oman^{*}.

Wauhope's last meeting with the Turkish commissioners was on board the Royal Indian Marine steamer *Dalhousie* in the Red Sea on June 13th, 1904. The boundary had at last been settled, the pillars built, the treaty and maps signed. Although the climate of the Highlands in the interior had been pleasant, the coastal zone had been oppressively hot, and Wauhope had suffered frequently from malaria. The long strain of the negotiations nad also affected his health, and he felt that his constitution had been impaired. He proceeded to England on leave, and a year later, not having regained his normal strength and activity, he retired from the army at the age of 50.

After his retirement, Colonel Wauhope and his daughter lived at Alverstoke, on the Solent. In 1905 he was asked to write the article on Arabia for the forthcoming new edition of the *Encyclopædia Britannica*. During the years he had spent in the Aden hinterland he had made a study of the geography and history and dialects of Arabia,

* Encyclopædia Britannica, 11th edition, article "Arabia."

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and the article which he wrote has been recognized by orientalists as a scholarly and impartial contribution to a controversial subject.

A few years later he joined the Royal Geographical Society's Committee, as the representative of the India Office, for the revision of the spelling of geographical names, and his knowledge of the Arabic, Persian, and Pushtu languages rendered his advice valuable to the committee on the vexed questions that had arisen out of the clash of different systems of transliteration in Mesopotamia.

Services during the War, 1914-1918.—On the outbreak of war with Germany in 1914, Wauhope rejoined the army, and was at first appointed to the Ordnance Survey at Shrewsbury and Edinburgh. But when the garrison at Aden was attacked by Turkish forces, he offered his services to the India Office, and in July 1915 he was appointed political and military Intelligence Officer for S. W. Arabia. He had once more become a strong active man, but he was sixty years old in August, 1915, when he arrived at Aden.

Our forces were in contact with the Turks behind Aden, and there was continual skirmishing, which occasionally developed into fighting, but neither side was strong enough to inflict a decisive defeat upon the other. Wauhope endeavoured to get into communication with the Arab Shekhs who dwelt in rear of the Turkish positions, but as he was cut off from the land side by the Turks, his only means of communication were round the coast by steamer. He made many journeys up and down the Gulf of Aden and the Red Sea, halting at Perim and at the Arabian ports of Mokha and Hodeida. He also visited the island of Kamaran, situated in the Red Sea, 200 miles north of Perim. Ever since the boundary commission of 1904 he had had in mind the conflicting evidence of explorers concerning certain hills of Arabia; from an analysis of their narratives he had become convinced that two high mountains shown upon maps on the authority of different travellers were really one and the same. On one of his trips to Kamaran on intelligence work he took a theodolite, and from points on the island he was able to observe certain peaks inland. It is not on record whether his own observations helped him to come to a decision, but subsequently when he was revising the map of Arabia in the Survey of India Drawing Office, he moved the two explorers' routes nearer together in latitude, and by so doing he was able to convert their two separate mountains into one. The evidence available certainly seemed to favour this solution.

The Survey of India had become weakened during the war by the transfer of the greater number of its military officers and of many of its civil officers to military duties with the armies in France and Mesopotamia. As new maps of Arabia were wanted for the war with Turkey, the Surveyor-General asked for the services of Colonel Wauhope, as soon as he could be spared from Aden, and in June, 1916 Wauhope rejoined his old department. For the next $2\frac{1}{2}$ years he worked at map-compilation and map-drawing in the Survey Office at Dehra Dun. He brought Hunter's map of Arabia and of the Persian Gulf up to date, and he compiled some excellent maps of S. W. Arabia. His knowledge of languages enabled him to revise the spellings of geographical names, and he compiled two pamphlets on this subject for the use of map-makers, one dealing with the languages of Western Asia (Arabic, Persian, Turkish), and the other dealing with the Mongolian languages (Tibetan and Chinese). The senior Indian draftsman at Dehra Dun has written— "During Colonel Wauhope's re-employment in the Survey of India he once again won the admiration of all those seeking advice on geographical matters of which he possessed a vast knowledge ; he was himself a neat draftsman, and the maps produced under his direction are monuments to his ability."

