The Royal Engineers Journal.

VOL. LVII. DECEMBER, 1943.

CHATHAM:
THE INSTITUTION OF ROYAL ENGINEERS.
TELEPHONE: 2669.
AGENTS AND PRINTERS: W. & J. MACKAY AND CO., LTD.

LONDON:
HUGH REES, LTD., 47, PALL MALL, S.W.1.

All Correspondence connected with Advertisments should be addressed
THE SECRETARY, THE INSTITUTION OF ROYAL ENGINEERS,
CHATHAM, KENT.
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ALL contributions for *The R.E. Journal* from Officers on full pay (other than those serving in India), including Memoirs and Reviews, should be forwarded to the Editor as laid down in *K.R.* 547 (c) (1940), in duplicate if possible, together with a statement from the authority (if any) under whom the writer is immediately serving, that such authority has no objection to permission to publish being applied for. The Editor will then apply to the War Office for permission to publish. Articles written by officers serving in India should be submitted for permission to publish to the Commander-in-Chief in India, before despatch to the Editor.

Only very few contributions concerning recent events have been received from officers on the Active list during the last eighteen months, but it is these which are the most valuable.

Such articles enable other officers of less experience to visualize the conditions under which field engineering is carried out under war conditions, and give a clear picture of the numerous and unforeseen difficulties which arise on service through human failings, accident, enemy action, or under-estimating.

It is appreciated that officers, when in the field or out training, cannot submit articles typed in duplicate as in peace time. The editing of an article received in the form of notes, and the reproduction of rough drawings in the normal magazine form, can be done at the Secretary's office. Payment will be made for all articles accepted.

Articles from those with experience on the following subjects would be very welcome :—

Road Work.
Bridging.
Reconnaissance problems, including the use of air photography.
Mining.
Airfield Construction.
Use of Mechanical Equipment.
Works Problems, overseas and at home.
Organization of work with native labour overseas.
Demolitions.
Training of Airborne R.E.
Engineer organization, including works in formations and units.
Engineer Stores.
Water Supply.
Geology and Geophysics.

Even though it prove impossible to pass all articles through the Censor's office for immediate publication, they will have great value after the war.

Articles are none the less desirable because they raise matters which are controversial. *The R.E. Journal* is in no sense a text book.

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EARL KITCHENER.

The above photograph, by Bourne and Shepherd, India, was taken when Earl Kitchener was Commander-in-Chief in India, and is reproduced from a copy kindly placed at our disposal by Major-General H. Mullaly, C.B., C.S.I., R.E., Garrison Commander, Thames and Medway.

Earl Kitchener

KITCHENER—THE MAN.

By LIEUT.-COLONEL E. W. C. SANDES, D.S.O., M.C., R.E. *(retd.)*

BORN near Listowel in Kerry on 24th June, 1850, Horatio Herbert Kitchener died on 5th June, 1916, when *H.M.S. Hampshire* struck a mine off the Orkneys and sank with all but 13 hands—a tragic event in which England lost one of her most famous soldier-administrators, and the Corps of Royal Engineers its most distinguished Field Marshal since Lord Napier of Magdala.

To the general public, " K. of K." was always an enigma. He appeared as a majestic personality, aloof and inaccessible, a man of ruthless action in the field and autocratic bearing in the council chamber. He was thought to be hard and unsympathetic, impervious to sentiment and pity, one who had little regard for life, who ruled with an iron hand, who could be turned by nobody from the course on which he had decided ; a man, in fact, to be honoured and admired for his gifts and accomplishments, but not loved for what he was. Such an atmosphere often surrounds the unknown and it enveloped Kitchener to the end of his days. Accordingly, I propose to present the man as he appeared to some of his most intimate associates and those who really touched his life at any point, and thus to dispel a few popular illusions.

Kitchener's personal appearance supported the common conception or misconception of his character. As I saw him in 1904, he certainly inspired awe. Over six feet in height, square-headed and massive about the shoulders, his general aspect was striking, and the impression was heightened by the impassivity of his face from which a stranger could gather nothing. A slight cast in his left eye, caused by an accident while a child, increased the difficulty of judging his thoughts, though it is said that his intimate friends could form their own conclusions by watching that eye, in which the cast increased if he were troubled or annoyed. In 1904, Kitchener came to Secunderabad as Commander-in-Chief in India to inspect the garrison under Brigadier-General Sir James Willcocks, after I, as a young Garrison Engineer, had been warned on the previous afternoon that he had broken a leg in a riding accident at Simla and would be unable to mount his charger. I set two carpenters to work and by dawn they had made a small table with a hinged ladder to serve as a mounting block. This was produced on parade, and Kitchener hobbled from his carriage and mounted it. Nothing, however, would induce the charger to approach the table, and, with K's popular reputation in mind, my heart sank into my boots. The horse circled round and round the table and K. pivoted to watch it. Never was I more agreeably surprised than when he smiled, made some jocular remark, descended the ladder and was hoisted on to the charger by his Staff.

After the parade he visited the military hospital, where he noticed some curious markings on a stone-flagged verandah floor and asked Willcocks to explain them. Willcocks did not know, the Brigade Major would not even attempt a guess, and accordingly a shout was raised for the R.E. Officer and I was pushed to the front from the end of the procession. " What has caused these marks ? " said K. looking at me with one eye and not quite at me with the other, which I found very disconcerting. " Weather, Sir," I replied promptly, knowing that some reply must be given at once though I had no

more idea of the cause than he. "Ah!" said K. and passed on apparently satisfied. I discovered afterwards that the markings were made by swirling sand and so my guess was correct; but my chief recollection of the incident is the relief I felt when swallowed up once more in the crowd, for in spite of his geniality on parade that morning, my conception of the great soldier was still based on the popular idea that he was severity personified.

My meeting with Kitchener in 1904 had a curious sequel in 1935 when I was motoring with a friend along a desert track in the Sudan to visit the deserted city of Berber on the Nile. On our way we picked up the headman of New Berber, who seemed interested in me and entered into voluble conversation with our Sudanese driver. On the previous day the driver had discovered that I belonged to the same Corps as Kitchener and had met him on one occasion, and with Oriental embellishment he now proceeded to inform the headman that I was, in fact, an intimate friend of the late Sirdar. When we alighted in New Berber the headman studied me carefully from top to toe and then remarked in Arabic "No. He is no friend of the great Sirdar. He *is* the Sirdar." Having little resemblance to Kitchener, except in height and colour of eyes, I hastened to disclaim the honour, explaining that I was merely a *Kai-makam* (Lieut.-Colonel) of Kitchener's Corps who had met him once and talked with him. But the headman would take no denial. "I saw the Sirdar often in Berber in 1898 when I was a boy," said he, "and Your Excellency cannot deceive me," and, turning to the bystanders, he announced that Kitchener had returned to Berber. The news spread with alarming rapidity and I had to undergo the ordeal of much embarrassing adulation before we could make our escape by car to Old Berber.

Perhaps the best portrait of Kitchener is that given by Sir George Arthur who was his Private Secretary from 1914 to 1916 and had known him since the days of the Nile Expedition. "Excelling as he did as soldier and statesman," writes Sir George,* "as administrator and diplomat, as linguist and archæologist, and proving his worth in other vocations, it is yet arguable whether any single element in his character, or any event in his career, stands out so boldly as to explain a domination which, without effort or intention, he exercised not only over those in close contact with him but over millions whom he never saw. It is perhaps true that a singularly happy combination of noble qualities, a singularly fine record of notable achievements, made him the least ordinary of men, but behind all this was the man himself. No one could leave his company without the impression of a personality majestically solitary in an inexplicable distinction . . . . . Kitchener's mind was as infinitely broad as it was accurately precise. For this man nothing was too small, nothing too large, nothing too distant . . . . . For him everything was dross compared with public duty. Rigorous with himself, he was not inclined to be less exacting with others. Good work never lacked his approval, but it was for the most part silent approval. If there was little praise, there was infinite trust, and to those who served him the Chief gave loyalty as illimitable as he expected from them. . . . Although he disliked most social engagements, he still more disliked being entirely alone. . . . The deep seriousness of his disposition was lightened by a genuine sense of fun and a keen eye for the ridiculous. . . . He was ever reluctant to believe that an attack on himself could proceed from malice. Sensitive by nature, he had schooled himself, through long years, to be stoical under criticism. He welcomed all and any criticism from which something could be learned, but mere denunciation broke unavailing on his stately reserve. His life was based on religion in the primary sense of the word, and the sacramental truths in which he had steeped himself in early youth

*Extracts from *Life of Lord Kitchener* by Sir George Arthur, M.V.O., Vol. III, pp. 363-372.

must have instilled in him the reverence in which he held all sacred things. . . . It was said—and with perfect truth—of Kitchener that in life he knew no rest and in death he found no grave."

Kitchener was a good soldier and a capable engineer, though more experienced as a surveyor. His engineering ability showed itself from time to time, as for instance in 1899 when he was directing the re-planning and rebuilding of devastated Khartoum. On one occasion, when his Director of Works had submitted a design for a large building, he opened a drawer and produced a plan of his own on which he must have worked for many hours. He was interested also in telegraph and railway work. He issued his orders and then left his subordinates to carry out his instructions, but he often surprised them by his knowledge of their work and was always ready with advice when consulted. During the Dongola campaign his young Director of Telegraphs was puzzled as to the best method of loading long coils of telegraph wire on to donkeys. Kitchener solved the problem for him by backing a donkey until its hind legs were within the coil and then hoisting the coil over its rump so that it could trot away quite happily encircled by the coil. His efficiency as a surveyor is shown by his work in Palestine from 1874 to 1877 and in Cyprus from 1878 to 1883, during which periods he developed his passion for collecting art treasures.

As an administrator, Kitchener showed a keen insight into the immediate problems of ruling a turbulent and recently re-conquered Sudan, though his procedure was too " rough and ready " to suit his superior, Lord Cromer. " My Sirdar's very drastic method of dealing with civil affairs is a never-ending source of amusement to me " wrote Cromer in 1899. " The other day I told him that land speculators in Egypt were sending money to Greeks in the Sudan in order to make purchases, and that some little care was necessary as there was at present no legal means of acquiring a valid title. He replied that he abounded in my view—and would I like him to expel every Greek from the country who bought or sold anything without his consent ? " Kitchener favoured a patriarchal and autocratic form of government, and in furtherance of this policy he was always readily accessible to the people he ruled. On his arrival in Suakin in 1886 as Governor-General of the Red Sea Littoral his first care was to establish better relations with the local tribes. " I have written upon the gate of Suakin ' Peace be to those who enter and who leave this place,' " said he. He invited friendly Sheikhs to come and see him : he gave salutary warnings and good advice to the hostile. Yet his conciliatory policy was always tempered by strong action if occasion demanded, for he knew that conciliation is often interpreted as weakness. Later, in the Sudan, he instructed his subordinates that their first duty was to acquire the confidence of the people, and thus secure the moral and industrial regeneration of the conquered territory. He visited as many districts as possible, gave audiences, heard complaints, established local authorities and rewarded fidelity with honours. As British Agent in Egypt before the Great War of 1914-1918 he pursued his normal policy of friendly autocracy so far as was compatible with the growth of self-government and some rivalry between religious creeds. But his eye was always on the poor and needy. Being keenly interested in Agriculture, his policy was framed chiefly to promote the material welfare of the down-trodden *fellaheen*, and this he achieved with marked success through his " Five-Feddan " Law. In the opinion of Lord Esher, he displayed all the highest attributes of a constructive administrator, a clear sense of objective, undivergent resolve ; flexible methods and patience. He seemed to be almost unduly sensitive to giving pain, even to those who served him badly, if they had worked to the best of their ability, but for carelessness or neglect of duty he had no pity. Once he had made up his mind that some end had to be

reached, few could turn him from his purpose. Intellectual courage was perhaps his greatest asset in civil administration.

But Kitchener possessed physical courage and resource equal to his intellectual courage. During the Franco-Prussian War, Kitchener and a friend—later Sir Henry Dawson—while cadets at Woolwich, offered their military services to France. They went to that country without permission and were appointed to the Army of the Loire, which was composed largely of Guardes Mobiles. While ballooning with a French officer at Laval, Kitchener caught a chill which developed into pneumonia and nearly cost him his life, his recovery being retarded by the fear that he might not have the strength to be a soldier. His share in the actual fighting was thus very limited, but his daring appealed to the French and in 1913 the Republic conferred on him the medal for the campaign of 1870. On his return to England, young Kitchener found that his alleged breach of discipline had been taken seriously and he was ordered to report himself at the Horse Guards. Brought into the awe-inspiring presence of the Duke of Cambridge, he was severely reprimanded and warned that he might lose his chance of a commission, but at the end of his tirade the Commander-in-Chief murmured "I am bound to say, however, that in your place I should have done the same."

We read that, when the Palestine Survey party was attacked by a gang of Arabs near the Sea of Galilee in 1876, Kitchener engaged one of the men in single combat, amid showers of stones from the others, and thus saved the life of a brother officer. At that time he is described as tall, slim and vigorous; a frank and most outspoken character, with high spirits and an astonishing ardour for work. We find him a few years later, disguised as a Levantine and engaged in spying out Arabi's defences at Zagazig in Egypt when discovery meant certain death. He had repeated in some respects his earlier escapade by leaving Cyprus without permission and voyaging to Alexandria, where he hoped to see some fighting instead of working a theodolite. The result was a peremptory recall to answer a charge of being absent without leave, but nevertheless the initiative and courage which he showed while serving for a few weeks under Sir Garnet Wolseley helped to secure his appointment to the Egyptian Army in 1883. At the end of July, 1884, he set out from Korosko as a Political Officer to reach Dongola, through country infested with Dervishes. He was dressed as an Arab and accompanied only by a few Sheikhs of the Ababda tribe, though on the advice of the Mudir of Dongola, and with excellent political effect, he reverted to uniform before reaching his destination. The mission was considered to be so dangerous that an Egyptian officer had asked for a reward of £10,000 before attempting it. Established finally at Ed Debba, Kitchener reconnoitred routes for the advance of the Nile Expedition, carrying with him always a small bottle of poison to be used if capture and torture seemed imminent. His resource as a Political Officer is illustrated by the following incident. Two Arab spies had been caught and confined in a tent. They pretended to be deaf and Kitchener could get nothing from them. Soon afterwards, another spy was captured and pushed into the tent. The three started to talk freely and later the third spy asked to be taken to headquarters. This was done, and the third spy then revealed himself as Kitchener, whose Arabic was sufficiently fluent to pass muster in polyglot company. His talent for disguise was so extraordinary that a soldier once flung a stone at him thinking he was a prowling Arab. In September, 1913, his personal courage was shown once more after a plot against his life had been hatched in Egypt. He was to be murdered at Venice while returning from leave in England, but although he heard of this design when in Italy he refused to alter his plans. He went to Venice and his visit passed without incident.

Kitchener was by nature, or became by force of circumstances, a profound

The above reproduction is from a photograph by Elliot & Fry of EARL KITCHENER when he was a subaltern in "C" Telegraph Troop, 1873, which has been kindly placed at our disposal by Brig.-General A. H. Cowie and Officers of the Corps at Aldershot.

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FIELD-MARSHAL EARL H. H. KITCHENER OF KHARTOUM AND OF THE VAAL AND ASPALL, K.P., G.C.B., O.M., G.C.S.I., G.C.M.G., G.C.I.E.
(As a Major-General about 1900.)

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economist. Unless personal expenditure was politically or socially advisable he preferred to spend little on himself except in persuit of his hobby of collecting art treasures, in which, after the manner of many ardent collectors, he showed marked acquisitiveness tempered by generosity. In securing works of art, he was prepared to be as lavish as the situation might demand. His natural frugality may have been fostered by the extreme thrift forced upon him by the Egyptian Treasury before and during his campaigns on the Nile. " Lord Kitchener won his well-deserved peerage because he was an excellent man of business " wrote Cromer. " He looked carefully after every important detail and enforced economy." It is recorded that as soon as Kitchener became Sirdar of the Egyptian Army in 1892 he began to husband the slender resources available. Nothing was discarded till it fell almost to pieces. Equipment was repaired again and again. Europe was scoured for cheap fabrics for uniforms, and factories were established in Cairo to compete with imported goods. The length to which Kitchener was prepared to go in his policy of retrenchment is illustrated by his treatment of some battalion commanders at Suakin. In August, 1893, these officers asked him that, for convenience of accounts, clothing should be issued to their men in January and July each year instead of in March and September. " Very good " said K., and ordered that the next issue should be in January, thus avoiding the normal issue in September. In the following June the disappointed commanders applied for a reversion to the original system. K. said he would consider the application and shelved the matter until September, when he agreed to the reversion and remarked naïvely that, as the next issue under the original system would not be due until March, *two* issues of clothing would have been saved, which was very satisfactory ! And so it was, except to the unfortunate battalion commanders and their men. From such experiences the Sirdar's subordinates got to know that little or no money could be expected for any new project. Their wits must supply the means. Bound by rigid financial rules, the Sirdar could not accord official sanction, but his officers discovered that he was not too particular as to the methods employed provided the work was done, and he was always ready to help an ingenious and trusted subordinate in throwing dust in the financial eye.

During a tour in Africa in 1910-11 Kitchener re-visited Khartoum, where he was welcomed by Sir Reginald Wingate, the Governor-General, and when the latter suggested that there should be a monument to him in the capital of the Sudan, he enquired whether a replica of a bronze equestrian statue would be acceptable, as this could be made from one which was being cast by a London firm for erection in Calcutta. Sir Reginald was delighted, and K. said he would arrange the matter. The result, however, was the receipt from an Indian Committee of an estimate amounting to some thousands of pounds, for which there were no funds. But Sir Reginald was equal to the occasion. He despatched to the London firm several tons of brass ingots made from cartridge cases gathered from local battlefields which, if mixed with tin, would form a suitable bronze, and the firm generously undertook to cast the replica and send it to Khartoum free of cost. There is a story that on its arrival in Khartoum after many adventures a notification was received in the usual form that a ' parcel ' was available for collection at the Post Office and consequently an orderly was sent on a bicycle to take delivery ! In this unobtrusive fashion the statue reached Khartoum and was erected on the bank of the Blue Nile in 1921. It had cost Kitchener nothing, and the Sudan Government only £700.

On occasion, Kitchener showed considerable finesse. Before the Dongola campaign in 1896 he was considering an alternative line of advance from the Red Sea coast, and much of the work which he initiated at Suakin was designed

for that purpose, though undertaken nominally to improve the existing accommodation. For example, he directed that a new prison should be built by convict labour at Suakin and insisted that it should be on the water's edge and that the rooms should be large, as he wished the prisoners to be comfortable. But when he came to see the finished work he showed disapproval. " I don't like this building " said he. " The convicts must build another on more healthy ground outside the walls of the town. This one will make an excellent Supply and Ordnance Store." Thus he got his Store for nothing and without sanction from Cairo.

His adroitness, however, once landed him in a difficult situation. When on leave after the Dongola campaign he was commanded to Balmoral Castle for a short visit and told to bring with him a number of relics of the battlefields which Queen Victoria wished to see. After dinner the Queen asked him to relate the histories of all these trophies. Now it so happened that Kitchener had never set eyes on the things till that moment, but he rose gallantly to the occasion and, drawing on his imagination, invented a thrilling story for every sword, spear, drum and suit of mail. Queen Victoria listened with rapt attention to the long recital and afterwards Kitchener retired for the night well pleased with himself. As he was undressing, however, an Equerry knocked at his door and said, " Her Majesty asks that you will kindly write down all that you have told her," and so the unfortunate Sirdar had to enlist the help of the Equerry and sit up half the night trying to recollect what had been said, for he knew that the Queen had an excellent memory.

Kitchener's dislike of publicity, and consequently of the activities of War Correspondents, is well known. It brought him unpopularity with the Press. The correspondents, whose presence in the theatre of war was only grudgingly tolerated, were forbidden in 1896 to proceed beyond rail-head, and even when this rule was relaxed they were prohibited from approaching the Sirdar himself. Gradually, as Kitchener came to know them better and trusted them more, their position improved, and in November, 1897, he made use of them for his own ends. He was intent on pushing forward the desert railway from Wadi Halfa for the final advance on Khartoum, and rail-head was still far short of Berber. A technical officer reported to him one day that excellent facilities existed for building an alternative line from the Nile at Atbara, through Sinkat, to Suakin. " Keep that to yourself " said K. " Don't say a word to the War Correspondents. We need all our money for the line from Wadi Halfa, so I have sent the correspondents over the Sinkat route in order that they may report how utterly *impossible* it is to build a railway to Suakin." The correspondents duly reported to that effect and, with the support of public opinion, the Sirdar was safe against interference with his own plan of extending the railway to Berber and thence to Atbara.

At about this period Kitchener defeated, with some cleverness, a scheme to supersede him in the chief command because his Egyptian Army force was to be strengthened by the addition of British troops for the advance on Khartoum. He gambled on his reputation and won. He was being harassed by the Financial Adviser, who was urging him continually to effect further economies and wished to tie him down to a definite sum of £200,000 for all expenditure on the campaign, foreseen or unforeseen. " I do not think I can stand much more " wrote Kitchener. " I feel sometimes so completely done up that I can hardly go on and wish I were dead." The last straw was an order to find a garrison for Kassala without extra expense. It drew from Kitchener a dispatch to Cromer which ended " Feeling, as I do, my inability to cope with the difficulties and grave responsibilities of the position in which I find myself, I beg to tender my resignation to your Lordship." His iron constitution and indomitable will were strained almost to breaking point, but there can be little doubt

that he judged rightly that his services were too valuable to be lost, and that his resignation would not be accepted. His estimate of the situation was correct. Cromer refused to forward his resignation, eased him of petty financial inflictions and restored his peace of mind. And thus, by staking his career on Cromer's decision, Kitchener shelved the project for his supersession by a British Army commander and at the same time relieved himself of many financial worries. This was not the first occasion on which he had tendered his resignation as a protest. He had done so to the Khedive Abbas Hilmi in what came to be known as the "Wadi Halfa Incident," when he considered that the Khedive's remarks at a military review were derogatory to the Egyptian Army troops on parade and reflected on him as their commander. This drastic action caused Abbas Hilmi to withdraw his remarks after Lord Cromer had heard the details of the incident.

A curious instance of temporary indecision, so foreign to Kitchener, is apparent when he tried to induce Lord Cromer, who had done no soldiering for many years, to express an opinion on a question of pure strategy and thus to share with him the responsibility for success or failure. The occasion was the projected attack in April, 1898, on the Dervish leader, Mahmud, who was entrenched on the bank of the Nile above Atbara. "Yesterday I discussed it with Generals Gatacre and Hunter" wrote Kitchener. "The former was inclined to attack Mahmud's present position; the latter to wait here. We should have great advantage of ground if Mahmud would advance; but if he retires without our attacking him, the opportunity will have been lost of dealing a blow by which future resistance in the Sudan would probably be considerably affected. I have little doubt of the success of our attack on his present entrenched position, though it would probably entail considerable loss. I have decided not to change my present policy for three days, before which something will, I hope, be known. I shall be glad to learn your views on the subject."

Now why did Kitchener ask for Cromer's views? Perhaps he considered that, as he now had British Army troops under his command, the concurrence of the commander of the British Army of Occupation in Egypt should be obtained, through Cromer, before these troops were committed to a bloody battle; but it seems more probable that he wished merely to secure the support of Lord Cromer before putting his fortune to the test. However, that astute diplomat was not to be drawn. Cromer sent a guarded reply, enumerating the arguments for and against attack and advising the Sirdar to await developments. The message crossed another from Kitchener announcing that he had now decided to attack; but when Cromer's message reached him, Kitchener altered his plans again and resolved to postpone his attack and advance cautiously and he informed Cromer to that effect. His fleeting vacillation had passed. He assaulted the Dervish position and overwhelmed Mahmud on 8th April, 1898, in the battle of Atbara. It seems that his indecision before Atbara was such that he had also consulted Lord Salisbury, who wrote that the British Government would offer no opinion but would support him in whatever course he took. Lord Salisbury added that, if Kitchener were superseded, the Cabinet would have to find another Prime Minister.

It might be thought that Kitchener, being resolute and dogmatic by nature, would be averse to criticism and advice; but this was not the case provided that the criticism was justifiable and offered in the right manner, and the advice helpful and given by the right person. He never ceased to learn, and would listen with exemplary patience to anyone whose ability he recognized. Such a person was Lieutenant E. P. C. Girouard, R.E., his young Director of Railways in the Sudan, who was permitted extraordinary latitude. Girouard was a French Canadian who had no respect whatever for rank but was loved by all for his geniality and admired for his mastery of his profession. It is

related of him that at his first interview with the Adjutant-General at the War Office he offered his left hand to shake and, when the A.-G. enquired sympathetically whether he had hurt his right hand, produced from behind his back a well-licked stump of tobacco and replied "No. Only a *seegar*." Between Kitchener and Girouard there was a bond of mutual understanding. The Sirdar liked a man who was not afraid to speak his mind, and he learned many home truths from his Canadian assistant. For instance, on one occasion during the Dongola campaign, he was in such a hurry to get on that he mounted the footplate of a locomotive, shunted the train himself, left part of it behind and then told the driver to take charge and "Go like Hell." He completed the journey in record time over a corkscrew line; but at the end of it he said to Girouard "What a dreadful journey we have had! Terrible, Girouard! Terrible!" and the Canadian answered "Yes. You will break the record one day *and* your own neck."

Although Kitchener usually asked Girouard for advice on everything connected with railways, he acted occasionally on his own initiative and without consulting his laconic and outspoken subordinate, as happened when he placed an order, while in England, for six locomotives for the projected railway from Wadi Halfa across the Nubian Desert. Cross-examination by Girouard after the Sirdar's return to the Sudan showed that the locomotives were unsuitable. "How much money have you got?" asked the Canadian. Kitchener quoted a figure, probably a conservative one. "Then you had better send me to England at once to order proper material" said Girouard; and to England he went, being seen off by Kitchener with the injunction "Don't spend too much, Girouard. Remember we are terribly poor." It is well, perhaps, that this warning was given, for Girouard had large ideas. Only three years later, having been appointed Director of Railways for the South African War, Girouard demanded from the War Office an initial credit of £50,000 for the necessary stores. Within a fortnight he was told by the Treasury that only £5,000 had been allotted. "That's a pity", said he. "I have already placed orders for £300,000 and am asking for another £150,000 to-morrow." Marvellous to relate, his demands were met in full. Such was Girouard, Kitchener's favourite adviser and highly privileged critic.

While British Agent and Consul General in Egypt before the Great War of 1914-18 Kitchener was always ready to gather information, and accept criticism, from a certain elderly Egyptian Princess who lived in Cairo. She had known him for many years and treated him with scant respect, pouring forth a torrent of questions news and advice, to which he listened with great good humour and from which he derived valuable knowledge of the machinations of the Khedive Abbas Hilmi. Kitchener's attitude towards women in particular and society in general was somewhat peculiar. A confirmed bachelor, he was shy in the presence of women who were strangers to him, but he enjoyed meeting those he had known long and well, provided that they were intelligent or entertaining. With these he would laugh, joke and even indulge in quiet repartee. His popular reputation as a woman-hater may be attributed in part to his refusal, while Sirdar of the Egyptian Army, to allow any of his young British officers to marry or even to become engaged, a restriction imposed purely in the interests of efficiency and instant readiness to take the field. The type of woman whom Kitchener abhorred was the sycophant seeking advancement for her husband or friend; and it is thought that he deliberately encouraged the popular conception that he was a misogynist to protect himself from such persons. Female society might entail frequent attendance at social functions, which Kitchener disliked. He preferred to meet congenial male companions under less formal conditions. Yet he could be an interesting and fluent conversationalist in feminine society when occasion demanded, as

Queen Victoria recorded when she wrote in October, 1898, " I saw the Sirdar, Lord Kitchener, who only arrived in London a few days ago. I spoke to him of all that had passed and how well everything had gone off. He was very agreeable and full of information." On the other hand Kitchener was described in 1884 by Bennet Burleigh, the War Correspondent, as a listener rather than a talker, though readily giving an opinion if called for, so it seems that his conversational powers must have improved with age and experience.

