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TATTOO SEARCHLIGHTING.

By LIEUTENANT R. B. MUIR, R.E.

INTRODUCTION.

WITHIN the last decade the tattoo, which has no legitimate counterpart, curiously enough, in countries outside the Empire, has firmly established itself as a singularly popular source of public entertainment. Although the advisability of viewing it in the light of genuine recruiting propaganda may be false in principle, there is certainly no doubt whatsoever that it affords a unique and invaluable liaison service between the soldier and his civilian brother.

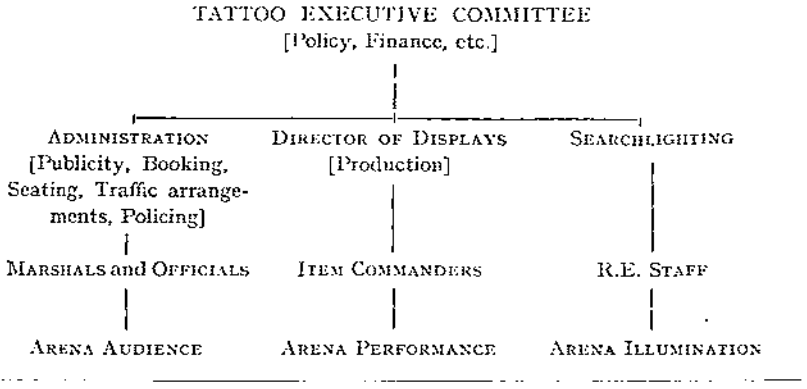
Each year tattoos are becoming more ambitious, more commercialized, " more of a business," and, with production costs being very considerable, all concerned have a most real and somewhat anxious sense of the value of their efforts. The following notes, based mainly on experience at Tidworth Tattoo but largely of a general nature, are offered in the rather diffident hope that they may be of some little assistance to the ubiquitous Sapper officer, who suddenly finds himself involved in the responsibilities of tattoo searchlighting.

GENERAL ORGANIZATION.

The object of the tattoo is to raise funds for military charities and troops' recreational facilities, and none of the cost may be borne by army funds. The controlling body is the Tattoo Executive Committee, comprising senior military officers in the command and a full-time secretary. General production is in the hands of the Director of Displays, who is normally a field officer. Individual items of the

programme are allocated to particular service units, who appoint their respective Item Commanders. Working from the general conception of the Executive Committee, Item Commanders fashion their acts and supervise rehearsals, which frequently begin more than six months' ahead, and, finally, their work is co-ordinated and the whole performance beaten into shape by the Director of Displays. A typical tattoo organization is illustrated diagrammatically in Fig. I.

FIG. I



It will be apparent that the Officer i/c Searchlights works in conjunction with the Director of Displays in the design of the searchlights of the programme.

"STRATEGICAL" LIGHTING PRINCIPLES.

The general principles affecting the "strategy" of tattoo searchlighting are as follows :—

1. The illumination of the performance must be adequate and without any possibility of annoyance from glare, even when viewed from the various extremes of the seating.

2. The intensity over a floodlit area must be uniform.

3. Only sufficient area as is necessary for the particular happening at any one moment should be illuminated. Superfluous marginal light results in loss of effect.

4. The lighting plan must be sufficiently flexible to allow changes in the size of floodlit area being made during the course of an item, without any appreciable variation or disturbance of illumination.

5. Any floodlit area should form a regular pattern with clean-cut, well-defined edges, *e.g.*, a rectangle.

6. The keynote of the lighting design should be "variety," thus affording relief to the eyes of spectators and performers alike.

7. "Quiet efficiency" in the operation of the searchlights is

essential. Any distraction due to stray light or noise is a very definite liability.

"Tactical" Lighting Principles.

In pursuance of the above principles the following "tactics" are recommended. Note that these are enumerated in order to correspond with the foregoing paragraphs.

1. The efficiency of the lighting is a function of the judicious siting of the individual searchlights, which are located behind the spectators and distributed in a series of banks. The beams are superimposed on each other at such angles as to eliminate shadow effect from performers. During initial rehearsals, observers should be distributed at representative positions in the seating, and an analysis of their reports taken as a basis for formulating the final plan.

2. The chief attribute to attaining uniform intensity of lighting is undoubtedly patience—quantity unlimited. For any particular area it is quite an easy matter to work out on paper a suitable symmetrical layout of lights, but the practical application falls far short of the theoretical result and the obvious reason is because the arena has naturally enough not a "billiard-table surface." The brighter the searchlights the more accentuated are the black shadows resulting from unevenness of the ground. It is entirely a question of trial and error. The selected "paper" pattern should be built up by exposing beams individually. Disturbing elements can then be diagnosed, and, by making small alterations in azimuth and focus, the trouble can be largely eliminated. It should be appreciated, however, that the antidote is a lengthy business, demanding the most meticulous attention to detail.

3. It must be at once apparent that, in order to carry out this next principle to the letter, each projector would occupy probably some sixty different positions in the course of a performance—quite an impracticable proposition for the searchlight operator. To borrow a much-overworked word from industry to-day, the solution then is standardization. Having decided on the illumination required for each item in conjunction with the Director of Displays, the Officer i/c Searchlights must analyse the lighting requirements of the entire programme, and, by a systematic compromise, evolve certain standard areas of lighting, three or four at the most, which can be used for the greater part of the performance.

4. Flexibility of lighting, also, is ensured by the foregoing procedure, and it is a simple matter to distribute the number of lights for each standard area so that the intensity of illumination does not vary appreciably. The lighting of the remainder of the programme, for which standards are unsuitable, can be effected with additional positions of various lights, and, in the design of this feature, the

tasks should be distributed as far as practicable over all available lights, thus keeping to a minimum the number of positions of individual projectors. Note that in this system, the actual number of changes which the searchlight operator has to make during a performance is of little consequence, since, having so few possible positions, he can be trained readily to function quickly and accurately.

5. Once the general shapes of the standard illuminated areas have been determined, a polish is effected by the production of straight, clean-cut edges to the figures. One method is by manipulation of the front-door lens or the parabolic-ellipse reflector, whichever form of beam dispersion is employed, but this obviously suffers from the disadvantage that it can only meet the one case, since it would be quite impracticable to make the alteration during the programme. Hence, it should be decided which standard has priority, and this procedure adopted.

Again, this question is intimately connected with the height of the projectors. The higher the light source, the less acute is the angle of strike, the more definite is the cut-off, and, incidentally, the less marked is the variation in the ground pattern caused by the inevitable accidental alteration of the projector elevation. As much use as possible should be made of the roofs of the seating stands for locating searchlights, and, where towers are necessary, as on the flanks, a minimum height of 50 ft. is advocated.

6. As a form of variety, colour changes are both effective and popular. Choice of colour is largely a matter of experiment depending on the colour scheme of the particular spectacle. As a guide, the following combinations are effective for "stationary" scenes when the audience is essentially most critical:—

(*a*) Mauve and violet on scarlet uniforms.
(*b*) Amber ,, green uniforms.
(*c*) Blue and green ,, light uniforms, viz., white P.T. kit.
(*d*) Copper ,, a general mixture, viz., finale.
(*e*) Red ,, guns coming into action.

Colour changes can be advantageously exploited to disguise possible errors in the arena: for example, a bad dressing during a wheel of the massed bands. In the colour plan, as a generality, the principle of "little and often" should be followed, but restraint should be practised to avoid colouring items better left alone—such as trick motor-cyclist and historical items.

Again, another variation of effect can be obtained by employing different speeds of exposing and dousing of the lights. Instead of the instantaneous exposure, the intensity of illumination can be brought gradually from zero to a maximum, at any desired rate, by means of a series of synchronized movements of the projector

shutters. Alternatively, only a percentage of the beams can be exposed initially and the remainder subsequently superimposed, but it is difficult to effect this particular method without violating the principle of uniformity. A "slow douse" can be extraordinarily effective on occasions such as the exit from the arena of a band or other formation, when the fading of illumination, combined with diminution of the sound, gives the impression of distance. This variation is also applicable to and recommended for colour changes.

Spotlighting can also be included for effecting variety. Judicious use of spotlights is not only attractive from the spectators' point of view, but most economical for the Officer i/c Searchlights, since it gives a breathing-space for his operatives, and, what is more important, greatly facilitates his design of the standard light areas. Included in the layout, there must be a minimum of two spotlights, and more if it can be arranged. Another great asset in this direction is flexibility: using a 60-cm. projector with a 16° dispersed beam as a spotlight, it is quite easy to follow a full gallop charge down to as low as 200 yards' range.

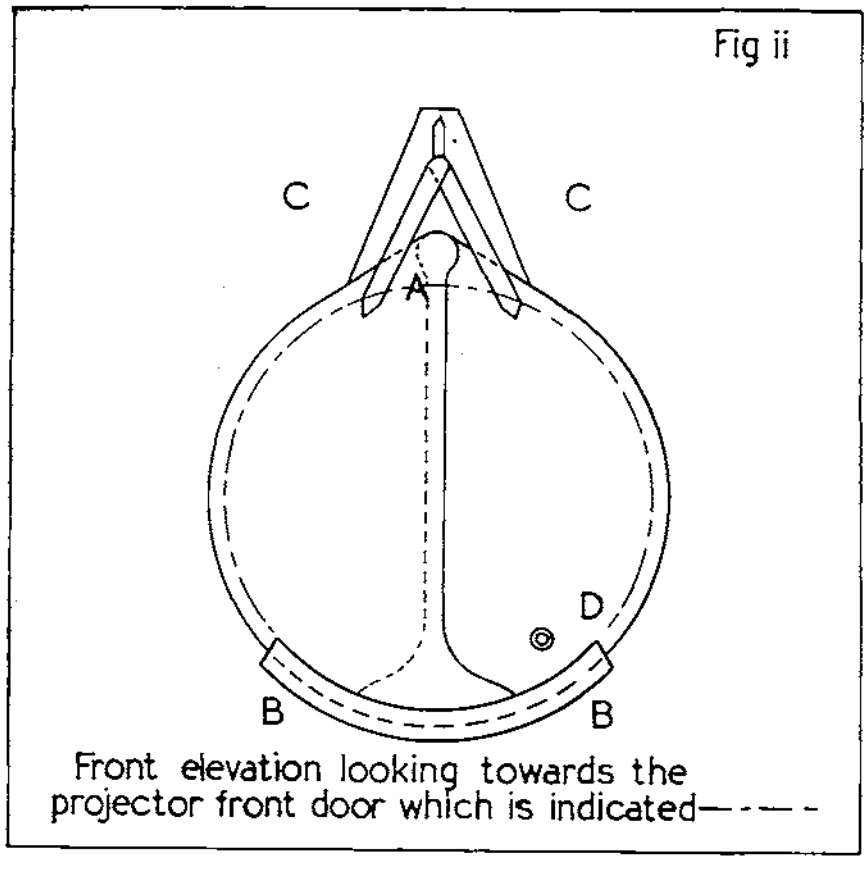
7. Finally, efficiency of operation is essentially dependent on the intensive training of all searchlight personnel. Not by any means is it intended to infer that this work is a bigger undertaking than more orthodox Sapper employments, but it should be realized that tattoo searchlight is definitely "tricky" and includes some entirely novel features. Regular night running of the lights should commence at least four weeks ahead.

Technical Principles.

1. The possibility of a serious breakdown in the lighting must be eliminated. If power is taken from a central D.C. sub-station, the incoming feeders must be duplicated, while, on the other hand, if the source of electrical supply is individual field generating sets, one extra set per four searchlights should be provided. Again, a surplus of at least one lamp unit per stand must be available in case of emergencies. Further precaution is ensured by rigid daily inspection and test of equipment.

2. It is completely essential that a steady burning arc be maintained and, assuming efficiency of operation by the S.L.O., a centralized source of supply from busbars has the advantage of stability. Bad electrical connection is contributory to arc flicker, and for this reason the split ferrule is preferable to the spring type, which can be converted readily by cutting a slot. Of course, above all, the operator must run his light correctly at the required current and voltage, by manipulation of arc length and the variable field resistance. This can only be guaranteed by concentrating on it to an almost absurd degree during initial rehearsals.

3. The searchlights must be capable of being doused and exposed practically instantaneously. One method is by sliding a shutter, running in guides, over the front door, but this involves an appreciable time-lag and a danger of noise nuisance. It might be of interest to describe briefly a new type of shutter which was evolved at Tidworth Tattoo, 1936, and operated with considerable success. This shutter,



which is a fixture in the projector, is simple, silent and practically instantaneous in action.

As shown in Fig. II, the shutter is in two sections, pivoted on a fulcrum "A," and each running in its own guide "B," thus obviating jamming. Two operating arms "C" are pin-jointed to the shutters and also to each other at the apex, which incorporates a roller running in a slot guide. To expose, the handle "D" is pulled outwards. This design is economical to produce, and suggested materials are light steel strips for the operating arms, and the commercial "tinned plywood" for the remaining parts. An

additional advantage is that, by virtue of this shutter exposing from the focal axis outwards, with slow-motion operation, a perfect "fading-in" effect is ensured, since the reflector is parabolic, and hence the cross-sectional area of light emission does not vary appreciably during the stages of partial obscuration of the front door.

4. Colours must be able to be changed without necessarily having an intermediate white stage. Hence it is essential to have at least two separate guides for the colour screens which slide over the front door. The normal screen material is heat-resisting only to a limited degree, and, unless information is available to the contrary, a maximum of seven minutes' exposure at a time should be adhered to. It is important to provide each projector with a frame for holding the coloured screens, and to insist on their always being packed in a definite order, with a view to speed and accuracy of operation.

5. The nerve channels or telephone communication circuits must be meticulously maintained, and, it is equally vital that personnel employed on their working are thoroughly efficient. An excellent investment during the preparatory training period is an intensive coaching of telephonists, emphasizing that speech must be clear and natural, and that all orders must be repeated. Provision must be made for a breakdown by nominating one searchlight stand as "master," and, in the event of telephone failure, it will carry on under direct orders of Officer i/c Searchlights, and the remaining stands will follow its lead. The cue sheets which are described later are invaluable in this contingency.

Layout of Plant.

The following is a brief description of a typical layout of searchlight plant, that of Tidworth Tattoo, 1936.

1. The searchlight stands A, B, C, D, E and F (see Fig. III) are of tubular scaffolding construction and average 60 ft. in height above the arena.

The projectors are numbered consecutively from one flank and each has a floor area of approximately 6 ft. x 6 ft. With the exception of the two spotlights 12 and X, which are carried on a platform P on the roof of the grandstand, and lights 3 and 23, which are employed solely for special items located on the polo ground, all the searchlights are symmetrically distributed for arena floodlighting illumination. Only the following two types of projectors are used :—

(*a*) The Standard 60-cm. L.C.D. of 30 million candle-power, with a front-door lens of 16° dispersal and complete with a field resistance box.