Wauhope remained with the Survey of India until peace was declared with Germany, and finally retired from the Government service in 1919. He returned to his home at Alverstoke, and his daughter rejoined him from her work in France. Eighteen months later they went to Switzerland for winter sports as they had done before; but Wauhope was no longer strong enough for a life at high altitudes, and he died suddenly, on January 23rd, 1921, of heart failure at Morgins in the Alps. An admirable appreciation of his life's work appeared in the *Times* under the title of "A Maker of Maps," and over the signature T. H. H. It closed with the words—" His many friends recognize a certain sad fitness about his end amidst the snows and peaks of Switzerland."

Colonel and Mrs. Wauhope left one daughter and one son; the former was her father's companion and created for him his home on the Solent; the latter entered the Survey of India, and has shown an hereditary aptitude for oriental languages and for dealing with frontier tribesmen.

Colonel Wauhope's services were brought to notice in dispatches on numerous occasions. He received medals for the Afghan War, for the Punjab Frontier, and for the Tirah Campaign, and five additional clasps. In 1895 he was made a Brevet Lieut.-Colonel, and in 1899 a Brevet Colonel. ⁶ In 1896 he was awarded the C.I.E. for his services on the Pamir Commission, and in 1904 the C.B. and the C.M.G. for his services on the Arabian Boundary Commission.

As a surveyor Wauhope was of the accurate type ; before descending from a hill-station he always liked to make quite sure of his results, and to leave nothing to chance. He accommodated himself with unfailing cheerfulness to the hardships of service and weather ;

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when sleeping on the ground in the rain, sheltered only by a waterproof thrown over his theodolite stand, he not only did not complain, but he seemed to derive some satisfaction from such conditions.

His attachment to the classics continued through life, and it was seldom indeed that he was without his *Homer* and *Horace*; if they were not in his pocket on the hill-side, they were in his mule-trunk, or slipped into his theodolite box.

αίων άσφαλής

ούκ έγεντ' ούτ' Αλακίδα παρά Πηλεϊ, ούτε παρ' άντιθίω Κάξμω. λέγονται μαν βροτών όλβον υπέρτατον οί σχειν, οί τε και χρυσαμπύκων μελπομεναν έν όρει Μοισαν, και έν έπταπύλοις

a or OnBais . . .*

There are Survey stations in Southern India, which are over 125 years old, and which are still known as Lambton's stations, after the founder of the Triangulation of India. And there are survey stations in Northern India which have for over 90 years been venerated as Colonel Everest's stations. Wauhope's surveys were carried out in wilder countries, but there are many important mark-stones and cairns on the hills of Asia, from Arabia to the Pamirs, which will be known to posterity as Wauhope's stations.

* "A secure time fell to the lot neither of Peleus the son of Æacus, nor of the godlike Cadmus; howbeit these are said to have had, of all mortals, the supreme of happiness, who heard the golden-snooded Muses sing, one of them on the mountain, the other in seven gated Thebes."

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CORRESPONDENCE.

THE TECHNICAL TRAINING OF ENGINEER OFFICERS.

Dear Sir,

I have read with interest the "Professional Note" communicated in the January number of the R.E. Journal by the Commandant S.M.E., and am glad to note that the question of sending young R.E. officers to Cambridge as a permanent arrangement is under consideration at the War Office.

It is stated in the memorandum that it has been published with a view to drawing criticisms from those opposed to the idea, and consequently it might seem that, as I entirely approve of the suggestion, no remarks from me would be called for.

As, however, the length and scope of the proposed course have not been dealt with, and as I have had exceptional opportunities of considering the subject, I venture to think that my views may be of some value.

For nearly a quarter of a century it has fallen to my lot to closely study the question of the training of engineers. For seven years I was at the head of the R.I.E. College (Cooper's Hill) and for many years subsequently I was a member of the committee appointed by the India Office to select candidates for the Indian Public Works Department, and was thus in touch with all the engineering colleges.

I have also kept myself in close touch with the curriculum of the R.M.A.