He disliked being "lionized." Nevertheless, as the recent victor of Omdurman, he attended in 1898 a succession of banquets and receptions in England. He accepted a Sword of Honour and the freedoms of the cities of London and Edinburgh. He was the guest of honour at a Corps Dinner at Chatham, arriving by special train and driving with the Mayor and Corporation through streets lined with troops and spanned by triumphal arches. In fact, he lived for a brief period in a positive blaze of publicity and under a shower of honours. It is difficult to say why he consented to do so, for he had little or no tendency to self-glorification though he possessed a natural pride in his achievements. Possibly he was actuated by a sense of duty to his Sovereign and the people. However, he turned his popularity to good account on behalf of the Sudan by appealing for and obtaining a sum of no less than £100,000 towards the erection of a college in Khartoum in memory of Gordon. None knew better than he the value of properly staged ceremony and display, particularly in the East, and towards the end of his career he used that knowledge as effectively as Lord Curzon had done in India. When he arrived in Egypt in September, 1911, as British Agent and Consul General he came in no such unpretentious style as would have sufficed his predecessor, Sir Eldon Gorst. He landed from a cruiser and reached Cairo by special train. British officials were required to attend at the railway station in top-hats and frock coats. All the Ministers of Foreign Powers were there, in addition to the Members of the Egyptian Cabinet and numbers of Egyptian officials and leading business men. A Guard of Honour presented arms and a band played the National Anthem as he stepped from his carriage to the carpeted platform. It was all very grand and all utterly unlike the Kitchener of the Sudan deserts. And throughout his period of administration in Egypt he maintained a similar regal state. Gorgeously clothed *syces* ran before his carriage when he drove through the streets. His household servants were resplendent in gold-decked Turkish costumes. He entertained lavishly and added accommodation to the Agency, which was always crowded with callers anxious to remind him of their existence. His purpose is clear. By such display he restored a waning British prestige to the pinnacle it had attained under Cromer, and at the same time, by heightening his own standing in the public estimation, he facilitated the fulfilment of his administrative duties and simplified his task of frustrating many intrigues in Egyptian court circles.

The determination shown by Kitchener in his efforts to suppress subversive political movements placed his life in danger, but he paid little regard to warnings given by the Cairo police until an attempt was made to assassinate him in July 1912, and the existence of a secret society directed against the Government was disclosed. As already related, a further attempt was planned to be made in Venice, but nothing came of it. He had friends among all classes of the population in Cairo and consequently many underground sources of information to supplement the occasional news conveyed to him by the Egyptian Princess and reports made by the police ; and thanks to his fluency in colloquial Arabic, and easy approachability, he was kept fully informed not only of local intrigues but of illegal dealings in outlying districts. There is a story that a village headman once told him that a certain influential Egyptian had

made £20,000 through a dishonest transaction. Kitchener listened without comment and then produced a notebook from his pocket and turned over a few pages, "Ah!" said he. "I think you are mistaken. The actual amount was £23,000."

In the battles of Atbara and Omdurman, and later at Paardeberg in South Africa, Kitchener showed that he could force himself to be ruthless when occasion demanded; and after Omdurman he approved the destruction of the Madhi's Tomb—an act which aroused consternation in certain circles—but in each case he considered that drastic measures were necessary and consequently he did not hesitate to take them. At Paardeberg he foresaw that if he assaulted the Boer laager he would lose hundreds of men, but that if he invested it he would lose thousands from sickness. Hence he steeled his heart and gave the order for immediate attack. His grief over wounds and death sometimes brought tears to his eyes. The anticipation of the probable losses in the attack on Gallipoli in the Great War caused him sleepless nights, and later he insisted that his Government car should be used to transport wounded men in London. Nevertheless, though essentially humane, he displayed at times a hardness which was somewhat disconcerting. At Wadi Halfa in 1896 he asked the manager of the local Railway Workshops why a certain heavy locomotive was out of action. The manager replied that the boiler had cracked again and was dangerous. "What a pity" remarked K. "That engine could take a large train-load of supplies across the desert. After all, we aren't particular to a man or two!" Again, in 1899, after he had ordered his Director of Telegraphs to extend the telegraph system southwards from Khartoum and had warned him that it must cost nothing and that no transport could be given, he added "I know that the natives around Goz Abu Guma are starving, so you can get as many as you like for a handful of grain a day. As to transport, you can go a little way up the White Nile and seize the first native boat you happen to meet. The line will be finished before the complaint reaches me." While Governor-General in the Sudan he drew up a civil ordinance under which any man found wandering without visible means of making an honest livelihood was summarily arrested and made to work for Government, a procedure reminiscent of the press-gang. These are a few typical examples of his iron-handed methods of administration which may, however, have been justified by the circumstances.

Kitchener never blustered and never hurried. His movements were deliberate and he weighed his words. Yet on occasion he could be caustic. It is recorded that when he entered the War Office as Secretary of State for War on 6th August, 1914, he remarked "Dear me! What a War Office! Not a scrap of Army and not a pen that will write!"

Though endowed with ample commonsense and sound judgment, Kitchener was not infallible, and, if economy were involved, he could show an obstinacy which sometimes landed him in difficulties. For instance, in August, 1898, his Director of Telegraphs had to establish communication across the Nile at Atbara and the cable supplied was found to be 60 yards short even of the estimated length of 1,200 yards which the Sirdar had deemed sufficient after getting a Survey officer to check it. The Director and the Survey officer had quite rightly allowed for the height of the banks, depth of water, irregularities of bottom and the impossibility of laying the cable straight from shore to shore and had finally added 5% for contingencies; but Kitchener, after examining the calculations, had insisted that the cable *must* be laid straight and had struck out the 5%. The attempt to lay the cable began. The ship could not steam properly against the swift current and went across the river in a wide curve, Soon it was apparent that the cable would never reach the far bank and an attempt was made to anchor; but before the anchor could get a grip the last

turn of the cable had gone overboard, and for the remainder of the morning the Sirdar was unapproachable.

Accustomed to rough and ready soldiering with poor equipment and little money, Kitchener always refused to be bound too closely by rules and regulations. Red tape found no welcome in his office and any waste of time on unnecessary official returns was anathema. "Don't quote regulations to me" said he. "They are made for the guidance of fools." He disliked correspondence and rarely altered a letter submitted for his signature. If he disapproved of the wording, he preferred to re-write the entire letter himself. Yet sometimes he undertook voluntary literary work. In 1875, for example, while recovering from fever contracted in Palestine, he produced his only publication, a small volume entitled *Lieutenant Kitchener's Guinea Book of Photographs of Biblical Sites*, and in 1885 he wrote an article for *The R.E. Journal* on the fall of Khartoum. His view of regulations was that they should at least be interpreted with common sense. One day in 1898 the captain of the gunboat *Malik* protested to him against the loading of the ship until her Plimsoll mark was submerged. The Sirdar eyed him coldly. "Plimsoll's dead" said he. But perhaps his attitude towards rules and regulations is best illustrated by his method of recruiting officers for the Egyptian Army. Nothing could be more informal, nor more fully justified by the results. Candidates were interviewed in a small room in the Junior United Service Club and, if approved, were certain of appointment. There were no Selection Boards, no examinations—the Sirdar was the sole arbiter. In November, 1898, while dining in the R.E. Mess at Aldershot, Kitchener heard good reports of a subaltern in the 17th Field Company, R.E., so he sent for him after dinner and asked him point-blank whether he would like to go to the Sudan for telegraph work. The youngster jumped at the chance and soon afterwards received official orders from the War Office, but so rapidly had the selection been made that when he reported himself at Egyptian Army Headquarters in Cairo he was told that nothing was known of him or his appointment. Permission, however, was given to him to proceed up the Nile and he soon reached Khartoum to grapple with the problem of erecting hundreds of miles of telegraph line without material and without cost.

Kitchener had little faith in examinations, though he recognized the value of the Staff College and the necessity for an examination for entry to it. Captain A. G. Hunter-Weston, R.E., who joined his staff during the Dongola campaign, was urged by him to try for entry as soon as possible and duly qualified under most unorthodox conditions. "From time to time" he writes, "I was given a paper, and without any preparation—for there were no text-books—I had to attempt to answer the questions while sitting in a small tent, covered with sweat which dropped on to my dust-covered table and formed mud." Again, when a certain R.E. subaltern at Khartoum was due to qualify for promotion in 1899, the procedure was even more informal. He had to submit an "Active Service Project"; so Kitchener, who was well aware that the lad was fit for promotion, sent for him, showed him some previous projects, and told him to set himself a suitable one. This he did, and passed with flying colours!

Marked unselfishness was shown by Kitchener in his care for the future of his chosen subordinates, and in return for the support he gave them, he expected and received their loyalty and devotion. He was a staunch friend, if a hard taskmaster. "Give a man rather more than you think he can manage and nine times out of ten he will do it" said he, and acted on that assumption; but if he heard that an officer was tired and over-worked he would insist on his taking leave. The eight R.E. subalterns, known as the "Band of Boys," who served him so well in the Dongola, Atbara and Omdurman campaigns,

were objects of his particular solicitude. Most of them rose to be Generals, and all who survived had notable careers. Whenever military operations were imminent, Kitchener ordered them up from the lines of communication and attached them to the Staff as "gallopers" so that they should have a chance to distinguish themselves in the field. These outings came to be known as "week-ends at the front." The practice was defensible because few technical units were available and the engineer officers could give useful advice to infantry commanders. Kitchener never attempted to keep an officer, however efficient, if by so doing he would prejudice his career. In June, 1898, Lord Cromer offered Girouard the highly paid appointment of President of the Egyptian State Railways, and Kitchener, with fine generosity, urged Girouard to accept the offer though the Canadian was his chief adviser on railway work in the Sudan. Reluctantly, Girouard agreed and departed for Cairo, thus severing his connection with the Sudan and with Kitchener himself until they met in the South African War.

Normally impassive and imperturbable, Kitchener displayed at times the deepest emotion. When the gunboat *Zafir* had been brought in sections over the Kerma Railway to Kosha during the Dongola campaign and had been laboriously assembled, launched and fitted, Kitchener embarked for a trial trip; but hardly had the stern wheel begun to revolve than a cylinder burst with a violent explosion and the *Zafir* was out of action. Kitchener had set his heart on this ship, and the disaster upset him so much that he retired to his tent and was not seen for hours. Again, at the moving memorial ceremony outside Gordon's ruined palace in Khartoum on 4th September, 1898, when the final cadences of Gordon's favourite hymn "Abide with me" had sunk into silence over the Blue Nile, the Sirdar was visibly affected by the solemnity and pathos of the situation and showed that a very human heart beat within his breast.

A childhood spent in Ireland seems to have bequeathed to him an Irish sense of humour which revealed itself on occasion. He could appreciate the point of a joke against himself and could derive much amusement from it if it was presented tactfully at the right moment. In 1892 his staff in Cairo drew up secretly a facetious list of maxims for newcomers. "Never write anything" it ran. "If you want something done, catch the Adjutant-General—he is sure to be here tomorrow. If you want leave, catch the Sirdar. If you *get* leave, go home and take care never to come back." And then the unexpected happened. The Sirdar came in and found a copy. He studied it slowly and carefully. "Very sound" he remarked, and promptly initialled it. A few years later an incident occurred which amused him greatly when he heard of it. He had been wounded in the neck during a skirmish near Handub on the Red Sea Coast, and a brother officer came to see him in hospital in Cairo. While they were talking, he had a fit of coughing and said he had swallowed something, so the doctor prescribed a large dose of castor oil and hoped for the best. Now Queen Victoria was greatly concerned about Kitchener, and on the following morning she wired as usual for details of his condition and progress. The doctor sat down to draft a reply. "Kitchener passed good night" he wrote; then paused, sucked his pencil and added "and bullet."

The incident of the Camel Stamp may be quoted as an example of Kitchener's sense of humour. Towards the end of 1896, the Sirdar decided that the Sudan should have its own postage stamp and secured a beautiful design from a British artist; but when he heard that the fee would be 25 guineas he rejected the design and ordered a young subaltern of the infantry to prepare another. "Remember" said he. "There must be no caricature of me or anyone else in it. The design must be ready in five days. Good morning." The subaltern induced a local Sheikh to pose for him on a camel and produced

his sketch. "Not bad" remarked K. "I think it will do. Good morning," and in due course the stamps appeared. The young designer then suggested to Kitchener's A.D.C. that he would greatly appreciate a set of the stamps signed by the Sirdar as a memento. To which K. replied "Certainly, provided that he pays the necessary 4s. 6d. for the stamps!" Needless to say, no charge was actually made and the signed stamps were added to the subaltern's collection.

During the Dongola campaign, accidents occurred daily on the Kerma Railway, caused by the inequalities, sharp curves and steep gradients of the line which Girouard was extending rapidly along the right bank of the Nile. One such accident resulted in a whole day being wasted, and Kitchener, who had recently congratulated Girouard on the advance of the rail-head gangs, wired to him "Am bitterly disappointed at your miserable progress." Girouard was furious until he discovered that the message was a specimen of the Sirdar's humour and not meant to be taken seriously. However, a few months later, the tables were turned and the Sirdar himself was the victim. Water had been found unexpectedly at a point far out along the Desert Railway on which Kitchener depended for his advance southwards, and a bottle of it had been brought to Wadi Halfa. "Don't say a word" said Colonel Maxwell, the Commandant at Halfa. "We will have some fun with the Sirdar when he arrives." In came Kitchener and was invited to have a whisky and soda. He did not seem to appreciate the taste and asked Maxwell what it was. When told that the "soda" was actually water from No. 4 Desert Station, struck at 72 feet below ground, he was delighted and took the joke in good part, for the discovery of water ensured the success of his project.

As British Agent and Consul General in Egypt from 1911 to 1914, Kitchener had many stormy interviews with the Khedive Abbas Hilmi, whose deposition he secured shortly after the outbreak of hostilities. Abbas Hilmi was an adept at evasion, and on one occasion, when he had taken an unfortunate decision as ruler of Egypt and afterwards excused himself for it on the ground that he was a mere vassal of the Sultan of Turkey, Kitchener lost patience with him. "Your Highness" he remarked. "My own position here is anomalous enough. We really cannot have *two* incomprehensibles."

It is recorded that at a state ball in Cairo, given in honour of the Crown Prince and Princess of Germany, the German Consul-General became engaged to a charming lady. Kitchener heard of the happy event and next morning he sent the Consul-General a cordial note of congratulation—together with a cushion on which the suitor was presumed to have knelt to make his proposal! The visits of another foreign Consul-General afforded Kitchener much secret amusement. This individual, after loosing a flood of intricate exposition and explanation to which K. listened with his usual calmness for half an hour, would pause breathless and then exclaim "Et maintenant, Monsieur le Maréchal, je vais vous dire la verité." These few episodes, selected haphazard from many others, show that Kitchener was keenly alive to the ludicrous and by no means lacking in wit.

Although the good things of life appealed to him, he was moderate in the use of wine and alcohol. He liked a whisky and soda at lunch, another after sunset, and a little wine at dinner. It is curious how the legend of insobriety attaches itself to any public man whose private affairs are matters of some conjecture. It was so with Gordon: it was so again with Kitchener. In both cases the allegation was unfounded. Both men were normal, and sometimes spartan, in this respect. When Bennet Burleigh, the War Correspondent, visited Kitchener in the desert during the Nile Expedition he wrote "Captain Kitchener gave me a hearty welcome and added to my debt of gratitude by producing two bottles of claret, his whole store, which we drank most loyally

at dinner." It may be remarked that in 1915 Kitchener followed the example set by King George V and became a total abstainer for the remaining period of the war. His doctor did not think this wise, but he persisted and substituted strong coffee for whisky and soda and wine. To sum up, he appreciated occasional and well-earned refreshment but never exceeded the bounds of propriety and commonsense.

In conclusion, a happy story from the South African War may be re-published by the courtesy of the Editor of *Blackwoods Magazine*. After the cessation of hostilities in 1902, two Boer Commandants applied to the C-in-C. for a " safe conduct " to visit their families in Pretoria. Kitchener readily granted the request and suggested that they might lunch with him during their visit; but on the appointed day he was unavoidably detained and accordingly sent a message of apology and asked that lunch should be started without him. Towards the end of the meal, he was heard approaching and a Staff Officer suggested to the Commandants that they should hide under the table, remarking jocularly " He has never caught you yet and must not do so now." Kitchener entered, noted their absence, and expressed his regret for being late and so missing them. Then the Commandants appeared, grinning, from beneath the table and surrendered themselves in time for port and biscuits.*

A schoolboy joke some would say. But such jokes can only take place among those who are determined henceforth to be members of one family and consign differences to the past. Besides, are not all truly great men schoolboys at heart? Of a surety, Earl Kitchener of Khartoum, K.P., G.C.B., O.M., G.C.S.I., G.C.M.G., G.C.I.E., etc., etc., formerly Commander-in-Chief South Africa, Commander-in-Chief India, High Commissioner of Egypt, Conqueror of the Sudan, Secretary of State for War, remained a schoolboy at heart to the end.

This portrait, however inadequately and imperfectly painted, may serve to show the man as he was and not as he was popularly supposed to be. Almost unnoticed in youth and early manhood, he emerged in the thirties as a born leader, brave, strong, resolute, capable, ingenious, shrewd, and thrifty, humane by nature, hard yet very sensitive, outwardly reserved yet inwardly inclined to be sociable, a loyal friend, an implacable foe, and an indefatigable worker whose life was devoted wholly to his country and his profession. " The unresting giant who above war's din held his grave course and laboured mightily, now beyond toil and clamour sleeps within the bosom of the eternal sea." So runs the epitaph in the cathedral in Khartoum. It is a fitting memorial to an outstanding figure in history.

*Ex Africa semper aliquid novi. [Ed.]

THE ROYAL STAFF CORPS, 1800–1837.

PART II—New Orleans and Waterloo.

By LIEUT.-COLONEL F. S. GARWOOD, R.E. *(Retired)*.

SUPERVISING the construction of the bridge of boats across the river Adour, in February, 1814, does not finish the story of Major Alexander Tod and his Company of the Royal Staff Corps. The last shot in the Peninsular War was fired at Toulouse in April, 1814, and the veteran survivors of so many battles might reasonably have looked forward to returning home and enjoying the comforts of peace. But this was not to be. Unfortunately on June 18th, 1812, the United States had declared war against Great Britain, the conquest of Canada being one of the objects which they had in view; but in the first two years of the war three attempted invasions had met with no permanent success. The end of the war with France enabled the British Government to hurry reinforcements to Canada and greatly strengthen the Colonial Forces, which had so long and gallantly resisted their powerful neighbour. It was time to carry the war into the enemy's country, and an expedition against Washington was prepared under the command of General Ross. The troops for the attack were mostly composed of Peninsular Veterans, and amongst them was the Second Company Royal Sappers and Miners, under the command of Captain Blanshard, R.E. This campaign included the Battle of Bladensburg, the capture of Washington, and the attempt on Baltimore.

At Baltimore General Ross lost his life, and his troops which had been repulsed, were sent to Jamaica, where they were joined by a body of Peninsular Veterans, which arrived from England under General Keane. That officer now took command of the united force, numbering nearly 6,000 men, and landed with it on December 24th, 1814, at the head of Lake Borgne. It had been decided by the British Government to strike one more blow at the Americans, making full use of the Peninsular Veterans. Admiral Sir Alexander Cochrane promised them pockets full of prize money; for this expedition was to be as profitable as the raids of the Elizabethan Buccaneers upon the Spanish Main. Several convoys, packed with troops, were sailing across the Atlantic under orders for Negril Bay, Jamaica, hoping to discover Eldorado, but for many it was to be a rendezvous with Death.

A ROYAL STAFF CORPS CONTINGENT.

Major A. Tod's Company of the Royal Staff Corps spent the summer of 1814 at Hythe, where Ensign C. R. Scott, who was just 17, joined them. It was then that he copied into his Note Book the drawings of the bridges, which Major Tod had made in the Peninsular War. Unlike his Gunner cousin Tom, he did not keep a diary, but he has left behind a small book, labelled "Private Memoranda" etc., in which from time to time he jotted down important events.

But this little Memorandum book is about to start on a long sea voyage and will not return to Hythe until after the Duke of Wellington has stood all day at bay at Waterloo, and muttered under his breath that if his army had only been composed of his Peninsular Veterans, he would have won the battle

in three hours. Major Tod's Company has received orders to proceed overseas.

Aug. 1st. 1814.		Arrived at Fort Cumberland, Portsmouth to embark for America.
Octr. 2nd.	,,	Embarked on board the Atlas 408 and same day changed to the *Hyperion* No. 203.
Octr. 9th.	,,	Arrived at Plymouth.
Octr. 29th.	,,	Sailed from do.
Dec. 2nd	,,	Made Dominica and Martinique.
Dec. 13th.	,,	Made Jamaica. Spoke *Statira* Frigate next day.
Dec. 17th.	,,	Made Cuba.
Dec. 29th.	,,	Made Mobile.
Dec. 30th.	,,	Made Mouth of the Mississipi.

From Burgoyne's journal we know that the *Hyperion* was sailing in a convoy, in charge of H.M.S. *Vengeur*(74) and containing General Lambert and about 2,000 troops—7th Fusiliers, 43rd Regiment, etc. Ensign Scott describes the voyage in a letter to his mother, which was commenced on the 7th November and added to from time to time. The *Hyperion* did not touch at any port, nor speak any homeward bound ship, so the letter grew longer and longer and could not be sent home until after the attack on New Orleans. It finally reached Mrs. Scott at Woolwich on March 9th, 1815. From the letter and the notes in the " Private Memoranda " book, a complete picture of the ill-fated expedition can be pieced together.

THE VOYAGE OF THE "HYPERION."

November 17th, 1814. (At sea.) We had a narrow escape at Plymouth, the evening before we sailed, we had orders to send all our limited service men on shore, to be discharged ; these amounted to 43 out of 62 ; so our company would have been reduced to 19, in consequence we should not have gone. The wind however became fair, and next morning being in our favour, so that we had not time to put the order into execution. We expect to rendezvous at Bermuda, but the orders are sealed, so we can form no certain opinion. Certain it is, however, that it will be a permanent landing, since we are taking dismounted Dragoons. I hope we shall make some prize money—I think it not at all improbable, particularly if we go to the Floridas.

Note. This gives the strength of a Royal Staff Corps Company as a Captain, three Subalterns and 62 men. There were eight officers in the Dragoon Mess, and four in that of the Royal Staff Corps.

December 4th, 1814. Martinique. We came in sight of land this morning, but as we are not to stop till we reach Jamaica, this will not be sent till then. A fortnight ago we were three days sail from Barbadoes, when the wind changed in the middle of the Trades, and has kept us out of sight of land till now. When you will get this the Lord knows ; and if peace is made, which is not improbable, the first you will hear from us will be from Plymouth. It is now reported through General Lambert that we go to New Orleans at the mouth of the Mississipi.

December 15th, 1814. Again, my dear mother, we have been disappointed ; we were two miles from Kingston (Jamaica), but unable to send letters or anything else. The Admiral's cutter came out and gave his instructions to General Lambert and we proceeded to the end of the Island, and as it afterwards turned out, waited there for the arrival of General Pakenham in the *Statira*, Frigate, from England. Fortunately we fell in with him this morning. In the same ship with the General are General Gibbs, Colonel Burgoyne

of the Engineers and Colonel Dickson of the Artillery. After staying with General Lambert about an hour, they made all possible sail, in hopes of overtaking General Keane's expedition before they land.

Our force is to consist of General Ross's late army, about 4,000, our own about 2,500. General Keane's 2,500. Another coming from Portsmouth 2,000; and another from the Mediterranean, making altogether about 13,000 men. General Pakenham commands the whole. Sir Alexander Cochrane, who is to command and act in concert with us, has landed a body of Marines, and destroyed the fortifications of Pensacola. I don't know what you will think has become of us. We expect to eat our Xmas dinner at New Orleans and to return with our pockets full of money. I hope we shall be disappointed in neither.

Narrative from Memo. Book.

Sir John Keane landed at the mouth of a creek, about 15 miles from New Orleans on the 23rd December; he proceeded with about 1,500 men as far as the banks of the Mississipi to within about six miles the same evening. After encamping and whilst the troops were cooking their supper, they were surprised by an attack from the Americans, who having heard of their landing, marched about 3,000 strong to attack the British. At the same time a Frigate and Brig dropped down the river and took our troops in flank. They were at first thrown into confusion, but by the exertions of Sir J. Keane they were finally repulsed. The 85th and 95th were chiefly engaged and suffered materially. Our loss was 291 killed, wounded and missing. The Americans retreated about three miles and then threw up an entrenchment reaching from the Mississipi, on which their right rested, to an impassable wood, which secured their left.

Account in Letter Home.

January 7th, 1815. We landed on the third, after being buffeted about the Gulf of Mexico for nearly three weeks. We found the Army waiting for us before they could advance. Knowing you will expect it, I will give a detail of what has been done. In consequence of a Captain of the Navy in Jamaica the Yankees knew of our coming two months ago, and had collected an army of about 13,000 men under General Jackson to oppose us on landing.

General Keane's expedition about 3,000 strong arrived about the 19th, and finding the River Mississipi too strongly fortified, determined on coming as near to the town of New Orleans as possible by the Lakes. The ships were therefore anchored about one hundred miles from the city, not having sufficient water to go nearer; and the men were sent up in boats to Pine Island, where they remained about three days. This is about 40 miles up. General Keane then proceeded up the Creeks, about fourteen feet wide, 50 miles further up. He arrived there on the 23rd of December, and after having made a road for his provisions, etc., through a dreadful thick wood with a marshy bottom. On that evening when the men were at supper, and sitting round their fires, a schooner of eighteen guns opened a fire close upon them with grape. They were on the banks of the river, and the American army attacked them with about 7,000 men, on the other flank at the same time. Our Artillery was called up and was just opening on the schooner, when they were informed that the 95th were drawn up in front of them; they therefore were of no use. The night was so dark, there was no knowing friend from foe. After our troops had suffered most severely, they were brought into action, when they drove the Americans in the most gallant manner before them, killing and taking about 500 men. Our loss was 300, a great part of which were unfortunately officers. All who had been in the peninsula say they never saw anything like

it; the surprise and confusion was so great. The Yankees must have succeeded, but that their officers were almost all drunk, otherwise our small army must have been annihilated. The next day the schooner was burnt; and the day after General Pakenham arrived. Since then the Yankees have not ventured out.

NARRATIVE FROM MEMO. BOOK.

1815. Jan. 1st. Discovered the Fleet and came to anchor off Ship Island.
Jan. 2nd. Embarked in Schooner and went up the lakes.
Jan. 3rd. Landed and joined the Army before New Orleans. Employed constructing bridges until the 8th.
Jan. 8th. Attack on the enemy's lines repulsed.

THE ATTACK.

Sir Edward Pakenham having joined some days after, and the Army having been reinforced with the 7th and 43rd Regiments; he determined on attacking the Americans without delay. For this purpose he caused a canal to be cut, communicating between the Mississipi and the small river by which the Army had come up. The object of this canal was to enable our men of war's boats to be transported to the Mississipi and thus carry part of our troops to the opposite bank.

Everything being ready, the attack was made on the morning of the 8th January, about 5 a.m. in four columns. One on the right bank of the River and the other three directed to the left, centre and right of the enemy's Lines. The centre column, which was the principal attack, completely failed. Sir E. Pakenham and General Gibbs being both killed, and Sir J. Keane and Colonel Thornton (Brig. Genl.) wounded, Sir John Lambert, on whom the command devolved, thought it prudent to retire to our former position, which was done without any opposition from the enemy.

The attack hardly lasted twenty minutes; but our loss was severe—291 killed, 1,292 wounded, 454 missing, chiefly killed, total 2,027. The Americans, including the Militia, were supposed to be about 15,000 strong: our force about half that number. The breadth of the River Mississipi averages about 700 yards, the current extremely rapid.

ACCOUNT IN LETTER HOME.

January 8th, 1815. As I suppose, my dear mother, that dispatches must be sent home after this unfortunate day, I shall bring my letter to a conclusion, as I go with Tod and Campbell to make a road on the river to-morrow. Our boats were passed through the Canal into the river by daylight this morning. The troops they contained were the 85th, the Marine Battalion and sailors, in all about 800 men, under Colonel Thornton of 85, who was severely wounded at Washington.

The signal was then made for the general attack, when both sides advanced. Sir Edward Pakenham placed every regiment on their ground and then went and gave his orders to the 44th Regiment to maintain the ground they then occupied till he gave them further orders. He then went to the right to order the 4th Regiment to advance; and after having done so, returned to the place where he had left the 44th. They however had retreated without firing a shot, and the ground was occupied by the enemy, and he was shot before he had well discovered his mistake. In the meantime the 95th and 4th had forced the lines; and had the 44th come to their assistance, as was intended the victory must have been certain.

The Americans did not venture to quit their lines, we therefore occupied

the same position as before the attack. Our loss has been very severe; besides General Pakenham being killed, General Gibbs is mortally wounded and General Keane slightly in two places, besides several field Officers and about 1,000 men in killed, wounded and prisoners. Nothing could have been more unfortunate than the loss of a man, beloved by the whole army. His loss is partly supplied by General Lambert, who is considered an excellent officer.

On the left bank of the river everything we could wish was performed. The two batteries, which enfiladed our position, were forced in the most gallant manner; and with the loss of a very small number of men, we took 14 pieces of Artillery and some prisoners. Colonel Thornton was unfortunately slightly wounded. We keep our ground on the other side, and are in hopes of enfilading their lines in return. I think I have managed to fill this sheet of paper tolerably well, and as I am writing in a most uncomfortable position, shall not trouble your eyes with any more bad writing. You must not expect me to be in good spirits. I am however in excellent health, which I attribute partly to the present state of the climate and to not having been off my legs for half a dozen hours together since I landed.

Ever your affectionate son,

CHARLES ROCHFORT SCOTT.

COMMENTS.