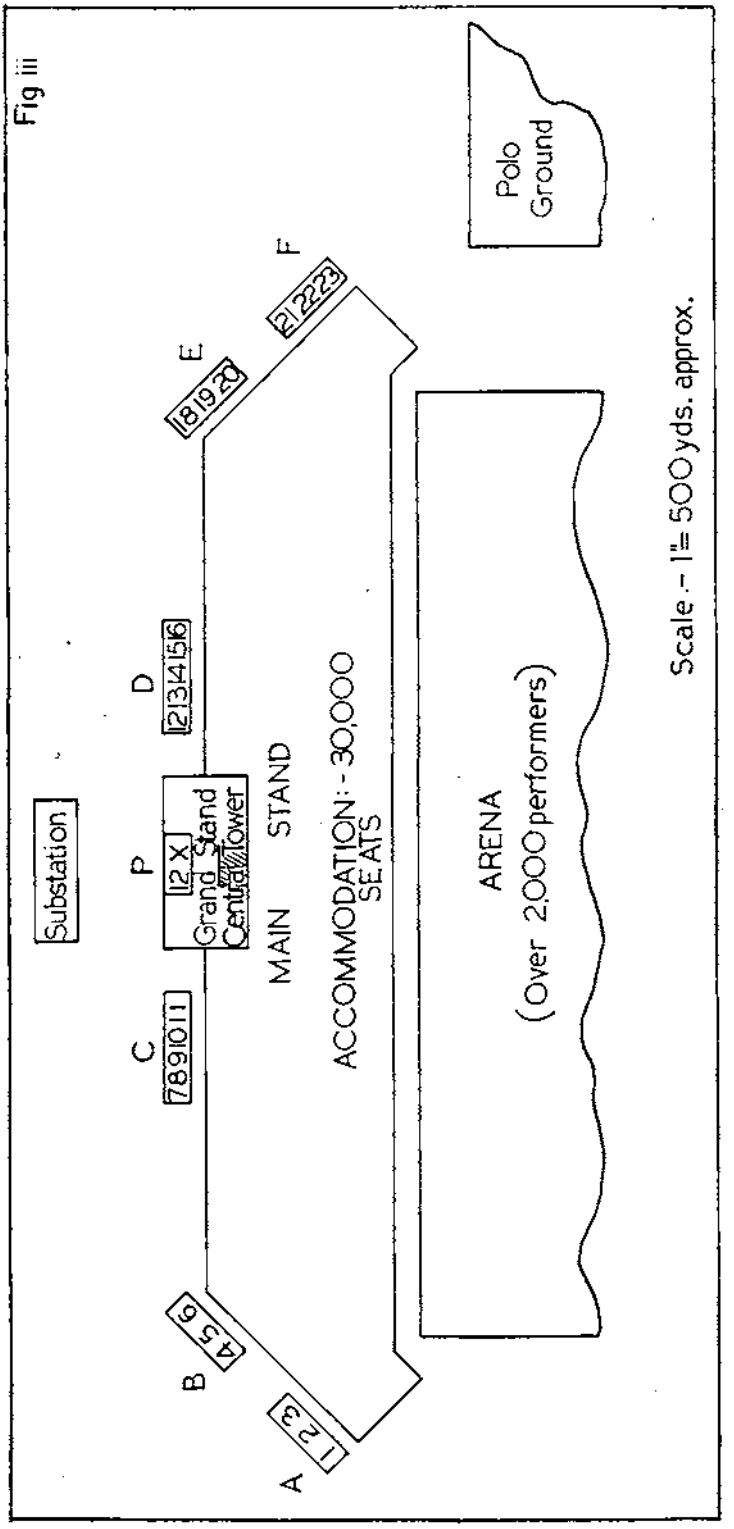
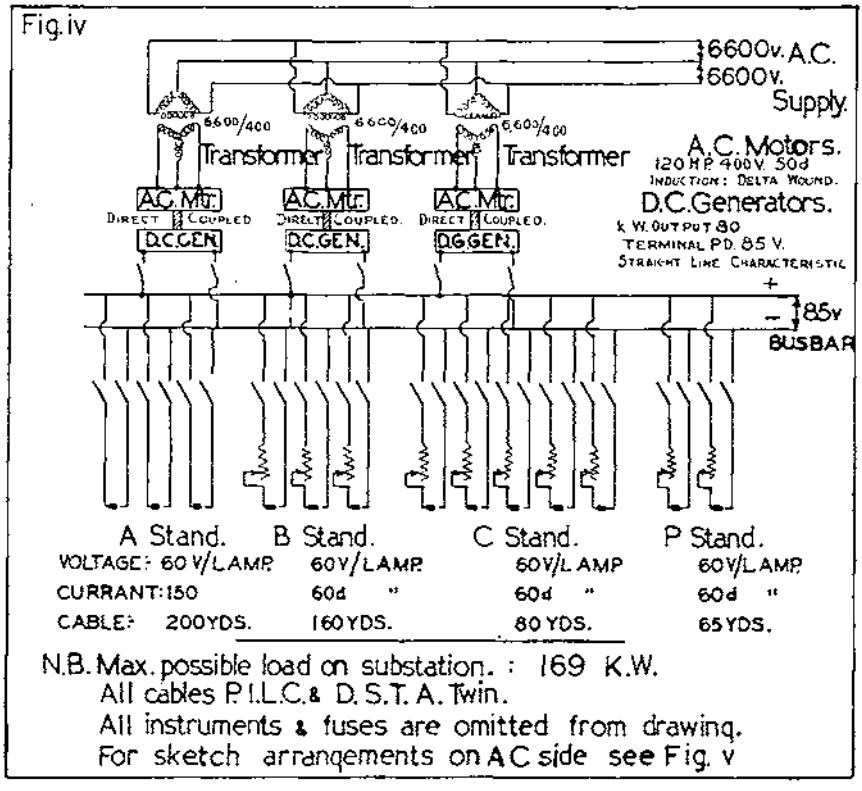


Fig iii
Substation
P
12 X
Grand Stand
Centre Tower
C
7 8 9 10 11
D
1 2 13 14 15 16
E
18 19 20
F
21 22 23
A
1 2 3
B
4 5 6
MAIN STAND
ACCOMMODATION: - 30,000
SEATS
ARENA
(Over 2,000 performers)
Polo
Ground
Scale - 1" = 500 yds. approx.

(*b*) The 90-cm. C.D., L.C.D. of 40 million candle-power, with a front-door lens of 30° dispersal and in this case the length of cable alone provides sufficient stabilizing resistance. Note that if C.D. type of projector is not available the A.A. type fitted with a short arm control will do. Similarly, the M.C.D. lamp can be readily improvised to L.C.D. by removing the "Green" control, substituting a circular piece of hoop-iron to act as the arc centralizer, and by turning out another set of ferrules to fit the new carbons.



The lights 1, 2, 3, 21 and 22 are type (*b*) and the remainder type (*a*). Actually one of the spotlights PX is used both with a 16° beam and a 3° beam by fitting a front-door lens and a plain glass front door respectively—the change-over being effected comfortably within four minutes.

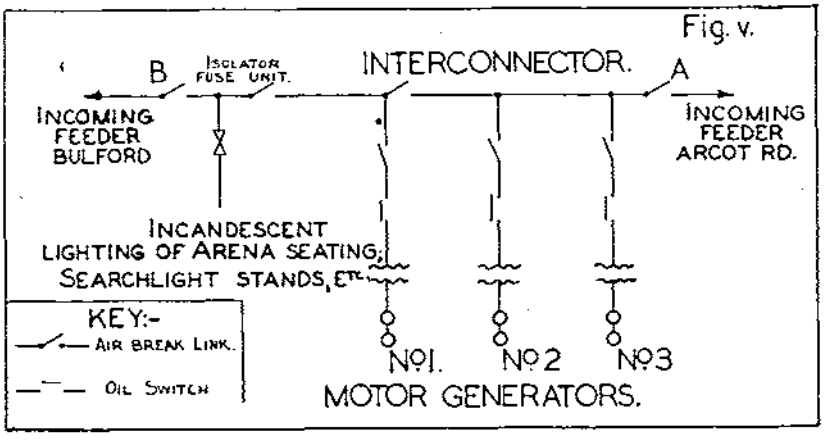
2. Separate cables extend all the way from the busbars to each individual lamp. It is not possible to run a single cable to a distribution box on each stand, because then momentarily fluctuations on one lamp would affect all the other lights on the stand. The electrical connections are indicated in Fig. IV, and,

since the arrangement is symmetrical on each side of P, only stands A, B, C and P are shown.

The incoming A.C. power supply is taken from two separate W.D. power stations, and either feeder is capable of carrying the total load. Two of the three M.G. sets in the tattoo sub-station can generate the maximum load, but, as it is more essential that " the show must go on " than that the sets are run at optimum efficiency, all three machines share the load throughout the performance.

3. The normal working of the sub-station and the action to be taken in cases of emergency are detailed briefly as follows :

Fig. v.



(*a*) *Normal Running Arrangement* (see diagrammatic sketch, Fig. V). The incoming links A from Arcot Road and B from Bulford are closed, and the interconnecter link is open. Thus Bulford is running one set together with the arena incandescent lighting, and Arcot Road the remaining two sets.

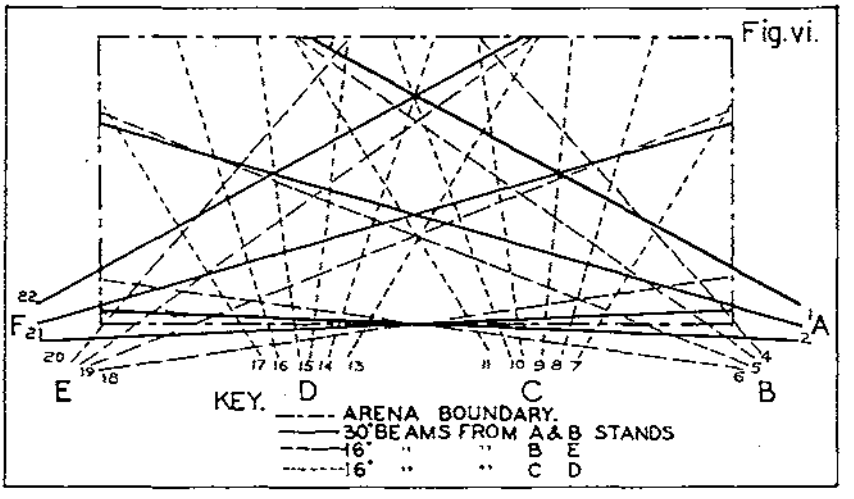
(*b*) *Failure of Bulford Supply.* The total busbar load will be thrown on to Nos. 2 and 3 Sets, and the arena incandescent lighting will fail. No. 1 oil switch and link B are immediately opened, and the interconnector closed. Then No. 1 oil switch is closed, and this set started up and paralleled back on to the busbars.

(*c*) *Failure of Arcot Road Supply.* In this case, the total searchlight load will be thrown on to No. 1 Set. Since this constitutes too high an overload, the only solution is to determine what searchlights, if any, are not indispensable. Actually lights 1, 3, X and 22 can be temporarily disconnected without serious loss of effect in the arena. Then Nos. 2 and 3 oil switches and link A are opened, and, finally, the interconnecter is closed, and Nos. 2 and 3 Sets paralleled back on to the busbars.

Design of Illumination.

As an example, the general design of the illumination for Tidworth Tattoo, 1936, and a searchlighting summary of the programme are now described briefly.

(1) Three standard illuminated areas are evolved and designated General, Inner and Outer Positions. In each case the elevation, azimuth and focus of the projector are conspicuously labelled—a satisfactory method is by means of improvised sheet-metal pointer indicators.



(*a*) General Positions provide a uniform illumination of the entire arena and the arrangement of searchlight beams is sketched in Fig. VI.

The lights from stands A, B, E and F are well out of focus, and those from C and D slightly out of focus.

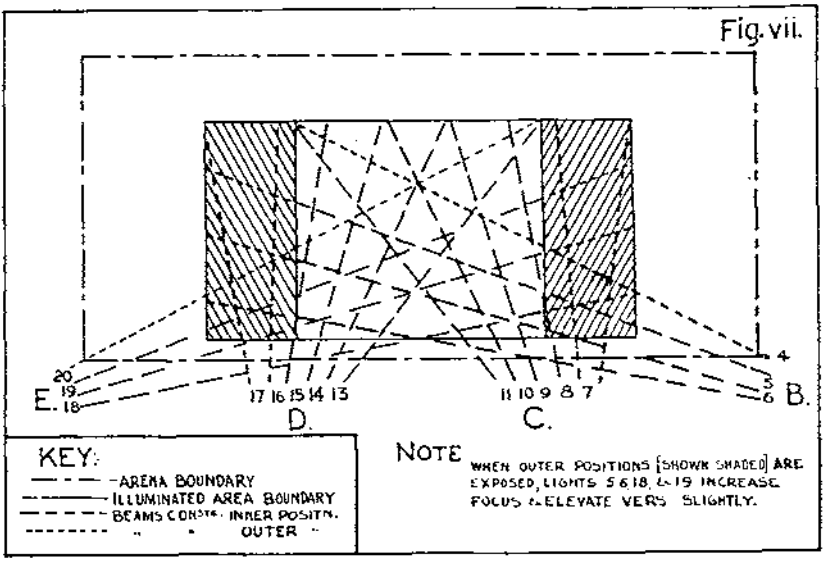
(*b*) Inner Positions represent a uniform illuminated area in the centre of the arena and are applicable to such items as the massed bands at the halt (see Fig. VII).

The lights from stands B and E are slightly out of focus while C and D are practically in focus.

(*c*) When it is required to produce a broader floodlit area than Inner Positions, but less than General Positions, a " three-quarter " standard light area is effected by adding Outer Positions to Inner Positions. Outer Positions constitute exposing the following additional lights 4, 7, 8, 16, 17 and 20; and the consequent increase in illumination is shown shaded in Fig. VII.

(2) A summary of the comprehensive searchlighting of the programme is given in tabular form (Fig. VIII).

Although the spotlights appear to have rather a lot of work to do, they are employed invariably for short periods and, hence, ample preparatory time is available for the operator. On the other hand, it is essential that the searchlights responsible for the standard areas have an absolute minimum of different positions (three in this case), since, in the course of one item, numerous instantaneous change-overs may require to be made from one standard to another.



The photographs, which were taken during actual performances, and are reproduced by kind permission of Messrs. Gale and Polden, Ltd., Aldershot, illustrate typical applications of the lighting design.

Lights Personnel.

The following organization of the searchlighting personnel is recommended :—

(1) The men actually running the lights are formed into Stand Sections, and each section comprises :—

(*a*) One N.C.O. i/c Stand. It is important to make him feel that he is completely responsible for the efficient operation of his stand, rather akin to the N.C.O. i/c A.A. detachment.

(*b*) One S.L.O. per lamp ; and one S.L.O. per stand surplus for casualty replacement.

(*c*) One screenman per lamp to operate the dousing shutter and

FIG. VIII

Item No.	Description.	Standard Light Areas.			Spotlights.		Extra Lights.		Additional Positions on Lights.
		General Positions.	Inner Positions.	Inner and Outer.	12	X	3	23	
Opening	Cavalry Trumpeters	—	—	—	—	Yes	—	—	—
1	Pipes and Drums	—	Yes	—	Yes	Yes	—	—	—
2	Fife Bands	—	Yes	Yes	—	—	—	—	—
3	Motor-Cyclists	—	—	Yes	Yes	—	—	—	—
4	Subaltern's Dream	Yes	—	—	Yes	Yes	Yes	Yes	D & E
5	1st Entry Massed Bands	Yes	Yes	Yes	—	—	—	—	—
6	P.T. Display	—	Yes	Yes	Yes	Yes	—	—	—
7	Historical Episodes	Yes	—	—	Yes	Yes	Yes	Yes	A, B, C & F
8	Fireworks	—	—	—	—	—	—	—	—
9	Musical Ride	—	Yes	Yes	—	—	—	—	—
10	Drill Display	Yes	Yes	Yes	—	—	—	—	—
11	2nd Entry Massed Bands	—	Yes	Yes	Yes	Yes	—	—	—
12	Musical Drive	Yes	—	Yes	—	—	—	—	—
13	Finale	Yes	—	—	Yes	Yes	Yes	Yes	—

coloured screens. Two men may be necessary for a 90-cm. projector in an exposed position.

(*d*) Two telephonists per stand—one on the omnibus circuit, the other on the exchange.

(2) At least one Repair Party should be provided to effect repairs during and between performances. It should include one mechanist, two fitter-drivers, two electricians, two carpenters and one instrument mechanic. A Central Workshop must be available, and it is advisable to divorce the carpenters' working area from that of the fitters.

(3) For the Stores Branch a permanent staff of one N.C.O. and two Sappers should suffice, but it is important to choose them wisely, since the work entailed is both considerable and responsible. Inefficiency in this branch will have a serious dislocating effect on the entire organization.

(4) Finally there is the usual administrative personnel. No efforts should be spared in instituting as high as possible a standard of administration of the searchlight detachment. Good cooks must be insisted on, and P.R.I. worried for an extra messing grant. When personnel are accommodated under canvas, at least an additional 10 per cent. of tentage above scale should be "wangled." Tattoo searchlighting involves long and exhausting hours, and it is absolutely essential, if they are to be efficient, that the men eat well and sleep comfortably.

CONTROL.

(1) The system of control of the searchlights is as follows. During performances, the Officer i/c Searchlights operates from the Control Tower, which is located normally on the top of a central seating stand, and he commands an uninterrupted and comprehensive view of the arena. Two telephone circuits are available from each searchlight stand to the control tower. The omnibus circuit is a one-way system connected permanently to every stand and, by means of a microphone, the Officer i/c Searchlights passes over his orders to the stand telephonists, who relay them to the operators. An ordinary telephone exchange system is also installed. (See Fig. IX for diagram of communication.)

(2) It will be appreciated that the times for speaking the many warning orders and executive commands demand careful synchronization with the performance in the arena. As rehearsals proceed, the Officer i/c Searchlights gradually evolves a cue sheet, but, owing to the many inevitable amendments due to changes in production, it should not be published until the first service dress rehearsal, when each stand N.C.O. is given a copy as a guide. An extract from a typical cue sheet is shown in Fig. X (page 192).

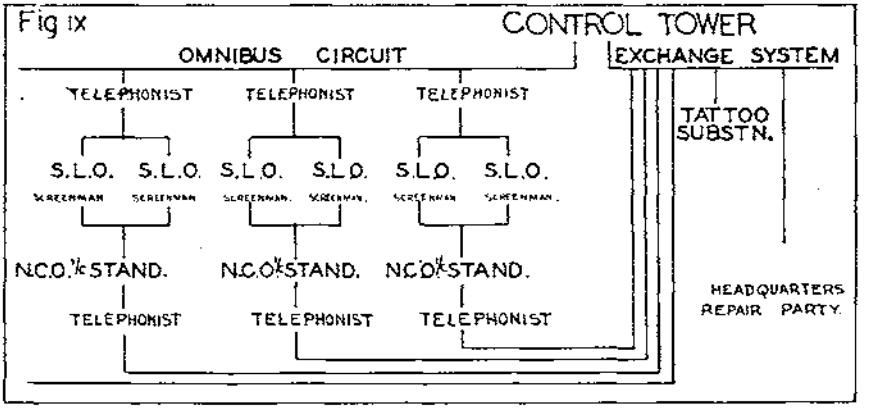
Note that all orders must be clear, concise and non-ambiguous, and, in order to reduce the listening strain of the omnibus telephonists, the particular stands affected must be detailed right at the beginning of each warning.

Routine.

The work involved in tattoo searchlighting may be divided into the following five periods :—

(1) *Initial Preparation.*

This requires a carefully planned programme, and includes the move to the tattoo locality, collection of stores, institution of a store



and workshop, preparation of site and erection of searchlight stands, distribution of equipment to stands and its assembly, laying cables and connecting up, preparation of the engine-room, installation of telephone line and incandescent lighting system to the stands, and final test. Initially the number of working parties will be one or two, and this increases with the completion of the heavier work, until the final decentralization should constitute each stand section assembling its own equipment. Normal working hours are recommended for this period.

(2) *Night Runs.*

From the time the lights are first ready for action, it is desirable to earmark about a fortnight for intensive training of personnel. Here is a suitable daily routine :—

0730. Réveillé.

0830. 1st Work Parade. Practical daylight running of lamps ; training screenmen in the operation of dousing shutters and coloured screens ; instruction to telephonists ; normal cleaning and maintenance.