My first remark, therefore, is that the engineer cadets leaving the Academy could certainly be made to reach a standard as to Mathematics, Mechanics, Experimental Physics and Chemistry equal to that of the Intermediate Examination at the end of the first year of study at engineering colleges, though I am doubtful whether all would attain the "First Class Honours" level.

The question, then, is as to what the future course should be.

My view is that, on leaving Woolwich, the next year should be spent at the S.M.E. with a view to (1) a complete *military training* as laid down in the memorandum (p. 23); (2) a thorough survey course; (3) a complete course of *field engineering and fortification*; and (4) signalling.

Following this they should go to Cambridge for the Mechanical Tripos Honours Course and should study there for two years.

Here, as pointed out in the memorandum, they would receive a thorough grounding in the theories of engineering as also in the mathematical, mechanical and physical sciences that form their foundation, but it cannot be too clearly recognized that on completion of this course the students are not yet engineers, but have merely received the necessary *theoretical* training enabling them to take advantage of future opportunities of mastering their profession.

Lastly, they should return for yet another year to the S.M.E., with a

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view to a short refresher course of military training, and a thorough insight into the work that may come their way in the ordinary course of their service; for instance :--the construction and maintenance of buildings (barracks, hospitals, etc.), camps, military roads, water supply, the usual machinery used in peace and war, searchlights, fortification and military bridging.

I am quite satisfied that nothing short of the four years' course above indicated as required after leaving Woolwich would suffice to bring our young engineers to the required standard, and I feel certain in my own mind that the sandwiching of the two years' Cambridge course between the two S.M.E. courses would prove to be far away the best solution of the problem.

> JOHN W. OTTLEY, Colonel (late R.E.), M.I.C.E.

REVIEWS.

MANUAL OF MAP READING AND FIELD SKETCHING, 1921.

The new manual is a much more ambitious production than its predecessor. Indeed, it is inevitable that the appearance of large scale gridded military maps and of photographs taken at every conceivable angle, should call for a corresponding increase in the study of their possibilities. Many of the additions, such as the chapter on the new grid, are therefore indispensable. On the other hand, it seems doubtful whether the examiner will not profit, even more than the average student, from much of the new matter; or whether there is a call for the inclusion, even as appendices, of projections, land forms, and spelling of place names. However that may be, the manual is a mine of information not only for the map-reader, but for the surveyor.

As a matter of arrangement, dictated by the effort to restrict to Part I all that is essential to the military training of an N.C.O., I think it a pity that chapters on copying, enlarging and reducing maps and on military reports, or reconnaissance, have been moved from Part I to Part II. They could with advantage have taken the place of Chapters IX, "Maps of the British Empire," and X, "Special Military Maps," in Part I. It is also common to find N.C.O.s and men who develop a marked talent for panorama drawing, an exercise which does much to educate and interest the individual in ground forms, and the chapter on this subject might have found a place in Part I.

Apart from the re-arrangement, and the expansion of matter noticeable throughout, Part I follows much on the lines of the last edition. The first noticeable addition is that (on p. 30) describing the numbering of the international I/M Map Sheets and of G.S.G.S. Maps. The inclusion amongst the plates of indexes to the W.O. I/20,000 of England and to r in. to I mile Ordnance Survey Popular Edition would have been welcome. The next addition, and the most important one in the book, is the chapter on the new "Grid," which is very clearly explained. It is regrettable, however, that this admirable system has been added to

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by introducing a small square number in each kilometre square. This number represents the kilometre co-ordinates of the S.W. corner. To add these numbers here and there, say every third square, is useful. To place them in every square may seriously interfere with the map detail, and is an undeserved reflection on the average intelligence. A much more serious point, however, is the insertion of commas and dashes in the co-ordinates themselves. A reference such as A 5473 is all-sufficient (within a 10-km. square). To make it into A 5, 4-7, 3 will imply such cumulative troubles in telegrams, reports, letters, and printed and typed orders that the rule will, inevitably, be honoured more in the breach than the observance. If the first number did not always refer to the same unit, or the individual co-ordinates were ever given to different degrees of precision, the case would naturally be altered.