This letter which has covered a period of two months, and which mentions many details of the voyage which have been omitted, was hastily completed on the 8th January and despatched. It was hot from the battlefield and the writer was susceptible to every rumour that was flying round the camp, so little importance need be attached to the disparaging remarks on the conduct of the 44th Regiment. The whole disastrous episode occurred at dawn and was over in twenty minutes and two of the principal actors had been killed.

The R.E. Historian quotes from the R.A. Historian that General Pakenham was killed after having galloped up from the rear to rally the brigade, which had made the attack. But Major-General Porter's chief concern is that Colonel Burgoyne's entry in his journal consisted only of the words: "January 8th 1815. Attacked the enemy's position without success. Sir Edward Pakenham killed." His brevity is assumed to mean that he was disgruntled, because at a council of war held on that day he had strongly recommended the renewal of the attack. Colonel Thornton's attack on the right bank of the river, had met with complete success. The enemy's battery had been carried and all their guns captured. In later years General Jackson frankly admitted "This unfortunate rout had totally changed the aspect of affairs. The enemy now occupied a position from which they might annoy us without hazard, and by means of which they might have been able to defeat, in a great measure, the effects of our success on this side of the river." Burgoyne had the thankless task of rowing up the river in a small boat and ordering the victorious Soldiers, Marines and Seamen to retire.

General Lambert held a council of war and decided to retreat. With an army encumbered with many wounded, camped on a river-side marsh, with not even a village to afford shelter, what else could he do? A most vivid description of the hardships endured by the expedition is given by a sailor. "But now comes that infernal affair, New Orleans; a more horrid business was never gone through by man or beast. May be you don't know Lake Borgne, and yet it is no lake, for it opens out into the Gulf of Mexico. It is a very shoal navigation, so that we had often seventy miles to go in open boats, loaded with sogers; and buckled and belted as they were with knapsacks, there was no swimming for it when the boats were upset or sunk, and many a poor trooper lies at the bottom there. The shores are low, swampy and covered with reeds; and for

the climate, I never thought there was such a place under heaven, a place where you have summer and winter in twenty-four hours. In the day time we were scorched, in the night we were frozen. Who would have thought of ice about a boat's bows in a place so near the West Indies. The black regiments had no more notion of Jack Frost than 'bite 'im no see 'im.' They died like rotten sheep. Many a weary pull and sail I've had up and down that infernal hole, which I wish I may never see again. It is fit for nothing but snakes, alligators and Yankees—begging the Jonathans pardons for knotting them together."

From "The Night Watch or Tales of the Sea." H. Colburn. 1828.

THE RETIREMENT.

Memo. Book.	Jan. 9th, 1815.	Ordered to the rear, to make a road for the army to retreat by.
	Jan. 18th. & 19th.	Army retreated to the Landing Place and I embarked in the Dover's boat.
	Jan. 20th.	Obliged from bad weather to put on board the *Ranger*, Transport.
	Jan. 26th.	Arrived at the old *Hyperion*.

As the boats belonging to the Fleet could not transport at one time more than 2,000 men. and could only effect that once a day, it would necessarily have required 5 or 6 passages for the boats to have removed the whole army, considering the number of wounded, the Artillery, Stores, etc. This likewise would have been a difficult matter to have effected before an enemy so very superior in number, as he must latterly have been. To do away with this inconvenience Sir J. Lambert ordered Major Tod to make a road from the Provision Depot to the first Landing Place at the mouth of the river, a distance of about 7 or 8 miles. The stream along the banks of which this road was to be made, ran through a boggy morass, which extended for several miles on each side; the whole of this space was covered with reeds about 9 feet high and no wood. The stream received several lesser boyaux in its course and some of equal size with itself, which greatly increased the difficulty of making the road, and no materials for bridging were to be had. Major Tod's inventive genius supplied, however nature's deficiencies; he caused a number of trees to be felled, from a wood a little in rear of our position, and floated down stream to the places where he had occasion for them. Those streams which were too wide for the trees to span, he bridged by means of trestles, made with the before mentioned trees; and for one river about 100 yards across he was obliged to employ three flat bottomed boats. The trees having been laid across, he caused fascines made with the reeds to be placed transversely and then tied down with spun yarn, which answered tolerably well.

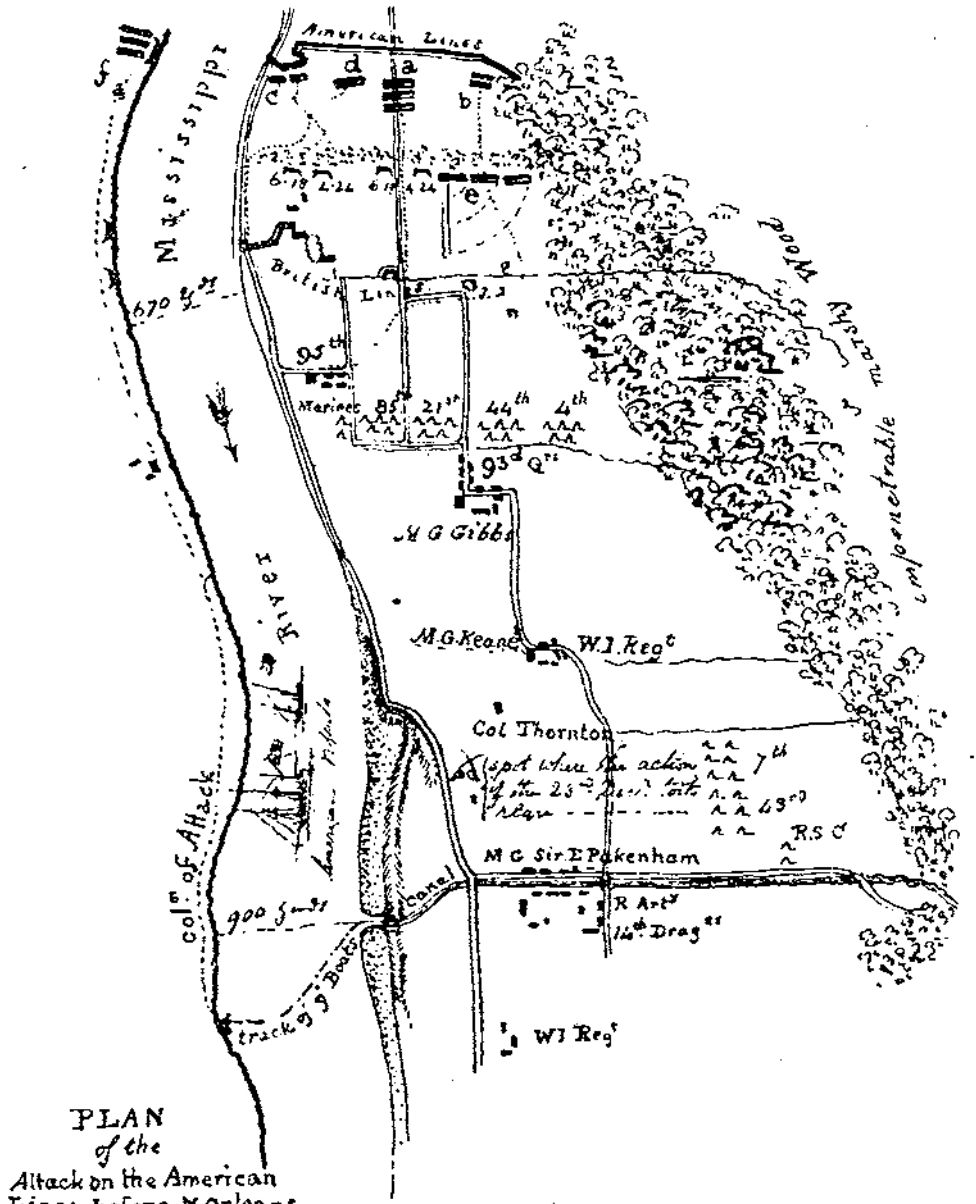
Everything being ready, the Army retreated on the night of the 18th. The sick, stores and chief part of the Artillery had been sent off by water whilst the road was preparing. The retreat was covered by a gun boat, which destroyed the bridges as soon as the troops had passed. The Americans however were amused with the fires, which were kept burning; and were not aware until some hours after, that we had retreated. They pushed on a few vedettes on the 19th; but merely to see if we were off.

THE PLANS.

The most interesting and valuable contents of the Memorandum Book are the plans on pp. 4, 5 & 6.

Plate 1. Plan of the Attack on New Orleans on January 8th. 1815. On the

Plate 1



PLAN
of the
Attack on the American
Lines before N. Orleans
Jan^y 8th 1815

References

a. Centre Col^n of Attack consisting of the 44th 21st & 4th Regiments
b. Right Column of Attack consisting of the 95th (Rifles) & Light Comp^ies of 44th & 21st
c. left Column of Attack consisting of the Light Comp^ies of 93d & Flank Comp^ies of 43d
d. The 93d Reg^t forming Part of the left Col^n but sent to support the Centre
e. The Reserve - consisting of 7th 43d & a Regt of India Reg^t
f. Column on the Right Bank of the River. 85th Marines & Seamen

Plate 2

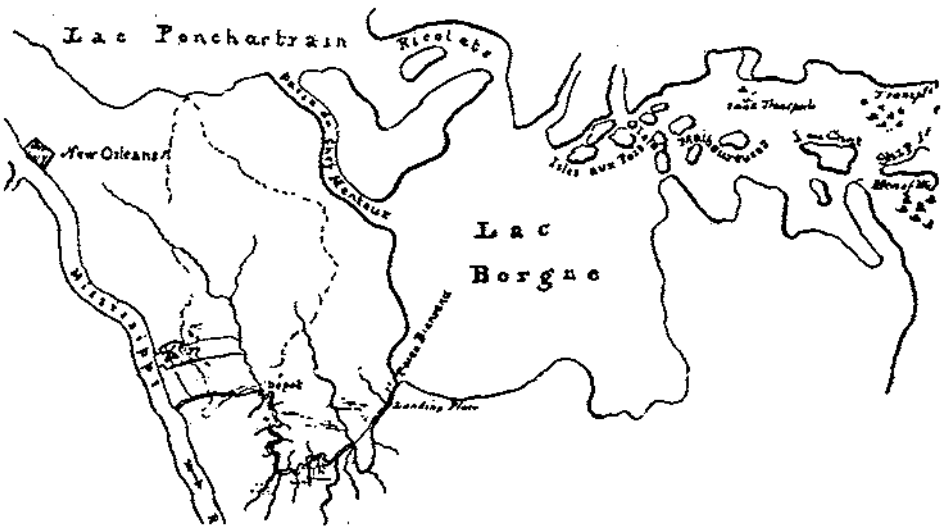
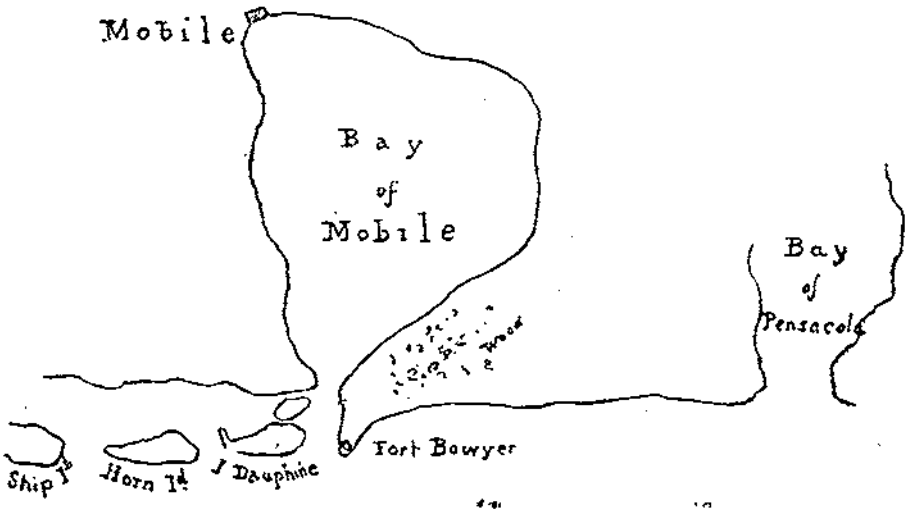
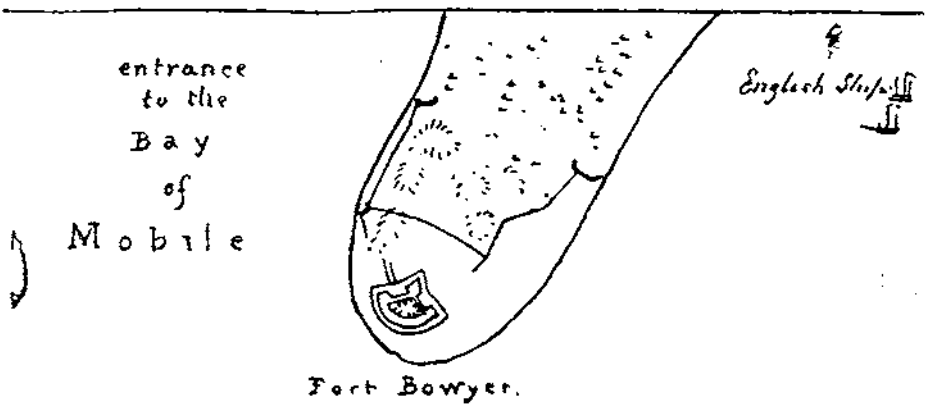


Plate 3





margin of p. 2 the following Regiments are entered. 7th Foot. 4th, 21st, 43, 44, 85, 93. 95 Rifles. 1st W. I., 7 W. I.

Plate 2. Plan of Lac Borgne.

Plate 3. Plan of Mobile Bay and Fort Bowyer.

The plans are drawn on both sides of the paper, and it needed great skill on the part of the printer to reproduce them. The Memo. Book shows that the *Hyperion* anchored at Spithead on 5th June, 1815, and all subsequent entries commence on p. 7 proving that the plans and notes on the expedition, which are all on preceding pages are all of an earlier date. Major Tod and the officers of the Royal Staff Corps in his company, besides being skilled bridge builders were trained map makers, and it is unlikely that any more reliable map of the expedition of so early a date exists. Ensign Scott developed into an expert cartographer and all the plans of Battles in "The Life of Wellington" were drawn by him.

The Landing Place. (Plate 2.)

The Landing Place was a dry spot of ground at the mouth of the Baiou Bienvenu. There were a few fishermen's huts there and Sir J. Keane surprised an American picquet here on his first arrival. Three of the picquet escaped, but three days after, came in almost dead, and gave themselves up, not being able from the nature of the country to make their way to New Orleans.

Fort Bowyer. (Plate 3.)

Fort Bowyer is a wooden fort, built in the style of the American Block Houses; it commands the entrance to Mobile Bay. One of our frigates attacked it a short time before we took it; but unfortunately running aground and it coming on to blow it was itself taken.

Memo. Book. 1815.

Feby. 6th. Dropped down to Ship Island.
Feby. 7th. Dropped down to Horn Island & ran aground.
Feby. 9th. Embarked in a Schooner & landed on Isle Dauphine; bivouacked on oyster shells and prickly pears—a hard bed.
Feby. 10th. Arrived at Head Quarters.
Feby. 11th. Fort Bowyer surrendered.
Feby. 12th. Crossed over to Fort Bowyer, Garrison marched out. 375 Men. 24 Pieces of Artillery.
Feby. 13th. News of Peace with America arrived, (Signed at Ghent. December 24th).
April 3rd. *Hyperion* sailed for home.
May 9th Made Bermuda and spoke a schooner, which informed us of the Revolution in France.
May 22nd. The *Manly*, Brig of War, hailed us and said war was declared with France, on 20th April. All hands up and gave three cheers.
June 5th. Made the Needles and anchored at Spithead.

THE ARMY OF OCCUPATION.

The Peninsular Veterans returned to England too late to take any part in the Waterloo Campaign; but for the next three years the Allies had to provide an Army to occupy France. These were the years when the grass grew in many barracks in England, for every fit man was needed on the other side of the Channel. By June 24th, 1815, Major Tod's Company was under orders for France. On July 20th, Scott was gazetted a Lieutenant in the Royal Staff Corps and embarked from Dover for Ostende, July 22nd. Landed at Ostende and embarked in barges for Ghent. July 23rd, Ghent. On the 8th August the Company arrived in Paris, exactly a month after the first English troops had entered the City.

Henceforward they were always stationed with the Headquarters of the Army. The Memorandum Book states: "Towards the end of January the Army left Paris and marched into Cantonments in the neighbourhood of Cambrai and Valenciennes. Headquarters were fixed at Cambrai and the Cavalry Headquarters at Cassel." The next two years were uneventful, much time being spent in reconnaissances, while leave home was liberally granted. The end came in October 1818."

"Grand Review of the British, Russian, Hanoverian, Saxon and Danish Contingents at Valenciennes. The Emperor of Russia and King of Prussia were present and the Army amounted to about 80,000 men. The day after the Review, Cole and self set off for Calais, to assist in the superintendence of the embarkation of the troops, which occupied about a month. We then embarked ourselves and landed at Ramsgate, from whence we proceeded to Dover and Hythe."

Enough has been said to show that the Officers of the Royal Staff Corps were veritably Staff Officers in the modern sense of the word; but only the junior ones were serving with the companies. The following account reveals on what sort of duties the other officers were employed.

A STAFF OFFICER AT WATERLOO.

"As the most trifling particulars relating to a great man are interesting, it may be mentioned that the Duke wore on the day of Waterloo a plain blue coat, a short cloak of the same colour, and a low cocked hat without feather or ornament, save the British, Spanish, Portuguese, and Netherlands Cockades, the three foreign ones being very small and attached to the Black Cockade of England. He was mounted on his favourite charger 'Copenhagen,' and carried throughout the day a large field telescope, which was generally drawn out for use." But it was not upon his telescope that he relied upon obtaining early information that the Prussians were coming to his assistance. At 8 p.m. the last desperate attack by the Imperial Guard had been made and beaten off, and not a single Prussian had been seen. Officers of the Royal Staff Corps had been detailed to look out for them; and here is the story of one of them.

"All was quiet in our front about 7 o'clock, at which time I was on the look-out for a Prussian Corps, we had for some time been expecting to come upon our left by way of Ohain. Perceiving no indication of its approach, I rode in the direction of that village, and having proceeded more than a mile, saw, but still a good way off, a body of cavalry, that I rightly concluded to be the advance of the corps of which I was in search. Upon riding towards it, I fell in with a line of skirmishers and learnt from an infantry Officer, whom I accosted, that the cavalry I saw was commanded by General Von Rœder, who immedi-

ately afterwards appeared on a rising ground near me, at the head of his staff, and I recognised his person, having met him before at Brussels. After exchanging a few words with the Prussian officer, who was anxious to learn something of our battle, and having told him that his men might spare themselves the trouble of looking in the standing corn for an enemy, as I saw some of them doing, there being none within two miles of them, I retraced my steps. All this time I had heard no firing, except of a few cannon from the direction of Mont St. Jean, but on my way back I could see the flashes, for it was then growing dusk, and hear the report of guns far in advance, but rather to my left, which I conjectured to be from the Prussian Artillery.

On regaining our position I found to my surprise that it was unoccupied; but on the crest of the opposite hill dark masses were in motion. The French had been defeated, and our troops were in pursuit. I saw no Prussians crossing the valley towards La Belle Alliance, and was satisfied that none of the troops, belonging to the corps moving by Ohain, were then up. I had not ridden fast, for my horse was both wearied and wounded; but I still must have been far in front of General Rœder's Cavalry, which was moving very slowly when I left it. What afterwards fell under my observation may not be unworthy of notice. Passing down by La Haie Sainte, around which our Lifeguardsmen and French Cuirassiers lay very thick, I went along the chaussée towards La Belle Alliance; but was obliged to go off it before I arrived there, in consequence of the road being blocked up with French guns and tumbrils. I counted 20 pieces as I hastily passed, jammed into a space about 50 yards in length, where the chaussée had low banks. Some distance after passing La Belle Alliance, and near the farm of Rossome, I came upon a spot to the right of the chaussée, where hundreds of bright French muskets lay almost as if a body of troops had been ordered to ground arms; they must have belonged to the Old Guard.

At this place I crossed to the left of the road and directly found myself amongst Prussian infantry, who were streaming across the country from the direction of Frischermont, in a state of anything but order. I saw these troops savagely bayonet the unfortunate wounded Frenchmen as they passed along; and an English Light Dragoon, who was sitting with his back against a wall, would have shared the same fate by mistake, but for my intervention. Pushing on I soon after overtook some of our own infantry; and also came upon our glorious commander, who was very thinly attended, most of the staff having been either killed or wounded. It was then dark, and I heard orders given by the Duke for his troops to quit the chaussée and halt. They moved accordingly to the right and left the road clear for the Prussians.

After this His Grace remained for a few minutes, immediately in rear of the 52nd Regiment, conversing with Colonel Colborne, and other people, whom I was unable to distinguish; and saying he would order up some provisions for the troops, the Duke turned his head towards Waterloo. By this time the Prussians were sweeping across from the direction of Frischermont in vast numbers. When near La Belle Alliance, the Duke met with a group of mounted officers and continued for some time in conversation with the principal individual of the party, but who he was I could not discern on account of the darkness. We were surrounded by Prussian Infantry, and upon asking an officer near me, who the Duke was speaking to, he said it was Blucher. I imagine it must then have been near ten o'clock. The interview between the two commanders was brief; and the Duke of Wellington, followed by only five officers, continued on at a foot's pace to the village of Waterloo. Darkness shrouded from our view the spectacle presented by the great number of dead, as we rode by La Haie Sainte, but the frequent snort

and start of our horses reminded us that the ground they trod was tenanted by dead and dying men.

It is necessary for me to add, that I was then serving in the Royal Staff Corps, the officers of which were chiefly employed in the duty of reconnaissance; and being attached to headquarters, I had the opportunity of witnessing much of the battle, as well as seeing the situation of the 1st Prussian Corps, which latter circumstances gave rise to this—perhaps too lengthy—narration.

Major Basil Jackson,
from "The Life of The Duke of Wellington."

AUTRES TEMPS—AUTRES MŒURS.

The Victorians have consistently blackened the reputations of King George IV and his brothers on account of their morals. For them every man should live like Sir Galahad, whose strength was as the strength of ten because his heart was pure. It must be admitted that neither the sailors of Nelson nor the soldiers of Wellington were able at all times to live in such a rarified atmosphere. But the Royal Dukes retained both the devotion and the affection of the Navy and the Army to the end. The second brother, King William IV, as soon as he mounted the throne, visited Woolwich and invited 42 R.A. Officers to dine with him at St. James' Palace and bestowed on the R.A. and R.E. the Motto "Ubique quo fas et gloria ducunt," which they have borne to this day. The eldest brother Frederick, at the commencement of the Century, apparently on his own initiative and by the force of his own personality, created the Royal Staff Corps, and by the end of the war, had so improved the training and organization of the British Army that it became the best in Europe. As more than a hundred years have passed since the Duke of York's death it may be of interest to recapitulate his claims to be held in perpetual honour by the British Army.

THE DUKE OF YORK.

Lord Nelson gazes down on thousands of passers-by from a lofty column in Trafalgar Square. Everybody knows what Nelson did. King George IV is perpetuated in Regent Street at the end of which, in Waterloo Place, another tall column stands commemorating his brother the Duke of York. Time has dimmed his fame and obliterated even the name of the Royal Staff Corps, which he founded. The statue of Field-Marshal Burgoyne stands near the base of his memorial, and not one passer-by in a thousand could tell you who he was. The equestrian statue of the Duke of Wellington has been banished from London, yet no one would suggest that the Iron Duke has a prior claim to overlooking Waterloo Bridge than his quondam Commander-in-Chief, Frederick Duke of York. He died on January 5th, 1827, and already by the 10th January Tom Scott's Diary records that at the Royal Artillery Headquarters at Woolwich "at twelve o'clock a General Meeting was held in the Mess Room to consider the proposition of Lt.-Col. R. Pym, which was carried unanimously, that the wish of the Regiment to subscribe generally with the Army to erect a statue to the late Commander-in-Chief, should be notified to the Master-General. A Committee was appointed for that purpose, to forward the communication."

The monument to the Duke of York is the tribute of every branch of the British Army to the man, who was their Commander-in-Chief from 1795 to 1809 and again from 1811 to 1827, comprising practically the whole period

of the Napoleonic wars. What had he done to deserve such an honour? The answer to the question is given in a lengthy "Memoir of the Duke of York" in the "Literary Gazette" of the 13th January, 1827, by no less an author than Sir Walter Scott, who says that "the Royal Duke had early in his career, acquired and kept to his death the epithet of the Soldier's Friend." A few salient points have been extracted from this memoir.

"It is as the reformer and regenerator of the British Army, which he brought from a state nearly allied to general contempt, to such a pitch of excellence, that we may, without much hesitation, claim for them an equality with, if not a superiority over, any troops in Europe. The Duke of York had the firmness to look into and examine the causes, which ever since the American War, though arising out of circumstances existing long before, had gone as far to destroy the character of the British Army, as the natural good materials of which it is composed would permit. The heart must have been bold that did not despair at the sight of such an Augean stable. In the first place, our system of purchasing commissions, itself an evil in a military point of view, and yet indispensible to the freedom of the country, had been stretched so far as to open the way to every sort of abuse. No science was required, no service, no previous experience whatsoever; the boy, let loose from school last week, might in the course of a month be a field officer if his friends were disposed to be liberal of money and influence. It was no uncommon thing for a commission to be obtained for a child in the cradle; and when he came from college the fortunate youth was at least a lieutenant of some standing, by dint of fair promotion. To this state of things, by a succession of well considered and effectual regulations the Duke of York put a stop with a firm but gentle hand. Terms of service were fixed for every rank and neither influence nor money were permitted to force any individual forward, until he had served the necessary time in the present grade which he held. No rank short of that of the Duke of York, no courage and determination inferior to that of His Royal Highness, could have accomplished a change so important to the service, but which yet was so unfavourable to the wealthy and to the powerful, whose children and protégés had formerly found a brief way to promotion.

Thus a taste for studying mathematics and calculations applicable to war was gradually introduced into the Army. If, therefore, we find in the modern British Officer more information, a more regular course of study, a deeper acquaintance with his profession and a greater love for its exertions; if we find the private sentinel discharge his duties with a mind unembittered by petty vexations and regimental exactions, conscious of immunity from capricious violence and knowing where to appeal if he sustains injury; if we find in all ranks of the army a love of their profession, and a capacity for matching themselves with the finest troops Europe ever produced; to the memory of His Royal Highness, the Duke of York, we owe this change from the state of the forces thirty years since. The means of improving the tactics of the British Army did not escape his Royal Highness' sedulous care and attention. Formerly every Commanding Officer manœuvred his regiment after his own fashion; and if a brigade of troops were brought together, it was very doubtful whether they could execute any one combined movement, and almost certain they could not execute the various parts of it on the same principle. This was remedied by the system of regulations compiled by the late Sir David Dundas, and which obtained the sanction and countenance of His Royal Highness.

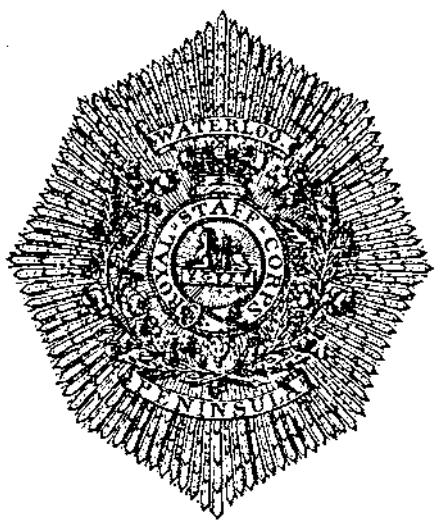
We can but notice the Duke of York's establishment near Chelsea for the orphans of soldiers, the cleanliness and discipline of which is a model for such institutions; and the Royal Military School or College, at Sandhurst,

where every species of scientific instruction is afforded to those officers, whom it is desirable to qualify for the service of the staff. The excellent officers who have been formed at this institution are the best pledge of what is due to its founder. Again we state that if the British soldier meets his foreign adversary not only with equal courage, but with equal readiness and facility of manœuvre; if the British officer brings against his scientific antagonist, not only his own good heart and hand, but an improved and enlightened knowledge of his profession, to the memory of the Duke of York, the army and the country owe them."

CONCLUSION.

It was due to the Duke of York that the British Army possessed in the Royal Staff Corps as capable and highly trained a body of Staff Officers as any in Europe. By his death they lost their best friend, and the war-weary Nation cried: "Away with them, we shall never require their services again." For that redoubtable old warrior the British Lion is obsessed by one of the strangest of phobias, he hates soldiers. The result is when his tail is twisted and he, very unwillingly, goes into battle, he is always unprepared. Thousands of soldiers lives have been sacrificed because of his negligence, while he remarks quite cheerfully: "I always lose every battle but the last." And when that has been won, it is little concern of his, what happens to the soldiers who, so gallantly fighting against desperate odds, were victorious in the end. What was the final fate of the thousands of men, who wore King George's uniform? That is the real problem after every war. Were the Peninsular Veterans, whose bones are buried on the banks of the Mississipi, better off than their comrades who returned to England? If you study the diary of Bt. Major Thomas Scott of the Royal Artillery, who died in 1834, which reveals the poverty and misery endured by the ex-service men of his generation, you would certainly say that they were. But you have only to read your Dickens to learn that the England of those days was no land fit for heroes to live in.