FIG. X

Time.	Item No.	Cue.	Lights.	Command.	Remarks.
	No. 4 [Cont.] Subaltern's Dream (7 minutes)	Immediately.	A, B, C, D, E, F	All lights stand by to expose general positions.	
		Immediately.	P12 & X	Pip stand by to change to white and follow on next expose.	
		As Subaltern mounts.	A, B, C, D, E, F, P	Lights—Expose.	P12 and X douse in own time when field enters arena.
		Immediately.	A, B, C, D, E, F, Px	All lights stand by to douse. Pip X stand by to expose amber on bivouac on next douse.	
		Finish of kill.	A, B, C, D, E, F, Px	Lights—Douse.	Px exposes.
		Immediately.	D, E, F23, Px	Don, Edward, Freddy 23 stand by to expose Subaltern's Dream positions. Pip X stand by to douse on next expose.	
		After 6th round fired.	D, E, F23, Px	Lights—Expose.	Px douses.
		Immediately.	D, E, F23	Lights stand by to douse and re-expose slow general positions.	
			A, B, C, F21, 22	All lights stand by to expose slow general positions.	
		As last limber leaves.	D, E, F23	Subaltern's Dream—Douse.	
10.02	No. 5 1st Entry, Massed Bands. (14 minutes)	Green light.	A, B, C, D, E, F	General positions—1—2—3—4.	[Lodge Gates expose.]
		Band breaks into quick time.	A, B, C, D, E, F	Ack, Freddy stand by to douse on next change. Beer, Charlie, Don, Edward stand by to change to inner and outer positions.	
		Band approaches centre line from the left.	A, B, C, D, E, F	Lights—Change.	A and F douse. [Lodge Gates douse.]

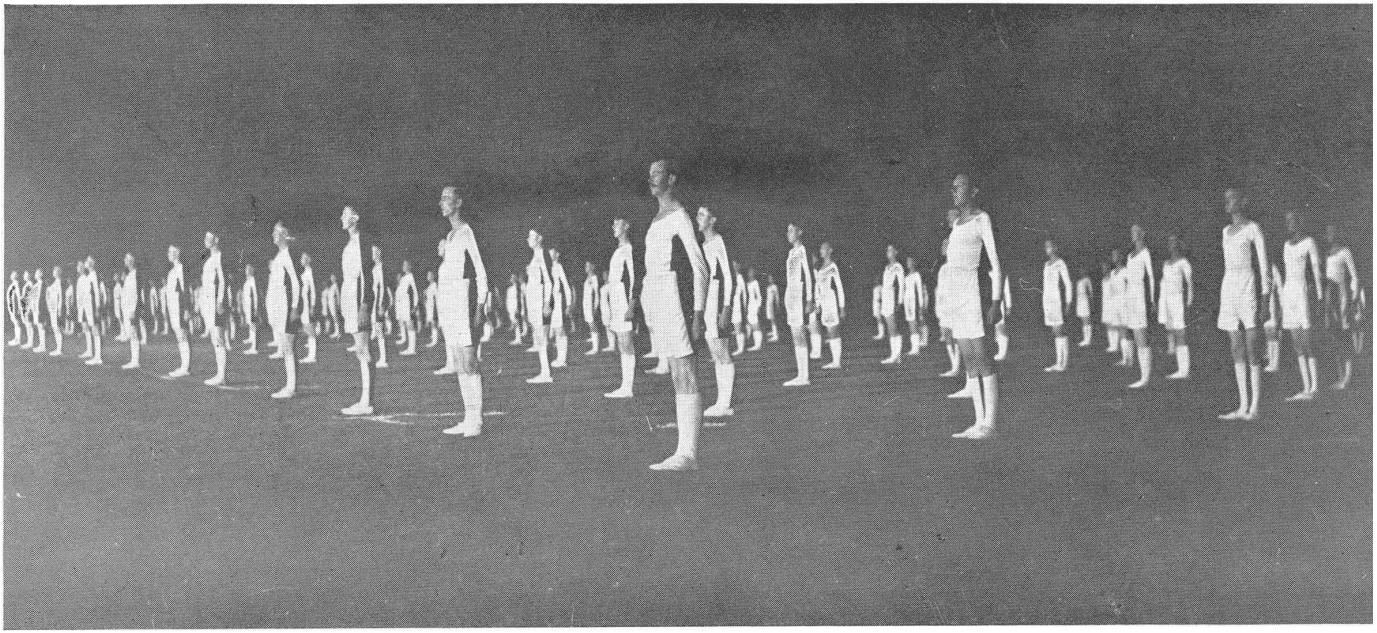
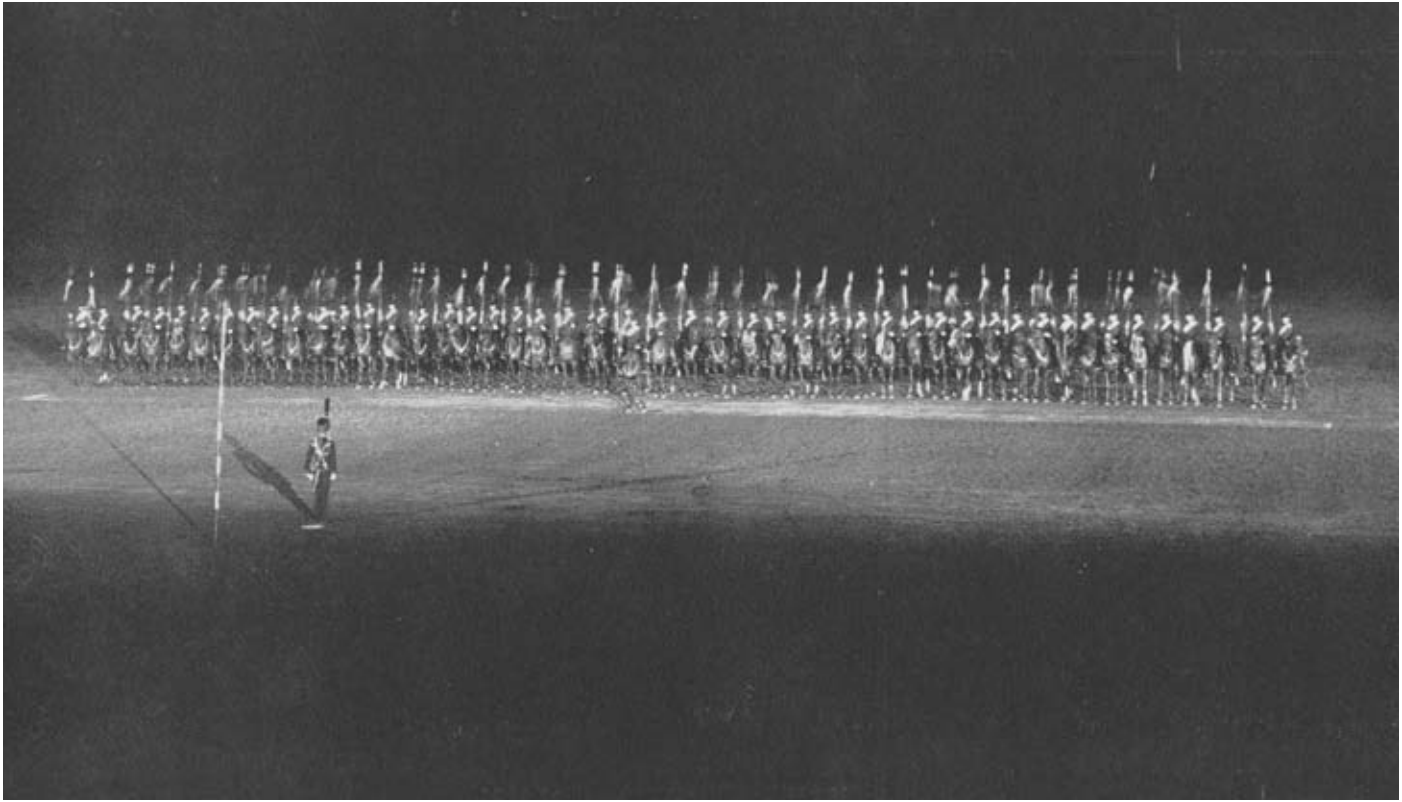


Photo. No. 1.—P.T. Item—Inner and Outer Positions.

Photographs by kind permission of Messrs. Gale & Polden, Aldershot.]

Tattoo searchlighting 1



Tattoo searchlighting 2

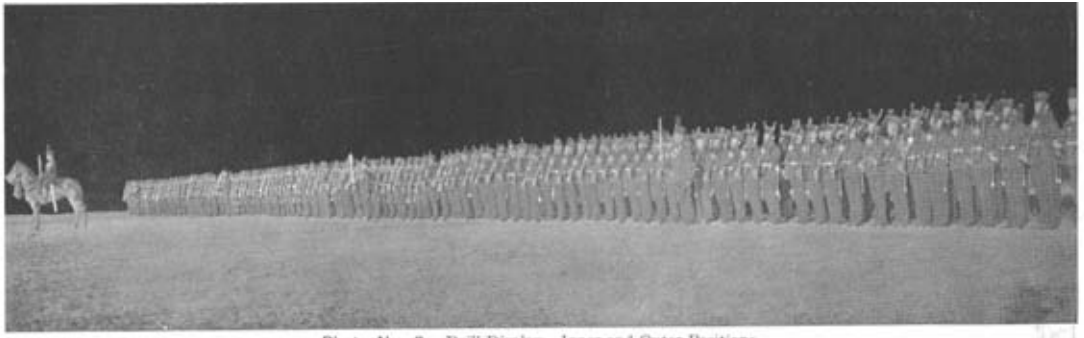


Photo No. 3.—Drill Display—Inner and Outer Positions.

Photo No. 4.—2nd Entry Massed Bands—Inner Positions. During the playing of a massed Xylophone piece, the Xylophones (seen along front) were spot lit copper coloured, and the accompanying bands coloured blue simultaneously.

Tattoo searchlighting 3& 4

Photo No. 5.—Musical Drive—Inner and Outer Positions coloured red when guns in action.

Photo No. 6.—Finale—General Positions and spotlights copper coloured during Last Post.

Tattoo searchlighting 5& 6

1130. Inspection of stands by Officer i/c Searchlights.
1200. P.T. Parade.
1300. Lunch.

The troops have no duties immediately after lunch. Occasional cricket matches, etc., against local units are a good thing, but this must not be overdone as the men normally prefer to rest.

The Officer i/c Searchlights will find the afternoon invaluable for conferences with the Director of Displays and Item Commanders; for getting thoroughly conversant with the items under rehearsals; and for mapping out his ideas of the standard illuminated areas.

2030. 2nd Work Parade. Night run of the lights with the arena unoccupied. Further training of all operators is concentrated on and experiments with the lighting areas carried out.

(3) *Night Rehearsals.*

A fortnight before the actual tattoo, the first night rehearsals of items begin and, during the ensuing period, the cue sheets attain a reasonable degree of finality. It should be realized, however, that Item Commanders will occasionally demand impossibilities from the lighting, and moments of discouragement are inevitable for the harassed searchlight staff. Consolation should be sought in the fact that the view from the Control Tower is the most critical possible, and consequently the value of any improvements effected is of a relatively higher order in relation to the audience. When he has completed his final design of the standard areas, the Officer i/c Searchlights must not adopt a policy of obstruction towards changes, but rather he should constantly anticipate a satisfactory compromise of possible difficulties in production.

(4) *Public Performances.*

It is important to avoid a tendency on the part of the searchlight personnel to be " overstrung " at the first public performance of the tattoo and casual at the last. At the conclusion of the programme, the searchlights assist in the traffic arrangements by illuminating car parks and pedestrian routes; and hence a late breakfast, followed by a short cleaning and maintenance parade, is recommended for this period.

(5) *Dismantling.*

The " dismantler " must keep constantly before him the point of view of the subsequent " assembler."

The essentials here are the conspicuous labelling and systematic packing of all tattoo permanent stores, and the compilation of a comprehensive record of the source of the remainder.

CONCLUSION.

In conclusion it might be added that besides exhibiting enthusiasm, patience and perseverance, the tattoo searchlight officer should display a progressive outlook.

The potentialities are far from fully exploited, and developments along the following avenues seem probable :—

(*a*) The exclusive employment of H.C.D. lights, thus substantially reducing the number of searchlights necessary for a particular task, and so facilitating a more ambitious lighting programme.
(*b*) A more centralized method of control, *e.g.*, push-button panel system for exposing and dousing.
(*c*) The adoption of ingenious commercial products, such as Neon tubes and Franco studs.
(*d*) The introduction of illuminated aerial effects.
(*e*) The application of indirect and silhouette lighting.

Hence, in spite of its occasional trials, this game need never be dull, and the fact that all ranks associated with the tattoo approach the last performance of the season with genuine regret is a sufficient testimony of its popularity.

THIS GRID BUSINESS.

By CAPTAIN D. R. CRONE, R.E.

THE endless variety of maps on which the soldier may be required to train or fight is supposed in our present system to be rendered uniform by the imposition of a so-called standard reference grid. To the infantryman or cavalryman who does not always know, and certainly does not care, whether the sides of the grid square are 1,000 yards, 1,000 metres or half a mile, this grid does appear uniform except on those rare and regrettable occasions when he is given two adjacent sheets gridded from different origins. To those who have to prepare the grids, and even more important, to those who have to use them for accurate calculations, nothing could be more diverse. The grid origins are dotted at random about the Empire as convenience dictates, little thought is taken of how foreign countries can be covered from existing origins and, even if grid origins were planned systematically, to cover the land surface of the earth conveniently would require over one hundred different grids.

A simple logical system of sheet layout and map referencing is an urgent necessity, and it should be one which can be applied to any type of foreign map by the veriest novice. In what follows, I have attempted to develop some such system from first principles and to examine some of the possible objections to it.

The following brief outline of how maps have grown up will indicate the cause of the present unsatisfactory grid system.

The desire for security of possession probably first interested man in maps and gave rise to the graphical record of rights or property map.

In India at the present time almost all types of cadastral map are employed and a review of these gives an excellent picture of the development of maps. In the Bombay Presidency and in Berar, the cadastral surveyor measures a base with a chain across each holding and makes measurements to the corners and around the perimeter. A sketch of the holding has these measurements recorded on it and the details of holder, title, boundaries and holders of neighbouring holding, etc., are recorded below this map and the whole forms the record of rights and provides data for the collection of land revenue. This map fulfils its primary function of a property map, but it is quite clear that where several holdings go to an acre, such maps cannot be assembled to provide even a village map, so that

finding one's way through a volume of such records written in script is, at any rate to the casual British officer, almost an impossibility.

The disadvantages of this method are obvious, but it still remains, at any rate in Berar, because the post of cadastral surveyor is an hereditary one and the introduction of an improved system would be practically impossible.

In other provinces, such as the Punjab, Bihar and Orissa, the horizon has been extended beyond the single field or individual holding to the next administrative unit, the village. Here maps of the whole village are made by chain traverse and holdings are numbered on the map and the record of right written with reference to these numbers. This is an important advance, but there are still the inherent defects ; no map can be made of the *tehsil* or district, although, as far as district administration is concerned, most ends are served by an index made by pasting together reductions of the various village maps.

The Central Provinces, Bengal and Madras have extended their horizon beyond the village and have taken advantage of the valuable work of the Great Trigonometrical Survey to place their villages correctly in the sub-continent of India, and so eliminate to a great extent the problems involved in changing boundaries. Their district maps are therefore maps in the real sense, although they are not put to their full use owing to the gulf fixed between the provincial responsibility for cadastral surveys and the central responsibility for topographical surveys.

Thus we see in India the horizon slowly expanding from the individual holding to the district. The tale may be taken up in England where the cadastral map is in units of county size, or areas about the size of an Indian district. This narrow county outlook has served its purpose well in the past, but difficulties thicken around it and the only solution is an expensive operation to adopt the whole country as a unit.

In our insularity we may well be satisfied with a nation-wide map horizon and consider that all our colonies can also be adequately served each by its own little map horizon represented by a local grid. That we are not quite satisfied is indicated by our concern over the co-ordination of African surveys. But even here the proposals only involve the increase of the map horizon to cover belts about 400 miles wide. But is this a logical place to stop ? Surely the only satisfactory map horizon is one which is world-wide.

Having arrived at the necessity for world-wide map horizon, we may consider how the ordinary person would deal with the problem of map layout utilizing the survey principle of working from the whole to the part, that is, from the earth as a whole to the large-scale map. He would first have to select a suitable reference figure of the earth, not a momentous decision as the choice is small and the

range of sizes available is within about 1 part in 10,000 of the mean. This selection could best be made with regard to convenience rather than with regard to absolute accuracy.

Having selected a suitable size for the earth, it is necessary to decide on the parts into which to divide the earth for mapping purposes. The only suitable world-wide system is the division by latitude and longitude. Division by this method produces curved figures of regular trapezium shape and sub-division can be carried out continuously down to the very smallest unit. The only particular decisions required in the adoption of such a division are (i) the reference longitude to be adopted, and (ii) the system of angular measure. For the first the Greenwich longitude is universally accepted and its choice must be unquestioned. In the British Empire the sexagesimal angular measure is universal, but the merits of the Continental centesimal system must be borne in mind and to this we will revert later.