Part II deals with more advanced subjects and with work in the field. Critics will no doubt differ in their opinions as to the inclusion of some of these subjects in a manual of map reading and field sketching, but none will find much quarrel with the matter itself.

The chapter on plane tabling is a particularly full and detailed guide to an art which should be taught to every Cadet. There can be no guide to map reading more efficacious than actual survey on the ground.

The chapter on the use of aeroplane photographs is a useful addition, especially for the Royal Regiment.

In Appendix II, "Notes on the Projection of Maps," p. 190, appears the statement that "there can be no single grid" upon a "polyconic series of maps." It is no wiser, as a general rule, to mix one's projections than one's drinks; but so long as no sensible error is to be found in maps on any one projection, a grid on any other projection, similarly free from distortion, may be overprinted. Such an arrangement is far from ideal and implies as a corollary the recomputation of the trigonometrical data in terms of the superimposed grid, but it has been done, notably on the Italian Front.

Part II will make many a surveyor regret the inadequacies of his education.

The plates and figures are very well reproduced. It is curious to note that the words "Military Edition" appear above the samples of Ordnance Survey Maps. There is no special Ordnance Survey "Military Edition" and the samples refer to the ordinary series on sale to the public.

The book is of handy size and well bound.

H. ST. J. L. WINTERBOTHAM, Lieut-Colonel.

THE PRACTICAL ELECTRICIAN'S POCKET-BOOK AND DIARY, 1922.

London. S. Rentell & Co., Ltd. Price 3/-.

This handy little volume attempts fairly successfully to cover a very wide field. The practical electrician of to-day is a very talented person indeed if he has a sound knowledge of the multifarious branches of electrical engineering treated of in this book.

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In order to compress into some 560 small pages a comprehensive survey of the whole subject, vigorous sub-editing has apparently been necessary; opinions will naturally differ as to the relative importance of the various subjects, but it would appear that the process of condensing has been applied somewhat unequally.

Fifteen pages have been allotted to the Control of Lighting Circuits. The subject is treated very fully with a wealth of diagrams. It is questionable, however, if the various switching arrangements are used to any extent. Five pages are occupied with the description of one particular make of electric clock, no mention whatever being made of the other excellent types in use. Electric plant is dismissed somewhat summarily, whilst what used to be called Prime Movers amongst them can only muster a few pages. Oil and petrol engines account for two or three pages only, illustrated by a small cut of a quite unrepresentative type. The section dealing with the electric plant is little more than an enumeration of the various types.

The tables on pages 126 and 127 on the power required to drive various machine tools are somewhat misleading, as the limits for each type are so wide as to be of little or no value. For example, it is scarcely helpful to be told that a circular saw requires 2-5 h.p., if of medium size, and 10 h.p., if large. Installation work is treated fully, but overmuch space is given to the description of numerous lead-covered wire-systems which appear to differ in little more than name. Some 18 pages are devoted to Electric Welding, a subject of somewhat limited appeal : here, again, one particular system is given prominence to the exclusion of other equally meritorious systems.

The pocket-book, undoubtedly however, fills a want, and will prove (and has proved) exceedingly useful to practical electricians such as foremen, wiremen and works electricians. The Diary portion might with advantage be considerably larger or be omitted altogether; as it is, it is too cramped. The book is clearly printed on good paper, the size of page being convenient for the pocket: in common with all books of the type, however, it tends to develop *embonpoint* with the passage of the years.

R. CHALMERS BLACK, Capt., R.E.

ALPHABETS OF FOREIGN LANGUAGES TRANSCRIBED INTO ENGLISH ACCORDING TO THE R.G.S. II. SYSTEM.

(London R. Geographical Society). Price 7/6.

This pamphlet, the second of the R.G.S. Technical Series, is the work of a Permanent Committee appointed with the object of determining the proper spelling, for British official use, of foreign place-names. It should become a reference book for all time, and will have achieved invaluable service if it succeeds in reducing to order the very confused spelling of many of our foreign maps and reports. Seventy-nine languages are treated, and much information is added, showing the varieties of pronunciation peculiar to each.

THE OFFICIAL HISTORY OF AUSTRALIA IN THE WAR OF 1914-18.