As for the Royal Staff Corps, I do not know what happened to that capable officer Colonel Alexander Tod, C.B. But as a sign of good faith and to prove that the Corps really existed, I conclude with its crest, which was pasted inside a volume, which once belonged to the disbanded Mess at Hythe.



THE METAMORPHOSIS OF INFANTRY.

By CYRIL FALLS.

(*Republished from The Illustrated London News of 17.10.42 by kind permission of the Editor.*)

LAST week I wrote about some trends of strategy; this week I shall try to relate them to the developments of tactics which exercise so strong an influence upon them. I shall deal particularly with infantry, first, because it has taken an important part in the developments, and, secondly, because its prospects have greatly improved in the process. I do not want to suggest that there has been any sudden or abrupt change in tactical practice, still less in theory. There seldom is in warfare. Admittedly the change at the beginning of this war appeared to be revolutionary, but solid links can be discerned running from the Battle of Cambrai in 1917 through the campaigns of 1918, the British plans for 1919—never put into effect because of the German collapse—the Spanish Civil War, to the German campaigns against Poland and France. Some observers of these last wondered what the Germans wanted with all their infantry divisions, and were greatly astonished when they heard that more were being created. It is true that Germany might not have created these fresh divisions had she not intended to wage war in the wide spaces of Russia. Yet it is not the case that the number of divisions which she possessed at the time of the French campaign was excessive in view of her possible needs. Nor is it correct to suppose that those campaigns could have been won and the victories completely clinched without infantry in mass. A portion of that mass took an active part in the fighting. That portion which was not called upon to fight constituted a reserve which helped to impose a decision by its very presence.

Yet there can be no doubt that armoured forces dominated the battlefields of Poland, Belgium and France, and that they do not dominate the battlefields of to-day to the same extent. One of the reasons for this is obvious: Germany's foes are now more strongly armoured than they were in 1939 and 1940. Armour imposes respect upon armour. A second reason is the increase in the number of anti-tank weapons, not merely as a whole but also of those placed in the hands of the infantry. A third reason is the fact that the German tank's ally, the dive-bomber, does not have matters all its own way as once it did. A fourth reason is the scientifically planned attack from the air upon the transport of the armoured division. A fifth—where British and Russian Armies are concerned, for German field artillery does not appear to have lived up altogether to its old reputation for quick adaptation—is the effectiveness of the field gun against the tank. And last, but not least, is the habituation of the soldier's mind to a new problem, the thought which has been applied to its solution, and the consequent improvement in infantry tactics. Tanks can no longer afford to take the liberties they did. They must have the co-operation of other arms, of all other arms, to a greater extent. They can pin down troops holding a position and virtually prevent movement upon it, but they cannot charge a strong position unless a large proportion of

its anti-tank guns have been put out of action. They have become mobile armoured gun positions rather than mechanized armoured cavalry, though the armoured car still fulfils this role. They need increased infantry support, and this has been obtained by reducing the tanks and augmenting the infantry of the armoured division.

As I have previously pointed out, the infantry has taken a part in bringing about this state of affairs and profited by it, as is only just. Nor does this apply only to the infantry which forms part of the armoured division or to the infantry divisions which are ranked as "motorized." For, if the armoured division has become increasingly a force of all arms used in complete co-ordination, infantry has not stood still in this respect. Indeed, the infantry of 1942 is astonishingly different from that of 1914, with its two machine-guns to a battalion, and a great deal more powerfully armed than that of 1918. The normal British infantry battalion possesses its own light armoured fighting vehicle, the "carrier," a useful, hardy and reliable little vehicle of which the Germans have no complete equivalent. It has a great volume of fire-power from automatic weapons, anti-tank weapons and mortars. It can do its own mine-laying under the instruction of its own pioneers. It carries its own wireless sets, works them itself, and keeps them in order. The infantry division has at its disposal a reconnaissance unit which is nominally infantry also—with the badge of an infantry regiment—but which is equipped for extremely rapid movement and is at the same time extremely hard-hitting. In one respect British infantry has an advantage in striking power over that of almost all other nations because of the increased apportionment to it of the infantry tank, comparatively slow-moving beside the cruiser of the armoured division but much more powerfully protected.

The effects of the developments to which I have referred have been of importance both materially and morally. Freedom of manœuvre has been to a considerable degree restored to the infantry. It is true that all manœuvre, all movement even, is conditional upon readiness to adopt instantly a disposition suitable for defence upon the approach of hostile armoured forces. But that is a condition which is not peculiar to infantry; artillery caught in the open on the move finds itself in an even more parlous situation. Yet perhaps that is not the right way in which to look at the question. It is not infantry so much as the infantry division which has regained this freedom of manœuvre, the well-armed infantry battalions of to-day backed by highly mobile and hard-hitting field artillery, such as the British 25-pounder gun. With hostile fronts generally far apart as they commonly are now before battle, the infantry may have to make long approach marches, drive in the enemy's outpost screen in the half-light before dawn, and before day has broken form up for assault upon a flank or a previously discovered weak point. That is to say, some of the conditions of older wars have returned, but they have come back accompanied by greatly increased pace of movement in mechanized transport. And thinking, command and control are vastly increased by increased pace. There is no more difficult lesson for the experienced infantry officer to learn than that of operating at the new pace of warfare.

On the moral side the effects have been no less striking. When the tank and the dive-bomber appeared to rule the battlefield it was unavoidable that the average infantryman should feel his self-confidence shaken. He was still prepared to fight hard, to do his utmost, but he could not look forward at best to do more than play a very minor part, while at the worst he felt he might be swept away like dust before a broom. If the battle ended successfully, the victory was not his, and his contribution to it was of the smallest. In case of defeat, the odds were heavy that he would be overrun and, if he survived,

would fall into the hands of the enemy. That day is passing. The infantryman still runs big risks and has to face one of the hardest roles in battle, but he can reap the reward of his labours. He can feel that he is pulling his weight and take pride in his achievements. And he can realize, if he is taught to do so, that of all the fighting men of the Army he is the man who is called upon to display the highest all-round skill. Others may be more skilled technicians in this line or in that, but no other has to know or to do as many things as he. At his best he is the ideal trained soldier. And the most devastating error that could be made by the Adjutant-General's department would be to copy the policy of the latter half of the first World War, to give the other arms their requirements from the intake first and then hand over the leavings to the infantry. I see no signs that such a policy is, in fact, being followed.

The tactics of an infantry division in the offensive will be strongly influenced by the information available as to the whereabouts of hostile armoured forces. Should it appear improbable that there are any of them so placed as to be able to intervene during the day of the attack, then the infantry division may adopt a very bold policy after the outer crust of the enemy's resistance has been broken. The more open the order in which it moves, the wider will be its opportunities and the smaller the risks from hostile air attack. Against an enemy who can move no faster than it can itself, it has no need to be greatly perturbed about the danger of a sudden counter-attack. If one is launched and strikes a single small column, the rest will have time to coagulate. Very different will be the case if there should be reason to expect the intervention of the enemy's armoured forces within a few hours. In such a case the infantry division may still venture to advance at a fair pace but it cannot venture to spread itself over so much ground, and it can scarcely take the risk of moving all at once, all of a piece. Perhaps its best model in such circumstances will be one of those caterpillars which move forward on a group of fore-legs, then bring these to a halt and move the hind-legs up to them, at the same time arching the middle part of the body. That is how an infantry division should move in face of such a threat, the fore-part consisting of an infantry brigade reinforced with artillery, the hinder-part consisting of the main body of the fighting troops, with the larger proportion of the anti-tank guns always covering the part which is halted.

I have left myself little space to deal with defence, of which, however, I have frequently written in these pages. A system of deeply echelonned fortified localities defended by forces of all arms may be inadequate to withstand a really strong armoured attack over a long period unless the ground is exceptionally favourable, but it will impose respect from the enemy's armoured forces and at least gain time for friendly armoured forces to move up to its aid. But I must leave that subject for this week, because I want to make one more point which seems to me to be of great importance.

This comparative recovery of freedom of action by the infantry should be of exceptional value to the British. The British officer is, as a rule, an indifferent theorist. His preparation for war is therefore, as a rule, inadequate because he does not make the logical deductions of the German—nor, incidentally, does he have at his disposal the material with which to test them. But when he settles down to war and has to bring his practical abilities to bear upon a subject with which he finds himself constantly at grips, he often attains mastery over it. The Briton has a remarkable gift for the practical side of war, and not least for tactics. British infantry, in particular, has had a good reputation in this respect in almost all the wars in which it has taken part. It is, therefore, of good augury that the British infantryman of to-day should see before him a prospect brighter than that of three years ago, a chance of

reaping the reward of his natural initiative and resource. But he must remember that in some directions he still has ground to cover before he can catch up. Apart from that, he is working in a field where there is no perfection and where the most skilled must go on learning.

THE UNIQUE SECOND-LIEUTENANT.

IN *The Royal Engineers List* issued in April, 1942, and again in that issued in October, 1942 only one Second-Lieutenant (Regular) is shown viz.: Holmes, W D.C.—surely a state of affairs unique in the history of the Corps.

* * * *

At the top of the tree
There's one Chief R.E.
Down at the root
There's one Second Loot.

It's normal to be
The one Chief R.E.
But Holmes, as the only
Second Loot, must feel lonely.

Can't someone recruit
One more Second Loot
Or discover a plan
To promote the poor man ?

A.R.A.I.

* * * *

The above was unfortunately mislaid at the time of receipt, but the Editor trusts that the Season of the year and the excellence of the verse will be sufficient apology for its tardy appearance. Our kind-hearted readers will be glad to know that 2nd-Lieutenant Holmes was promoted on 1st October, 1942.

ELECTRIC ARC WELDING.

By E. S. WADDINGTON, M.S.E., M.INST.W., A.M.I.E.(S.A.), ASSOCIATE I.E.E.

(Extracted by the kind permission of the Society of Engineers from their *Journal and Transactions* for January-June, 1943.)

THIS paper is intended to deal with some of the developments in electric arc welding in the last few years, and for purposes of convenience it has been divided into the following sections :—

1. Electrodes.
2. Arc Welding Machines.
3. Arc Welding Technique, Practice, Testing of Welds, etc.

SECTION 1.

ELECTRODES.

Whilst in the early years of electric welding bare wire rods were used, European practice in recent years has been almost entirely in favour of coated electrodes and even in the United States of America, where at one time a considerable quantity of bare wire was used, coated electrodes are now being used almost exclusively.

Before dealing with the various types of coated electrodes, it may perhaps be as well to point out the disadvantages of bare wire. When arc welding the temperature lies between 9,000 and 12,000°F. and such temperatures affect the gaseous medium in the neighbourhood of the arc, causing the oxygen and nitrogen to be atomized.

The combination of oxygen and the molten metal tends to form iron oxides and has the effect of producing porous welds, whilst the nitrogen forming Fe_3N tends to cause the weld metal to be brittle. These effects of atmospheric conditions on welding with bare wire led to the need for coating the wire with various forms of fluxes, which enabled protective slags to be formed and for embrittlement and porosity of the welds to be avoided. Later, flux coatings providing protective gases as an envelope to the arc were adopted. The wire, when produced in this form, is known as an electrode, as distinct from a welding rod which is uncoated wire.

The main types of electrodes are :—

(*a*) Electrodes for mild steel.
(*b*) Electrodes for "D" steel and high tensile steels.
(*c*) Electrodes for maganese steels and wear-resisting steels, tool-tipping, etc.
(*d*) Electrodes for non-ferrous alloys, cast iron.
(*e*) Electrodes for light alloys.

These main groups of electrodes can in turn be sub-divided into a number of special classifications, and the mechanical properties demanded in each classification may vary widely.

Dealing with the first main group, namely, mild steel, the first classification for ordinary work can be stated as an electrode complying with the following conditions :—

Tensile strength .. .. .. 24-27 tons/sq. in.
Elongation on 2 in. in the region of 10-14 per cent.

This classification is not sufficient, however, for work which is subject to high static and dynamic loads. For this class of work an electrode is required having mechanical properties in the neighbourhood of :—

Tensile strength	30-33 tons/sq. in.
Elongation on 2 in.	28-32 per cent.
Yield point	24-27 tons/sq. in.
Cold bend angle (over 2d.) ..	180°
Brinell hardness	145 (approx.)
Izod impact	55-56 ft. lbs.

For the second main group, high tensile and special steels, a type of electrode is required with the following characteristics :—

Tensile strength	33-48 tons/sq. in.
Elongation on 2 in.	24-26 per cent.
Brinell hardness	160-200

There are certain types of high tensile steels containing a copper content so as to prevent oxidization. The deposited metal of electrodes suitable for this type usually contains about 5 per cent copper.

The next group of special electrodes is for reinforcing purposes. The most common types are electrodes designed for reinforcing or repair of points and crossings for railways. A typical classification for such electrodes is :—

Tensile strength	25-29 tons/sq. in.
Elongation on 2 in.	17-21 per cent.
Brinell hardness	250

For this type of electrode the deposited metal can be hardened by quenching with water, and in this case a Brinell hardness in the neighbourhood of 400 can be obtained, or 250 if oil quenching be used.

Another type of electrode for the reinforcing of mild steel and manganese steels, and obtaining an extremely hard weld to give resistance against subsequent oxidization, is the type of electrode used for dredger buckets, steel sieves, vibrating tables, etc. Modern examples have a Brinell hardness of about 600. This type of electrode is limited to steels having a maximum content of 8 per cent manganese, and for high alloy steel containing 11 to 14 per cent manganese a special type has to be developed, but the Brinell hardness is usually in the neighbourhood of 200, although cold working will increase this to 500/600.

Tooltipping Electrodes.—In addition to hard depositing electrodes of the above types, electrodes of high speed steel have been developed the weld metal deposit of which corresponds to high speed steel in general use. It is claimed that tools and cutters made from this type of electrode can be put into production under exactly the same conditions as the original steel. In view of the importance of high speed steel and the considerable saving made by depositing such electrodes on to carbon or nickel steel blanks this development is one of importance. The cutting edge deposited by such electrodes has a hardness of between 61-64 Rockwell "C" scale.

Electrodes for Stainless Steel.—In addition to electrodes for the welding of mild and high tensile steels and for reinforcing, electrodes have also been made for the welding of stainless steels.

These weldable stainless steels are nearly all of the chrome nickel alloy type known as 18/8 (18 per cent. chrome and 8 per cent. nickel) and can roughly be divided into two types :—

1. Those having a low carbon content.
2. Those having a high carbon content.

Certain of the stainless steels have a molybdenum content varying from 1.5 to 3 per cent., this being added to prevent corrosion.

A typical specification of a straight 18/8 electrode would be :—

Tensile strength	38-48 tons/sq. in.
Elongation on 2 in.	35-45 per cent.
Brinell hardness	100-180

Another type of steel used is 25/20 and a suitable electrode specification for this would be :—

Tensile strength	45-51 tons/sq. in.
Elongation on 2 in.	30-35 per cent.
Brinell hardness	190-220

Electrodes for Non-Ferrous Metals and Cast Iron.—Recently arc welding electrodes have been developed for the welding of non-ferrous metals such as aluminium and copper, but the application of such electrodes is not on a very extensive scale at the present time.

Very considerable research has been made on types of electrodes suitable for welding cast iron in order to produce machinable deposits, and electrodes in this category can be divided into two grades :—

1. Those suitable for welding cast iron, the deposit of which is not machinable without heat treatment.
2. The other type, the deposit of which is machinable without heat treatment. These electrodes have a monel base with a high nickel content.

Electrode Efficiency.—Very extensive experiments have been made regarding electrode efficiency, and the particulars given hereunder show a comparison between two types of electrodes (called A and B for convenience), and also show the basis used for calculating the efficiency of electrodes.

		A	B
1.	Weight of core wire (in ozs.) in one rod	1.02	1.04
2.	Weight of core wire (in ozs.) in fused part of rod	0.915	0.93
3.	Deposited weight (in ozs.)	0.81	0.87
4.	Actual welding time per rod (in mins.)	1.35	1.06
5.	Welding-arc current in amps	130	140
6.	Welding-arc voltage in V	26	29
	Calculated Values.		
7.	Welding-arc energy in watts	3380	4060
8.	Theoretical depositing efficiency in %	88.5%	93%
9.	Practical depositing efficiency in % ..	80%	84%
	Data per 100lbs. of Deposited Welding Material.		
10.	Number of rods	1975	1840
11.	Actual welding time in mins.	2675	1950
12.	Primary power consumption in k.w.h.	188	160

Having considered the question of electrode efficiency, the most recent development is the consideration of electrode speed, and speed of welding deposit is, in the author's opinion, far more important from the practical point of view than high theoretical values.

The speed of welding of various types of electrodes is proportional to the time required to deposit a fixed size of electrode over a foot of weld. In both cases the thickness is pre-determined and electrodes chosen, the mechanical properties of which are identical, or which meet the requirements of the particular section. An example of the enormous improvements made in this direction can be seen by the fact that an older type of electrode, of 8 s.w.g. in a butt weld, would take approximately 33,500 hours for one million feet, whereas with one of the new type high speed electrodes an exactly identical weld would take approximately 17,000 hours. The speed of electrodes probably represents, next to the improvement in

mechanical properties and weldability, the most important advance in recent years.

The speed of welding has been developed in three ways :—

1. By using large size electrodes with more or less normal speed with heavy currents.
2. By using high speed electrodes on which the comparison mentioned above is based.
3. By a combination of 1 and 2.

This demand for high speed welding has required the provision of electrodes with mechanical and physical properties, and a speed of deposit considerably in excess of that previously employed for normal welding. Further, the flux coating of these electrodes is designed to avoid lack of penetration, porosity and undercutting.

Recent developments also include the construction of rods known as universal rods, *i.e.*, electrodes that can be used for downhand, vertical and overhead welding, and universal rods possessing these characteristics have been produced.

Apart from the special electrodes mentioned above, another development, is the production of light gauge electrodes for the welding of sheet metal, these electrodes varying between 20 and 16 s.w.g., whereas previously most makers—and many actually still do so—only produced electrodes down to 14 s.w.g. Owing to the light gauge of these electrodes a very lengthy series of experiments were carried out by the makers concerned to produce suitable electrodes, and in many cases the electrodes are between 9 in. and 12 in. in length, so as to avoid " whip " during welding. The technique for sheet metal welding and its development are dealt with later.

Before leaving electrodes the following tables and curves dealing with the currents and welding speeds of modern electrodes will probably be found of interest.

TABLE 1.

EXAMPLES OF SAVING IN MAN HOURS AMOUNT AND PERCENTAGE BY USING HIGH SPEED ELECTRODES.

Footage welded.	Type of joint.	Plate thickness.	Man hours saved.	Value of saving at 2/- per hr. incl. overheads.	Percentage of saving.
				£	%
1,000,000	Fillet—Reasonable throat thickness	$\frac{1}{4}$"	9,305	930	32
1,000,000	Fillet—Full throat thickness	$\frac{1}{4}$"	1,278	1,027	21.2
1,000,000	Butt	$\frac{1}{4}$"	11,805	1,180	24.1
1,000,000	Fillet—Reasonable throat thickness	$\frac{1}{8}$"	15,977	1,597	38.7
1,000,000	Fillet—Full throat thickness	$\frac{1}{8}$"	24,306	2,430	26.1
1,000,000	Butt	$\frac{1}{8}$"	17,222	1,722	21.1
1,000,000	Fillet—Reasonable throat thickness	$\frac{1}{2}$"	11,945	1,194	33.1
1,000,000	Fillet—Full throat thickness	$\frac{1}{2}$"	43,330	4,333	27
1,000,000	Butt	$\frac{1}{2}$"	51,250	5,125	46

TABLE 2.

TABLE GIVING COMPARISON OF WELDING TIMES OF NORMAL AND HIGH SPEED ELECTRODES.

Plate Thickness	Electrode S.W.G.	Type of Weld	No. of Runs	Unit of Deposit in grams per ft.	Time for Normal Electrode	Unit of Deposit in grams per ft.	Time for High Speed Electrode
¼in.	10	Fillet—reasonable throat thickness	1	30	102 secs.	30	66 secs.
¼in.	10	Fillet—full throat thickness	1	40	159 secs.	40	128 secs.
¼in.	10 & 8	70° Vee Butt	1-10 1-8	54	180 secs.	54	129 secs.
⅜in.	8	Fillet—reasonable throat thickness	1	50	140 secs.	50	85 secs.
⅜in.	8 & 6	Fillet—full throat thickness	1-8 2-6	150	333 secs.	150	226 secs.
⅜in.	10, 8 & 6	70° Vee Butt	1-10 1-8 1-6	120	313 secs.	120	221 secs.
½in.	6	Fillet—reasonable throat thickness	1	60	119 secs.	60	77 secs.
½in.	6	Fillet—full throat thickness	4	300	616 secs.	300	414 secs.
½in.	8 & 6	70° Vee Butt	1-8 3-6	200	423 secs.	200	307 secs.

SECTION 2.

Arc Welding Machines.

Before considering the improvements and developments in arc welding machines, the author would clarify the types of arc welding plants commonly employed into the following groups :—

1. Engine or motor generator sets.
2. Welding transformers.
3. Welding rectifiers.
4. Dual current plants.
5. Automatic welding machines.

Welding Generators.

These consist of suitable generators driven either by A.C. or D.C. motors or, in the case of petrol sets, by a petrol or crude oil engine.

The earlier type consisted of a generator with a variable resistance in the positive output. Modern machines, however, owing to the wastage of current with this method, have been designed with a drooping voltage characteristic, the aim being to produce a curve similar to that produced by the previous resistance and to have an arc striking voltage of between 80 and 100 v. with an arc welding voltage of 25 to 30 v., depending upon the exact design of the machine used.

The control of these machines with some makers is obtained by using a tapped series field in conjunction with a shunt regulator, this regulator giving fine controls and the series tapping giving coarse controls.

In other cases the regulating equipment is built as a unit to be mounted on the machine, and new applications, particularly the method of control on modern types of generator plants, have been so arranged that the control of arc heat and penetration is obtained by means of variable open circuit voltages. This voltage-ampere control of the current is controlled by two dials mounted on the machine, which vary the characteristics. For portable plants, where extremely long cables have to be used, instead of the drooping characteristic, a rising characteristic machine is sometimes employed.

Other types of machines, so as to simplify the control from the operators' point of view, use single dial control, the characteristics being varied by the resistance of the circuit and the heating speed, this type of control being known as " pre-set " control.

Portable machines of the engine driven type are generally single operator with an output of between 250 and 500 amps, and a striking voltage of 70-100 v. Some types of machines use two 250 amp. generators and can be used either as a 500 amp. single operator machine, or a 250 amp. two operator machine.

The chief developments in engine driven sets are the substitution of petrol engines by high speed Diesels on account of fuel economy; although many users prefer the petrol driven set because of its greater reliability, less skilled attention required for maintenance and repair and lower capital cost, which compensates for the running economy of the Diesel.

The governing of engine driven sets has also called for considerable developments and the type of control by means of a resistance connected across the generator—which was automatically switched in when welding commenced—has been superseded by various forms of mechanical governors, which give extremely accurate governing. Large engine or motor driven generator sets, up to 250 operators, or even more, have been constructed chiefly for large shipyards. Due to the very long cable runs and consequent high resistance losses and the liability of inter-action between welders, the

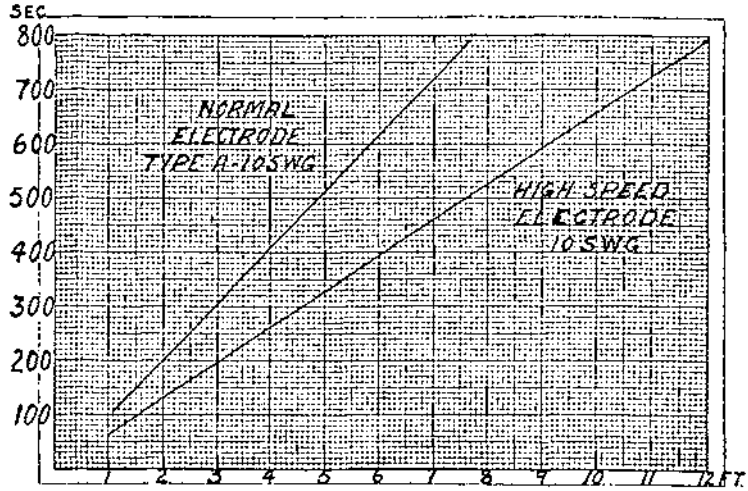


FIG. 1.—Showing comparison in welding speeds between normal 10 SWG electrode and high speed electrode.

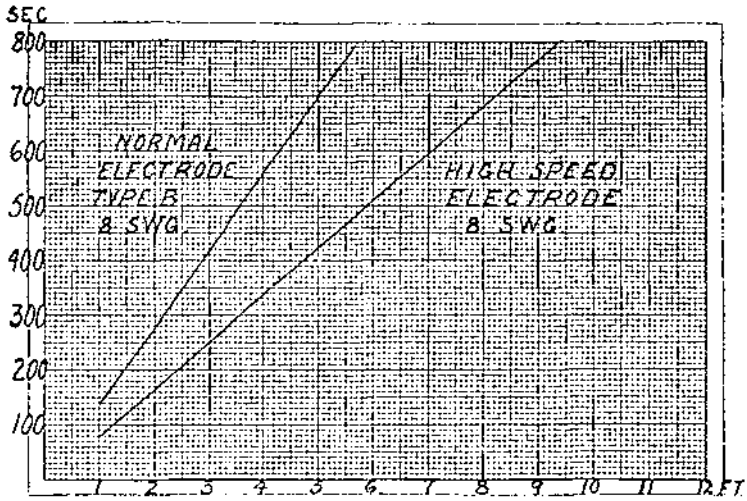


FIG. 2.—Showing comparison in welding speeds between normal 8 SWG electrode and high speed electrode.

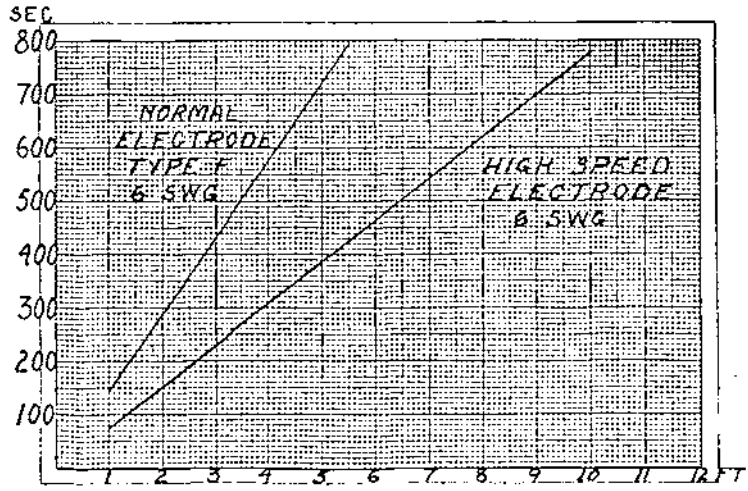


FIG. 3.—Showing comparison in welding speeds between normal 6 SWG electrode and high speed electrode.

leaning is more towards one or two operator sets, except for special installations, or transformer sets (which will be dealt with later).

The main use for generator sets is where only D.C. supply is available or where no electricity supply exists—for instance, for field work, emergency breakdown repairs, etc.—although some users prefer motor generator sets, particularly in America and where D.C. welding current for welding special steels is essential, but at the same time these are in many cases being replaced by the welding rectifier, which is described on pages 273-4.

Various special circuits have been employed in D.C. generators to overcome the effect of armature inertia, and to enable these plants to be used for sheet metal welding or other welding where instantaneous speed of recovery is required. The foregoing remarks probably cover the main developments for generator sets.

In addition to the improved electrical circuits, improvements have been made in employing semi or totally enclosed machines, and the use of flexible couplings, also, in some cases, employing a common shaft for the motor and generator. Steel castings, arc welded fabricated frames, arc welded fabricated body plates and arc welded chassis for the portable plants, also represent improvements by saving of weight, increased rigidity and reduced costs. Also improvements have been effected in the control gear and the mounting of this. Further improvements in the machines are heat resisting windings, either of the asbestos or glass insulated type: improvements in the power factor of the driving motors in A.C. to D.C. plants and, in these cases, condensers are sometimes built in the machines and still further improve the power factor.

Nearly all the improvements and developments in motor generator sets have been small, but the total results in themselves have caused the modern machine to be greatly superior to the earlier type. High speed motor generators in the neighbourhood of 3,000 r.p.m. have also been produced, but the author does not consider this a real improvement, as even if these motors are of the highest grade workmanship and design, trouble is likely to be experienced, under rough welding conditions with a short life compared with the standard 1,500 or 1,000 r.p.m. machine.

Small generators for use in engineering shops can be obtained for driving from a line shaft, but owing to the lack of portability of such machines their use is greatly restricted.