If we accept the principle of division and sub-division by latitude and longitude we must consider how the maps are to be made. Since geographical maps are almost invariably divided on this principle, we will pass them over for the moment and consider the larger scales, from ¼-inch up to 25 or more inches to the mile. Much time and trouble is wasted in the teaching of topographical surveying over the question of suitable map projections. In topographical practice, the consideration of projection is quite unnecessary and is a complication which has been introduced by the pundits apparently with the idea of "blinding with science." The essentials of any map are that it shall have a uniform scale over the whole sheet and that directions shall be true. Since the earth's surface is curved and the map sheet is flat, this cannot be perfectly achieved, but on all topographical scales over the largest sheet that can be easily handled it can be achieved well within the limits of distortion of the paper on which the map is printed, and this can be effected quite simply by drawing the sheet edges in the form of a regular trapezium with sides of the correct length of the trapezium on the reference spheroid.

For this method of projecting sheet edges, all that is required is the lengths of the units of latitude and longitude for the different latitudes concerned. These lengths are a function of the figure of reference only and are commonly required in the computation of triangulation. This method eliminates the laborious mathematical conjuring tricks involved in selecting artificial projections and of determining the co-ordinates of sheet corners.

The projection actually employed, if a name is required, is indeed a slightly conventionalized polyconic, which merely means that each sheet is on its own conic projection with the north and south edges as its standard parallels.

So far we have built up a simple logical system of sheet edges.

There remains the question of a reference system for identification of points on the map.

The logical extension of the method of map sub-division is to apply this sub-division to the reference system and identify every point by its latitude and longitude. We have now designed a map layout and reference system which covers the whole world based on three fundamental points only :—

A standard reference spheroid,
A standard meridian, and
A standard sub-division of the circle in angular measure.

Map references are unique in the world and dependent on the standard meridian and angular measure alone. The skeleton of this design is logically the only one which can be said to conform with the basic principle of survey. The sub-division of the reference system is a matter of detail, but a very important detail, as upon it depends the convenience with which the reference system may be used.

The desiderata for the division of a reference system are (i) that the division should be on the decimal system, and (ii) that the reference square printed on the map should be a convenient size so that it is not too small to obscure detail on the map, nor so large that division by eye into ten parts is difficult. The best size is between $1\frac{1}{2}$ and $2\frac{1}{2}$ inches.

The units available in the sexagesimal system are the degree, the minute and the second. The second of arc is a surveyor's unit, which is scarcely appreciated by anyone else and has little to recommend it. The minute of arc is a more generally known unit and is not inconvenient.

Numbering the circumference of the earth in minutes would be an unacceptable proposition as it would in effect mean the introduction of new units of angular measure of 100 and 1,000 minutes of arc. The alternative of abandoning the decimal system and keeping to the degree and minute system amounts, as far as the reference system is concerned, to a discontinuity of reference numbering at each degree similar to the discontinuity at the edges of individual rectangular grids.

There remains the degree. This is a unit universally known for fixing places on the earth. It is the basis for the sheet lines of the international 1 : 1,000,000 map and decimal sub-divisions of it, though conveying little to the ordinary person as a measure of angle, will provide suitable reference figures. The objections to it are that existing latitudes and longitudes in degrees, minutes and seconds would require conversion to decimals of a degree and that the numbering is discontinuous along one meridian. The latter is not a serious objection, as the meridian of 180° east of Greenwich falls almost entirely on the sea. The decimal division of the degree

inevitably suggests the centesimal angular measure, which is perhaps the most suitable measure if the work could be started right from the beginning, as it overcomes the two objections to the decimal division of the sexagesimal degree. The sole objection to it is the common use of the sexagesimal system and the fact that no English tables of functions of angles in the centesimal system appear to exist, though excellent tables are published on the Continent. As far as the suitability of the size of the reference figures on the commonly-used scales is concerned, the sizes in inches at latitudes 50° are given in the following table for the three most important scales in the order of their importance. The size of the square, using the yard unit, is given for comparison.

Scale.	Yard.	Sexagesimal.				Centesimal.	
		Degree.		Minute.			
		N. & S.	E. & W. (50°)	N. & S.	E. & W. (50°)	N. & S.	E. & W.
1 : 25,000	1·44	1·75	1·27	2·92	1·88	1·58	1·14
1 : 50,000	0·72	0·88	0·64	1·46	0·94	0·79	0·57
1 : 10,000*	3·6	4·38	3·18	7·30	4·70	3·94	2·86

* Or 1 : 100,000.

From this table it is evident that, as far as convenience of size is concerned, the order is minute, degree and centesimal measure.

Taking everything into consideration the centesimal measure is the soundest logical choice and could be adopted probably with less inconvenience than the adoption of a metre grid, but the decimal division of a sexagesimal degree appears reasonably convenient and could be adopted with the least trouble and inconvenience.

The principal objections which are levelled at the use of the spherical graticule for map-referencing are that in high latitudes the quadrilaterals printed on the maps are elongated, making the judging of the tenths within a square difficult, and that the gunner who wishes to shoot from the map will have to indulge in spherical trigonometry.

The only way to judge the validity of these objections is from actual examples in reasonably bad circumstances.

Fig. I is a diagram of the north-east corner of a sheet on the 1 : 25,000 scale, covering the area from 4° 0′ (176.00) to 4° 15′ (175.00) W. and from 53° 0′ (53.0) to 53° 06′ (53.10) N. The mean size of a rectangle in the sheet is given on the map. The basic data is given below the map. Fig. II is a diagram of a similar sheet with rectangular grid in yards on Lambert's Cônical Orthomorphic Projection.

The most obvious points about these two diagrams are the unfamiliar shape of the reference figure on the meshed map and the considerable and complicated nature of the basic data on the gridded map.

On these maps two points G and T have been plotted to illustrate the problem of map mensuration usually required in the army. They represent a gun at G required to fire at a target T.

Direct Measurement.—By measuring direct from the map with a protractor and scale of yards, the range and bearing from Fig. I is 5875^{x}, 85° 30′ True ; and for Fig. II is 5850^{x}, 88° 40′ Grid.

On both maps the measurements are simple and, as we shall see later, equally accurate.

By Calculation.—Now suppose that the co-ordinates of the points have been accurately determined and greater accuracy is required.

The calculation on the mesh is made on the assumption that the reference figures are rectangles of the mean size for the map sheet, thus :—

	E.		N.	
T	175.99	433	53.09	923
G	91	454	09	548
	7.	979		375
log 7979	0.9019		log 375	5740
log 733	2.8651		log 1217	3.0853
sum	3.7670		sum	2.6593
log *sin* B true	$\bar{1}$.9987			3.7670
Difference	3.7683	= log Difference *cot* B		2·8923
Range	5865^{x}		B	85° 32′ True

On the grid	E.		N.	
	707072		1 020	242
	701218		1 020	116
	5854			126
log 5854	3.7675			
log 126	2.1004			
log *tan* B = Diff.	1.6671	B=88° 46′ Grid.		
log 5854	3.7675			
log *sin* 88° 46′	$\bar{1}$·9999			
	3.7676	= Range 5856^{x}		

In these calculations the mesh calculation is slightly longer by two addition sums and looking up the logs of the lengths of the sides of the rectangle. These logs only require to be found once for all operations in one map sheet and therefore represent very little lost time.

The true distances and bearings at G are—

Range 5863^x ; True Bearing 85° 30′
Grid Bearing 88° 46′.

The errors are thus

Mesh 2^x Range and 2′ bearing,
and Grid 7^x ,, ,, 0′ ,,

which are in this case negligible.

The errors of the mesh calculation are due to the assumption that the reference figures are rectangular and of the mean size, and the errors are therefore proportional to the difference in easting, but they may be considered negligible for light and field artillery as the error in bearing only reaches 5 minutes of arc at 10,000 yards in these latitudes. For medium artillery, corrections to the bearings must be applied, but the corrections are very simply obtained from the difference of easting. With the difference of easting in hundreds of a degree the correction in minutes is 0.3 *sin l*.*d*E, or for the latitude 53° of the example 0.24 *d*E (where *l* is the latitude and *d*E the difference of easting). The correction is additive for the easterly point.

For actual artillery survey work covering any considerable area of ground, calculations would require to be carried out rigorously. For all such practical purposes the mid-point method is adequate.

The example already given worked by this method is shown on the next page.

This method is quite straightforward and follows the lines usually adopted by the gunners.

There is one further calculation frequently used in which a map is required and that is the computation of azimuth from sun or star observations. For this, the latitude is required. On the meshed map this can easily be read off, but on the gridded map it is obtained with considerably more difficulty. The computation gives the true bearing, which is directly applicable to the meshed map, but requires reduction to grid bearings for the gridded map, and for this the longitude is required, another operation presenting some difficulty on the gridded map, and the calculation of DE *sin l*, where DE is the difference in longitude from the origin and *l* is the latitude of the origin. This requires greater accuracy than the corresponding

correction for mesh bearings, as the grid convergencies run into a number of degrees.

One of the greatest objections to a mesh from the gunner point of view is that map references cannot be plotted on a gridded battery board. This is more or less obvious, but with a mesh map reference system the battery boards must be meshed. A board cannot, however, be meshed once and for all, as the mesh varies with the latitude. The gunner in the field seldom requires or obtains an accuracy of greater than 1 : 200 from a battery board, so that the mesh need only be changed when the error is greater than this figure. This means that a board meshed for a certain latitude will serve for considerable areas north and south. In latitude 30° it may be used up to 35 miles on each side and in latitude 57° 15 miles on each side. If the board is originally ruled with the centre meridian and the parallels in ink and a scale of breadths of rectangles for degrees of latitude included, the ruling of the remaining meridians is a simple matter.

	E.				N.		
T	175	99	433		53	09	923
G		91	454			09	548
dE		7	979	dN			375
log dE	0.90195			log dN	$\bar{1}$.57403		
*log $\frac{\pi \nu \cos l}{180 \times 100}$	2.86488			*log $\frac{\pi \rho}{180 \times 100}$	3.08532		
Sum	3.76683			Sum	2.65935		
log *sin* B	$\bar{1}$.99868				3.76683		
	3.76815 = Difference log *cot* B				2.89252		
				B =	85° 32′ 08″		
Range	5863^{x}						
				log dE	0.9020		
				log 0.3	$\bar{1}$.4771		
				log *sin l*	$\bar{1}$.9029		
				Sum = log correction	0.2820		
				Correction	1.91 minutes		
					1′ 55″		
				True Bearing at G—	85° 30′ 13″.		

* From Table for Clarke's 1858 figure for mid-latitude 53.097.

Summary.

The main considerations in the question of the mesh *versus* the grid are summarized on page 204. These are the theoretical considerations. Apart from these, I am convinced after practical experience of both systems in artillery practice camp and in the drawing office that the great majority of Sappers and Gunners with the same experience would become strong advocates for the adoption of a universal mesh.

MESH.	GRID.
1. Uniform world-wide system, easily applicable to maps of all nations.	1. Numerous isolated systems. Origins and even projections selected in peace may prove unsuitable for extension to war zones.
2. Fundamental data are :— (i) Reference spheroid. (ii) Reference meridian. (iii) Angular measuring system.	2. Fundamental data for each grid are :— (i) Reference spheroid. (ii) Reference meridian. (iii) Angular measuring system. (iv) Grid projection. (v) Grid origin. (vi) False origin to render co-ordinates positive. (vii) Linear measuring unit.
3. Mesh reference figures become distinctly oblong in high latitudes.	3. Grid squares are always square.
4. Breadth of figures changes rapidly in high latitudes but changes are continuous.	4. Size of grid squares changes slowly over usual areas covered by single grids, but a grid may require to be extended to give considerable divergences of the square from its reputed size or a line of discontinuity introduced involving overlaps with maps gridded on two systems and consequent risk of confusion.
5. Reference system is the same as normal geodetic system and conversion is simply conversion of minutes and seconds of arc to decimals of a degree. No special tables are required for R.E. survey.	5. (*a*) Lengthy and laborious computations are necessary to convert geodetic data to grid terms. (*b*) Special tables for each grid origin are required to enable survey work to be carried out in grid terms, or alternatively second-third order points require conversion by the same method as geodetic points.
6. R.A. calculations are slightly increased :— (i) For field artillery by an operation similar to conversion from metres to yards. (ii) For other survey work by the further addition of a simple correction to bearing. Sun-star azimuth computation is simplified.	6. The grid system is the existing basis for R.A. calculations.
7. R.A. battery boards require a new mesh drawn after moving a certain distance north or south (70 miles in latitude 30°, 30 miles in latitude 57°).	7. R.A. battery boards have permanent grids drawn on them.

Figure 1

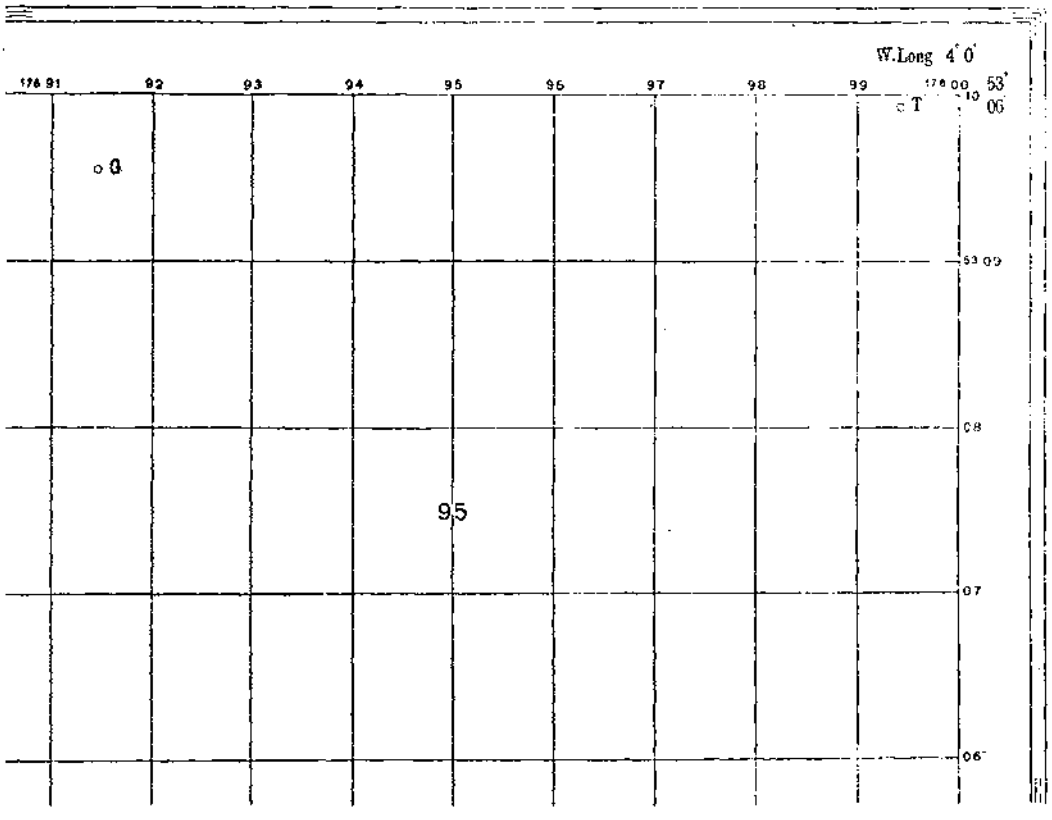
MESHED MAP

(Reduced by 1/2)

Magnetic North is 15°30' W in 1927
(Annual decrease 8)

Scale :- 1/25,000

The small rectangle measures { 1217' N & S / 733' E & W } in the centre of this sheet.



DATA

The small rectangles are 0.01 degrees of latitude and longitude. Longitude is measured east from 180° West of Greenwich. The reference spheroid is Clarke, 1858.

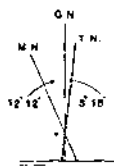
Figure D

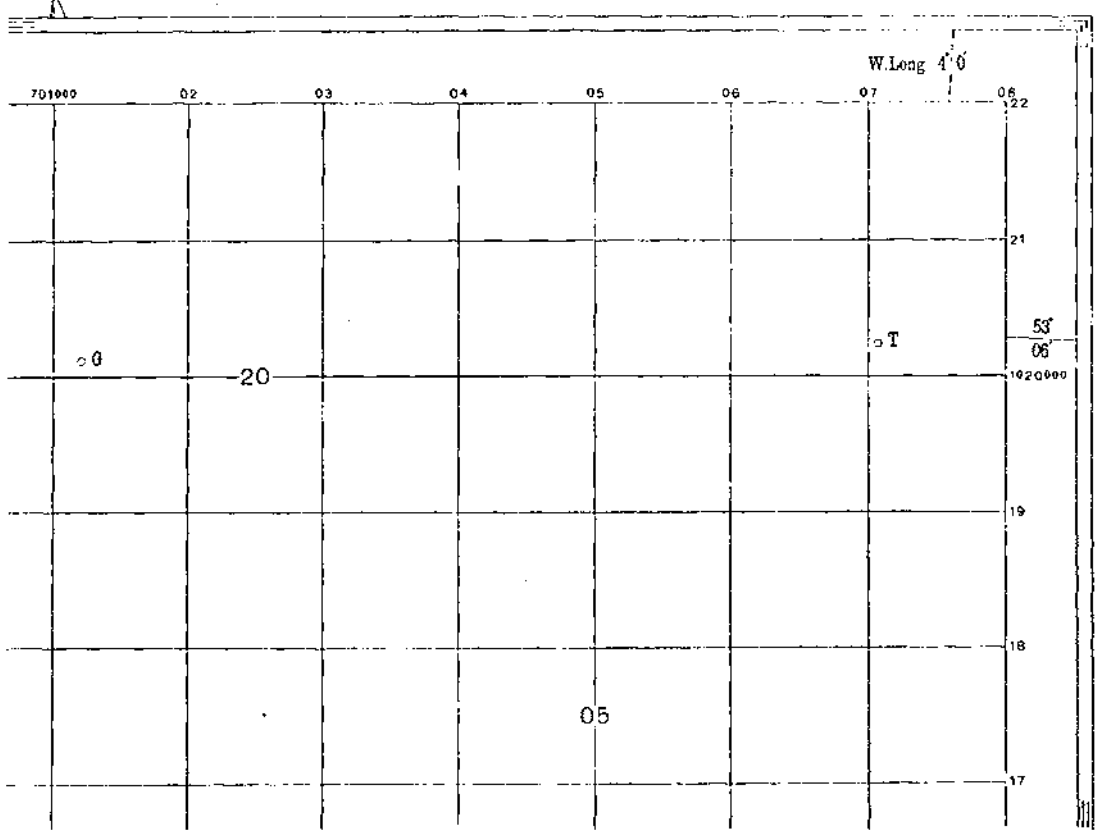
GRIDDED MAP

(Reduced by 1/2)

Scale :- 1/25,000

True North is 3° 18′ East of Grid North
Magnetic North is 12° 12′ West of Grid North in 1927 (Annual decrease 8′)
} to the centre of this sheet.