VOL. I. THE STORY OF ANZAC. THE FIRST PHASE. By C. E. W. BEAN. Published by Angus and Robertson, Ltd. Price 21/-.

It is the intention of the Australian Government to publish twelve volumes of this Official History, of which six, describing the work of the A.I.F. in the various theatres, are to be written by Mr. C. E. W. Other volumes will deal with Sinai and Palestine, The Bean. Australian Flying Corps, The Royal Australian Navy, etc. The book before us, the first of the series, contains 660 pages, III maps and 56 illustrations. It deals with the outbreak of the war, the raising of the A.I.F., its training in Egypt, including the first Turkish attack upon the Canal, the landing at Anzac, and the operations in Gallipoli up to the end of the First Phase of the campaign on 3rd May, 1915. It is written in a popular, but by no means a journalistic, style, and its interest is enhanced by the free publication of names and units. Every action is clearly explained by the help of abundant maps and photographs, and a description of each is also given from the Turkish point of view, as after the armistice Mr. Bean spent a week in Gallipoli with a senior officer of the Turkish War Office and with him discussed the fighting at every point. The book is extraordinarily interesting, and will remain a valuable record. The Australian nation is to be congratulated on its historian.

F.E.G.S.

NOTICES OF MAGAZINES.

REVUE MILITAIRE SUISSE. No. 9.—September, 1921.

The War in Anatolia .- Colonel Feyler, who spent many weeks with the Greek Army in the field in Asia Minor during thes ummer of 1921 gives an account, in the original article, of the chief features of the Greco-Turkish conflict. He is of opinion that the campaign in Anatolia furnishes lessons of considerable value to the military student ; lessons more diverse in their nature than those usually met with in military history. He thinks that there is as much to be gained by a study of the Greco-Turkish campaign in Asia Minor as there was in the Boer War of 1899-1902, which, in its time, excited deep interest in military circles. Colonel Feyler starts with an investigation into the political causes which led to a declaration of war in the Near East, and then proceeds to discuss some of the military problems which have had to be handled by the Greek General Staff. At the date when Colonel Feyler wrote his article (August, 1921), the War had passed through three distinct phases. The first stage was the campaign of 1920; the chief object of the operations at this stage was to relieve the pressure on the British troops in the region of Constantinople, where they were in danger of being pushed back to the Black Sea. During this phase the Hellenic forces occupied the western portions of Asia Minor, and, in co-operation with British troops, also the southern shores of the Sea of Marmora, the Dardanelles regions, and the country about Brousse and Ismid (Nicomedia). The

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second phase began in the spring of 1921 : the ease with which success was obtained in the first phase led the Greek General Staff into the error of being over-confident and the mistake was made of dividing the Greek Army into two distinct groups, one of three divisions and the other of four divisions, which were separated by an intervening space of 125 miles, a separation which prevented the two groups lending one another effective support. Moreover, the divisions were much below establishment: the strength of the companies being only 70 rifles. Faulty strategy, coupled with the tactical weakness of the forces employed, resulted in the attack by the northern group of divisions on Eski Chehr being abortive, whilst the Divisions of the southern group, which had proceeded some 60 miles E. of Afiun Karahissar, ran the risk of being cut off from their base. On the termination of these operations the Greek General Staff reviewed the whole position of affairs, and prepared an appreciation of the situation; the conclusions arrived at are briefly set out by Colonel Feyler. At this juncture, Greece was threatened with isolation in the sphere of international politics ; the Western Powers offered their mediation, but as a condition precedent demanded that the region of Smyrna should be evacuated by the Greeks. The Government at Athens was not willing to comply with this condition, and replied with a non possumus. In these circumstances, it became important that the Greek Army should not meet with a reverse in its further operations. The subsequent strategic plans of the Greek General Staff were, in consequence, drawn up to meet a situation in which the dominant factor was politics, home and international. Experience had shown that it was an expensive game to attempt to drive the Kemalist soldiers from their fortified positions, and it was, in consequence, felt that a preferable course would be by manœuvre to draw the Turks out of their strong positions and, having done so, to compel them to fight in the open. Such was the philosophy which dictated the movements carried out by the Greek Army in the third phase of the campaign in Anatolia; many new problems came under the consideration of the Greek General Staff in connection with this phase of the War. Colonel Feyler calls attention to the main points connected with them in his. article, and briefly describes the plan of campaign adopted for the Greek Army : it consisted in a concentric movement of four columns, which, advancing from a base line some 125 miles long from extremity to extremity, eventually converged on to a line some 60 miles in extent in front of the centre and right of the enemy. The plan was a bold one, and in view of the fact that the several columns were for a time isolated from one another some risks were run. However, the Greek General Staff had obtained the correct measure of its enemy, and the course of