Some of the newer types of motor generator are fitted with remote control, or with a controller that is removable, so that the operator can adjust the output from a distance, this control being operated either mechanically or electrically. The mechanical systems are the simplest, but suffer from disadvantages; for instance, they are liable to stick and have a certain amount of back-lash: they are also liable to be rather inflexible.

The electrical systems of remote control have the disadvantage of additional trailing cables, but are otherwise usually found satisfactory, although one school of thought is in favour of pre-set machine control rather than individual operator control. The general trend, however, is in the direction of simplification.

Welding Transformers.

For some years the motor generator was practically the main type of plant, but with the introduction of coated electrodes, making possible the use of A.C. welding, the original welding transformers employing resistance control came into being.

The next step was the introduction of choke control, either with tappings or with a moving iron core, which can be locked into position. With the

introduction of choke or reaction control to the transformers followed the development of multi-operated transformers, in this case suitable for 3, 6, 9, 12 or even more operators, each operator having his own controller. Whilst the single operator transformers were single phase, the multi-operator machines were wound for 3-phase, the groups of operators being spaced over the phases.

The transformers employed for the single operator type are usually air-cooled and multi-operation transformers are usually of the oil-cooled type. The tendency for larger outputs for single operators has caused the oil-cooled type to be used for these equipments also.

It was, of course, necessary, owing to the wave form of A.C. plants, to keep a higher open circuit voltage than for D.C. plants. The open circuit and arc voltages range from 65/100 and 25/40 v. Some manufacturers supply an open circuit voltage of 80 v. for general work with tappings for 100 v.

Owing to the drooping voltage characteristic of the welding transformers, resulting in a lower power factor, generally in the neighbourhood of .5 or less, and the objections to heavy single phase loads on 3-phase mains, attempts have been made to design three to single phase transformers, using the Scott connection and other similar circuits, but in the author's opinion it is impossible to obtain satisfactory balancing by these means, as either a definite out of phase or lagging will always occur, even with such transformers. The power factor problem has, fortunately, been comparatively easily overcome by fitting condensers to raise the power factor to that required by the Supply Companies or Tariff conditions. On normal installations, where it is necessary to correct, it is usually raised to .85 or .9.

The improvements in the above types of transformers have been largely a matter of detailed design, improving insulation, the use of asbestos-covered insulation, and, recently, the use of silicate or glass-covered wire, the heat-resisting properties of which enable smaller and more compact transformers to be designed with improved power factor and characteristics.

The use of air-cooled transformers, whose output is adjusted by a movable core, permits infinitely variable regulation, ease of adjustment, moderate costs of manufacture, greater portability. They are mounted in sheet steel cases—some models being mounted on wheels for portability. Further recent developments also include high frequency attachments, so as to give a pistol arc for light gauges, and also limiting devices for reducing the open circuit voltage when welding under hazardous conditions.

High Frequency Attachments.

The idea of high frequency attachments to the transformer is the superimposition of high frequency current upon the welding circuit, as it has been found that this influences the arc on low amperages and also renders striking easier ; it also enables 16 s.w.g. and downwards to be welded with A.C. and, in certain instances, bare wire to be used. The circuit is so arranged that a high frequency flows from the electrode tip to the work as soon as the electrode is struck. Further, as the high frequency arc is struck before the main arc, the high frequency discharge enables the operator to concentrate on the direction of his electrode.

Atomic Hydrogen Welding.

The principle of this process is that the arc is struck between two tungsten electrodes, and a jet of hydrogen is concentrated on the arc core. The hydrogen passes quickly from the core to cooler regions where it recombines into a molecular state. During this process the hydrogen gives up the energy previously absorbed from the arc.

A further advantage is that the flame does not combine with oxygen, as is usual in all other welding flames. The temperature is extremely high, in the neighbourhood of 3,700°C. which is above the melting point of the hardest metals. The apparatus consists of a special welding torch, necessary welding transformer, etc. Usually a 100 v. arc is employed with an operating voltage of about 36 v.

The tungsten electrodes used can be fairly far apart, the process is simple to operate and can be used for all types of material and is found suitable for such equipment as exhaust pipes, rings and sheet metal work ; also for stainless steels and special alloys.

The Welding Rectifier.

Probably the most radical development in recent years was the development of the welding rectifier and its companion plant, the dual current machine.

During investigations, particularly on sheet metal welding, it was found that the speed of recovery played a very important part, and that a welding plant with practically instantaneous speed of recovery would have many advantages. Whilst this speed of recovery was obtainable in transformer plants, with D.C. plants of the generator type, armature reaction and inertia were experienced, particularly for sheet metal, so that ideal welding conditions were not found, and as D.C. welding was found to be essential for sheet metal, stainless steel and alloy welding, the problem was to develop a type of plant with practically instantaneous or a very high speed of recovery.

The principle of the welding rectifier is the employment of heavy duty rectifying valves with a transformer to step down the A.C. supply to a suitable rating, the rectifying valves being of the oxide cathode type, which enables a rectified direct current to be obtained. The first types of machines were arranged to have an output of 20 to 200 amp. D.C. with an arc voltage of 28 v. and a striking voltage of 65 v. The D.C. output was controlled by a tapped choke giving 38 steps. Special precautions were taken to protect the valves against mechanical shock, a cradle being arranged for this purpose. The plants are equipped with a cooling fan to provide a supply of cool air over the valves and transformer.

To avoid the plants being operated before the valve filaments are fully heated, a bi-metallic relay of the thermionic type is incorporated, with a suitable oil-encased contractor, which renders welding impossible until such time as the filaments are fully heated. As the current obtained from these plants is purely static, no moving parts being employed for the rectification, it can adapt itself practically instantaneously to current variations and the speed of recovery is in the neighbourhood of .0017 secs. It was also found that rectified current was particularly suitable for those applications where D.C. welding was required, especially in the case of sheet metal welding.

The next development of the welding rectifier was that of special plants for sheet metal welding, and these plants consisted of a suitable transformer, Scott-connected to two oxide cathode valves to give an output of 8 to 50 amps. D.C. The control in this case was by movable iron core giving infinitely variable variation. Owing to the fact that smaller types of valves are employed, it was not necessary in this case to incorporate bi-metallic relays or fan cooling, and it was this plant that made possible, on mass production lines, the arc welding of sheet metal from 22 s.w.g. upwards.

The chief advantages of the welding rectifier are therefore :—

1. No lag in adapting itself to arc variation.
2. Practically instantaneous speed of recovery.
3. A very flexible arc.

4. Extremely accurate current control.
5. A balanced input from 3-phase mains.
6. High power factor.
7. A better efficiency, particularly at low loads, than on motor generator sets.

An interesting fact emerged from the employment of these plants in large quantities on mass-production in that the cost of the fabrication of sheet metal was reduced, in many cases, by 50 per cent when compared with gas welding, the reason being that the distortion of sheet metal with arc welding as compared with gas is very appreciably less and therefore the grinding and finishing time is greatly reduced.

The characteristics of welding rectifiers have been investigated in a number of ways, one method being to take a high speed cinematograph film of the welding; also oscillographs have been used to obtain the exact time of recovery and voltage and current variations.

Dual Current Apparatus.

The next development in welding rectifiers was the production of plants incorporating a rectified D.C. output and also using a transformer for obtaining A.C. welding current. The reason that this development took place was that the D.C. outputs of the welding rectifiers were limited to the valve capacities, and whilst 200 amps. is satisfactory for most classes of work, where D.C. current is essential, certain users required the higher output for ordinary work where it was immaterial whether the current was A.C. or D.C. The dual current plants have been produced in a variety of models, one type of which has a 10/80 amp. range on the D.C. side and on the A.C. side an output of 25/175 amps.

The change over from A.C. to D.C. welding is accomplished by a multi-contact switch which cuts out the rectifying operation and connects the transformer sections in series. The current control is by movable core which enables variable output to be obtained.

Another model is constructed to have a 25-140 amp. D.C. output and 60-300 amp. A.C. output. In this case, on the D.C. output, a bi-metallic relay is provided and a cooling fan is incorporated for cooling during both A.C. and D.C. welding. Again the movable core type of transformer is employed with the necessary locking device. The plants have a satisfactory power factor and efficiency, and the power factor can be further corrected, if necessary, by incorporating condensers.

Automatic Arc Welding Plant.

Amongst the developments in arc welding, one of the problems that have interested welding engineers is the development of automatic plants to replace the skilled welder, and three main methods have been developed for this purpose.

The first method is the provision of automatic welding heads, either of the semi or fully automatic type, employing special electrodes which are either fed from the magazine or hand connected by male and female joints.

Another type is by means of the use of a special flexible electrode which consists of a core wire covered with a suitable flux, embodied in which is a spiralized wire, the whole being covered with a suitable foil. This flexible wire is mounted on a drum and fed through a special head.

Some makers employ a magnetic clutch which is driven by a variable speed motor, the clutch control being by means of adjustable relays. This enables the arc length to be uniformly maintained and corrected to very fine limits. A control panel is provided on which feed and speed controls are

fitted : arc length regulation and all necessary switches. The current is supplied to the electrodes by means of a copper nozzle : for where weaving is required a weaving motion is incorporated and this type of machine probably most nearly represents the human welder.

Should, however, very heavy automatic welding (and automatic welding is chiefly employed for heavy constructions) be required, instead of the flexable continuous electrode another method is used and in this case machines have been developed to employ very heavy electrodes such as " O " gauge or " OO " gauge, with magazine or manual feed. Yet another method is for the flux to be supplied separately to the electrodes. By this method bare wire is used either in rod or coil form, the wire being automatically fed as previously, and the flux being distributed along it. In the case of comparatively simple machines this flux is distributed by hand : other machines have a flux feed through the welding head distributing the flux in front of the electrode, the process being that the flux is heated by the arc to such a high temperature that a slag is formed so as to obtain the necessary shielding of the arc. This independent flux and wire method has been used more particularly in America than in Europe and a very large variety of fluxes have been developed for this purpose. The majority of these fluxes are composed of dioxide, feldspar, suitable clay, sodium carbonate, with the necessary water, but many other formulas are used, some with a magnesium base and some with an iron base.

Fluxes have also been developed with an aluminium base, but the main bases for fluxes for automatic welding remains of the silicate type.

Satisfactory tensile strengths, yield points and mechanical properties have been obtained with both the above methods of automatic welding.

Another process of automatic welding is by means of the carbon arc, and in this method the electrodes and flux are replaced by a carbon arc mounted in a suitable head. Some makers of carbon arc automatic welding plants also use a vegetable element to form a gas shield during the welding process and this element is fed in the form of a cord to the arc so as to form gas pockets during the welding process. Others use a paste deposit which is spread over the work before welding. Any additional filler metal is provided by wire or strip fed into or placed in the joint.

Carbon Arc Welding, Non-Automatic.

As well as automatic carbon arc welding this is used particularly on sheet metal and the process can be used with normal plants using a special carbon electrode holder, provided the open circuit voltage of the plant is in the neighbourhood of 70 v. or over.

The process has been applied to sheet metal welding, but has not been extensively adopted. The carbons used range from approximately 3 mm. to 25 mm. and a suitable paste is spread over the joint before welding.

SECTION 3.

Arc Welding of Sheet Metal, Welding Practice, Technique, Testing of Welds, etc.

Arc Welding of Sheet Metal.

As previously explained, due to the introduction of the welding rectifier, high frequency attachments and atonic hydrogen, the arc welding of sheet metal became a practicable proposition for mass production. The develop-

ment is due also to the special electrodes produced for this purpose, in addition to the necessary technique.

It is, of course, essential that the electrode for sheet metal welding has a suitable coating and that the deposited metal corresponds as nearly as possible to the parent metal.

Normal operating currents are as follows :—

20 s.w.g. electrode	8-20 amps.
16 s.w.g. electrode	15-30 amps.
14 s.w.g. electrode	25-50 amps.

It is particularly important for sheet metal welding that the operator has accurate control over his electrode, and the arc should be struck to touch the work lightly with a slight withdrawing action.

The procedure for different types of welds varies slightly, but it is of primary importance that the joints are as close as possible and that the edges are kept perfectly clean and are a good fit. It is generally advisable to tack the work in position and these tacks should be kept small. In some cases carbon arc is used for tacking, although the author is not in favour of this owing to the possibility of carbon inclusion. It is also advisable to ensure that correct penetration is obtained, and care must be taken to use the correct gauge of electrode, current, length of arc and welding speed. For mass production it is usual to make special jigs or clamps to hold the work in position.

X-Ray Examination.

One of the developments for examining welding without destroying the weld is by X-ray.

This method is either visual or photographic ; for accurate results, however, the photographic method is generally used, the procedure being similar to that adopted for normal X-ray photographs, with the defect being shown on the plate. Plate up to 5 in. thick can be handled by this method ; for this plate visual examination is generally employed, and in some cases stereoscopic examination is made and in other instances photographs are taken in two or more planes. The method is extensively used for pressure vessels and in cases where it is of primary importance that the welds are 100 per cent.

Crystal Analysis and Magnetic Crack Detection.

As well as X-ray testing, X-ray crystal analysis of welds has also played an important part in research.

Another method of testing is by magnetic methods, as welds may have defects due to various causes such as faulty welding, slag inclusions or cracks, the importance of which varies as to where they are located, *i.e.*, surface faults or cracks penetrating to a depth to render them harmful to the weld, and magnetic methods have been developed for testing.

This method consists of cleaning the weld surface and placing a sheet of suitable material, generally glass, over the weld. Ferrous fillings are then sprinkled thickly over this material and a current of electricity passed through the test piece. The magnetic fields thus set up act on the iron fillings and cause them to form up the shape of the weld, any crack being shown up by interruptions in the formation.

Another method is the use of wax paper so that a permanent record may be obtained. In some cases the paper, glass or other sheet is dispensed with and the forms made direct on the weld.

Use of Jigs Manipulators and Turntables.

These of the elaborate type, are a development in welding, particularly for heavy articles, but simple types of jigs consisting merely of clamps or locking devices to hold the work in position before tacking and during welding, have been in existence for a considerable time. These simple clamps, whilst satisfactory where normal production is required, would obviously be unsuitable for mass production or for the handling of heavy sections or articles, and accordingly the development of welding manipulation tables on which large work pieces could be clamped and held rigid was taken into account.

In the larger sizes these tables are mechanically driven and for very large sizes hydraulically or pneumatically operated clamping is employed. By the use of such devices all welds may be made in the downhand position, with an increase in speed and quality.

Costing of Welding.

Another advance where considerable investigation has been made is the costing of welding and the simplification of estimating. Unfortunately, it is generally impracticable to cost welding on a tonnage basis, as was common practice with riveting or bolted fabrication, and it is necessary to reduce all the costs to a common multiple, it being usual to take 1,000 ft. of welding as a basis to estimate the cost. This is generally calculated to allow for the following items :—

Labour, based on an hourly rate, and varying according to the nature of the work, at so many man hours per 1,000 ft., the usual method being to add the shop costs and overheads as a percentage of labour, but recently there has been a tendency only to calculate these on a thousand feet unit basis rather than a flat overhead, particularly where large space is required to layout the work.

The cost of electrodes can, of course, be calculated theoretically dependent upon the length of the runs, type of weld, and a percentage added, generally about 10 per cent, for loss due to end pieces, but the more usual practice is to take an actual deposited figure, based upon experience, and use a multiple.

Power is generally calculated at the cost of so many k.w. units per 1,000 ft. of weld, or per hours of welding.

The other factors which previously were not taken seriously into account, but which are now being very carefully considered in the costing of welding are such items as drawing costs, floor to floor handling costs : costs of preparing special drawings for welding, if the original job was designed for other methods : allowance for inspection, handling and rejects, also if extra floor space is required.

Analysis of welding costs show that far too much time is spent in preparation, assembly, etc., in proportion to actual welding time. Any reduction in non-welding time effected by the use of good jigs and fixtures, handling facilities, etc., has a good effect on total welding costs, and low production costs for quantities can only be obtained by study of such methods.

ENGINEERING IN ANTIQUITY.

By LIEUT.-COLONEL J. V. DAVIDSON-HOUSTON, M.B.E., R.E.

1. INTRODUCTION.

THE enormous progress made, during the last hundred years in almost every branch of science, has blinded many of us to the fact that in some respects we have only recently drawn abreast of the ancients.

It is not surprising that the old civilizations, being dependent to a large extent on plentiful slave labour, have bequeathed to us massive monuments of civil engineering, which their successors were for centuries unable to emulate, and are even now regarded with admiration. The Roman roads, the Pyramids, the Great Wall and the Grand Canal, furnish a few examples.

It is in the consideration of detail, however, rather than in general contemplation, that the modern engineer may derive interest, perhaps even profit, from an examination of these remains. The writer, during a dozen years' sojourn in the Nearer and Farther Easts, enjoyed opportunities of visiting archæological sites in several countries, and appends a few examples of antique engineering practice, in the hope that other officers of the Corps may be encouraged to publish their own experiences.

2. THE PYRAMIDS.

There is a generally accepted theory that the massive stones composing the pyramids were carried up to their positions by means of a ramp. Assuming a pyramid 400 ft. high, a ramp gradient of 1/10, and a roadway 20 ft. wide along the top, the amount of material required for the ramp alone would be of the order of 3,000,000 cu. yds., which is nearly three times the volume of the pyramid itself. The materials available to the Egyptians for this work were

(*a*) Sand
(*b*) Rock, or Stone
(*c*) Nile mud

(*a*) and (*c*) can be ruled out as impracticable; if the ramp had been of stone, its construction would have vied with that of the pyramid itself, and the subsequent disposal of the material would have presented a problem of which some record would surely have remained. It is therefore probable that some other method, not yet established, was employed for the purpose.

3. BABYLON.

The lack of stone in Mesopotamia led to this great city being built entirely in brick, and it is probable that the art of brick-building originated in that region.

Although Babylon was reduced to ruins some 2,500 years ago, enough remains to furnish interesting material for study. There does not appear to have been a standard brick, but the dimensions encountered by the writer all exceeded those of modern British practice. A recently excavated street is bordered by beautifully coursed and pointed walls in a perfect state of preservation; but the most interesting feature is the roadway itself, which consists of a brick soling surfaced with bitumen. This material, which is locally plentiful, was extensively used not only for streets but for damp-proofing in houses, a practice that appears to have remained in abeyance from ancient times until the late nineteenth century.

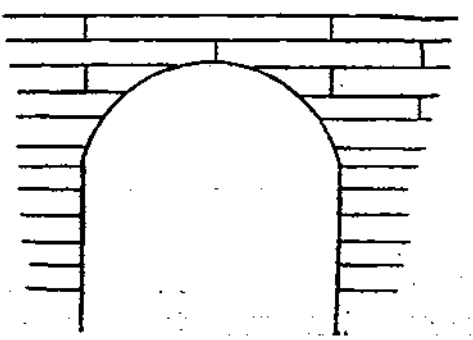
4. Ctesiphon.

Not far from Babylon stands an extraordinary building; comprising a brick arch about 90 feet high in the centre and 80 feet wide at the base, flanked by wing walls some 40 feet high. It was in existence at the time of Alexander the Great's invasion. One of the walls collapsed shortly after the last war, while the other is leaning forward dangerously; a specious explanation is disturbance of the structure during the Battle of Ctesiphon in 1915.

The arch, however, still stands, an example which suggests the use of false-work on a gigantic scale.

5. Delhi.

Among the ruins of the cities which preceded the modern capital the writer came upon a false arch, apparently of Hindu origin. Instead of resting on a ring, this "arch" had been formed by corbelling out successive courses of masonry until a junction was made. The corners had been cut away, until a smooth curve was obtained, giving the appearance of an arch.



Arch at Delhi.

6. JERASH.

The remains of a well-planned Greek town, which was inhabited from the third century B.C. to the seventh of our era, are to be seen in the wilderness of Transjordania.

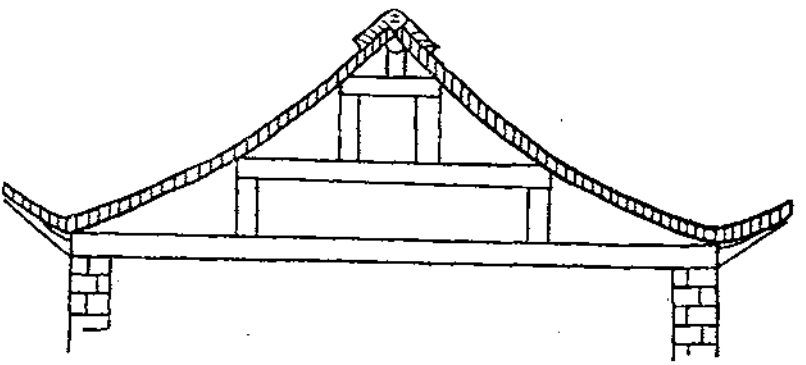
Not only do the main streets meet at "Circuses," laid out with geometric accuracy, but underground drains run beneath each of these highways and are reached by manholes at regular intervals. The manholes are still protected by circular stone covers, although the iron lifting rings have disappeared.

An interesting feature of the theatre is a step about 1½" high midway down each row of seats, which prevented the feet of spectators from sticking into the backs of those in front of them. Each seat is engraved with a Greek letter-numeral.

7. CHINA.

The Chinese, whose architecture is of ancient origin and has dominated for centuries the building styles of Eastern Asia, never made use of a roof-truss.

The Chinese roof is supported by a series of trestles built one upon the other with decreasing spans, so as to form the characteristic curved gable. The size and weight of the tiles, which are designed to resist heavy rain and extremes of temperature, together with the great height of the roof relative to the walls, make the structure extremely ponderous and uneconomical in materials.

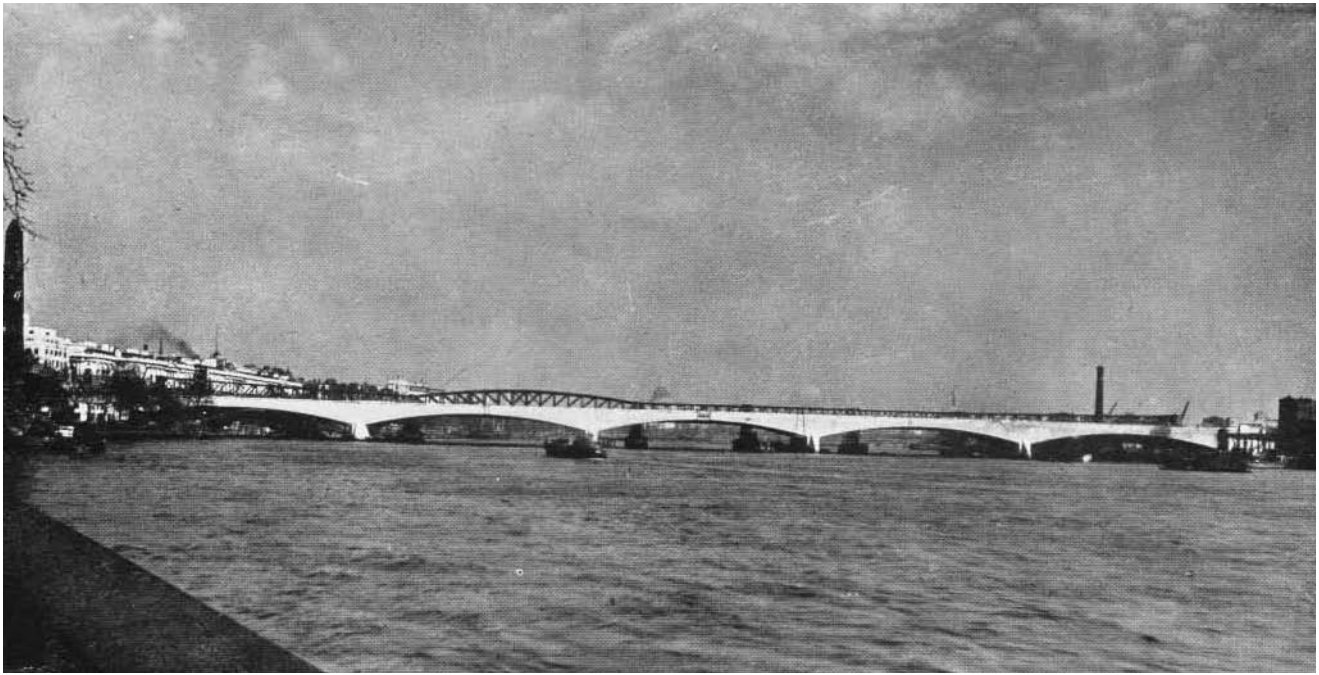


Chinese Roof.

8. NORMAN ENGLAND.

Richmond Castle in Yorkshire affords an interesting example of an early flush closet.

The seat was built over a vertical shaft opening into a small horizontal passage below. By pouring water through one end of this passage, excrement was effectively carried away through the Castle wall on to the roofs of the houses in the town.



The Waterloo bridge

THE WATERLOO BRIDGE.

By COLONEL D. PORTWAY, T.D., M.A., A.M.INST.C.E.

THE June number of the *Journal of the Institution of Civil Engineers* may well be called the New Waterloo Bridge number. It contains a full description of the bridge in a paper by Messrs. E. J. Buckton and John Cuerel; this is followed by a considerable discussion in which Sir Giles Gilbert Scott, the Architect, Mr. Peter Lind, the Contractor, Sir T. Peirson Frank, Chief Engineer to the L.C.C., Dr. Oscar Faber, Consultant to the Contractors, and others, took part.

John Rennie designed the old Waterloo bridge, first called the Strand bridge. Built in stone, and comprising nine semi-elliptical arches, it was from the first acclaimed a masterpiece. The main criticism centred round the ornamentation, consisting of twin Doric columns, copied from the temple of Segesta in Italy, and placed on each pier above the cut-water. A distich very popular at the time of the opening ran as follows :—

> Brother dear, what do we here ?
> I know not, ask the engineer.

A large memorial panel with typical portions of Rennie's bridge has been skilfully incorporated into the south abutment of the new bridge. The old bridge—opened on the second anniversary of the battle of Waterloo—took five years to build, about the same time as the new structure. It was built by private enterprise and operated as a toll bridge. It never paid its way, and was bought by the Metropolitan Board of Works for about half its original cost in 1878.

From 1923, when a serious movement in the old bridge was first observed, until 1937, when the erection of the new bridge was agreed, a dog-fight took place over the bridge compared to which the original battle of Waterloo was a mere skirmish. Parliament and the L.C.C. were the antagonists in this, but various bodies and individuals actively participated. The early plans envisaged a stone bridge of a monumental nature which pleased nobody, and it was only when the present design was introduced that opposition to the proposals died down. Even Mr. Bernard Shaw agreed that the new bridge had some architectural style ! As will be seen from the photograph, the elevation is both simple and dignified. Reinforced concrete allows the arch to be more slender and flat than is possible with stone, and the members are further reduced by a heavy system of welded reinforcements and modern methods of concrete mixing and placing. The view down river with St. Paul's in the background is thus preserved and the simplicity of the design incidentally allowed a saving of £100,000 on the earlier scheme. The actual cost of the bridge was about £650,000—the cost to Britain of about one hour of war !

Six lines of traffic on so short a bridge tend to produce a tunnel-like and heavy effect. To obviate this the architect insisted on twin arches and this twin girder construction spelt trouble both to designer and contractor. The

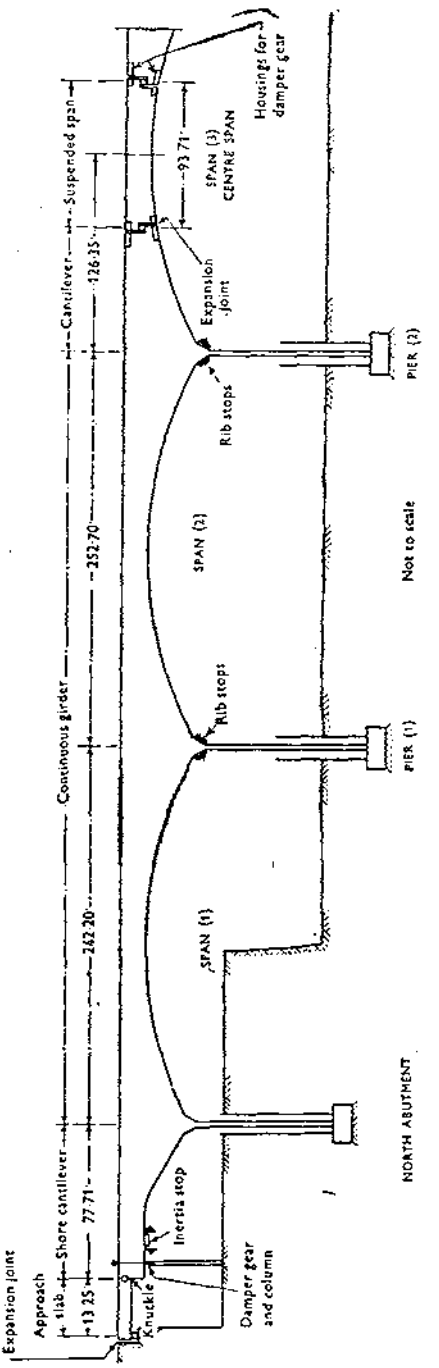

Housings for damper gear
SPAN (3) CENTRE SPAN
93·71
Suspended span
Cantilever
126·35
Expansion joint
Rib stops
PIER (2)
SPAN (2)
252·70
Continuous girder
Rib stops
PIER (1)
Not to scale
SPAN (1)
262·20
NORTH ABUTMENT
Inertia stop
Shore cantilever
77·71
Damper gear and column
Knuckle
13·25
Approach slab
Expansion joint

FIG. 1.

bridge is virtually carried by two box-girders located under the pavements, which are of course lightly loaded. The weight of the traffic has to be transmitted to these side girders by cross girders which subject the main box-girders to torsion and considerable additional stress. But the architect was no doubt correct in his insistence on this feature, without which the æsthetic effect due to the flat soffit would not have been achieved.