DATA

1. *Sides of squares are 1000 yards.*
2. *Reference spheroid is Clarke, 1858*
3. *Projection is Lambert's Conical Orthomorphic*
4. *Origin is 53° 0′ N. on Greenwich meridian*
5. *Scale at origin is 794/795 x 1/25,000*
6. *1,000,000 yards have been added to Eastings and Northings to make them positive.*

A COURSE AT BIGGIN HILL.

By MAJOR H. B. T. WAKELAM, R.E. (T.A.),
35*th* (1*st Surrey Rifles*) *A.A. Battalion, R.E.*

A YEAR or so after the Great War I resigned from the Royal Regiment of Artillery, being gazetted on to the Reserve of Officers with the rank of captain.

Being still of a military age, and thinking that in my humble way I might somehow be of service, I joined, last November, the old 21st London Regiment, the 1st Surrey Rifles (who were converted into an A.A. unit just over a year ago), coming in as major and second-in-command, owing to my previous army connection.

Having watched and taken part in one or two recruiting shows at our Camberwell headquarters, and having assisted in a B.B.C. feature programme "The Air Defence of London," my next step, obviously, was to learn as much as I could about the technical side of my new job, and so, having duly applied, I was given a vacancy in the 48th A.A. Defence Course, starting at Biggin Hill on January 13th last.

During the previous week, I received from the School adjutant a detailed list of things required, trains, times, and so on, and having rushed round to make up the necessary kit (I found I could just get my old Sam Browne to meet in the very last hole—but overalls were quite a different story !), I set off, by car, from my home in West London on the Sunday afternoon, feeling in some way rather like a small boy *en route* for his first boarding-school term.

I did not quite know, for instance, how to put on correctly those very complicated-looking Sapper leggings, which I, for one, at any rate, would be very glad to see replaced by the far more serviceable and better-looking modern field boot. In addition, my mess jacket had not arrived, and though I had been told that patrols and a dinner jacket were all that were required, I had in the back of my mind the possibility of a guest night, and so packed in a tail-coat and white tie as well.

It is not a particularly easy place to find in the dark, and, as it happened, in pouring rain, but eventually I got there, to sign in, and to be allotted a most comfortable quarter, with a bathroom next door, and a most efficient civilian batman, to whom I was requested to give the recognized amount of 1s. 6d. per week. He was an old

Shropshire Light Infantryman who, curiously enough, had been in the very same sector as I had in the early part of 1915 in France.

As I got out of my car, too, I ran straight into a regular gunner major, down on an "Archie" course, who had been "in House" with me at school, so at once it seemed that I had fallen among friends.

I found the Mess rather full, for apart from the permanent Gunner and Sapper Instructors, there were ten of us, and between twenty and thirty of these "Archie" gunners, including quite a flock of Y.O's, who had just completed their time at Larkhill; but the catering arrangements stood up well to the strain, and, after a naturally somewhat sticky first supper, I found the friendly spirit further extended, for our Class Instructor came round the anteroom, seeking us out, introducing us to each other, and generally doing his best to make us feel at home.

We were rather a job lot—two majors and eight subalterns, including men from the Stock Exchange, an architect, business men, and two mechanical engineers, and, also, we were at very different stages of learning.

One or two, for instance, had already done one or more "searchlight" camps—some, like me, had seen the things in action, but little else—and one, actually, had been gazetted only two days before, and so was the absolute and complete "new boy," for he had never previously been in a Mess in his life.

At once the thought struck me what a terribly difficult task our Instructors were to have, for we were only to be there for fourteen days, during which time they were faced with the problem of cramming into us as much as we could conveniently hold and absorb, and here already the complete ignoramus was mixed with the semi-skilled. That it worked out at all was surely a great feather in their caps.

And so, on that first night, to bed, with a large and cheerful fire to keep out the notorious Biggin weather, but alas! not to sleep, for years of civilian beds had made one's bones unaccustomed to hard lying, and indeed the knobs in my mattress were so unfriendly that I positively welcomed my batman's call at the, to me, ungodly hour of 7.15. (A tip to those that follow: take an extra pillow with you —you will want it!)

As the other ranks, of whom there were some thirty, had first to be medically examined, our opening parade was not until 9.45, when we were addressed generally on local conditions and mess rules by our Instructor, and then turned into the lecture-room for the "curtain raiser" of what it was all about.

For this parade only, we wore breeches and leggings. I still quite cannot make out why, for, for the rest of the time, slacks and

gum-boots (a most important item of kit) were the correct order of the day.

We met also that first morning our warrant officer instructors under the R.S.M.—fine types of long-service soldiers, as eager to help and teach us as we, presumably, were to learn. Our officer class, Class A, was allotted to the R.Q.M.S., who had served continuously since before the war, and also had the complete knowledge of his very varied craft at his fingertips. We found him a great enthusiast, ready and willing to give up his spare time to help us over this or that little problem which puzzled us, and now that I have temporarily abandoned the khaki again, I lift my civilian hat to him. He carried us through the detail and intricacies of manning drill, of the sound-locator (with its attendant binomial sense and instruction in correct and with balanced listening sides), and through the interesting stage of the spotting-room, where we learnt the mysteries of correct application of the leading point of the ring site and the methods of searching the sky for a possible target.

When we had gone through these preliminaries, he got us on to the visual plotter, on to what I consider, in my own parlance, to be the intelligence side of the whole thing, and after it, a step farther, on to the sound plotter. Perhaps because it recalled to me memories of gunnery tactics and dial sights, and so on, this particular science (and it *is* a science) interested and intrigued me enormously, and I think I can fairly say, that from this fortnight I have absorbed a very reasonable working knowledge of it.

The concentrator is at first a little difficult to grasp, unless you happen to be " telephone-minded," but once you understand what it is there for, and what it does, it is comparatively simple to puzzle out for yourself. I still do not understand, though, why No. 1 should use the " Head and Breast Set " labelled No. 3, and *vice versa*. It only looks to me as though it was just to make it more difficult !

In thus running over the part which the R.Q.M.S. took in our training, I am perhaps putting the cart before the horse, for in actuality, each particular subject was dealt with by our Chief Instructor, in lecture form before we got on to the practical side.

These lectures were usually of about forty to forty-five minutes' duration, and while one was provided with note-books and so on, to take notes if desired, at the end of each a *précis* was given out, embodying the main headings and points of the talk—a great help in revision.

Furthermore, we were instructed in the art of lecturing, even to the point of giving so-called " lecturettes " ourselves. The scheme of these roughly was as follows :

After two or three days, we were each issued in the closing afternoon period with a slip of paper, bearing the name of a certain subject, such as "Theory of Sound," "Visual Plotter," "Duties of Detachment Commander," etc. We were then expected to work up from our *précis* and notes and handbooks, a ten-minute talk, delivered in imagination, and as we so desired, either to raw recruits, or to intelligent N.C.O's, or even to an officer class.

Having prepared our talks, we then had to get them off, possibly the next day, to the rest of the class, with an instructor sitting there, and taking notes of our style, knowledge, correctness of facts, and so on. After each lecturette, this instructor would criticize our tale, pointing out its weaknesses or obvious faults, and usually, it is true, making us feel rather small. It is all very well, and undoubtedly a most excellent principle, for it serves a dual purpose—revision, as well as confidence in instruction; but in practice it is extremely difficult, for the time allowed is far too short to cover your subject properly and in consequence you can only skate over the greater proportion of it. Be sure, then, that your instructor will draw attention to the things you *have* left out!

I had three to do: "Theory of Sound," "The Visual Plotter," and the "H.C.D. Lamp." I put that last for a specific reason, for concerning it I have one of my few grouses of the fortnight. To anyone like myself, completely non-mechanical in mind, and also perhaps past the stage of true academic learning, it was the devil's own business to understand thoroughly. Solenoids and arc deflectors and potentiometers, and so on, were duly paraded before me by diagram and in the "actual flesh," so to speak, and I must confess that I learnt them off almost parrot-fashion, treating them strictly in rotation, with the refrain of "The music goes round and round" running collaterally in my brain. But I doubt if the knowledge thus gained is of any practical use to me, for it is the very electrical system which beats anyone brought up "horse-minded" like myself, and as we were told that any fault or casualty on the thing, apart from speed regulation, or carbon changing, necessitated the immediate sending for of a mechanist, or even a complete replacement, I am of the opinion that such fully-detailed instruction could be quite reasonably curtailed.

But perhaps my grouse is without any foundation beyond the fact that I definitely disliked the thing at first sight.

We had a lot of fun over the Manning Drill, a wretched job normally in "Biggin" weather, but here our instructor came to the rescue. It is one of the things upon which you are examined towards the close, the system being for a regular detachment to carry their drill out under your instruction and your imaginary picture. They are told to make mistakes, for which you must watch, and which you must check and correct as you spot them.

"Stop. No. 6, do not put your hand on the sound locator while 7 and 8 are on sound," and such-like.

To help us, the R.Q.M.S. therefore made us play this game with each other acting in turn as instructor, a game evolved no doubt from the old infantry wheeze of "Jenkins says Left turn" or "Left turn."

It certainly helped us a lot, and it kept us moving in that infernal biting wind. I suppose, whilst on the weather subject, that we were particularly unlucky, for we had the full issue, including quite a considerable fall of snow. And here a word of warning. "Don't take a valuable car down," for the garage amenities are not all that they might be, and there is a good deal of necessary "pulley-hauley" in the sheds which may result in damaged wings. This is apart from the chances of getting frozen up. The climate also only allowed us to have one "night run," and thus only one real opportunity of doing the work ourselves in action.

Surprisingly, we got on (by "we" I mean the officers' detachment) quite reasonably well, though the 7,000-foot target was at times difficult to follow on account of low-lying clouds.

Indeed, I did not envy the pilot, from the nearby Co-operation Flight of the R.A.F., his job at all on that night, and he must have been as glad to get down as we were to come in out of the cold drizzle in which the operation finished.

Speaking of the R.A.F., it was really good to see how perfectly the two Services worked and dove-tailed in together, in absolute harmony and each obviously out to help the other as much as possible. It was indeed an object lesson in that team work which must of necessity lead to success in A.A. defence work. On the last day we went down to the aerodrome, where, having been initiated into the mysteries of the combined operations room, we were taken into the hangars and told about the various types of machines on view.

I think I should have liked to have gone there earlier on, if only for a very brief visit, to impress upon me the veritable guts of the whole lay-out, and the end towards which we were to travel, step by step.

Our hours, to a civilian, were long. Lectures or practical work from 9 a.m. to 1 p.m., with a half-hour break at 10.45 a.m., then back at 2 p.m. for three periods until 4.15 p.m. tea. Then, if possible, a night run from 5.15 p.m. or so, until 8 p.m. dinner and the prospect of swotting up a lecturette for the next day.

If no "night run," a voluntary "knotty point" parade as explained earlier on.

Now this may be all right for the young man fresh from school, but frankly I found that by 4.15 each day I had reached almost to saturation point, and any further effort therefore turned my brain into an uncomprehensive whirl of ammeters, and Weekes pointers,

and map references and ill-disposed persons, and I was glad to seek sanctuary and brain-rest in some kind of relaxation or amusement.

Here, too, we were well catered for. To start with, there is a squash court, as well as tennis courts and a local golf links, all of which are covered by a 5s. Mess subscription. There is also the usual Mess billiard-table, a little short of scientific care and correct cue treatment, and a large and well-found library of books. If you are so inclined, it is also comparatively simple to get a game of "contract," for sappers are clever and brainy people by nature, and though at times the usual arguments about "Strong Two's" and "Culbertson's," and so on, crop up, you will probably come away, as I did, with one or two completely new outlooks on this most engaging pastime. The Mess stakes are 3d. per 100, so you cannot do yourself much harm anyway.

The food is plain, but definitely good. It may not have much variation, but it fully satisfies the hungry man, and as messing is but 2s. 6d. a day, one can hardly expect Ritz-Carlton menus or the cares of a Continental gentleman as *maître d'hôtel*. Drinks, too, are cheap and well kept, and other services, such as posts, etc., distinctly adequate. The local telephone exchange does not seem especially bright, but that, of course, is hardly a military matter.

To sum up, things are very comfortable, and clean, and the atmosphere is definitely friendly, so that even the youngest and most callow of subalterns may have no qualms as to his reception.

The Instructors are patient, clear-minded and ever ready to help in all directions, even to the starting of a refractory car, and they obviously are eager to teach you all that they can in the short available time, and the difficult class knowledge conditions.

My advice to any T.A. officer is "Go there if you possibly can," for you will surely come back a much enlightened and far more efficient man.

Do not forget the extra pillow and the gum-boots, and also remember that Barrack Wardens, or whatever they are known as nowdays, do not supply soap.

The remaining details need hardly be recorded here, for they are on the very comprehensive list sent out to intending visitors.

FLOODS IN FENLAND.

By Captain F. J. R. Heath, R.E.

Introduction.

At least two areas in fenland suffered from excessive water this spring. In the south level a watercourse known as Soham Lode burst its banks and considerable flooding occurred. In the middle level the wash* nearly burst its banks and, had it done so, about 250,000 acres of good farmland would have been flooded and spoiled. As an emergency measure, detachments of Royal Engineers with folding boat and kapok bridging equipment were drafted into the fen area to help prevent the occurrence of this calamity. Before going to the fens few, if any, of the personnel concerned knew much about them, how they worked or why they were flooded. A short historical note on the engineering works to be found in the fens seems to be the best way of clearing up a number of misconceptions, and following this a brief account of the work done will be given.

Engineering Works.

A large part of the fen country is below the sea level and the whole of it, together with the Wash, may be regarded as an arm of the North Sea which has been filled with silt by the many rivers which enter it, although there are " islands " such as the Isle of Ely, which stand above the surrounding country. Engineering works to keep these rivers within bounds and to keep the sea out were probably made by the Romans, but the bulk of the present works owe their inception to Francis, Earl of Bedford, who, with a great Dutch engineer—Sir Cornelius Vermuyden—and others, obtained a concession from King Charles I to drain the fens in return for a grant of 95,000 acres of the land so drained.

Vermuyden, in *A discourse touching the drayning of the Great Fennes*, published in 1641, says of the area in question :—" The levell lyeth in six counties (viz. : Cambridge and the Isle of Ely, Huntington, Northampton, Lincolne, Norfolke and Suffolke). It is of a great and vast extent. . . . There doe run through these Fennes

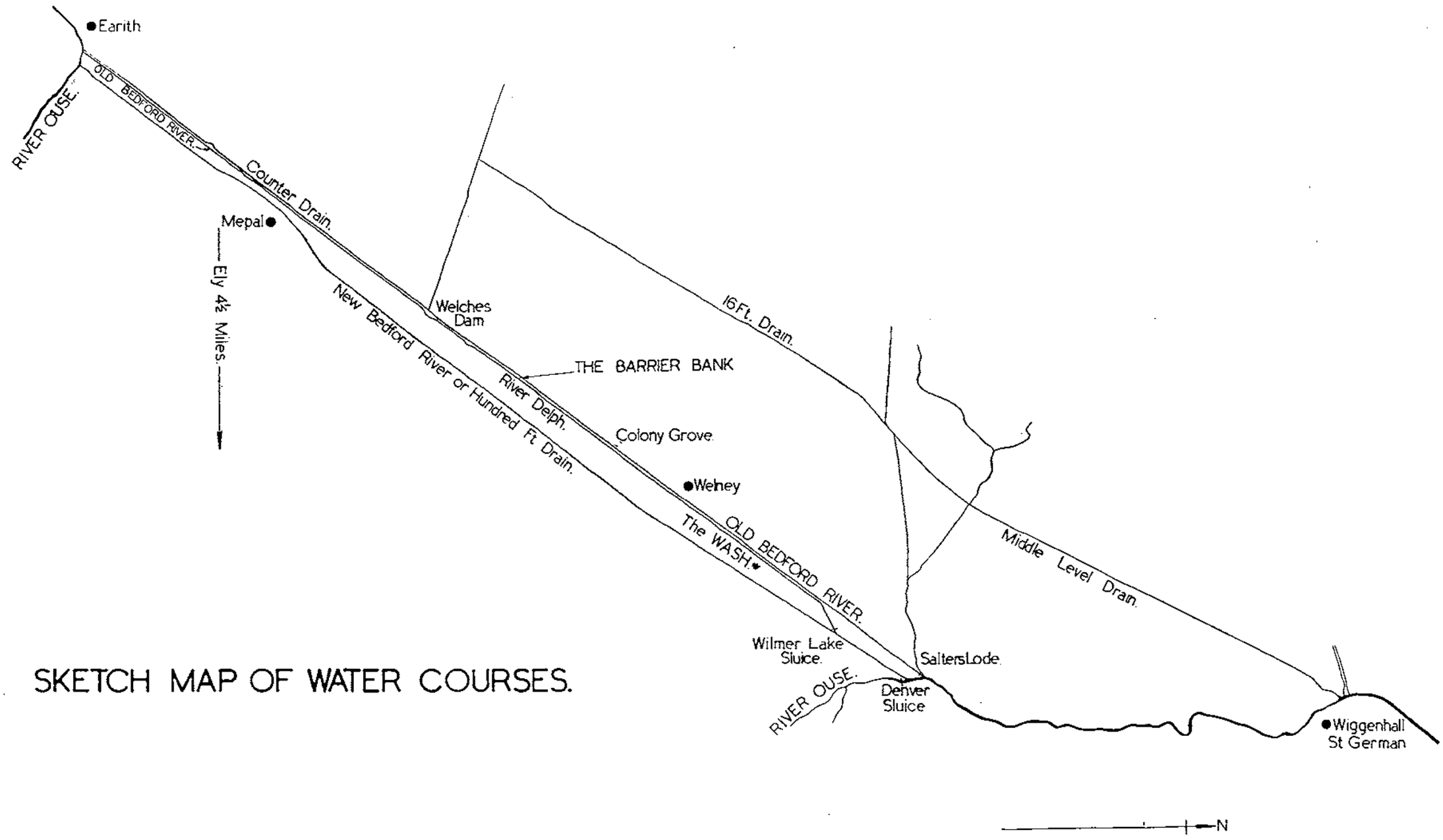
* The area of land lying between two made rivers—*e.g.*, between the new and the old Bedford rivers—is known as a wash. Strong embankments are provided on either side of these washes and they form large reservoirs to hold flood water. To distinguish such washes from that into which the River Ouse discharges north of King's Lynn they are printed in this article as wash*. (See Fig. 1.)

eight rivers which doe come out of divers vast and great countries which lye about it, the said rivers are called Glean, Welland, Neane, Ouse, Grant, Milden-hall, Brandon and Stoke." He then describes how these rivers are unbanked and the land often "overflowen" and says that to avoid expense the rivers must be "led about another way." Owing to opposition from the local inhabitants and from Cromwell, Vermuyden's plans were not completed until after the Restoration. The area he drained was divided into three levels, *i.e.*, north of the River Nene; between the River Nene and the old Bedford river; and south of the old Bedford river. These were called the north, middle and south levels and are spoken of collectively as the Bedford Levels. Since the seventeenth century the works have been added to and improved at frequent intervals and a glance at a map will show the highly artificial nature of the watercourses in the area. As recently as 1932 the barrier bank, which extends from Earith to Wilmer Lake sluice, between the old Bedford river and the wash* (some 18 miles), was raised 5 feet in height.