events which succeeded this move fully justify the measures adopted. Finance Arrangements of an Army.—Capt. L. J. Joyet calls attention in the original article to the large sums in cash, which under normal arrangements existing in Switzerland were withdrawn from circulation

atrangements existing in Switzerland were withdrawn from circulation and held in hand for the Swiss troops mobilized during the Great War. He points out that the interest on the money so immobilized ran into some millions of francs, and suggests that the waste this implies can be obviated by the introduction of a system of payments by cheques. He outlines a scheme to meet the situation.

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Military Bridges.—The original article consists of a review by Colonel Lecorate of an article on military bridges which appeared in the number of the *Revue du Génie Militaire* for June, 1921. The article in question has been reprinted in pamphlet form and is published by the Imprimerie Berger Levrault of Paris.

NOTES AND NEWS .- United States of America.- A special correspondent calls attention to some of the recent changes in the American Army : inter alia, it has been decided to form Tank Units in the National Guard, of which there are to be four battalions of three companies each (light tanks)... The twelve companies will be raised independently in each of the twelve States which have taken up the scheme. A movement has also been started in some of the States to raise Air Force Units in the National Guard; the First Observation Squadron, Tennessee National Guard, has already come into existence, and measures are on foot in connection with the creation of similar units in the National Guard of New York State. It is stated that by degrees, and without attracting too great public attention, measures are being introduced, the object of which is to assimilate the National Guard of the several States with the regular Army; and in the new Army organization, the National Guard Divisions will take their place side by side with the regular Divisions. As a preliminary measure, the National Guard Units have been given numbers in sequence on a general list, although they will continue to bear their former designations also.

Portugal.—Economy in military expenditure is the order of the day. The funds voted for the upkeep of the Portuguese Army have been cut down in drastic fashion, and Portugal will have to be content with an Army of four Divisions in place of the eight Divisions it has hitherto. been maintaining.

W. A. J. O'MEARA.

REVUE MILITAIRE GÉNÉRALE. October, 1921.

Albania .- By GENERAL H. SALLE .- The relations of the Jugo-Slavs, Greeks, Italians, and indirectly the remaining European powers, with Albania are intimately connected with the decisions which will be arrived at by the Conference of Ambassadors, or the Supreme Council, in regard to the future status of that country. The writer lived in Albania for fifteen months, 1917-18, as military commander and civil administrator of Goritza, for which reasons he hopes he may be considered qualified to instruct public opinion to some extent on that littleknown region. Like the rest of the Balkan Peninsula, its physical features are steep rocky mountains, intersected by tortuous valleys. None of its rivers are navigable, nor do the estuaries provide sea-ports. The few roads existing are in a deplorable state except where for military purposes certain sections have recently been repaired. The only highways are the Via Egnatia from Durazzo to Constantinople, via El Bassan, Okrida, Monastir, Salonika and Kavalla, and another running north from Santi Quaranta through Delvino, Liaskoviki and Goritza to join the former between Okrida and Monastir. Albania comprises the northern part of the ancient Epirus, the southern part of Illyria, and part

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of Macedonia. The inhabitants, in common with the Greeks, claim descent from the Pelasgians but differ from the rest of the Balkan races in language, creed, and manners and customs. Whether Bey, pasha, or herdsman, the Albanian is always a "Skipetar" or free man, recognizing no authority but the head of his clan, and, despising manual labour, is as rough and uncompromising as his own mountains.