Considered longitudinally (Fig. 1 for N half of bridge) the bridge is symmetrical about its centre and each half consists of a twin two-span girder continuous over the first river pier (pier 1 and pier 4) and cantilevered both shoreward from the abutments and into the centre span from pier 2 and pier 3. The gap in the centre space between the two centre cantilevers is filled by a suspended section, while the shore cantilevers carry a short span approach slab. The weight of the new bridge is only three-quarters of that of the old although it has almost twice the surface area—in plan—and can carry a vastly increased traffic load, all by the use of reinforced concrete. The bridge incorporates certain novel features such as pre-stressing, welding, flexible bearing walls, jacking and crack-control.

Piers.

The pier foundations consist of a solid block of concrete six feet thick, heavily reinforced both transversely and longitudinally. The reinforced bearing walls are constructed in two parts separated by a jacking gap 2 feet high about 8 feet below the superstructure. In this gap, 300-ton hydraulic jacks are placed (20 at a pier and 18 at an abutment). This not only affords a simple means of correcting initial settlement but it would also permit of levelling the bridge at moderate cost should an unexpected settlement occur. It also provides a very convenient means of decentering, allowing of that close regulation which is so important in relation to crack-control. The idea is that after a period for settlement to reach a steady state the jacks will be removed and the gaps concreted.

Pre-stressing.

Exceptionally high shear-stresses are set up in certain portions of the bridge and reinforcing bars in these parts are pre-stressed. Pre-stressed bars are made of medium high tension steel whose allowable stress is 30,000 lb. per sq. inch compared with 16,500 lb. per sq. inch in the mild steel reinforcement. These medium steel bars have screwed ends and are contained in steel tubes. Pre-stressing is carried out by passing steam through the tubes and taking up the thermal extension by nuts or turn-buckles. The bars are then grouted up solid in the tubes. For those who have had no opportunity of studying modern bridge design it is worth noting that this matter of pre-stressing is a factor of growing importance, but it is a fair query as to whether the correct pre-stressing is really produced in this case by so complex a method.

Welding.

High reinforcement is essential to secure the desired slimness, and welding, by eliminating laps, splice-bars and hooks, reduces dead weight to a minimum. It also adds resistance to displacement during concreting and assists in crack control. Nearly 1½ million welds were required in the bridge.

EXPANSION JOINTS.

At the extreme ends, and in the centre span at the bearings of the suspended section, expansion joints are provided. These are of the roller-bearing type and are arranged to cater for a total change of length of 6 inches, corresponding to a range of body temperature of 60° F.

SURFACE TREATMENT.

Portland stone facing was adopted in view of the high class nature of the bridge and to harmonize with adjacent buildings.

For those who are interested in modern bridge construction this paper and discussion will well repay close perusal. The bridge reflects the happy results consequent on a close collaboration between the engineer and the architect. When the unsightly railway bridge to the west has been demolished and the eyesores on the south bank have been replaced by buildings of æsthetic value, this part of London will be worthy of the capital of a great empire.

HISTORY REPEATS ITSELF.

By COLONEL H. M. FORDHAM, O.B.E., M.C., A.M.I.E.E. (*Ret.*).

IN the September issue of *The R.E. Journal* appeared an attractive article by Wing Commander A. G. Brickell, on the Laghouat Escape Tunnel. A short account of a similar case which occurred in South China early in 1916 may prove of interest.

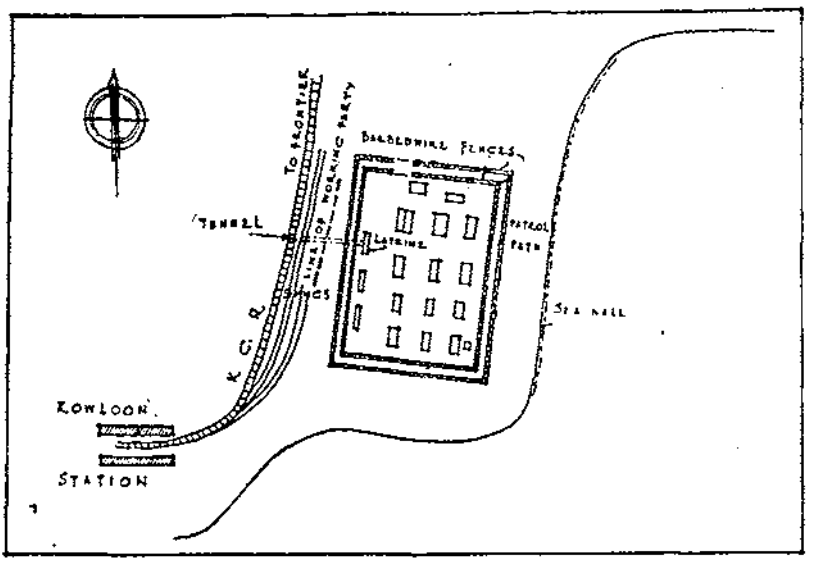
During the Great War, a German Prisoners-of-War camp was established on the mainland of the Colony of Hong Kong, *i.e.*, the Kowloon side, sited on some open ground to the East of the Kowloon-Canton Railway, and near the terminal station at Kowloon. The camp consisted of local pattern mat shed huts and a few simple brick-built cook-houses, etc.; the whole surrounded by two wide belts of barbed wire. The belts were separated by a pathway some ten feet wide which served as a patrol beat. The space between was well illuminated at night, electric current being available for the camp, but no water carriage system; the guarding was strict.

It was afterwards discovered that a carefully planned escape tunnel was started towards the end of 1915. The tunnel was driven Eastwards with the idea of breaking ground on the far side of the railway, where the exit would be concealed from the camp by trucks normally parked on the sidings. The last phase of the operation contemplated boarding a night or early morning train, as it proceeded slowly forth from Kowloon station, with the Chinese frontier and safety but 25 miles distant. Unfortunately for the hard-working tunnellers this finale was never reached. *Cherchez la femme*!

The wives of the German prisoners, conveniently housed in a block of unoccupied married quarters at Kowloon, were permitted to visit their husbands in the camp once a week. As the work neared the end and hopes were running high, one of the escape party could not resist hinting to his better half that

freedom, the just award of their subterranean labours, was near. Before long, this interesting piece of news was gathered by an *amah* in the married quarters, and was soon a popular subject of discussion in the inner circles of No. 1 boys. In due course, it also reached No. 1 Master, the Chief Engineer, Colonel C. H. Darling, who determined to delve into the problem. The Eastern or railway side of the camp was obviously the first line of investigation ; this was handed over to an R.E. subaltern aided by a working party of thirty Sikhs from the H.K.S.B. On their arrival, outside the camp, they were extended some eight feet apart on a line parallel to the railway (see sketch), and proceeded to excavate along this line, with a view to breaking into the roof of the burrow.

After half an hour's good digging into the mystery, the leader of the escapists, an *Ober-Leutnant* in the German Navy, came up and said "You win," and



showed with some pride the details of his scheme. The shaft had been sunk in the concrete floor of a latrine near the wire fence. The working shifts proceeded there, by night only, and one at a time, the mouth of the shaft was concealed by a wooden lid, brushed over with cement, of which a small quantity had been issued to the prisoners, in the early days of the camp, to build some minor amenities for themselves. The cross-section of the tunnel, if memory serves, was practically the same as that at Laghouat, unlined and unpropped. A *kutcha* system of electrical lighting was used for the work, but as the tunnel was somewhat shorter than that at Laghouat it was still possible to carry on without any form of extra ventilation when the story broke. It will be noted that a Lieut.-Comdr. played the chief role in each case, the only major points of difference in the two operations, a quarter of a century apart, being that: the first party were stopped short of a successful conclusion to their labours, but on the other hand, experienced no difficulty in disposing of the spoil, since this was carried away every morning by the sanitary coolies, as part of the camp contract, without extra charge.

MEMOIRS.

MAJOR-GENERAL SIR PHILIP G. GRANT, K.C.B., C.M.G.

PHILIP GORDON GRANT, the younger son of Colonel J. M. Grant, late R.E., was born on the 10th December, 1869, and educated privately and at the R.M.A. He was gazetted into the Corps in February, 1888, and on leaving the S.M.E. went to India and joined the M.W.D. at Jhansi. For a time, in 1892, he served with the Bombay Sappers and Miners at Kirkee, but soon returned to the Military Works at Lucknow. In 1895 he saw service in the Chitral Relief Expedition as Assistant Field Engineer, receiving the medal and clasp, and stayed on for a year in the Chitral garrison, attached to the 1st Company, Bengal Sappers and Miners, under Captain J. R. B. Serjeant. After some leave he rejoined the Military Works for a year, this time at Peshin, and, in 1899, returned home and was posted to Loan Works at Aldershot. Now a captain, he went out to the South African War as Assistant to the C.R.E., 3rd Infantry Division, and later became an extra Staff Officer, graded as D.A.A.G. When serving under General Gatacre he was present at the disastrous affair at Stormberg on December 9th, 1899 and, in 1900 at Pretoria was assistant to Lieut.-Colonel (afterwards Lieut.-General Sir) Ronald Maxwell. He is mentioned in the Official History of the war for removing the charges from the Bethulie bridge, which the Boers had prepared for demolition; this entailed being lowered through holes in the roadway by a rope round his waist. Grant remained in S. Africa until 1902 and received the Queen's medal with three clasps and the King's with two, besides being mentioned in Despatches.

An officer writing of him at this time adds, "I remember being struck by the long hours he used to work and the careful and conscientious way he used to tackle everything."

On return home he took over command of the 57th Field Company on Salisbury Plain. A few years previously he had qualified as interpreter in Arabic and this led to his employment, in 1903, on a boundary commission in the Aden Hinterland. In the following year he saw service with the Somaliland Field Force as Field Engineer and later as C.R.E. and gained the medal and clasp. Returning home he came to the Curragh to command the 57th Field Company. Those were happy and progressive years under G. K. Scott-Moncrieff, and I remember, among other interesting exercises, that our companies in turn took part in a bridging camp with the 3rd Cavalry Brigade near Rush and Lusk, where many bridging expedients then new to the army were under trial. Grant acted as instructor for part of the time and received a letter of thanks from the Brigadier, General Mike Rimington. In 1907 the company was moved to Bulford and, in 1909, Grant left it to take up the appointment of Director of Military Works in the Sudan. He had been promoted Major in 1906 and now held the rank of Miralai in the Egyptian

Major General PhilipG Grant KCB CMG

Army. At Khartoum he introduced sweeping changes by bringing orderly and economic regularity into the hitherto free-and-easy working of the Department. In *The Royal Engineers in Egypt and the Sudan* Lt.-Col. Sandes quotes instances how Grant was helped in his work by the ingenious humour which was so notable a trait in his character. Special mention must also be made of his formation of the Sudanese Sapper Section by training Nuba boy prisoners to become efficient sappers.

An officer writing about the raising of the Sudan Sapper Section says it was a most wonderful performance, the result of which was shown in the Darfur Campaign at 1915-16. Their loyalty to the British regime was proved in 1924 when the mutiny broke out in Khartoum; they did yeoman service, and were known as the only reliable Sudanese troops there.

The outbreak of the war of 1914-1918 found him still at Khartoum, but he was soon brought home to become C.R.E. of the 8th Division. After some service in France, during which he was promoted Lieut.-Colonel, he was ordered to Egypt as Chief Engineer, Canal Defences, with the rank of Brigadier-General. No account need be given here of these desert works, which were soon abandoned, but the difficulties were immense and these Grant tackled with his usual energy. In 1916 he was ordered to Mesopotamia to become Chief Engineer, 15th Corps, but did not take up the post, as at that time Lord Horne, being ordered to France to command the Fifth Army, took Grant with him as his Chief Engineer, an appointment which carried with it the rank of Major-General. In the retreat of the Fifth Army in March, 1918, Grant organized an impromptu force consisting of odds and ends of units to resist the German attack. For his services in the war he received the C.M.G. in 1916, the C.B. in 1918, and was promoted Brevet Colonel in January, 1917. In 1919 he was Deputy Chief Engineer, British Forces France and Belgium, and was promoted Major-General in June. In that year he was made a Grand Officer of the Military Order of Avis, by the President of the Portuguese Republic, and awarded the *Croix de Guerre* by the President of the French Republic. From 1921 to 1923 he was Director of Public Works in Palestine and in 1924 became Commandant S.M.E. and Commander of the Chatham Area, to which was added, in 1926, the appointment of Inspector of Royal Engineers. His last appointment was Director of Works at the War Office which he held from 1927 to 1931, and on his retirement he was created K.C.B. He died at Hurstbourne Priors, Hants, on the 14th July, 1943.

H.S.B., who served under Grant in the Fifth Army, in Palestine, and at the War Office, writes :—

Grant participated in the fluctuating fortunes of the Fifth Army almost from the time of its formation until the Armistice. As Chief Engineer he was quick to encourage any technical advance which might assist the work of the R.E. He was never to be found in his office in the daytime, but from an early hour would be out seeing the work that was going on.

During the short time he was in Palestine he organized the Public Works Department and established it on a sound footing, but no important projects were possible as little money was available. Nevertheless the roads were improved and extended, additions were made to the Jerusalem water supply, which having been taken over from the Army, was re-organized before being transferred to the Municipality, and various Government buildings were constructed. Grant, unlike some others, was able to get on with all sections of a cosmopolitan community and he liked the country. However, he was delighted when the call came for him to take over at Chatham.

Work at the War Office was probably less congenial. As in Palestine, shortened budgets forbade the initiation of large or interesting jobs ; he was tied to an office chair more than he could have wished, and was too forthright to be entirely happy in the web of peace-time works practice at Home, of which he had little experience.

During his time at the War Office the development of mechanization gave rise to discussions concerning the organization for design, procurement and maintenance of the increasing volume of machinery handled by the Army. Grant maintained that the R.E. should play a larger part in dealing with the engineering questions involved, and always deplored the fact that things turned out otherwise.

In administration, he believed in clear-cut definitions of duties. His drafts were models of lucid expression, and he would pick with an unerring eye on the weak point of an argument. But he never relied on paper alone. Whenever possible, he would see the job for himself and, more important still, the man in charge of the job.

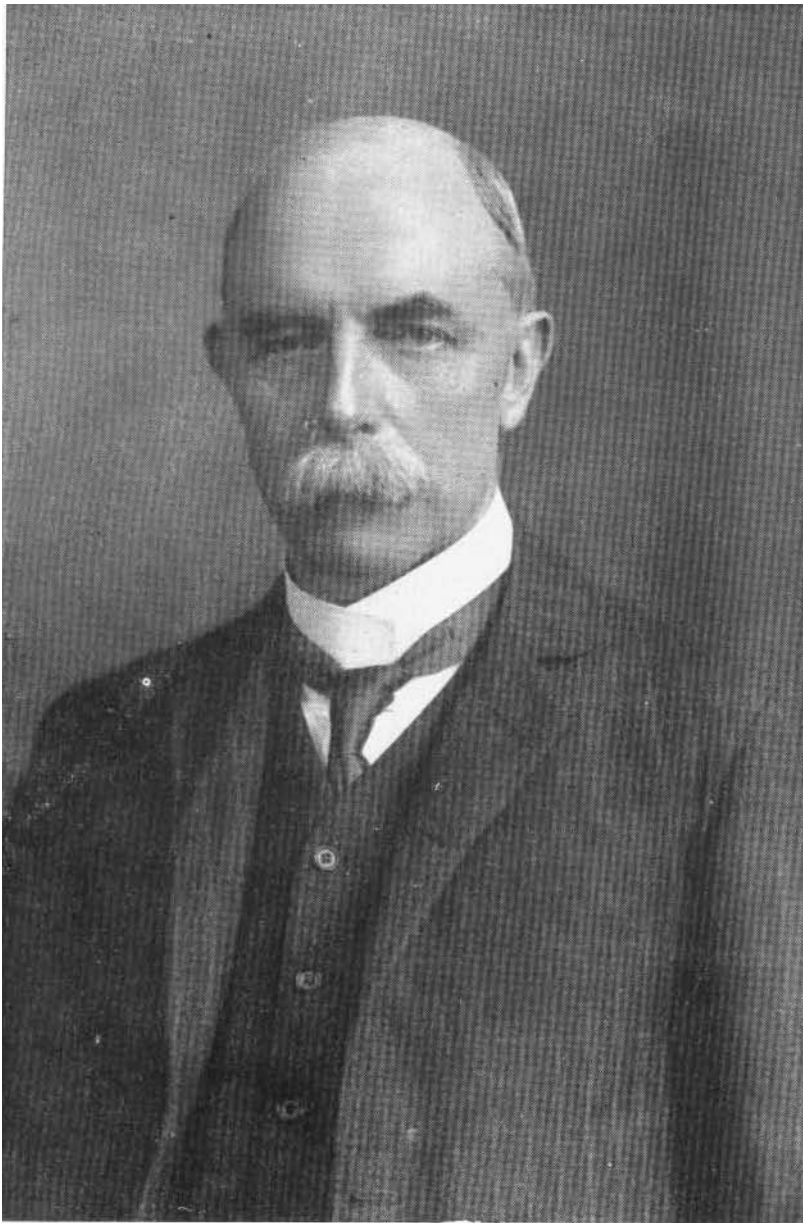
Many a commander achieves the respect and even the devotion of his subordinates, but more rarely is the gift bestowed of being able to inspire them with enthusiasm for their own work. Grant could do all these things.

Another officer writes :—He had an extraordinary knack of being well informed as to what was going on, and woe betide the officer who ventured to draw a red herring across his trail. He was a grand little man, and although he may have appeared on the surface to be a strict disciplinarian, behind it all lay a wealth of kindness.

Whilst Director of Works at the War Office, Grant was also President of the Institution of Royal Engineers. As Secretary I shall always remember his serio-comic way of encountering difficulties with the words " Shocking affair ! "

General Grant married, in 1907, Annette, daughter of Mr. J. Coventry, of Burgate Manor, Fordingbridge, Hants, and had two sons and three daughters. Of his sons, the elder has won the D.S.O. for duty on the Russian convoy, and the younger, Captain P. C. Grant, R.E., is a Prisoner of War in Japanese hands.

F.E.G.S.



Colonel Sir Sidney G Burrard Bart KCSI FRS

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

When William, Duke of Normandy, invaded England in 1066 he had among his companions two brothers, William and Roger de Bosc Roard, and from one of them, the family of Burrard is descended. From the end of the 14th century the family was concentrated at Lymington in Hampshire and took a prominent part in the affairs of the Borough. From 1679 to 1835 Lymington was always represented in Parliament by a Burrard. In 1769 the head of the family was made a Baronet and became Sir Harry Burrard, 1st Baronet of Walhampton, the name of the family seat close to Lymington.

Sidney Gerald Burrard was born on 12th August. 1860, the eldest son of Lieut.-Colonel Sidney Burrard of the Grenadier Guards, the third son of the 3rd Baronet. He was educated at Uppingham, and Wellington, where he showed good mathematical ability. He passed third into Woolwich, and in 1879 passed out second, receiving the Sword of Honour as S.U.O. and the prize for mathematics. After two years at the S.M.E. and a short time with a Field Company at home, he went to the Sappers and Miners at Roorkee and then to the M.W.D. in Baluchistan. In 1884 he accepted an appointment in the Survey and was posted to the Trigonometrical Branch. So began the long and distinguished career which made such important contributions to Geodesy, but in this short memoir the more noteworthy events only can be chronicled.

His exceptional powers were first displayed in 1889-90, when engaged on longitude determinations. These had been going on intermittently for many years, but were liable to large and unaccountable errors. Each arc of longitude appeared to have been measured with extreme accuracy, yet when circuits were formed large errors of closure generally appeared. It had been thought that perhaps the transit instruments lacked rigidity : they had been returned for overhaul to the makers, erected at Greenwich Observatory, and the Astronomer Royal (Sir George Airy) with other eminent persons had considered the problem, but without result. The instruments seemed faultless and were sent back, but the circuit errors persisted and there was no clue to the cause. Then one night while sitting in the observatory tent Burrard suddenly saw the probable solution, *i.e.*, the method of determining the collimation correction might be at fault, and if that were indeed the cause, its effect could be eliminated. To test this idea he re-computed the old arcs and the circuit errors disappeared. Space precludes a fuller explanation but a more complete account is given in the memoir of Burrard in the *Empire Survey Review*.

This great achievement led to a re-determination of the longitude of India by operations beginning at the Prime Meridian at Greenwich. The work began in the autumn of 1894 and was completed in the spring of 1896. Owing to the limitations of the telegraph the total distance had to be divided into a number of arcs. They were :—Greenwich—Potsdam ; Potsdam—Tehran ; Tehran—Bushire ; Bushire—Karachi. Karachi had already been incorporated in the Indian longitude net. Thirty years later, when any place could be connected directly with Greenwich by wireless, it was found that the old and new values of the longitude differed by less than one-fiftieth of a second.

This re-determination was most opportune for the total eclipse of the sun in January, 1898. The Government of India decided to prepare two camps, on the central line of the shadow, not too near together and easily accessible by rail, for the reception of the astronomers coming from Europe. Burrard prepared one, selecting Sahdol in the Central Provinces on the railway from Bilaspur to Katni. The Astronomer Royal (Sir William Christie) and Professor

H. H. Turner of Oxford were the principal observers at this camp. For their observations it was necessary to know the longitude with accuracy.

Burrard's most important work was concerned with deflections of the plumb-line and a few words of explanation will be necessary.

After Sir Andrew Waugh succeeded Sir George Everest as Surveyor General of India there was in Calcutta an excellent mathematician in Archdeacon John Henry Pratt. In 1852 Waugh asked Pratt to devise means of computing the effects of the attraction of the Himalayas on the plumb-line at certain stations of the chain of triangulation, called the "Great Arc of Meridian," which runs up the centre of India from Cape Comorin to the Himalayas. Pratt took up the problem with great energy and in 1854 he communicated his results to Waugh and to the Royal Society of London, which published them in its *Philosophical Transactions*. The results were surprising. They showed that the deflections of the plumb-line caused by the attraction of the mountain mass should be much greater than was compatible with expectations and the observations actually made. It was clear that the mountains were not, in fact, exerting so great an attraction as their apparent mass would produce. This discovery led to the theory of "mountain compensation," *i.e.*, that mountains are not added masses standing on a solid globe, but are produced, either by expansion of the material of which they consist or by some kind of flotation similar to that which supports icebergs. Pratt put forward the expansion theory, the flotation theory was proposed by the Astronomer Royal (Sir George Airy). Since observations showed that deflections, though considerable close to the foot of the mountains rapidly petered out and were imperceptible at a moderate distance, it was inferred that systematic deflections would not be found at places further away. Therefore, if any deflections were observed they must be due to purely local causes, such as underground masses of small dimensions but of abnormally high or low density. Deflections, therefore, would not be connected with the great tectonic mountain building forces and would be of little scientific interest. Burrard had long felt sceptical of these local peculiarities, so long ago as 1893 he had written a paper in which he expressed this scepticism, but it did not attract much attention and he himself felt that he had not got to the root of the matter. He continued his examination of the data, accumulated since the days of Waugh and Pratt, and in 1901 published a paper in which he expounded the ideas that he had formed. The paper, No. 5 in the series called *Professional Papers of the Survey of India*, is entitled "The Attraction of the Himalaya mountains on the Plumb-line in India." It is most interesting and it quite changed the ideas that had been held for nearly half a century.

It showed :—

(1) That the deflections are arranged systematically and are not due to small accidental causes.

(2) That the mountains and their compensation cannot produce the deflections that have been observed.

(3) That there must be another cause at work and that a "hidden range of high density" running across India parallel to the curved line of the Himalayas would be a possible and sufficient cause.

At once, therefore, deflections of the plumb-line are seen to be closely bound up with the great tectonic features and their variations become worthy of careful study. This discovery arroused great interest. In 1904 Burrard was elected a Fellow of the Royal Society, which gave him satisfaction and encouragement.

In 1899 he had been appointed Superintendent of the Trigonometrical Survey. In 1908 he officiated as Surveyor-General of India but reverted to his

substantive appointment in 1909. In that year he was on leave in England and attended the General Assembly of the International Geodetic Association which took place in London and Cambridge in the autumn. At that meeting Mr. J. F. Hayford of the United States Coast and Geodetic Survey presented his important work on *The Figure of the Earth and Isostasy*. It was *Professional Paper No.* 5 that aroused Mr. Hayford's interest in problems of mountain compensation and led to the elaborate investigation he had just completed.

In 1908 Burrard produced in collaboration with Mr. (afterwards Sir Henry) Hayden, Director of the Geological Survey of India, a remarkable book called : *A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet*, which is in fact a store-house of information. A second edition of this very interesting work with much added material was brought out in 1932.

In 1911 Burrard became Surveyor-General of India and received the C.S.I. at the Delhi Durbar, and in 1914 he was promoted K.C.S.I. Under the age rule Sir Sidney would have retired in 1915, but the Government of India very wisely extended his tenure of the office of Surveyor-General for the duration of the war.

About 1911 a movement started to create in India a Scientific Society like the British Association. This had Burrard's valuable support, and as a result the Asiatic Society of Bengal were asked to organize an Annual Science Congress. This was done ; the first Congress was held in Calcutta in January 1914, the second in Madras in 1915, the third in Lucknow in January, 1916, the last under the Patronage of Sir James (afterwards Lord) Meston, Lt. Governor of the United Provinces, with Sir Sidney Burrard as its President. His Presidential address, which was published in full by the Asiatic Society on the subject of Mountain Building Processes, contains many interesting ideas.

Sir Sidney retired from the Service in 1919 having held the Office of Surveyor General for 8 years, and having earned the gratitude of Government and the affectionate admiration of those who served under him. His name ranks with those of his illustrious predecessors Everest and Walker.

In 1933 he succeeded to the Baronetcy, becoming 7th Baronet.

After leaving India he settled in Farnborough, Hants, for the rest of his long life, and died on March 16th, 1943, in his 83rd year.

In 1887 he married Miss Gertrude Ellen Haig, eldest daughter of Major-General Charles Thomas Haig, R.E., then Superintendent of the Trigonometrical Survey, whose first cousin was the father of Earl Haig. Of this marriage there were two children, a son Gerald, now 8th Baronet, and a daughter, both of whom survive him.

Lady Burrard was an accomplished artist and painted many excellent portraits, several of which now adorn the walls of the Hd.-Qr. Office of the Survey of India in Calcutta. During her last years she was much crippled by arthritis and obliged to lead a very sedentary life. She died in 1928.

In 1935 Sir Sidney married Miss Alice Simons, who died in 1938. By that time his eyesight had become very bad and his last years were much saddened by this affliction and by his second bereavement, but so long as he could read he kept up his interest in the subjects to which so much of his life had been devoted, and contributed a number of papers to the *Proceedings of the Royal Society* and other scientific periodicals.

As colleague or companion there can have been few to equal him. His conversation was always interesting, original and entertaining, never commonplace.

His death removes a man who in any calling would have made his mark. The Corps of Royal Engineers may be proud to have possessed such an Officer.

BRIGADIER V. DYKES, C.B.E.

VIVIAN DYKES, the second son of Alfred Herbert Dykes, *J.P.*, of St. Swithins, Shortlands, in the County of Kent, was born on the 9th December, 1898, and educated at Dulwich College, and the Royal Military Academy, Woolwich. On the 6th June, 1917, he was commissioned in the Royal Engineers, and went to the S.M.E., Chatham, for the short war-time course. Dykes decided to take up Signal work, and early in 1918 went to France. He was wounded that summer when with the V Army, and returned to England.

Dykes served with the Royal Corps of Signals in Ireland, at Maresfield, and in India. He saw service again in Waziristan, and was twice mentioned in despatches. In October, 1922, he returned home, and rejoined the Royal Engineers.

Next year, Dykes went to Caius College, Cambridge, and then to Chatham for his Supplementary course. In 1925 he was posted to Aldershot as D.O. Marlborough Lines. Towards the end of 1926 he went to Italy on language leave, passing as a First Class Interpreter. He had barely got back to England when the Japanese threat to the International Settlement at Shanghai led to sending a British Division at short notice to China. Dykes sailed as one of the Engineer Officers who were to plan and build the accommodation required for the housing of this large force. This emergency called for hard work, improvisation, and resource, to which Dykes' character was well suited. A host of problems arose, and a new technique for dealing with Chinese contractors, unacquainted with the Barrack Schedule, had to be developed while work went ahead full speed. Dykes' share in the fine job done by the Sappers was recognized by the award of the M.B.E. In 1928 he was promoted Captain and returned home to Q.M.G. 7.