The method of working the fens is that water from the agricultural land runs into open drains—these are mostly below sea level, and the water is pumped from them into banked-up artificial watercourses such as the old Bedford river. Pumping was originally done by windmill; as a contrast, Fig. 2 shows part of the pumping station recently erected by the Middle Level Commission, at Wiggenhall, St. Germans. Here there are installed three 8-cylinder 1,000-h.p. Crossley Diesels, coupled to Gwynne's pumps, which deliver 1,200 tons of water a minute each. There is space provided for a fourth set. The water pumped into the rivers runs by gravity into the sea, except that at high spring tides some of the rivers are below high-tide level and the sea has to be shut out by sluices. Thus Denver sluice controls the outflow from the Ouse, Wilmer Lake sluice from the wash* and the sluice at Salter's Lode from the old Bedford river. It follows that during periods of spring tides, heavy rain is troublesome, for if the sluices are closed say 6 hours a day the time for releasing flood water is reduced to $\frac{3}{4}$ of the normal and flood water has to bank up in the watercourses and washes*. The wash* between the new and the old Bedford rivers is 18 miles long by 1,000 yards wide for most of its length (although as little as $\frac{1}{8}$ mile wide in places). This wash* was provided with the intention of using it as pastureland in the summer and as a reservoir for flood water in the winter.

As a result of pumping water out of the fenlands for so many years the peaty soil has consolidated and the general level of the ground has sunk about 18 inches, thus imposing an extra load on the works. Further difficulties are that the River Ouse from Denver sluice to the Wash is liable to scour away its banks if too much water is sent down the channel (were this to occur, serious flooding

FIG. I.



SKETCH MAP OF WATER COURSES.

would ensue), that a bridge at Wiggenhall St. Germans is being repaired with consequent interference to the channel and that the outlet of the Ouse through the Wash is much obstructed by sandbanks.

Legislation.

There has been a large amount of legislation to provide suitable powers to the sundry bodies that control the various rivers and drains. The first Sewers Act was passed in 1833, and in 1847 a Land Drainage Act conferred powers on occupiers of land to enter on their neighbours' property and carry out drainage works if the said neighbours maintained the drains so badly that flooding occurred. In 1861, Commissioners of Sewers were appointed under another Land Drainage Act, and there were further Acts in 1914, 1918 and 1931. The Act of 1931 grouped many of the bodies responsible for draining the area, but there are still a number of organizations with differing or even opposed interests and they have to administer a drainage system which, viewed as an engineering problem, should clearly be dealt with as a whole.

Floods in March, 1937.

It appears that in an attempt to avoid scouring the channel between Denver sluice and the Wash, it has been the practice in recent years to allow water to accumulate in the wash* during the winter as a matter of course—running it off in the spring. As a result of this policy, the full capacity of the wash* has not been available to take any large bulk of flood water, should there be heavy rains. In 1937, heavy rains occurred in February and March with a result that water level in the wash* rose to 16 feet 2 inches above O.D. (14 feet 6 inches above O.D. is ordinarily regarded as the danger mark). At a height of 16 feet 2 inches above O.D. the water is only 18 inches from the top of the barrier bank, and when, as happened on Tuesday, 16th March, there is a strong S.E. wind, waves are beaten up and these erode away the bank. It is considered by competent observers that, had that wind dropped eight or nine hours later than it did, the bank must have been breached and 250,000 acres of land flooded. In fact, for a distance of 200 yards near Colony Grove, the bank was dangerously weakened (see Fig. 3), and the most urgent work was to repair this place. There were many other places, however, where the bank was weakened to a lesser degree.

Royal Engineers' Work.

The intention was to bring barges loaded with clay up the old Bedford river to the site of the damage, and there to fill the cuts in the

bank with clay in sandbags. The difficulty was that between the barrier bank and the old Bedford river there was a towpath some 80 feet wide flooded to a depth of 3 feet. The barges when loaded drew about 4 feet 6 inches. That is where the F.B.E. and kapok came in. The diary of events is substantially as follows :—

Tuesday, 23rd March.

8 p.m. Lt. Nicholson and detachment of 36 O.R's from 7th Field Coy. with 112 feet F.B.E. left Colchester for Ely.

9 p.m. Capt. Cotton with a convoy of S.M.E. lorries carrying 400 feet kapok assault bridging, left Chatham for Ely.

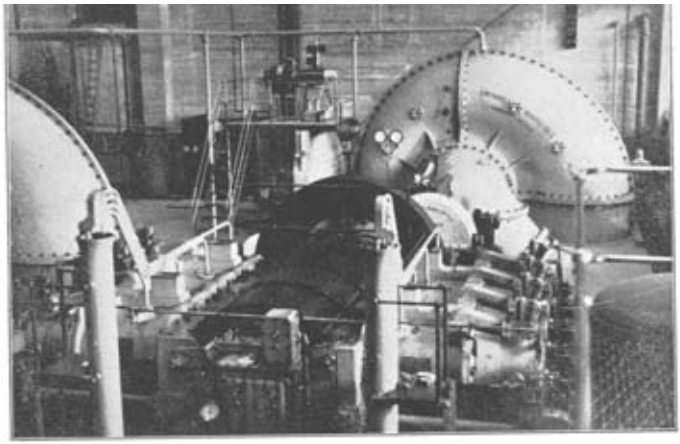
11 p.m. Capt. Heath and Lt. Galloway left Chatham for Ely.

Wednesday, 24th.

Between midnight and 2.45 a.m. all the above-mentioned parties reported at Flood Defence H.Q. at Ely, and were sent on *via* Mepal and the 16-foot drain to Welney. On nearing the final destination, signposts like that in Fig. 4 became frequent. By 5 a.m. all troops were under cover in Welney and there was a short interval for rest and breakfast before the engineer to the Middle Level Commission could be rung up at 8 a.m. He asked for two bridge piers to be constructed as soon as possible. The sites near Colony Grove were to be selected by his staff. Reconnaissance of bridge sites and approaches took until 10 a.m. There was only one approach to the river passable for motor transport near the selected sites. This was a concrete road 10 feet wide and just over a mile in length. At the river end of this road was a farm, where not more than two vehicles at a time could turn. The bridge site was over 1,000 yards upstream of the concrete road. The problem of bringing stores to site was clearly going to be the chief cause of delay. However, Lt. Nicholson and the 7th Coy. detachment (about 20 working numbers) had all the F.B.E. stores unloaded and carried 100 yards to the river by 1 p.m. Deck rafts were constructed, all stores put on board and the rafts were then warped up to the site, where a pier was completed by 4.30 p.m. A barge was moored alongside and was being unloaded within 10 minutes of the completion of the pier. (See Fig. 5.)

Meanwhile the kapok equipment from Chatham was unloaded and built into a pack bridge by a party of 12 recruits from the depot of the Suffolk Regiment, under the instruction of Lt. Galloway. This bridge was completed and towed up to the site by 6 p.m. when information was supplied to the effect that it would not be required until later the following day. It was accordingly moored alongside the bank for the night.

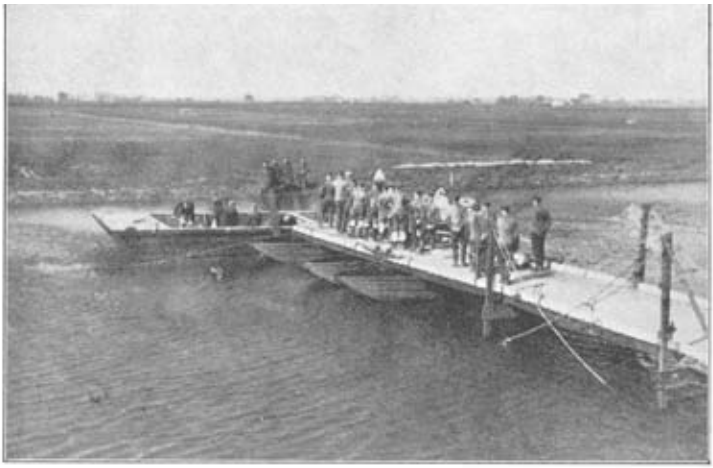
During the day a further 180 feet of kapok arrived from Colchester and about 9 p.m. the 11th Field Coy. from Aldershot, under the command of Major Reed, with 224 feet of F.B.E. and 230 feet of



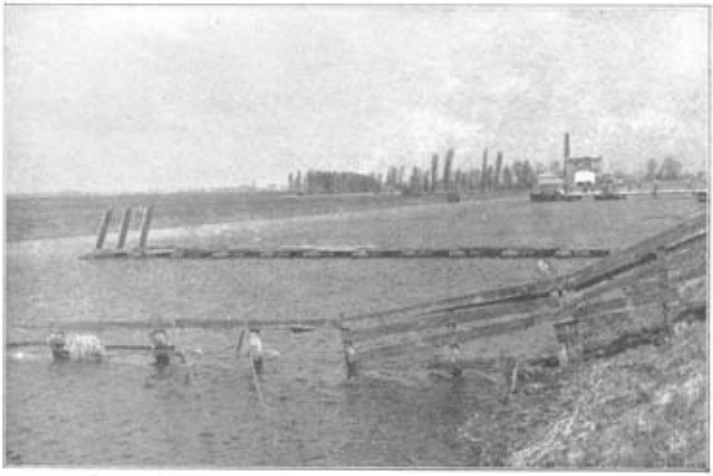
2.—One of three 1000-b.h.p. 8-cyl. Crossley oil engines coupled to Gwynne's 1,200 ton/min. pump installed in the pumping station at Wiggenhall St. Germans.

4.—Floods are presumed to be adjacent.

Floods in Fenland 2&4



5.— Barge unloading at F.B.E. pier near Colony Grove.



6.—Kapok pier near Colony Grove. Colony Grove pumping station in the background.

Floods in Fenland 5 & 6

kapok reached the fen district. The fenland flood area composite field company reached its maximum strength.

Thursday, 25th.

Lt. Galloway with 12 men from 7th Field Coy. completed the kapok bridge at the site selected the day before. At 10 a.m. the bridge was ready for use. We were then informed that it would be more usefully employed somewhere else (!) and it was towed 400 yards upstream and again fixed in position. Even so, it was ready before it was required (see Fig. 6). The remainder of the detachment of 7th Field Coy. spent the day putting finishing touches to both bridges—revetting steps up the barrier bank for use by carrying parties, etc. The afternoon was spent by officers in conference with the civil engineers in charge of the works, followed by reconnaissance of new bridge sites for the next day's work.

Friday, 26th.

Two piers were required at Welches dam, about $4\frac{1}{2}$ miles upstream from Colony Grove, to repair further damage to the barrier bank. Here, a week earlier, in the first rush of the emergency, earth had been cut away from the N.W. side of the bank to fill cavities on the S.E. side—a most unsatisfactory form of repair! Clay brought up in barges was required to make good the N.W. side and there was the same problem of the flooded towpath. In this case the job was easier, for lorries and trailers could be brought up to the river bank within 500 yards of the selected pier site. A detachment of 11th and 7th Field Coys. (28 working numbers) under Lt. Galloway, off-loaded the F.B.E., made up decked rafts, loaded on all stores and warped them upstream to site, where two piers were constructed about 100 yards apart. This was not a nice day for aquatic work—there was a biting north wind and for over an hour the work was hindered by a severe snowstorm. By 4.30 p.m. both piers were ready for use (but were not in fact required before Sunday morning).

Saturday, 27th.

Finishing touches to the piers at Welches Dam were provided. These included planked runways for wheelbarrows as the barrier bank was so slippery as to make it difficult to stand up on it.

Sunday, 28th.

On this day occurred the worst of the high spring tides, which necessitated the sluices being closed. There had been little more rain and it became clear that the emergency was over. The thoughts of those in command turned on dismantling and homeward journeys.

Monday, 29th.

Both piers at Welches Dam were dismantled and loaded. Men not employed on this work spent the day revetting the sandbag

filling that had been put into the barrier bank between Colony Grove and Welney.

Tuesday, 30th.

The Colony Grove piers were dismantled and loaded. (The kapok bridge was still in use up to 10.30 a.m.) It may be remarked that as soon as the R.E. equipment was removed improvised piers were constructed by civilian labour—large punts and timber scanthings being the basis of the work.

Wednesday, 31st.

All detachments and stores were dispatched to their normal stations and by midday all R.E. troops were out of the area. A final inspection of the work at Colony Grove showed that the whole of the 200 yards which had been weakened was filled with clay in sandbags well packed and revetted, and although a great deal of repair work remained to be done it was not of that immediate character which would justify the use of military personnel. It is satisfactory to add that the waters had now subsided to such an extent that the writer was able to drive his car across Welney wash on his way home. The level was now 9 feet 10 inches above O.D. compared with 13 feet a week earlier. The water came up to the floorboards but no farther!

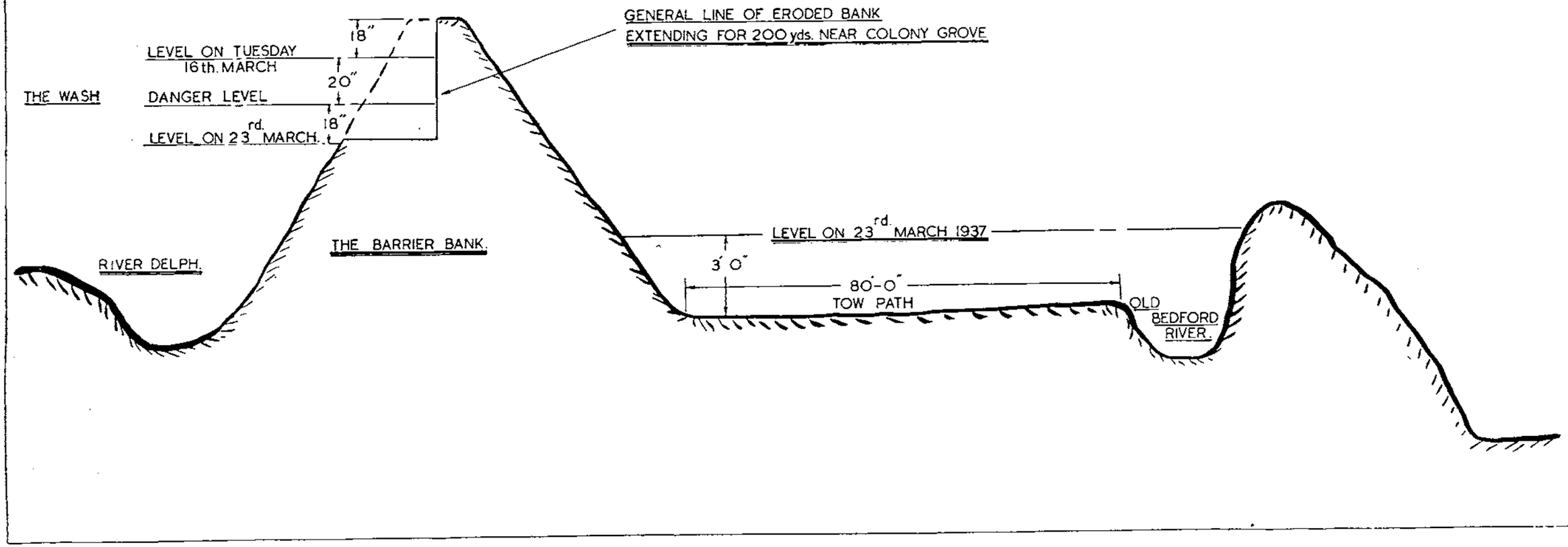
The lessons to be drawn from this expedition into civil engineering are not new. That the delay which bad approaches may impose on rapid bridging is great; that a large amount of Q. and A. work is required to maintain even small detachments is no doubt generally known, but these facts were emphasized to all who had first-hand experience of them in fenland. It is perhaps worth while to note that the kapok pier was left in the river for 6½ days and, although by no means as good as it had been, it was still surprisingly buoyant at the end of that time. The gloomy prognostication that, as it was training kapok, it would only float for 48 hours was completely falsified.