After the defeat of Pyrrhus, king of Epirus, that country, with Illyria. submitted to Rome, roads were made through the mountains towards. the Danube, Greece and the East, and Latin colonists introduced agriculture into the valleys and plains. Various ports, amongst them, Salona (Valona) and Dyrrachium (Durazzo) sprang up, and the Albanians retreated to the mountains, to descend periodically to pillage and lay waste the plains. In the Middle Ages the Venetians used the ports in their traffic with the East. The Slavs attempted unsuccessfully to subdue the country; the Turks, who followed them, found allies who helped them to overthrow the Serbs at Kossovo, but who, under "Scanderbeg," prince of the Albanians, and as popular with Moslem as with Christian, resisted every attempt to impose on them Turkish rule. On Scanderbeg's death in 1467 the Albanians nominally submitted to Turkey but retained their own customs and laws. Many adopted the Moslemreligion, while others emigrated to Sicily or Southern Italy, but never forgot their mother-country. Francesco Crispi, the Italian statesman, was one of the latter. In adopting Islam, the Albanians did not altogether forsake their old religion and the worship of saints and Christian emblems, and in their forays respected both Moslem and Christian monasteries, even endowing them with part of their booty. Their conversion saved them their lands, and many entered the Turkish military and civil services, in which not a few rose to the highest positions owing to their bravery and intelligence. Partly as a reward for these services, partly owing to the impossibility of coercing them, the Albanians were excused the payment of taxes and compulsory military service, and enjoyed other favours. In 1878 the "Albanian League" was formed to resist the stipulations of the Berlin Congress which assigned to Montenegro certain districts in the north of Albania inhabited by the powerful tribe of Mirdites and Malissores, who in a country of Moslems and Orthodox Christians had remained Roman Catholics-external aggression alone could consolidate the various tribes.

The Turkish revolution of 1908 was at first well received, the "Committee of Union and Progress" and the Albanians being united in hatred for the reforms introduced by Abdul Hamid and the Great Powers, but when the Young Turks tried to levy taxes and take a census, the *entente* ceased. Insurrections broke out and were repressed by the Turks with characteristic cruelty. In 1912, during the Balkan War, Albania did nothing to help Turkey beyond affording asylum to the Turkish generals Ali Riza and David Pasha after their defeats by the Serbs at Kumanovo and Monastir. Essad Pasha, who was an Albanian, surrendered Scutari to the Montenegrins, and in 1913 Turkish resistance collapsed. At the Treaty of London of 1913 Albania was declared independent under the government of the Prince of Wied, who adopted the title of "Brat" or King of Albania, but his authority hardly extended beyond the outskirts of his capital of Durazzo, and even this was due to-

the influence of his Minister for War, Essad Pasha. Profiting by the weakness of the Albanian Government, the Greeks invaded Northern Epirus (Southern Albania) and, on the pretext of protecting their co-religionists, installed themselves in Goritza, pillaging and burning the Moslem villages. In December, 1914, the Prince of Wied absconded. Essad Pasha seized the government and declared for the Entente. The Greeks at Goritza permitted of direct correspondence between the emissaries of King Constantine and Austria and Germany. At the end of 1914 the Italians, before they had joined the Entente, occupied Valona, a strategic position which has been termed the Gibraltar of the Adriatic. At the end of 1915 Essad sheltered the debris of the Serbian army, and allowed of its transport by the ships of the Allies to Corfu, where it was reconstituted for services later at Salonika. The Albanians paid for their generosity by undergoing invasion by Austrians and Bul-At the end of 1916, when Constantine had shown himself a garians. declared enemy to the Allies, the French occupied Goritza, driving out the Greeks and cutting their communications with Austria, and in 1917 joined hands with the Italians who had by that time spread over the whole South of Albania. At Goritza an autonomous government was set up, the so-called "Republic of Goritza," in reality controlled by a French general and staff. As the French commander, the writer found the Albanians, with few exceptions, brave and loyal. Certainly they were given bread, employed for pay on various work, and treated with justice and honesty, methods foreign to the Greek, Austrian and Bulgarian, and it may be hoped that the French occupation will not be forgotten. After the Allied successes of 1918 the Bulgarians and Austrians were driven out of Albania; at the time of the armistice only a few French and Italian battalions remained in the country. and in 1920 the last of these were withdrawn. A provisional Albanian government was constituted at Tirana which sent representatives to the Peace Conference, and Albania has been admitted to the Society of Nations.