In January, 1929, he was appointed Adjutant, R.E. 1st Division. This was a post after his own heart, regimental duty at its best, involving work with other arms, and the congenial atmosphere of the headquarters of the mounted portion of the Corps. At Aldershot Dykes spent three happy and successful years, which led to his nomination in January, 1932, to the Staff College, Camberley. Sir John Dill was Commandant at the time, and these two years at Camberley were full of interest and instruction. Dykes was not a games player, but the Drag gave him exercise and sport. He took a full share in its organization, and in the arrangement of the Point-to-Point races.

In October, 1922, Dykes had married Ada Winifred, younger daughter of Richard Smyth, Esq., of Castle Widenham, Co. Cork. There were three children of the marriage, two sons and a daughter. The second son, aged three, died at Camberley in 1932, a sad blow which cast a gloom over an otherwise carefree period.

Leaving Camberley at the end of 1933, Dykes had a short spell with the 1st Anti-Aircraft Searchlight Battalion at Blackdown, but was soon called to the War Office as G.S.O. III in the Italian section of the Military Intelligence Branch. Here his quickness of mind and powers of concentration stood him in good stead, and the excellence of his work led to his being offered, in October, 1935, the post of Military Assistant Secretary of the Committee of Imperial Defence, and Secretary of the Oversea Defence Committee. This brought him under Sir Maurice (now Lord) Hankey, and placed him in contact with all the leading figures in the armed forces, the Civil Service, and the Cabinet. The post of Secretary, Oversea Defence Committee, had been in

Brigadier Vivian Dykes CBE

existence since 1884, and had been held by a succession of Officers, all Sappers except for Colonel (now Lieut.-General Sir Henry) Pownall, who was Dykes' immediate predecessor. The Committee was responsible for reviewing the Defence Schemes of the whole Colonial Empire, receiving and remarking on the annual reports of Colonial Local Forces, and co-ordinating advice to Colonial Governments on all aspects of preparation for war. The work of Secretary was thus of great interest, and its importance and scope were increased as the holder of the office had also to take his share of the work of the Secretariat of the Committee of Imperial Defence, and of the Chiefs of Staff Committee.

This was a time of great activity in the C.I.D. Rearmament was in full swing, and immense efforts were being made to remedy the grievous deficiencies in our defences. Dykes' wonderful knack of spreading good humour and willing co-operation had full rein among those with whom he dealt. Many Officers and Civil Servants with difficult problems found in him one to whom they could come for assistance and encouragement. His colleagues in the Offices of the Cabinet and the C.I.D. soon appreciated his particular capacity for friendship, his vivacity, and his exceptional powers of humorous expression in speech and writing. His three years at the Committee of Imperial Defence were marked by a brevet-majority, a brevet-Lieut.-Colonelcy, and finally a C.B.E.

In October, 1938, Dykes became an Instructor at the newly established senior wing of the Staff College at Minley. The work here was not entirely congenial to him. Instructors at the Staff College are always hard-worked. This was no new experience to him; but his natural bent was towards the handling of concrete problems, or the commanding of men. However, soon after the outbreak of war in September, 1939, he was urgently summoned by General Ismay, who in 1938 had succeeded Lord Hankey, to return to his old Office, which now served the War Cabinet. Warmly welcomed by his old colleagues, he shared with them the anxiety of the early days of the war, of the invasion of Norway, and the fall of France. His strong desire to return to troops led to his departure in July, 1940, to take command of the 26th Field Company, R.E., which was reforming after its virtual destruction at St. Valery. Four months followed of the outdoor life which Dykes so loved. This was long enough for him to turn 250 men into a coherent and efficient unit. At the end of this time he returned to the War Office, first as M.O.I. Colonel, and later as Director of Plans. Before long he was selected to accompany the celebrated Colonel Donovan of the U.S.A. on a tour which he was making at the request of the President. Together they visited Spain and Portugal, Greece, Bulgaria, Yugoslavia, Turkey, Palestine, Iraq, and Egypt; seeing the leaders in each country, and examining the political and military situation throughout the Mediterranean basin. In August, 1941, as Director of Plans, Dykes accompanied the Prime Minister in H.M.S. *Prince of Wales* to the historic meeting with the President, at which the Atlantic Charter was drawn up and given to the world. These experiences led up to Dykes' last and most important duty. In December, 1941, a week after the attack on Pearl Harbour, the Prime Minister once more met the President, this time in Washington. This Conference led to the formation of the Combined Chiefs of Staff, consisting of the U.S. and British Chiefs of Staff, with permanent headquarters at Washington. A powerful British team, with Field-Marshal Sir John Dill at its head, was established to represent the British Chiefs of Staff. A Combined Anglo-American Secretariat was required, and the two men selected to found and build this important link were Brigadier-General W. B. Smith, U.S. Army (now Chief of Staff to General Eisenhower in the North African theatre), and Brigadier Dykes.

A happier combination could hardly be imagined. Smith and Dykes were determined and loyal; honest and straightforward in their dealings, with one aim, to foster the closest collaboration between the American and British Staffs. They were successful to a remarkable degree. Dykes gained the complete confidence of the American Chiefs, General Marshall, Admiral King, and General Arnold, while retaining in equal measure that of the Field-Marshal and the heads of the British Missions. The foundations, so successfully laid, have already shown results in the war effort, and may well enable a permanent structure of Anglo-American co-operation to be erected.

Dykes had been just a year in Washington, when he accompanied the U.S. Chiefs of Staff and Sir John Dill to the Casablanca Conference whose decisions have passed into history. He decided to return to Washington *via* London, and set off with a number of companions in an aircraft *via* Algiers and Gibraltar. The flight ended on 30th January, 1943, in disaster on the Welsh coast, and Dykes with his close friend and successor as Director of Plans, Brigadier Guy Stewart, lost their lives. Thus was cut short a career already full of achievement, and of promise for the future, not only in service to Britain, but in the cause of Anglo-American friendship.

Dykes' death caused consternation among his friends and colleagues in London and Washington. The opinion in which he was held by the U.S. Chiefs of Staff may be judged by the fact that he was posthumously awarded the Distinguished Service Medal, an American honour which had not been conferred, up till then, on any Englishman in Washington or elsewhere in this war. The medal was accompanied by the following citation :—

> " As British Secretary to the Combined Chiefs of Staff he made an outstanding contribution to the Allied cause and the war effort of the United States. His sympathetic understanding of American problems and aims, his broad knowledge and experience of British Military and Cabinet procedure, and his great organizational ability contributed in an important measure to the expeditious establishment of the Combined Chiefs of Staff on a sound basis."

The feelings of his countless friends in England were well summed up in *The Times* of February 4th, 1943, by Mr. Lawrence Burgis, one of his colleagues in the Cabinet Offices :—

" Brigadier Vivian Dykes, C.B.E., will be deeply mourned by a host of friends in this country and in America, where his efficiency, his dynamic energy, and his engaging personality quickly earned him the confidence and affection which he already commanded at home. Vivian Dykes was a man of singular honesty of purpose and complete selflessness. His one idea was to get on with the job on hand in the quickest possible time and in the most straightforward way. He had no use for subtleties or mental reservations of any kind. His pungency of phrase and graphic presentation of a case will never be forgotten by those who were privileged to work with him. But despite his refusal to mince words about his beliefs and views, he never hurt the susceptibilities of others. A tough, wiry frame was allied to a studious and thorough mind, a quick brain and loyalty as deep as the oceans. Was it, then, surprising that those who worked with him and loved him felt sure that he was destined for the highest offices ? Dykes' contribution to the Allied war effort was of importance measured by any standards, and this contribution was growing as the months went by. His passing creates an irreparable gap in the ranks of those who are content quietly and competently to dedicate their lives to the service of their country."

E.I.C.J.

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library at Brompton Barracks, Chatham.)

I RODE WITH STONEWALL.

By Henry Kyd Douglas.

(Published by Putnam & Company, 401 pp., 13 portraits and a map. Price 18s.)

The subtitle of this book is "The War Experiences of the Youngest Member of Jackson's Staff," and the text substantiates its truth. At the age of 22 the late Colonel Douglas joined the staff of General Thomas Jonathan Jackson as a galloper. He was in a couple of days promoted to more responsible work, and in under four years, through a series of divisional staff appointments, rose to the command of an infantry brigade. His story, now published by his nephew, was written long ago, being completed in 1899; but the greater part of it is even older, having been put together from notes and diaries in 1865 immediately after the close of the Civil War, when, as he says in a preface, his recollection was "fresh and youthful."

There are adventures enough and to spare. Douglas was present at nearly all the major battles in the Eastern (Virginia) theatre. As an intimate picture of Jackson and how he waged war his book has rightly been described as a "classic." It has however another aspect. It is emphatically a young man's book of war, better even than the memoirs of Baron Marbot, one of Napoleon's young men, set down when all was new and worth recording, and the senses were more impressionable than in later years. Its lesson is that an officer should do anything, however unpleasant and dangerous, that he is called on to do, either by his superiors or by his own judgment, without fear of failure or hope of reward.

One would like to have known young Douglas. His portraits indicate "blood" both in feature and expression, and as he was clean shaven—in a particularly hairy period in Armies—he might in appearance be one of the present generation of young officers of the best type.

He was born on the banks of the Potomac near Harper's Ferry; his earliest pages tell us all about "John Brown" (Isaac Smith) whom he knew before the man attracted public notice; he saw the attack on his stronghold and attended his trial.

At the end of 1860 Douglas began to study law at St. Louis; when Virginia seceded in April, 1861, he did not hesitate, but at once returned home and was soon on sentry-go on the canal path along the Potomac. He had joined a battalion in the formation under Jackson which was to go down in history as the "Stonewall" Brigade. Douglas fought in this brigade at the battle of First Bull Run, where it received its title, and a month afterwards was given a commission. He says:—

> "From my experience in the Army I am convinced that a good officer ought to have been a private (but not for long). Unlike poets, good officers are made, not born. There are many things officers do not know who have not served in the ranks; and while they are learning them the service and the troops under their command must suffer."

At the close of the battle of Kernstown, Douglas, riding 25 miles, took a message from Colonel Ashby to General Jackson. The latter immediately made use of him to carry an all-important order to General Ewell, eighty miles away on the other side of the Blue Ridge Mountains. The sun was setting, rain was falling heavily, and, in reply to "Good night, sir," Jackson shouted out, "A successful and pleasant ride"—not an endearing send off. Douglas got through and, on reporting his return,

Jackson merely said, "Very good. You did get there in time. Good night." Douglas felt disheartened and angry, but said nothing. Next day Jackson appointed him Assistant Inspector-General of his division (we should say D.A.A.G.). Such was his first step on the ladder. In this capacity Douglas took part in the remainder of the celebrated "Valley Campaign," in the march to join Lee near Richmond, and in the "Seven Days' Battle" before Richmond. It was not a safe task to follow Jackson in battle, as he rode about regardless of fire, even stopping to pick blackberries within easy range of the enemy.

After the battles of Second Bull Run, the Antietam and Fredericksburg, the Stonewall Brigade was so weak in officers that Douglas judged that the front offered better chances of promotion than the staff, and obtained Jackson's permission to return to his unit, the general saying that if he wanted to come back to the staff there would always be a place and a welcome for him. He did not long remain a regimental officer, being within the month appointed what we should call brigade-major.

In the reorganization after Chancellorsville and Jackson's death, Douglas was transferred to be senior staff officer of Edward Johnson's division and was badly wounded on the last day of the battle of Gettysburg. He explains much of the hesitation and loss of opportunity by the subordinate Confederate generals, adding significantly: "It took the battle of Gettysburg to convince General Lee that General Jackson was dead." Taken prisoner in a dressing station, he was exchanged after 10 months' captivity, and on the 5th May, 1864, rejoined Johnson's division just in time for the Wilderness Campaign, and the disaster to that division in the grey of the morning in the "Salient" at Spotsylvania. The Confederates expected attack, and the general and staff were up at the front; but assailed by four-fold numbers (Hancock's Corps), the division was overwhelmed. Douglas was one of the few who escaped.

Transferred as chief of staff to Early's division, Douglas saw at Cold Harbour the great defeat of Grant's last effort in the Wilderness, and took part in Early's extraordinary raid to the gates of Washington, which only just failed to dislodge Lincoln from his seat of Government. He witnessed a similar case of missing success by a head at Cedar Creek (Sheridan's lucky victory), of which Early said: "The Yankees got licked; we got scared." Douglas himself was nearly captured by Federal cavalry.

On the 25th March, 1865, he was given command of the "Light Brigade." He was still fighting on the 9th April, when Lee surrendered at Appomattox Court House, and a corps staff officer had to order him to stop.

His post-war adventures are in themselves as good as anything in "Gone With the Wind."

J.E.E.

TO STALINGRAD AND ALAMEIN.

By STRATEGICUS.

(Published by Faber & Faber, Ltd., 237 pp. with Maps. Price 10s. 6d.)

This is the fifth instalment of Strategicus' Chronicle of the War. It is in every way worthy of its predecessors, distinguished both by the clarity and brevity of the author's narrative, and by the reasonableness of his comments and deductions. Readers will generally agree with the latter although they may be sometimes open to argument.

The period covered by this booklet is from the winter of 1941-42 to August of the latter year; but, by a curious omission, the years dealt with are mentioned only on the paper wrapper. This matters little to-day, but should be corrected in any subsequent edition.

Where all are good, the most skilfully compiled chapters are certainly those dealing with the Russian theatre. A mass of detail has been pruned away, and all that matters in the narrative stands out in true perspective. For completeness combined with conciseness there has been no war-writing to surpass the author's descriptions of: "The German Winter Defensive" of 1941-42, Timoshenko's counter-offensive in May, 1942, or the operations which culminated in the siege of Stalingrad.

The purely British operations in various spheres provide rather a sad tale, although full justice is done to the gallantry of our troops, to the skill of Gen. Alexander in his conduct of the withdrawal from Burma, and to General Auchinleck in his spirited active defence of the Alamein position. Nor do our own and our Allies' experiences in "the Pacific Cauldron" make a very palatable story. Our present knowledge of later developments, however, takes some of the bitterness from the cup.

Although, in the period dealt with, there is little evidence of the existence of any great comprehensive Allied Strategy, side-lights which might affect it, in more or less degree, are shown in the pages devoted to: "The Tragedy of India," "The Home Fires" and "The Development of Sea and Air Power." Of these, the chapter on India, written entirely without prejudice, is specially suitable for study by political thinkers and dreamers.

T.F.

REPORTED SAFE ARRIVAL.

By Michael Harrison, late R.E.

(Rich & Cowan, 37 Bedford Square, W.C.1, 142 pp. Price 10s. 6d. net.)

This book purports to describe the life on a troopship to the Middle East in war time.

The conditions, messing and state of discipline revealed for the purposes of the story would be painful to read, but for the author's assurance that the ship and characters are wholly imaginary. The book is not, however, all exaggeration or caricature. Two of its pages might indeed with profit be extracted and issued to R.E. recruits of all ranks. The whole duty of the sapper in the field is packed into those two pages. In spite of its blemishes, this is a clever book and among all its misrepresentations it contains a modicum of truth and more than a modicum of laughter. The author confesses that he is no soldier and, having been discharged after a very few months' service, he can never be one; but he has the gift of observation and he wields a facile pen. "Characterization" is his strong point and his pictures of some of his comrades make them stand out as living types, firmly if somewhat coarsely outlined. His essay on the Cockney soldier is particularly well done; as also his appreciation of the "Old Sweat." "Dialect" is another feature of the book. Mr. Harrison has a *flair* for it which adds reality to the talk which he reproduces. The "Old Sweat's tale of Daft 'Arry," and his dissertation upon the "Lonely Sojer" make particularly amusing reading.

Reported Safe Arrival would be a better book if it were not spun out by a description of the author's reactions to his surroundings, a not very interesting psychological study which requires no further reference, except that he has written more for his own relief than for the entertainment or information of his readers. The regular soldier will find much that irritates but certainly some amusement in this book.

T.F.

THE MACHINE SHOP YEAR BOOK AND PRODUCTION ENGINEERS MANUAL, 1943.

EDITED BY H. C. TOWN, M.I.MECH.E., M.I.P.E.

(Paul Elek, Africa House, Kingsway. Price 30s.)

The object of this book of 496 pages, 412 figures, as stated in the publisher's note, is to present in a convenient and concise form the latest developments in the science of engineering production, management and design.

Part I, comprising 47 pp., includes interesting articles by experts on *electric control gear, optical instruments* as an aid to observation and measurement, *external centreless grinding* and its advantages over plain centre grinding, and the *direct hydraulic system* and its advantages over the older accumulator hydraulic system.

Part II (287 pp.) comprising the body of the book is devoted to descriptions of modern machine tools of all types commonly met with in production work, with notes on power transmission and electric and hydraulic control equipment. The principles and functions of the various tools are ably described and there is a wealth of useful information on cutting tools—material, sharpening, clearance and rake angles, heat treatment, speeds, consumption, etc.

The machining of non-ferrous metals and alloys is not forgotten.

Part III (145 pp.) consists of well-chosen (abridged) recent articles on machining and production processes which have appeared in the leading British and Foreign technical journals. It includes articles on cam milling, tool consumption, gas flame hardening, metal spraying, heliarc and unionmelt welding, quality control and process planning, plastics, presses and stamping operations, machine design and A.C. variable speed drives.

The subject matter is interspersed throughout with illustrated advertisements of engineering firms and there is a comprehensive index of engineering products and firms supplying them.

This book can be confidently recommended as a valuable addition to the library of every works manager and foreman.

W.M.

APPLIED MECHANICS.

BY ARTHUR MORLEY, D.SC., M.I.MECH.E.

(Longmans Green & Co., 360 pp., 162 figs. Price 7s. 6d.)

There are so many good textbooks on Applied Mechanics that at first sight there would appear to be no justification for adding to their number.

The author, however, is well-known as a writer of many excellent textbooks on this and allied subjects and in addition to his many years' experience as a teacher he was for some years H.M. Inspector of Technical Schools.

He states that this book is intended primarily for third year students who are taking the Ordinary National Certificate in Mechanical Engineering. As such students are usually tradesmen who can devote part-time only to academic work, the book will no doubt be popular with them as it deals lucidly with essentials only for the purpose in view. The treatment assumes the reader to have some elementary knowledge of the subject such as that given in Morley (same author) and Inchley's *Elementary Applied Mechanics* which has been a well-known textbook in technical schools for more than twenty years.

Many worked examples are given, and upwards of 160 examples (with answers) are included as exercises for the student.

The book can also be recommended for Engineers taking the Associate Membership examinations of the Engineering Institutions.

W.M.

ELEMENTARY SURVEYING.

By Arthur Lovat Higgins, D.Sc.

(Longmans Green & Co. Price 6s.)

Before the Ordnance Survey covered the land with the trigonometrical survey and with the bench marks of its levelling; before there were any published large-scale plans; land-surveying was taught in the high schools of the country towns, and a very welcome diversion to geometry and trigonometry that instruction must have been. The curriculum must have been very much what this small book deals with. The surveying is all large-scale, the instruments mentioned are all of the simplest, and there is no mention of that control on which the chain survey of any extended area must be based. Chainings and traverses are closed upon themselves; the only theodolite mentioned is a vernier, and the only level a Dumpy.

As the author says in his preface, the book aims at opening a vista of the educational and professional possibilities of surveying, and connects the simplest survey operations with the underlying geometry. The author achieves his object interestingly and readably. By intention, however, the book is one for the young and is not meant to help the Engineer, Royal or Civil, in the conduct of practical surveys with modern instruments.

There must be a considerable field of usefulness for the book, and one can imagine the enthusiasm of pupils, released from the schoolroom, and allowed to carry out on the ground, the exercises described by the author.

H.S.L.W.

HOW TO SHOOT THE U.S. ARMY RIFLE.

(The *Infantry Journal*, Inc., Washington, D.C. Price 25 cents.)

"Send me men who can shoot . . ."

Pershing.

This booklet has expanded into more than a hundred pages, a subject which *Small Arms Training* condenses into a mere handful; it stresses each separate point of the Rule of Aiming at length and with excellent illustrations; undoubtedly each point scores a bulls-eye! on the American recruit. It convinces each American that his rifle outmatches those of the enemy and reminds him that he has a reputation to maintain although we, as mere Englishmen, will have to forgive the quotation of the dying German who wrote "God save us from these Americans. They shoot like Devils . . . They are the best marksmen in the world."

We also have something new to learn: for example, the sitting and the squatting positions are introduced as standard positions; it should also be noticed the Americans still insist rigidly on the many details of the prone position, whereas we only recommend them, telling the recruit that he may adopt the "most comfortable" position.

To those who have been brought up on *Small Arms Training* this American booklet may appear revolutionary; not so much because of the material it contains but because of its presentation. The staff of the American magazine *Life* have certainly done a very good job and their efforts should go far to stimulate interest in what normally is considered a dull subject by Sappers in general.

G.M.L.

MAGAZINES.

THE ENGINEERING JOURNAL.

(*25th Anniversary Number, May 1943. Published by the Engineering Institute of Canada.*)

This issue shows in an interesting manner the immense progress made by the Dominion in Engineering since the first issue of the journal in May, 1918.

There are articles on Scientific Research, Telegraph, Telephone and Radio Communications, Air Transport, Railways, Water and Steam Power Development, Public Works, Highways, etc., from which it will be seen that Canada has more than held its own in all these fields during the past 25 years.

The Lumber Industry.

The development of the Canadian Lumber Industry, helped largely by the many rivers and abundant water power resources, has been most impressive during the period under review. More than one-fifth of the total land area of Canada (*i.e.*, an area roughly equal to the combined areas of the British Isles, France, Spain, Portugal the Netherlands, Denmark and Sweden) is covered with productive forests.

Large structures such as factories and airship hangars with clear span roofs up to 250 ft., bridges, etc., are frequently constructed of timber and it is estimated that over 2,000 tons of structural steel is saved in one airship hangar alone. 700 double hangars have been built in timber for the Commonwealth Air Training Scheme.

In 1942, as much as 400,000 tons of steel was saved for other essential war work by the use of timber.

Large numbers of *wooden ships* have been built, especially corvettes.

Plywood is being largely used in the manufacture of aircraft, owing to the shortage of aluminium. In this case also there are some virtues in the necessity. Plywood stands up better than duralumin to vibration, it does not corrode, a bullet leaves a clean hole whereas duralumin flowers with jagged edges, it makes possible a smoother external finish and therefore reduces aerodynamic drag, and the fuselage can be turned out by mass production in about half the time taken for an all metal plane.

The "Mosquito" Bomber, reported to be the fastest bomber in the world, large numbers of which are manufactured in Canada, is built largely of plywood.

The enormous importance of *paper* to the war effort needs no emphasis.

At the outbreak of war, wood pulp and paper was rightly considered as Canada's greatest manufacturing industry. The weight of pulp produced increased from 1,500,000 tons in 1918 to 6,000,000 tons in 1942, and half a million people in the Dominion depend upon this industry for their livelihood.

Then again, wood pulp is the basic constituent of "plastics" which will undoubtedly play an important part in the industrial world of to-morrow.

Great Britain always a large wood consuming country, has produced relatively little itself. We have, hitherto, imported mainly from Europe, but we are now dependent almost entirely on imports from Canada to supplement our own fast diminishing resources.

Minerals.

A chart is given showing that the value of mineral production has increased from £40,000,000 in 1917 to £100,000,000 in 1942. These figures include a metal production valued at £20,000,000 and £80,000,000 respectively. This means that the output of minerals per capita is now about 85 % of that of the U.S.A. Cheap hydro-electric power helped a good deal in this development, but the natural deposits are rich and

extensive. Canada continues to be the leading producer of nickel, but its output of copper, lead and zinc is now considerable. Surprisingly enough the value of the gold output has increased enormously from £3,000,000 in 1917 to nearly £40,000,000 in 1942, a value now much greater than that of the combined output of copper, nickel, lead and zinc.

War Weapons.

Since the war began Canada has produced more than 400,000 *transport vehicles*—215,000 in 1942 alone. More than half of the mechanical transport used by the 8th Army in North Africa came from Canada.

When Canada commenced the production of *war weapons* at the beginning of the war it can be said that it started from scratch. The industry simply did not exist, but the automobile industry, which has developed enormously during the past 25 years, proved its adaptability and largely helped in getting things going. In the 1914-18 war, Canada made explosives and manufactured shells and small arms but little else. It now turns out huge quantities of small arms, light machine guns, A.A. and field guns complete with control gear. Also large numbers of 18-ton Valentine and 30-ton Ram Tanks. (During 1942 Canada's entire output of Valentine tanks went to Russia.)

100,000 people are employed in the *aircraft industry* and there is an annual output of 4,000-5,000 aircraft varying from primary training machines to the largest bombers.

The aircraft industry is now capable not only of providing all the planes required for the gigantic British Commonwealth Air Training Plan, which is probably Canada's greatest single contribution to the whole war effort, but in addition is contributing substantially to the Allied cause in various parts of the world in both combat and transport types.

Canada is also building large numbers of ships both for the Merchant and Royal Navies.

Military Engineering.

A short chapter is devoted to a brief consideration of the work of Sappers in modern war and explains how conditions differ from those in 1914-18. This chapter is worth repeating in some of our British Engineering journals as a general corrective of the mistaken impression in some civilian circles that the R.E.M.E. has now taken over the work of the R.E. as regards mechanical matters.

General.

The British reader will be much impressed by the potentialities of the Dominion. Canada has untapped mineral resources and forests far exceeding anything in Europe or Russia. Yet it has only about 3 inhabitants to the square mile compared with about 700 to the square mile in Great Britain. Large scale immigration would appear to be a good thing for both Canada and Europe after the war.

Niagara.

The July number of this Journal, might well be known as the "Niagara Number." The chief feature is an extremely interesting paper on "The Preservation of Niagara Falls" presented at a joint meeting of the American Society of Civil Engineers and the Engineering Institute of Canada. The paper shows how power development has been, and can be carried out in the future, without impairing the integrity of the scenic spectacle. In 1878, due to the joint interest of the Governor-General of Canada and Governor Robinson of New York State, commissions were appointed to acquire park reservations on both sides of the falls, with the splendid scenic results to be seen to-day. In 1906 the rapid increase in power developments gave rise to the fear that the falls might be denuded of water in the future to an extent which would nullify their value as a scenic spectacle, and the Boundary Waters Treaty, 1909, limited the

diversion of water above the falls for power purposes to 56,000 cu. secs. Another factor arose more recently which caused concern, the effect of erosion, which during the last hundred years has resulted in the recession of the horseshoe crest of the falls some 360 feet to the southward. In 1926 a Special International Niagara Board conducted investigations into this and other matters affecting the preservation of the falls consistent with the use of the water for power. Their findings disposed of the widely circulated bogey that the falls might "commit suicide" by receding into a narrow notch. In brief they were :—

Firstly, for some years the recession of the crest had been upstream along two diverging channels; this had resulted in the "toe" of the horseshoe growing broader.

Secondly, the hard upper stratum of limestone increases in thickness steadily to the head of the upper rapids, and as the crest moves upstream this increasing thickness will decrease the rate of recession.

Thirdly, as the falls recede the crest will continue to increase in length and the consequent thinning out of the flow per unit of length will decrease the erosion.

Fourthly, the diversion of water for power reduces the rate of erosion.

It has been estimated that over the next hundred years the recession should not exceed some 250 feet and that it will not progress to the point of draining the American falls for 2,000 years at least.

In 1941 war emergency demands for power resulted in an authorization, by both Governments, of an increase of water diversion of 12,500 cusecs. on the United States side, and 14,000 cusecs. on the Canadian side. At the same time it was mutually agreed to put in hand at once remedial works above the falls for the improvement of power production as well as the protection of scenic values. This work is in the form of a submerged rock-built weir about half a mile upstream of the falls in the Niagara River.

The whole paper shows very clearly that during the past 60 years the conflicting claims of—obtaining the optimum power output from the falls, and maintaining their scenic grandeur, have been nicely balanced.

The July number also contains a very practical article on the "Heating of Dwellings," showing comparative costs using coal, oil, gas and electricity. The standard taken is the maintenance of an average internal temperature of 70° F. (some 5° to 10° higher than that usual in England) throughout the year, for a house in Montreal in which 20,000 cu. feet have to be heated, *i.e.*, the rough equivalent of a Group III Quarter. Except in the month of July a sensible amount of internal heating is always necessary to maintain this internal temperature.

Comparative Annual Costs, including Interest, Depreciation, Fuel or Power cost, Service and Domestic Hot water are :—

For Montreal and the province of Quebec—

Coal ...	$340	Gas ...	$342
Oil ...	$325	Electricity ...	$1,114

In conclusion the writer points out that, under the climatic conditions prevailing in Montreal and the province of Quebec, heating private dwellings with Electricity would be entirely uneconomical. The heating load needed for the City of Toronto alone would require seven times the output of Queenston, the Canadian Niagara Power station, or rather more than four times the total power output of the falls!