In conclusion it must be recorded (1) that this interesting excursion would not have been nearly so pleasant if it had not been for the forethought, helpfulness and efficiency of Captain MacBarnet, R.A., who, in his capacity of Staff Captain Flood Defences at Ely, seemed to have everything the troops could require ready before it was asked for and (2) that it was a real pleasure to work with and for the engineering staff of the Ouse Catchment Board and the Middle Level Commission.

FIG. 3.

SKETCH ILLUSTRATING FLOOD LEVELS 16TH.–23RD. MARCH. 1937.

NOT TO SCALE.



THE SEVEN-LENS AERIAL CAMERA.

By LIEUTENANT E. H. THOMPSON, R.E.

AN apology is due to readers for the length of the preamble to this paper. The writer felt, however, that, without such an introduction, the value of the seven-lens camera could not be fully appreciated.

When vertical survey photographs are used for supplying the planimetry* for a map, they are used in two distinct ways. First, they are used to provide graphical traverses which are extensions of the trigonometrical ground control, and secondly they are used for the more obvious purpose of filling in the detail. The former use would be unnecessary if the control were so dense that a fixed point appeared on every photograph, but evidently the fixing of such a control would be economically impracticable in peace and impossible in war. Fortunately the photographs may be used, to a high degree of accuracy, as records of horizontal angles measured from their centres to points of detail appearing on them, and, if the exposures are made so that each picture overlaps the preceding one by 60%, a traverse, known as a minor control plot,† can be constructed. These plots are made of every strip of photographs in the survey and link the photographs together. The plots are then adjusted to the ground control, after which the exact position (E. and O.E.) of the centre of every photograph is known. This technique forms the basis of what has come to be known as the Arundel method.

The ease with which the photographs can be used for filling in the detail depends upon two factors: the scale of the map in relation to that of the photographs, and the hilliness of the ground. In the majority of cases the latter does not influence the plotting seriously, but, of course, heights of features do introduce distortions which must be eliminated. Shortly, the process consists in fixing accurately, by graphical intersection, the positions of three points of detail and then tracing off the features lying inside this triangle. The size of the triangle depends entirely upon the flatness of the ground—the flatter the ground, the larger the triangle. But this simple method can only be successful if the photographic scale is somewhere near the map scale, otherwise tracing between the fixed points becomes very difficult.

* The detail as opposed to the contours.

† See the Professional Paper No. 8 of the Air Survey Committee, obtainable from H.M. Stationery Office.

Bearing these points in mind, it will be seen that the photographs must fulfil two requirements. They must cover as large an area as possible at each exposure and they must have a scale somewhere near that at which mapping is being carried out. The former requirement reduces to a minimum the number of photographs whose positions have to be fixed by the minor control plotting and the latter ensures that detail drawing is carried out economically. There is a limit to the area that can be covered by a single picture at a given scale, since the size of print should be between 9 inches by 9 inches and 7 inches by 7 inches for ease of handling.

The standard camera in use in the Service at the moment is known as the "F.24." The size of pictures taken with it is 5 inches by 5 inches and it is provided with an electric film-winding mechanism, which enables exposures to be made automatically at any specified time interval. When fitted up for vertical survey photography it is usually provided with a lens of 5 inches focal length. For other purposes there are several longer focal length lenses but they do not interest us here. Fig. 1 shows that this camera covers, at each exposure, a square whose sides are equal in length to the height of the aircraft above the ground.

Suppose we consider an aircraft flying 12,000 feet above ground level—an economic height suitable for survey work. The scale of the picture will be 5/(12,000 × 12 or 1/28,800), as can be seen from Fig. 1, by putting H = 12,000 feet and considering similar triangles. The 5-inch by 5-inch negative is too small for plotting purposes and the surveyor is supplied with an enlargement 7 inches by 7 inches in preference to a contact print. The enlarged scale is thus 1/20,600, and for mapping at scales between 1/20,000 and 1/25,000 this is very suitable and fulfils the three requirements mentioned above: it is the right size, it is at the right scale and it therefore covers nearly as much country as is conveniently possible.

For military purposes in comparatively well-mapped country, this camera undoubtedly provides the required photographs; that is to say, photographs suitable for making the artillery map. For the production of tactical and strategic maps in undeveloped country, it is not particularly well adapted. Such maps would be on scales of 1 inch to 1 mile or smaller, and we will take the 1-inch scale as a basis for discussion.

The photograph at a scale of 1/28,800 could be used for 1-inch to 1-mile mapping if reductions were provided. The resulting print would, however, be only about $2\frac{1}{4}$ inches square, and would thus certainly not fulfil the requirement of covering as large an area as possible consistent with its size being between 7 inches by 7 inches and 9 inches by 9 inches.

The only way of overcoming the difficulty with the F.24 camera would be to fly at 37,000 feet above the ground when the scale of the

7-inch by 7-inch enlargement becomes about 1/63,360. Such a procedure would, however, be quite impracticable economically and on account of weather conditions.

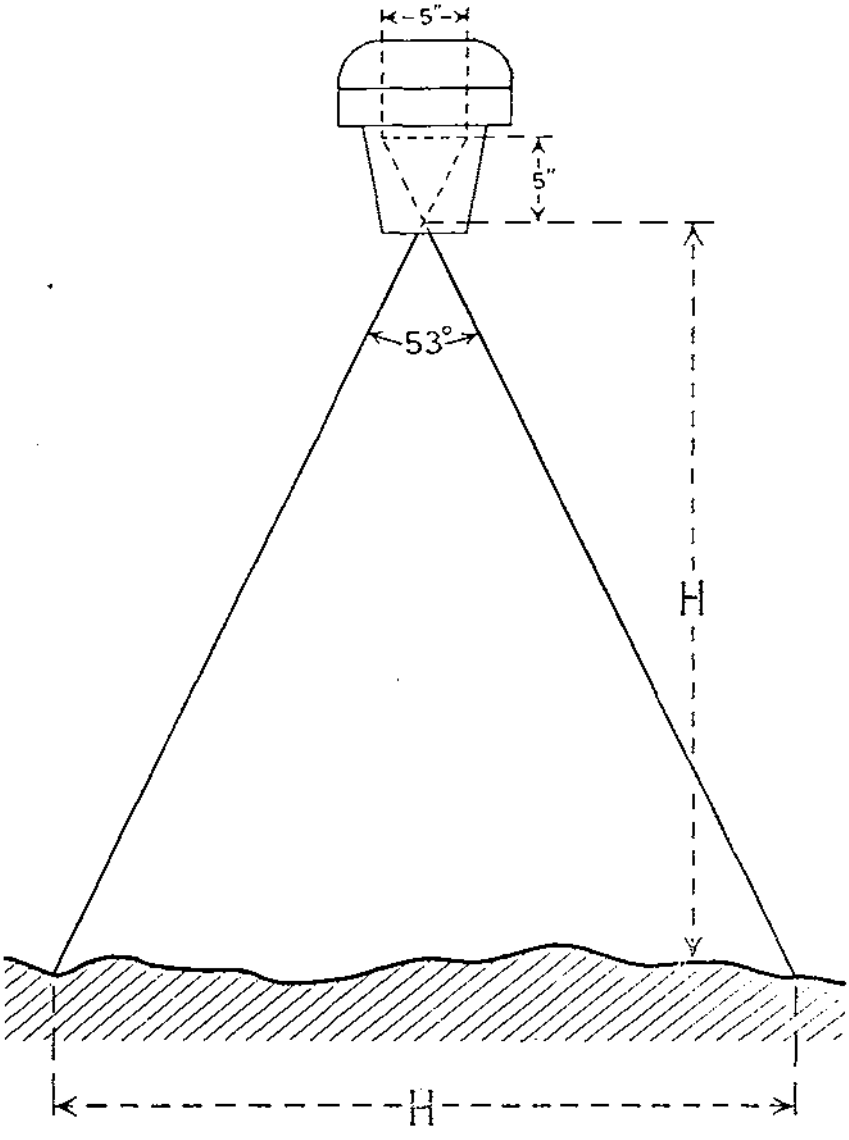


FIG. 1

Hypothetically, the requirements could be met by fitting a camera with a lens of 1·7 inches focal length, capable of covering the 5-inch by 5-inch negative. If the flying is now done from 12,000 feet the

7-inch by 7-inch enlargement will be at the correct scale. Fig. 2 shows the conditions and it should be self-explanatory. The reason why such a suggestion is only hypothetical will be seen in the following paragraph.

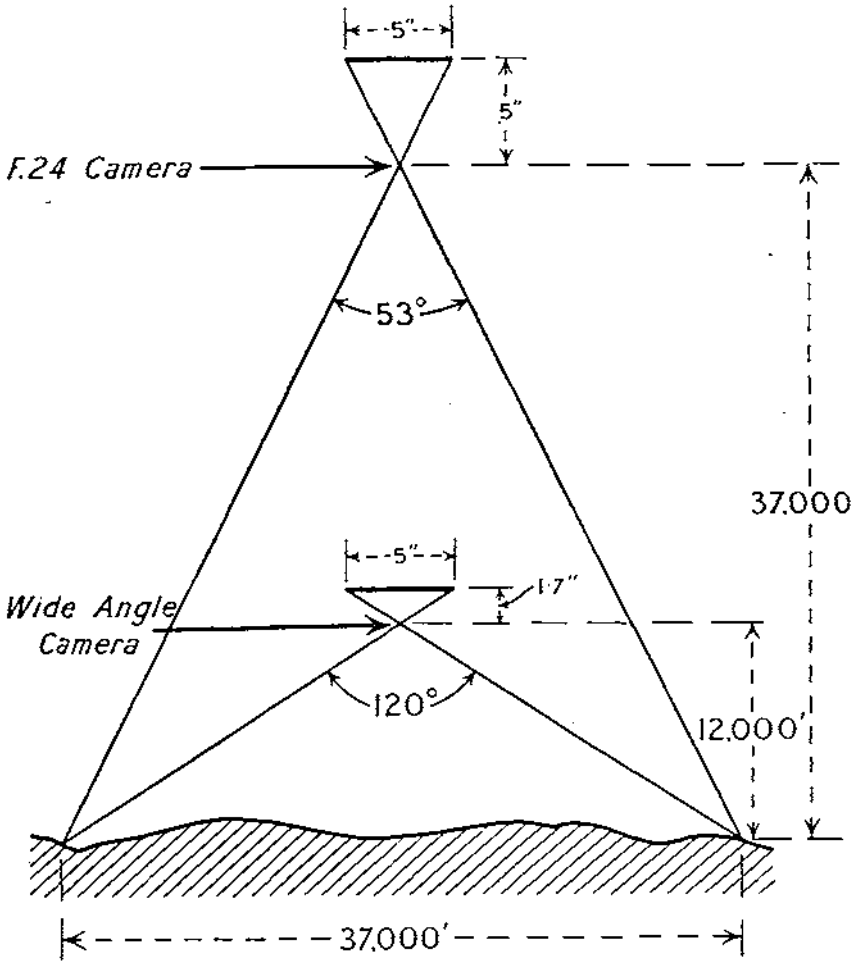


FIG. 2

THE COMPOSITE CAMERA.

The lens used in the F.24 camera for survey purposes is the Ross "Xpres E.M.I." lens. This lens has an aperture of F/4 and covers an angle of 70° without distortion, without loss of light in the corners of the picture and with a very high standard of definition. Any reader who has taken more than a passing interest in photography will realize that this is a remarkable performance.

The angle of 70° is the angle subtended by the diagonal of the 5-inch by 5-inch plate at the lens, which is 5 inches distant from the plate. It is more convenient to consider the angle subtended by the "flat" of the picture, that is to say the angle subtended by the 5-inch side at the lens. This is the angle, 53°, which is indicated in Fig. 2. A simple calculation will show that, in order to cover the 5-inch by 5-inch plate, the 1·7-inch lens must have a working angle of approximately 120° across the flats.

Lenses are improving and there is every possibility of a new Ross lens, covering 75° across the flats (95° across the diagonal), developing beyond the experimental stage in the near future; but it is a far

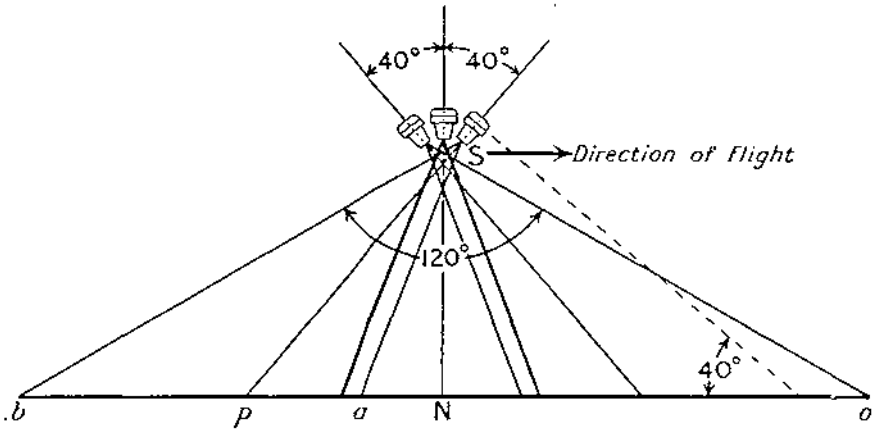


FIG. 3

cry from 75° to 120° and the difficulties of design by no means increase only in proportion to the angle covered. It is safe to predict that any considerable increase over 90° will not be obtained in the near future. One must remember that mere covering power is not everything. There must be very good illumination up to the edge of the picture and the wider the angle the more important this is and the more difficult to attain. For example, the ray to the corner of the 120° picture has to penetrate a column of air of a length equal to 2·6 times the height of the aircraft. This causes a loss of light which must not be aggravated by still further loss in the lens.

A more practical way of covering the wide angle is to mount several cameras together in the aircraft. A typical arrangement is shown in Fig. 3. Each camera is supposed to cover 40° and by deflecting the outer cameras through this angle a total of 120° can be covered. It is inevitable that a small area should be common to the inner and outer cameras, due to the displacement of the lenses, but it is only a matter of a few inches and it is evidently

negligible compared with the area covered. This overlap only appears large in Fig. 3, because the aircraft height must be shown out of scale from the cameras. It is usual, moreover, to deflect the outer cameras slightly less than the 40° so as to be certain that no gap will occur between adjacent pictures. The three shutters are released simultaneously and thus, from each position of the aircraft, are obtained one vertical* and two oblique negatives.

If the three pictures are separately used for plotting, the simple Arundel method must be abandoned and a more complicated and slower process of mapping substituted. The advantage of the wide angle is thus lost and straightforward, oblique mapping may as well be substituted. Fortunately by a simple process, known as *rectification*, the obliques can be transformed to the plane of the central camera and then joined up with the central picture to form one composite vertical covering 120°.

Rectification is a somewhat complicated subject and there are works without number in which it has been discussed very fully.† Here we must content ourselves with a short, non-mathematical description. It should be realized that the difference between obliques and verticals is simply one of perspective; that is to say, the detail appearing on a vertical also appears on an oblique taken from the same position; it is only the relative positions of points of detail which differ. This may appear obvious but it has been the cause of much misunderstanding, a common question being: on an oblique one sees the sides of houses, how then can an oblique be transformed into a vertical? The answer is that on a vertical, one also sees the sides of houses which are out towards the edges of the photographs but that, with the comparatively narrow angle photographs to which we are accustomed, this effect passes unnoticed.

A positive is usually made from a negative by placing the printing paper face to face with the film. It can also be made in an ordinary dark-room enlarger, and the positive will be at the same scale as the negative if the lens is mid-way between the positive and negative. Perspectively the condition which must be fulfilled is simply that the negative and positive planes must be parallel to each other.

Consider the right-hand camera of Fig. 3. Images of the points a, b and p will appear at the edges and centre, respectively, of the negative. Now suppose (Fig. 4) this negative placed on a plane OA′ at a distance f from a lens L, where f is the focal length of the three air cameras. A plane OA is inclined at an angle of 40° to OA′ and is in such a position that Ln is also equal to f. It can be shown that, if the lens is of a suitable focal length, and if its axis is normal to

* Throughout this article *vertical* is used simply as a comparative term and is not intended to indicate the direction of the plumb-bob. In general, the central camera would not be truly vertical owing to tilts of the aircraft.

† *E.g.*, *Surveying from Air Photographs*, by Captain M. Hotine, R.E.

OL, then the negative, a' p' b', may be projected upon OA perfectly in focus. If the central camera had been provided with a lens capable of including a, p and b their images would have appeared on a plane which was an extension of the central negative and therefore parallel to OA. In order to make a positive from this negative it would evidently have to be placed on the plane O″A″ distant f from L. If the points a, p and b appear on this negative at a'', p'' and b'' then it should be clear that La'', Lp'' and Lb'' must pass through a', p' and b' respectively. Thus the oblique negative projects into the same positive (*i.e.*, a, p, b on OA) as does the hypothetical vertical negative. A vertical picture can thus be made from the oblique.