During their occupation of Goritza the French raised a Corps of some 800 Albanians as gendarmes, with French officers. Each company was commanded by chieftains of the clan, and all rendered good service subject to the conditions that Moslems and Christians are not intermixed in the same company, and that, if clan companies are employed side by side in the same operation, they must be led by French officers or they would turn their arms against each other, instead of showing rivalry in courage and endurance. In considering the future status of the country the social organization of the Albanians must not be lost The family is the basis ; these are united into tribes or clans, sight of. the head of which is a Bey, generally the owner of land which he can parcel out to the families of the clan. Nearly every family and clan has its private vendetta, which may be composed for a time by a very powerful chief, but is bound to break out again. Few Albanians reach an advanced age. Again, the Roman Catholic detests the Moslem, the inhabitant of the North and Centre hates the dweller in the South, Moslem abhors Christian. No clan, family, or religion seems to be capable of uniting the whole population. Essad Pasha tried to do so and fell in Paris at the hand of an assassin, whether the victim of personal vengeance or political animosity, is not known. Since Scanderbeg,
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national unity has ceased to exist, and for many years to come the national individualist mentality will oppose fusion, unless it is secured by threat of foreign invasion. The people are prolific, and owing to the poverty of the country many emigrate to the United States, where they congregate and retain their own language and customs, and send home their savings. From these considerations it seems unlikely that Albania can exist of herself, and that to acknowledge her independence is to condemn her to anarchy. Thoughtful Albanians recognize that they need assistance from one or more foreign powers to develop their ports, roads, railways and industries. Jugo-Slavs and Greeks, their neighbours, can hardly aspire to this rôle owing to their limited means and ancient antagonism to the country. The former might, however, render assistance in the North near the Montenegrin frontier, where should pass their proposed railway from the Danube to a possible terminus at Alessio or St. Jean de Medua, via the valley of the Albanian river Drin ; the Greeks covet Goritza, Argyrocastro and certain districts in the South of Albania, but the Albanians will at present listen to neither. It seems probable that America, England or France may accept a mandate, which will, however, entail a heavy outlay and lead to complications with Italy, who intends to be mistress in the Adriatic, and for this reason might be given the mandate over Albania. Italy has many interests in the country, held from 1914 to 1920 the port of Santi Quaranta, also that of Valona, the best in Albania, Delvino, Argyrocastro and all the South of Albania, where she spent much money and even opened schools where the Italian language, as well as the Albanian, was taught. The mere suggestion has awakened Albanian nationalism, and a Council of Regency was nominated at Lushina in Central Albania in opposition to the Council of Tirana, which was suspected of favouring Italy. The movement even developed into a series of assassinations, some by nationalists, some by partisans of the Italians, and then into repeated attacks on isolated Italian posts, forcing the Italians to concentrate in the coast towns which were evacuated one by one, till Valona only was garrisoned. On 2nd August, 1920, an agreement was signed at Tirana between Italy and Albania, by which the Italians definitely agreed to evacuate Valona except the island of Sasseno, which commands the harbour, and recognised the independence of Albania. The latter engaged to defend her own integrity against all foreign interference (Greek or Serb) and to assure to Italy certain economic advantages. This amounts to an apparent diplomatic triumph for Italy disguising a check to her arms; the future will show whether the evident aim of the policy, i.e., the control of the Adriatic, will find accomplishment. The full independence of Albania is now recognised ; it remains to delimit her frontiers, but the form of her government is not assured, nor her economic development. Whatever form the government takes, it seems that a commission of international control may be necessary to preserve the land from internecine feuds, support the government, protect minorities and develop its economic resources. The writer considers that if any one nation could succeed in the task it would be France, and recommends French commercial and industrial interests to make the most of their opportunities.

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