The Deputy Director-General of Australian War Supplies Procurement gives a valuable and to many a surprising account of the wide and varied extent of Australia's war production, including Machine tools, Aircraft, Tanks, and Shipbuilding.

The August number presents a valuable paper on "Alternative Fuels for Motor Vehicles" early on the bill of fare. Between the two wars progress has been slow due to the convenience and low cost of gasoline, but the war has given

an intense stimulus to research in this, as in many other fields, and made Europe a testing ground. In many ways liquefied gas—mainly propane—stands out as the best alternative, having a high octane value.

So far, alternative fuels have proved more satisfactory in larger units than passenger cars. In the post war world the writer foresees a general restriction in the use of diesel oil and gasoline in industry and agriculture, owing to the great demands of aviation. The use of alternative fuels on a large scale would then be essential; fortunately much recent work has been devoted to the question, which it is undesirable to publish at the present time.

Colonel R. B. Maxwell, A.A.G., R.E.M.E., contributes indirectly a comprehensive article on the birth and growth of this Corps from the Beveridge Committee's interim report of August, 1941, onwards, giving the general picture of the Field organization. The numbers required per division, airborne or otherwise, will be a surprise to many even in this engineers' war.

W.M. & H.M.F.

PRODUCTION AND ENGINEERING BULLETIN.

Issued by the Ministry of Labour and National Service, 48 pp.

(*August*, 1943). This issue is well up to its usual high standard and contains several articles of great interest to the manufacturing industry.

The *Production Section* begins with a simple but clear explanation of *Quality Control*, the modern scientific method of detecting and preventing scrap at the earliest possible stage of production.

There is also an interesting description of an anti-scrap campaign organized by an important aircraft component manufacturing firm; this is followed by some practical methods of segregating swarf.

Another very informative article explains how to increase the life of grinding wheels. Care in their handling and storage is naturally emphasized, but methods of modifying large worn wheels for use as smaller wheels is the main purpose of the article.

The *Engineering Section* is largely devoted to describing the important part women are playing in all branches of war-time engineering, in the dockyards, railway workshops, and cable-making works; and in tank and aircraft manufacture. The versatility of women in the war effort is repeatedly brought out in these publications.

A short but valuable survey of the work of personnel management is also included.

W.M.

THE GEOGRAPHICAL JOURNAL.

The Geographical Journal for July, 1943, contains on page 26 an interesting short article on the Ankara-Cubuk Dam. It is an entirely Turkish conception, built from the resources of the country. This dam, across a gorge of the Cubuk river, is a beautiful work, 150 feet high and 660 feet wide, and contains some 3,000,000,000 gallons of water. The article is illustrated by four excellent photographs of the reservoir, dam, spillway and surrounds.

H.M.F.

JOURNAL OF THE UNITED SERVICE INSTITUTION OF INDIA.

(*April*, 1943.)—*Officer's training in the post-war army* is a trenchant criticism of pre-war training. That this has not been all that it might be is generally agreed, but in peace the army is up against financial restrictions. Moreover, we are not an aggressor nation, and it is unfortunately the dictator-led countries who have the initiative, can decide far ahead on weapons and on points to attack, and organize and train accordingly. A non-aggressor nation can only prepare against the most likely forms of attack, and so is bound to be handicapped at the outset of hostilities. The author summarizes his arguments under *fifteen* headings, and concludes with "let us remember that, if our tactical technique remains the same for two years, then it is probably out of date."

Thirty fateful years is a condensed history of 1909-39, which comments forcibly on the *laissez faire* policy in this country which allowed the present war to come to pass. A prophecy by Col. Temperley, made in February, 1931, is quoted, foretelling the outbreak of the war as August, 1939 at earliest and September, 1940 at latest. The futility of appeasement is demonstrated by many telling examples; the handing over to Eire in 1938, of the South Irish naval ports, while it produced no effect on the Anglophobes in Dublin, must have cost us thousands of lives for want of naval and air patrols based on those places. The wave of pacificism, culminating in the fatuous peace ballot of 1934, is another example. We must see that this cannot happen again, not for our sakes only, but for that of the whole world.

The welfare of the serving soldier tells us of the valuable work being done by the Directorate of Welfare for both British and Indian soldiers, in forces overseas based on India, as well as in that country. A great advance from the 1914–18 war!

Prisoners of War in India describes how the Italian is housed in camp. Our regulations are based on an international convention held at Geneva in 1929, to which, by the way, neither Japan nor the U.S.S.R. is a signatory. When the article was written, presumably early this year, the Fascist was decidedly top *dog* in those Italian camps.

Torpedoed—a thrilling rescue is an extract from a letter by a lady who, with her four children, was adrift for thirteen days in the Indian Ocean. They were down to ¼ oz. of water a day each. The rescue by a passing ship providentially came just in time.

Propaganda Problems reconsidered discusses the form we should propagandize now that victory is in sight. The man we want to confute now is the man who doubts the ultimate value of victory, in other words the cynic. We all know the harm done by the "what's the good of it all?" attitude of many of the generation which grew up between the wars. The finish of the article is worth quoting "The cynic . . . Destroy him. Or, better still, answer him. For thus you destroy two cynics, yourself and the other man."

The Study of Urdu in the Army urges officers to apply themselves whole-heartedly to the subject, not merely to treat the exams. as dolorous impositions from the powers that be. There is a useful method of instruction, given in the form of twelve drills, which certainly seems to be an improvement on most primers. But the main desideratum is a *munshi* above the common ruck, whose sole idea is to pass the candidate, however narrowly, through the exam., and pocket his share of the reward.

The Velocipede is a plea for the use of the push-bike in jungle warfare. The Japs have apparently used it with success in unpromising terrain in Burma. Photographs suggest methods of carrying L.M.G's and other weapons, and the article concludes with a proposed establishment for a company.

Regimental Badges an entertaining article, with many anecdotes showing how British regiments came by their distinctions in the matter of dress. We are reminded

that the 1st South Staffs. spent 90 years on continuous foreign service in the West Indies!

War Memorials for the Indian forces suggests educational facilities for sons and daughters of I.O's, the latter, as prospective mothers of the I.A. to be.

Your Country needs you asks *koi hais* not to segregate themselves in Cheltenham and Bedford, but to devote themselves to social work, helping villages and towns to run themselves, standing for election to borough councils and so on. Very sound advice, but little mention is made of children's education. Most officers retire with a family of school age, and their place of settlement is generally fixed by the location of the schools to which they have sent, or intend to send, their youngsters.

The Record of the I.A.F. in its ten years of life is a distinguished one; already it has to its credit campaigns in Waziristan, Persia, Iraq, and Burma, and is now entirely responsible for the air defence of the N.W. Frontier.

Some administrative suggestions to save officers office work, include one to give C.O's power to award up to 84 days' detention, to save courts-martial.

F.C.M.

REVUE MILITAIRE SUISSE.

(*May*, 1943.)—*Le Mortier géant contre le fortin betonné*. By M. Camille Rougeron. This is a review of an article in *La Science et la Vie* discussing the development of the great mortars throughout the ages. It shows how the big German howitzers of the Great War overcame the concrete structures which were expected to stand up to anything.

The giant mortar appeared almost as soon as artillery was first made. It was displaced by the rifled gun, but it re-appeared in 1914 for the destruction of concrete works. Then the air bomb supplanted it once more, but it re-appeared at the German siege of Sebastopol in 1942.

In 1914, the Germans brought out their howitzers which we called the 12 inch and 17 inch—made by the Skoda Works in Austria. The 12 inch fired a shell of 750 lbs. containing 95 lbs. of explosive. The 17 inch was of two types: one fired a 900 lb. shell with 112 lbs. of explosive; the other fired a shell of over 2,000 lbs. with 240 lbs. bursting charge.

"The examination of the permanent works captured by the Germans gave them "a false idea of the resistance of concrete to heavy artillery. This was the origin "of the pill-boxes with a roof about 4 ft. 6 in. thick, used in large numbers "both in the Metz defences in 1916 and in field defences in 1917."

But many "pill-boxes" were overturned by shells falling close beside them; in others, the occupants were all killed by concussion due to direct hits on the roof.

Up to the spring of 1942, it seemed that artillery had not made much progress since 1914 in its attack on fortifications; the dive-bomber with his greater accuracy had usurped the field. But the airman cannot always be on the spot. The only artillery weapon which can deal with modern concrete defences is a short range mortar of great calibre.

Commentaires sur la guerre actuelle. The stagnation after the Anglo-American landing in North Africa was a disappointment to the peoples of occupied countries. But the Allies would only act on certainties. They made the greatest use of the air arm and the tanks. Both of these necessitated a vast ground organization. While the Eighth Army was pursuing Rommel across Africa, the First Army and the Americans were building up their forces in Tunis. When the battle there opened Rommel struck against the inexperienced American Corps and for a time drove them back with loss. But Eisenhower shifted his main attack from the Eighth Army in the south to the First Army in the north, and brought an armoured division round from right to left. This caught Rommel unawares, the R.A.F. pounded him incessantly, his communications and his troops became disorganized.

The victory in Tunisia gave the Allies the whole of North Africa, and the use of the Mediterranean. Pantalleria, Sicily, Crete and the Dodecanese Islands still stood as out-posts of the fortress of Europe, but the North African coast gave the Allies air cover from Gibraltar to Alexandria.

The Russian front, however, still remained *the* front. Both sides were, in May, preparing at great speed for major operations. Now the situation in the Mediterranean might draw off a part of the forces which the Germans needed for the Russian front

(*June*, 1943.)—*L'Instruction individuelle du fantassin en service actif*. By Capt. A. Gisling. This article refers to the Swiss system, but much of it is applicable here. The author believes that soldiers show only a relative interest in individual training because of faulty teaching methods. Too frequently the officers and N.C.O.'s are content to apply on active service the training programmes of the barracks, drill, etc., and neglect the tactical training of the fighting man.

The author gives the following details of what he considers a suitable and condensed programme.

First (or elementary) class through which all men must pass :

1. Technical training (*a*) Handling the rifle in all positions. Judging distance. Aiming and firing in all positions. Elementary bayonet exercises ; (*b*) Handling the automatic rifle ; (*c*) Types of rifle ammunition ; (*d*) Grenades (e.g., Mills bombs). Throwing grenades at various distances from various postures ; (*e*) Gas mask, putting on, taking off and packing away under 45 seconds ; (*f*) The standard organization and function of the rifle section.

Second class.

Men who qualify in the first class pass on to the second class :

1. Ground-craft (*a*) Observation of 5 hidden objects at about 100 metres distance in less than 2 minutes ; (*b*) Move about a piece of ground 100 metres by 80 metres without being seen for more than 4 seconds. Starting from 100 metres inside a forest, reach the other edge without being seen by an observer stationed 100 metres away from the edge.
2. Use of ground for (*a*) Rifle or machine-gun fire :—at the foot of, or up a tree ; on a roof, etc. Making an M.G. emplacement with an entrenching tool ; bullet-proof, shell-proof thicknesses. Camouflage ; (*b*) observation, from a tree ; the edge of a wood ; or a house, etc. ; (*c*) taking cover from aeroplane view.
3. Tactical use of his weapons. Rifle v. grenade, features of the ground.
4. Anti-tank action. Anti-tank mines and obstacles.
5. Gas warfare.
6. What to do *if* wounded, a straggler, or a prisoner.
7. Organization up to companies.

Third class.

Then would follow a Third Class : 1. Technical knowledge of the light and heavy machine-gun, and anti-tank gun. 2. Map-reading and making. 3. Training of the section and company scouts. 4. The different kinds of Swiss and foreign aircraft. 5. The conduct of the combat group.

The Swiss soldiers form a militia, trained by a small professional army. Time for training is limited. Thus quick results are essential, as with us in the present war. A lively imagination, an individual effort, and an intense, sustained keenness are the essential qualities for those entrusted with training troops. A break-away from hard set-pieces is the best way to stimulate interest.

Une semaine à 4,000 metres. By Lt. René Roch. A regimental M.O. tells of a week with a brigade detachment on the summit of the Bieshorn (4,160 metres). They bivouacked in snow either in dug-outs or igloos.

Caves were hollowed out in the snow for six, four or three occupants. Those for three were the most suitable. The snow must be rammed and smoothed. A cave for six had three bunks on each side with a gangway between. A cookhouse was built up at the entrance, like an igloo, out of blocks of snow built in an arch. But the large

size was a drawback. The arched roof quickly sank and had to be supported by columns of hardened snow, the flattening of the roof increased by 40 cm. a day. If snow is falling, the load on the roof continually increases, and there is some danger of smothering the occupants. The smaller size cave for three is preferred.

One type was made by digging a sort of well, enlarging the diameter as excavation proceeded, and then closing the top with blocks of snow. The entrance is made sideways.

A sleeping compartment for four and a cookhouse was completed in four hours. The doorway was 1 metre high by 70 to 80 cm. wide, between the dormitory, and the cookhouse. The dormitory was 4 to 5 metres long by 3 wide. Snow benches were left at the head and feet to support the ends of the skis which formed the frame of the bunks. Between the benches was a trench 50 cm. deep, and 1m. 20 to 1m. 50 across, to keep the body lying down clear of the snow. A sort of hammock is formed by buttoning a " ground sheet " over the skis. The kitchen needs a flue. The stove burnt solidified methylated spirit.

With four men, and six candles burning, and the doorway closed with a double wall of snow blocks, the temperature never rose above zero centigrade. This was just as well, for should the temperature rise above zero, the atmosphere becomes like a fog. It is better to be a little colder and a little drier.

The equipment provided for the Swiss mountain troops was eminently suitable for the high altitude reached by the detachment. The overcoat with hood is a complete protection against the wind. Canvas gloves lined with wool cover the hands; canvas goloshes with rubber soles keep the feet from frost-bite. The sleeping bag is in two parts, the outside of canvas, and the inside lined with feathers. Anti-glare spectacles are essential.

Special care was taken with the rations, which were designed to give the maximum of calories and vitamins. Water obtained by melting the snow was the only source of liquid. For drink, there was tea, maté, cocoa, thick soup, Maggi soups, and ovomaltine. The latter was the most popular, being easily prepared nutritious and tasty, but too much of it led to constipation. The soups restored to the system some of the salt lost by perspiration. Rye bread was issued, it had the advantage of not freezing, also bacon sausages and pemmican. Bacon and pemmican are best for high altitudes. Each man received two hard-boiled eggs. Those who ate them the first day scored, for after two days they became uneatable. The whites of the eggs became like rubber and tasted as such. Cheese was popular, and was easy to carry. But a mixture of butter and honey seems to have been the luxury most appreciated. Oranges had to be thawed in hot water, and then they had lost their taste and became flabby. Thermos flasks were indispensable.

A further instalment is to follow.

Commentaires sur la guerre actuelle. One war contains the germs of the methods employed to begin the next. In 1918, two machines began to dominate the battle field: the aeroplane and the tank, in close collaboration with the infantry and artillery. The lightning warfare of 1939, 1940, and 1941 showed what could be done with these new arms. The initial pace has given way to a phase of stabilization which will last until one side has amassed sufficient means of bringing about the decision.

The Russian counter-offensive of the winter of 1941-42, the offensive of the winter of 1942-43, and the campaign in North Africa interrupted the German procession of triumphs. The Germans have now to keep hold of their gains. Whether they like it or not, the passage from the offensive to the defensive is a confession of weakness. To complete the defence of the Mediterranean Coast, time had to be gained by sacrificing the Afrika Corps.

The rest of this month's commentary is devoted to reflections on the anniversaries recalled by the month of June: the collapse of France, and the invasion of Russia.

W.H.K.

AN COSANTOIR.

(*July-August*, 1943.)—This Magazine is intended mainly for junior officers and O.R.'s of the Regular Army of Eire, and the L.D.F. (i.e. H.G.). Most of the original articles concern the training of small bodies, and are excellent for their purpose.

The July number contains an article by an Engineer on a rather elementary demonstration, interesting in that he ends with a grouse that the staff seem to lack imagination in using Engineers on an exercise and are generally reduced to employing them as additional Infantry. We can sympathise. This disease appears when training under artificial conditions subject to severe economic restrictions.

The article "First Aid" makes the good point that all such training should be based on the use of articles and remedies available in the average household—too often it presumes that the resources of an up-to-date dispensary are at hand.

The August number contains an article on the Epic of Calais—based on Eric Linklater's book. The author gives full recognition to the gallantry of the soldiers and makes his criticisms with the necessary reservation that the information on which they are based is very incomplete.

He makes two main points:—(*a*) The lack of any central control of the action; (*b*) The lack of engineer work such as demolitions and defending localities, etc.

As regards (*a*)—The difficulties of the situation are obvious; but was any attempt made to give the Commander even a skeleton signal's organization which would have enabled him to collect some information as to the progress of the battle. The gallant resistance of a Unit in an isolated locality, loses much of its point if they cannot get back information to their Commander as to what goes on in their sector after they set out to man it. The independent role assigned to the small Tank force also seems hard to justify.

As for (*b*)— Any appreciation of the situation at the time the decision was taken to send out this force should have shown that an engineer plan for demolitions, strong points and anti-tank obstacles, must provide a framework for any defence scheme. Even if it be too much to expect that an Engineer would automatically be chosen to command such a force—surely his first demand should have been for an Engineer adviser and all the R.E. who could be scraped together. A town like Calais and the quarries round it, could provide essential tools and explosives.

Another article discusses the technique of street fighting, but none of it takes place in the streets. The defence of Stalingrad has shown the importance of this form of fighting which has its special interest for the sapper. Both General Zukhov, defender of Stalingrad, and Mr. Tom Wintringham are quoted with appreciation, but the article is based on the writings of Mr. Bert Levy, familiar to all recent students of the subject. The detail technique of the attack varies only slightly according to the method of approach, which may be through the roof downwards, through the ground floor, or by tunnelling from below. A footing is gained by following one or more grenades into a room as rapidly as possible after the burst; then the room above (or below) is cleared as much as possible by firing a tommy gun through the ceiling (or floor). The details should repay careful study by all who may be called on to put a house in a state of defence; the novice would hardly realize the great advantage of having bullet-proof floors and ceilings.

The Coy. Commander's notes for his Platoon Commanders is a very sound and comprehensive summary of all the little things required for the proper administration and training of his unit. This particular Coy. Commander forbids his Officers and N.C.O.s to trust their memories, and requires them to keep a note-book for his inspection in which to record everything requiring improvement. This officer is sufficiently senior to have formed the impression that the army has gone to the dogs since he was young. He did 8 years as a 2nd Lieut and then had to pass a stiff exam. before he was promoted Lieutenant. He quotes with obvious approval a dictum of General Smuts which I had not heard before, that "an officer 10 years in the making and after 10 years reading is entitled to grow a moustache and look like an officer."

D.J.M.

INFANTRY JOURNAL.

(*September*, 1943.)—*Blind Man's Buff in Buna.*—Lieut.-Colonel L. Gmiener describes some of the tricks resorted to by the Japanese in jungle fighting in New Guinea. They were adepts in camouflage and—at first—very successful at ambushing. They constructed pill-boxes in the long grass, made of coco-nut logs and earth, cleverly concealed with natural camouflage, and often held their fire until the Americans unknowingly got within twenty feet of them. One pill-box was always covered by the fire of two more.

The Japanese gunner used his small mortar most effectively by employing direct observation. He would climb to the top of a tall tree and place the small notch of the grenade thrower against a branch. From that position he would notice any movement in the grass and lob the mortar shell at it at any range up to 500 yards.

The Americans at first regarded their own 60 mm. mortar as a pea-shooter, but when the Japanese used one that they had captured against them, the Americans came to realize that it was one of the infantry's best weapons under jungle conditions.

The hand-grenade is another, but *it needs practice to throw it accurately*; you may have to throw it from a crawling position at a target two feet long by five inches wide—the size of an opening in a pill-box.

Another article in the *Infantry Journal*, "War is like this," also emphasizes the value of the mortar and the hand grenade in jungle fighting, and mentions some Japanese tricks against which their opponents have to be on their guard.

Psychology for the Fighting Man. The subject treated in this month's article is eye-sight. To aid your vision, help your eyes to see their best. Since in warfare the object is to see the enemy and keep unseen yourself, you should reverse the hints given for good visibility and make it difficult for the enemy to see you.

Without light you can see nothing; but too much light—*i.e.* glare—is almost as bad. Seeing is made possible only when a clear image is thrown on to the retina of your eye. When the light rays are broken up and scattered, this image is distorted and blurred, or dimmed out. That is called glare, also produced by: Smoke, haze, dirty eye-glasses, or a dirty wind-shield.

Bright light, like that of the sun, reflected from shiny surfaces such as water, metal, glass, or a smooth roadway, can be very troublesome, but there is a good way of overcoming this blinding. A shiny surface makes the light waves reflected from it vibrate in one direction only—parallel to the surface. Polaroid sun glasses cut out the light that vibrates horizontally, letting all other light through. By wearing this type of sun-glasses the glare is much reduced, and it is possible to see fairly clearly.

Next we come to a description of how the eyes work, and the changes that take place in the lens of the eye with increasing age. With constant use, and especially with close work, the eyes become tired. The best way to cure eye fatigue is rest—enough rest—and in darkness.

The most general cause of eye fatigue is the use of the elaborate system of muscles for keeping the eyes moving in co-ordination with each other, for focusing, and for adjusting the eyes to varying amounts of light.

A set of rules is given for preventing or lessening eye fatigue. One recommendation made is to blink often. This is specially valuable for the less adjustable eyes of older people.

Other points dealt with in this article are: the eyes as a range finder; three dimension seeing—with one eye and two eyes respectively; range finding instruments; seeing speed; vision helps action.

Under the head of *Cerebrations* the editor invites contributions on miscellaneous subjects. "Lieutenant, Signal Corps" gives his views on *Service makes the Officer* as the result of his experience both as an enlisted man and as an officer.

When he was an enlisted man, he thought the West Pointer "the best damned officer a soldier could ask for." He took care of his men, was soldierly in bearing, knew his job, was fair, and maintained discipline. The Reserve officer, on the other

hand, was looked down upon. He was hesitant about giving commands, seemed afraid of hurting the men's feelings, and did not appear to know much about his job.

When, however, the writer became an officer, he suddenly changed his mind, realizing how inexperienced he was himself, and how little he knew. He no longer looked down upon the lowly Reserve and National Guard officer, but looked up to him.

He came to the conclusion that what the O.C.S. (i.e. O.C.T.U.) and Reserve officer lacked was experience as an officer, and that the transition from civilian or enlisted man to officer status must necessarily be gradual.

A.S.H.

THE INDIAN FORESTER.

(*May*, 1943.)—*Operations in the kachos of Sind.* The Indus in its flood season is very apt to erode its banks, depositing what it takes from a concave bank on to a convex part downstream; the area of deposition is known as a *kacho*. This is inundated annually, gaining a few inches in height every flood season. Within two or three years, the area, although still subject to inundation, is high enough to justify the planting of trees, acacia being the kind mostly used. The area is sown while still under water in September, and the operation has to be carried out at high speed as the river is then falling rapidly. The trouble is that, when the trees have established themselves, the river may swing back and carry away trees, *kacho* and all.

(*June*, 1943.)—*Cement roof tiles* are recommended as useful for forest buildings; their advantages are obvious. If suitable sand is available, only cement needs to be imported, with of course pallets and strikers. The tiles illustrated resemble the Mangalore in shape and size, and the cost—it is not stated in what part of India—is quoted as Rs. 10 per square, presumably excluding cost of woodwork.

On the food and feeding habits of the glowworm is an amusing, albeit erudite, article. The animal feeds on snails and such like, and a fight between a glowworm and its prey seems to be worth watching. After the combat, in which the glowworm is invariably victorious, and the subsequent banquet, it cleans itself with a curious brush with which Nature has presented it. The animal, we are told, is being introduced into Ceylon to counteract the depredations of snails in vegetable gardens.

(*July*, 1943.)—The defence department in India has been taking a million tons of timber annually during the war.

Water-finding, an extract from *Indian Farming*, is by a dowser, who states that he becomes aware of the presence of underground water by experiencing a pain in the calf. It would be interesting to know whether other diviners are possessed of similar means of detection.

(*August*, 1943.)—Exhaustive experiments are being made to discover plants capable of producing rubber or rubber-substitute. Some seventy are tabulated, with full particulars, the most hopeful seeming to be *Cryptostegia grandiflora*. This has just (*Oct.* 1943) been described by the B.B.C. as having satisfied local demands for certain kinds of rubber. It is a shrubby climber, growing over the greater part of India.

A note on cyclonic storms is of value to sailors, amateur and professional, as well as airmen and landsmen. It is largely a reprint of an out-of-print book, but instructive for all that. Heated air rises and winds blow into the area of low pressure so caused; the direction of these winds is curved, owing to the earth's rotation. Therefore cyclones move anti-clockwise in the northern, and clockwise in the southern, hemisphere. There are hints as to how to foretell a cyclone.

Improved wood deserves study. Pressure is the first means described, and it is noted that as the Sp. Gr. increases, so does the maximum crushing stress, in a simple ratio. Thus, a wood of Sp. Gr. .255 withstood a crushing stress of 2,000 lbs/sq. in;

when compressed to a Sp. Gr. of 1.1, the corresponding figure becomes 10,000 lbs. Lignostone, a patented article, finds application in the making of shuttles and similar articles. The process has not yet been extended to building sizes. Impregnation with synthetic resins is another method, and so is lamination. Finally, compregnation is a combination of all three methods, and is used in the manufacture of aeroplane propeller blades, textile machinery and so forth.

Entomological note, a series of random but interesting items, stresses the importance of honey bees in fertilizing crops. In the U.S.A., it was found that a mustard crop will attract bees to the detriment of neighbouring fruit crops, which flower at the same time. The remedy is to keep the two crops a bees' journey apart.

A short article notes serious danger to a stretch of the Eastern Bengal railway in Assam, where erosion owing to deforestation is increasing flood levels in numerous streams, which cross the line at right angles, with ever-extending damage to bridges and embankments.

F.C.M.

CORRESPONDENCE.

"Q" IN THE EAST AFRICAN CAMPAIGN, 1941.

42, Milsom Street, Bath.
August 26th, 1943.

To the Editor, *The Royal Engineers Journal*.

DEAR SIR,

Brigadier (now Major-General) A. C. Duff's article on "Q" in the East African Campaign, 1941, in the December, 1942, issue of *The R.E. Journal*, made absorbing reading for me, bringing back memories of places and things, and sorting out the chronology of events which had become mixed up in my memory. I have only recently seen it owing to my wanderings abroad, or I would have had something to say before this, about those lorries the Author accuses me of spoiling.

When I left England at the end of June, 1940, nothing could be spared from England for East Africa. India could supply some stores, and South Africa had anticipated most of our likely Engineer tasks, and was equipping her engineer troops magnificently, but there was no floating bridging, nor standard box-girder equipment—and no high tensile steel in all Africa. So we had to make our bridging equipment, pontoons and all, of such materials as we could get; and to cross the Tana and Juba rivers we needed at least 1,200 yards of floating bridging, of which half had to reach the Juba.

Floating bridge equipment will not travel twice 250 miles over a scrubby desert except on wheels, so I had to have suitable lorries to carry it. Those lorries were just as much part of my home-made bridging train as the pontoons, and were made to carry pontoons, not Alan Duff's bully beef.

So when he implies that I spoiled some of his transport I fancy he does it with his tongue in his cheek, because he knows perfectly well that actually

he had the reversionary use of mine. Luckily, I needed the lorries no more after the Juba crossing, because my Italian opposite number left me a nice lot of Engineer stores at most stages of our advance. He hardly ever let me down, bless him!

But of course I forgive Alan Duff—he knows I'd forgive him anything.*

Yours faithfully,
A. MINNIS, *Brigadier.*

* The True Xmas Spirit—[Ed.]

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c/o Lloyds Bank, Ltd.,
Hornby Road,
Bombay.
1*st August*, 1943.

To the Editor, *The Royal Engineers Journal.*

THE "BETTER HALF" OF RAILWAY ENGINEERING.

SIR,

Anyone who has visited Darjeeling cannot fail to have been struck by the technical excellence of the motor road and mountain railway which link that Himalayan hill station with the plains.

It is not however, till one refers to Dr. K. C. Bhanja's guide to Darjeeling that one gets a true insight into the problems which confronted the railway engineer.

Let me quote from Dr. Bhanja's work:

"... A mile from Chunbhaty is the first zigzag or reverse. It is a "device under which the train attains a comparatively much higher "elevation by traversing a short distance.

"The Engineer entrusted with the Survey of the line was at his wit's "end at this place when he found it practically impossible to extend the "line any further. He ascribed this state of affairs to a defective survey.

"When a fresh survey was under contemplation, his better-half "solved the problem by this ingenious zigzag device in which the train "runs forward and then backward, and then again forward, thus des- "cribing a path like the letter Z, on completion of which path, the train "is enabled to follow its usual course as chalked out by the survey."

Would that there were more wives capable of solving so neatly their husband's engineering problems.

Yours faithfully,
E. A. E. BOLTON, *Lt.-Col., R.E.*