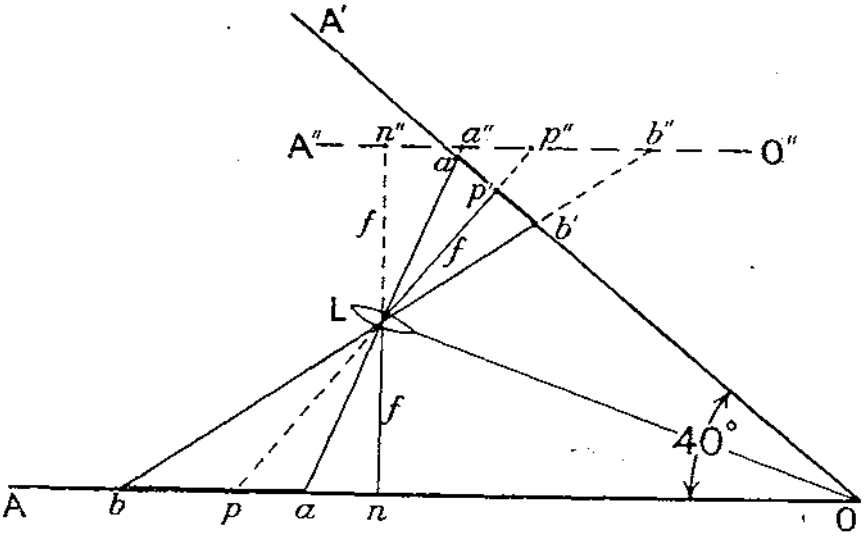


FIG. 4

This is only a description; a rigorous proof is fairly simple with the aid of similar triangles.

Before we leave the question of rectification one point must be mentioned. In the above explanation the planes OA and OA′ are shown inclined to each other at the angle between the two cameras. That such a condition is *sufficient* for correct rectification should be evident, but it can be shown that the condition is not *necessary* and that the two planes may be inclined to each other at any angle. The lens must, of course, be of a focal length depending on this angle and it must be placed in a certain calculable position also depending on the angle. This point will be raised again when the seven-lens camera is described. Further, by making Ln a suitable length we may give the rectified image any enlargement, as in the dark-room enlarger.

This description should be quite sufficient to show how photographs taken with the oblique cameras may be rectified to the plane of the central camera. The pictures can then be stuck together to form a composite vertical. This picture will be a rough oblong, but by providing six oblique cameras it would be possible to build up an approximate square.

The multiple camera arrangement does solve the problem but it is subject to various disadvantages. These are :

(i) It is expensive, heavy and bulky, since seven separate cameras are required.
(ii) The maintenance of the seven mechanisms is difficult.
(iii) It requires a heavy, rigid base to keep all the cameras pointing in their correct relative directions. (This is important, as correct rectification depends upon an exact knowledge of the angles between the camera axes.)

It was with the object of avoiding these disadvantages that the seven-lens camera, now at last to be described, was evolved.

DESCRIPTION OF THE SEVEN-LENS CAMERA AND RECTIFIER.

Fig. 5 shows a highly simplified section through the centre of the seven-lens camera. The central lens points vertically downwards and corresponds exactly to the central camera of the composite unit of the previous paragraph.

Six outer lenses, of which two are seen in the diagram, are placed with their centres at the corners of a regular hexagon and their axes parallel to that of the centre lens. Below each outer lens is a prism which deflects the rays in the manner indicated and, in effect, turns the lens into an oblique camera. The two reflections are introduced for several reasons—one being the fact that the rays remain deflected through a fixed angle depending upon the angle between the prism faces, and this angle is not affected by small changes in orientation of the prism. The adjustment of the apparatus is thus likely to be more stable than with single reflections. A common use of this principle is in the sextant. The focal plane of this virtual oblique camera is evidently parallel to that of the centre lens and one film can be used for both. This applies to all six lenses and thus, for the seven separate film magazines of the composite camera, one has been substituted. A single "roller blind" (focal plane) shutter only is necessary.

Plate I is a contact (unrectified) print taken from a negative. The fact that the outside pictures are obliques can easily be seen if one looks at each in a direction radially from the centre. The irregular shapes are so fashioned that, after rectification, the resultant

composite vertical shall be a perfect square with all the gaps exactly closed.

Plate II shows a general view of a camera with its lenses pointing upwards. The circular glass plate on the front carries a yellow filter which is essential for all photographic work from the air.

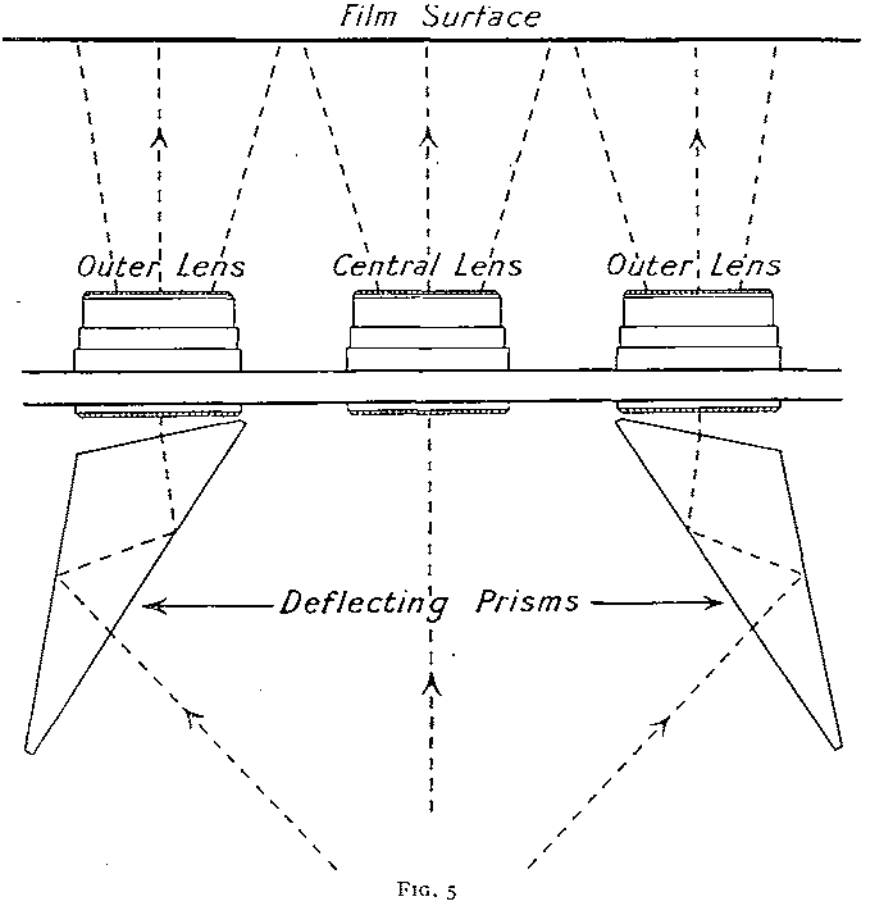


FIG. 5

Behind the filter can be seen three of the deflecting prisms and, reflected in the centre one, an image of a lens shows quite clearly. The camera is dissected into its component parts in Plate III.

On the right at A is the main body with the film magazine removed, the latter being seen at B on the left. The mask which divides the seven pictures and which makes the pattern of Plate I can be seen. It performs two further purposes: its top surface is flat and serves as a pressure plate for the film*, and it prevents

* The photograph only records information accurately if it is truly flat at the instant of exposure. Single-lens cameras are provided with glass plates, known as pressure plates, against which the film is pressed during each exposure. The pressure is provided by a pad at the back of the film and the pad is raised automatically to allow the film to be wound on for the next exposure.

stray light travelling from one lens system to another. At C is the lens and prism unit. Each lens is covered by a top-hat with a hole in it; this also prevents light straying—one of the hats is removed and the lens can be seen. The yellow filter in its mount is at D.

The prisms in the camera turn all the rays through 45° and thus the oblique pictures correspond exactly to those taken by a camera, inclined at this angle to the central camera. If the simple rectification scheme of Fig. 4 is used, then the planes must be inclined to each other at 45°. We have seen that it is not necessary to use this angle and for various reasons there are advantages in changing it. It is desirable, for example, to have the lens working under the most favourable conditions, and those readers with an optical knowledge will appreciate that the rectifying lens in Fig. 4 is working under very exacting conditions.* As usual in such problems several conflicting requirements have to be fulfilled, and it was found that a good compromise would be obtained if the negative and positive planes were inclined to each other at 90°.

Fig. 6 is a diagrammatic section of the rectifier and shows the central lens and two of the six outer lenses and prisms. It will be seen that the central lens makes a positive picture from the central negative without rectification but with a slight enlargement of about 1¼. The negative and positive planes are parallel and the angle of 90° is introduced optically by means of the prisms—this is explained, it is hoped clearly, by the dotted lines. The introduction of the prisms gives a symmetry about the centre which enables all the six negatives to be rectified simultaneously. Such a procedure would be clearly impossible in the simplified apparatus of Fig. 4.

The rectified positive, printed from the negative which made Plate I, is shown on Plate IV. Each component has been outlined in black—normally the joins between pictures are visible but not so clearly. By comparison between the shapes of the pictures on the unrectified and rectified prints, the deformation which takes place during rectification can be appreciated. The picture on Plate I is at approximately its natural scale but the rectified print has, for reasons of printing, been reduced; its true dimensions being 9 inches by 9 inches. The print shows a view of practically the whole of Aldershot taken from 1,800 feet, but the small scale makes it difficult to pick out features. The R.E. Mess is marked with an arrow and the Officers' Club can also be seen. The square shows the area covered by the F.24 camera from the same height.

* A photographic lens is usually designed for efficient working between a fixed pair of conjugate planes. Here the lens has to work over a very large range of conjugate planes.

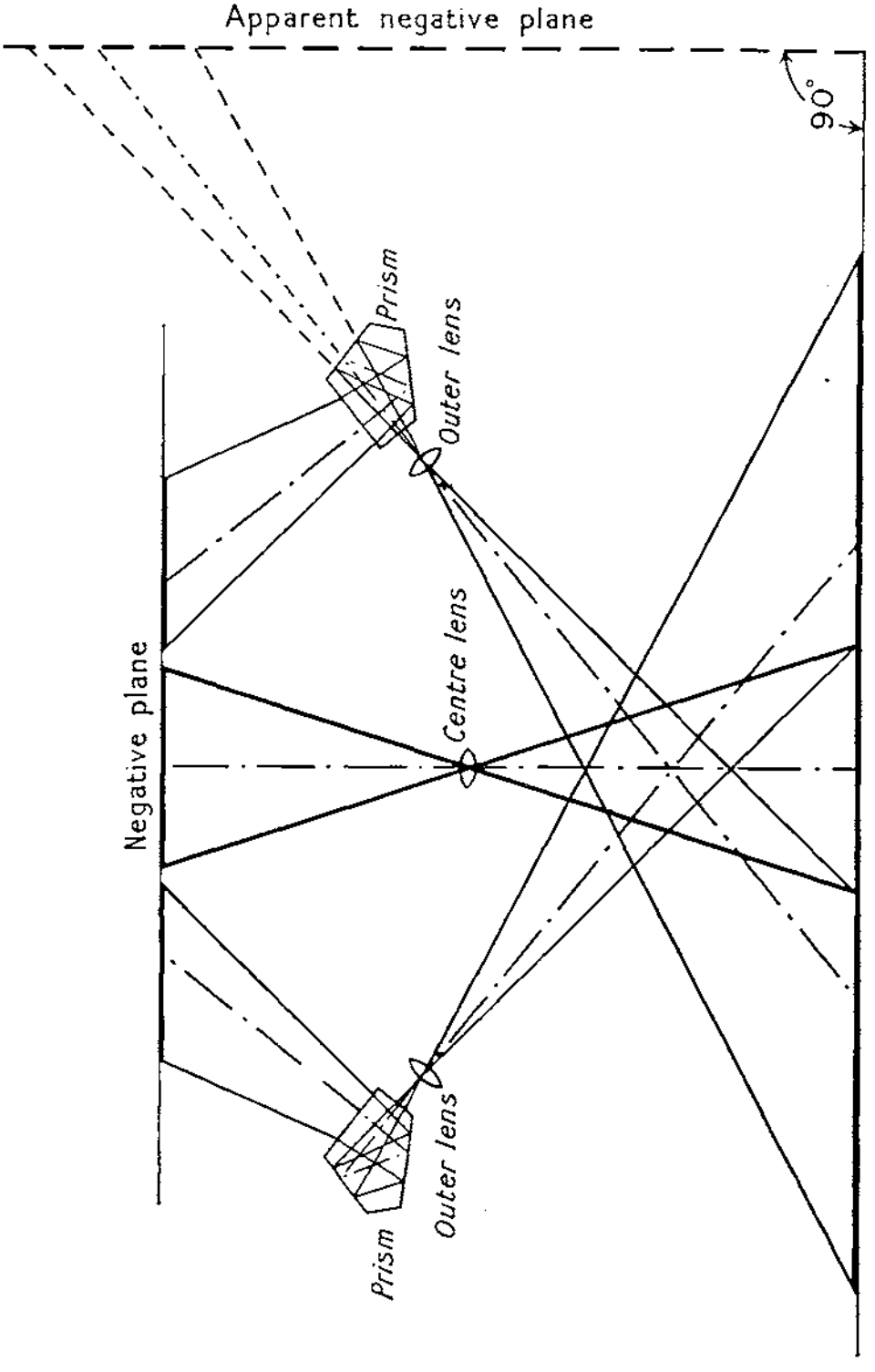

Apparent negative plane
90°
Prism
Outer lens
Centre lens
Negative plane
Positive plane
Outer lens
Prism

FIG. 6

General views of the rectifier can be seen in Plates V and VI. The negatives are not cut up after development but the roll is carried on two bobbins which enable each negative to be brought in turn into position on the negative plane. Exact positioning is made possible by adjusting screws on the axles of the bobbins. The film is kept flat by a glass plate on which rests the illumination unit, consisting of a lamp, diffusing screen and water filter for cooling. Since no glass plate can cover the positive without introducing geometrical and optical complications, the printing paper is held flat by suction. The holes through which the vacuum is applied can be seen in Plate VI.

A TEST OF THE CAMERA AND RECTIFIER.

As a first test of the camera and rectifier, strips of photographs were taken from about 12,000 feet over Salisbury Plain. The rectified prints were at a scale of about 1/60,000 and it was decided to map at a scale of 1 inch to 1 mile (1/63,360) in the style of the Ordnance Survey 1-inch Series. The strip chosen for plotting was about 12 miles long and 8 miles wide and contained five prints. It is instructive to note that, to cover this area with the F.24 camera from the same height, a theoretical minimum of about 60 prints would be required.

As control for the detail, two trig. points were used. It should be noted that the use of only two points gives an overall scale and orientation, but that the shape of the strip depends entirely upon the accuracy of the photographs themselves. There is considerable difficulty in finding the errors of a plotted map by simply laying a tracing from a standard survey over the plot. The only satisfactory method is to choose a fair number of points of detail at random, well spaced over the area, and to compare the co-ordinates of these points as measured from the plot with their co-ordinates as obtained from a map of considerably larger scale.

In this case some fifty points were chosen and carefully identified on the 1/25,000 sheets from which their true co-ordinates were scaled. The average errors of all the points were 47 metres in northing and 43 metres in easting. In view of the limited control, these figures are encouragingly small. As a matter of interest the co-ordinates of these same points were taken from the Ordnance Survey 1-inch Sheet. The average errors, as compared with the 1/25,000 figures were 23 metres in northing and easting. Thus, with a small amount of control, the air photo survey was only worse by amounts which, on the plot, corresponded to 0·3 millimetres.

Similar tests were made on the other four strips of the survey and with comparable results; showing that this accuracy should be

THE SEVEN-LENS AERIAL CAMERA.

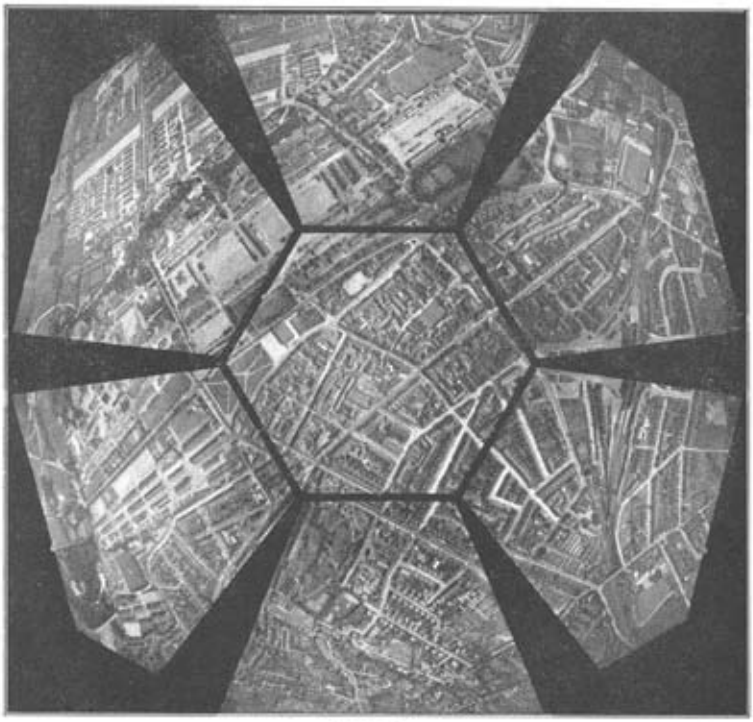


PLATE I.

The seven lens aerial camera Plate I

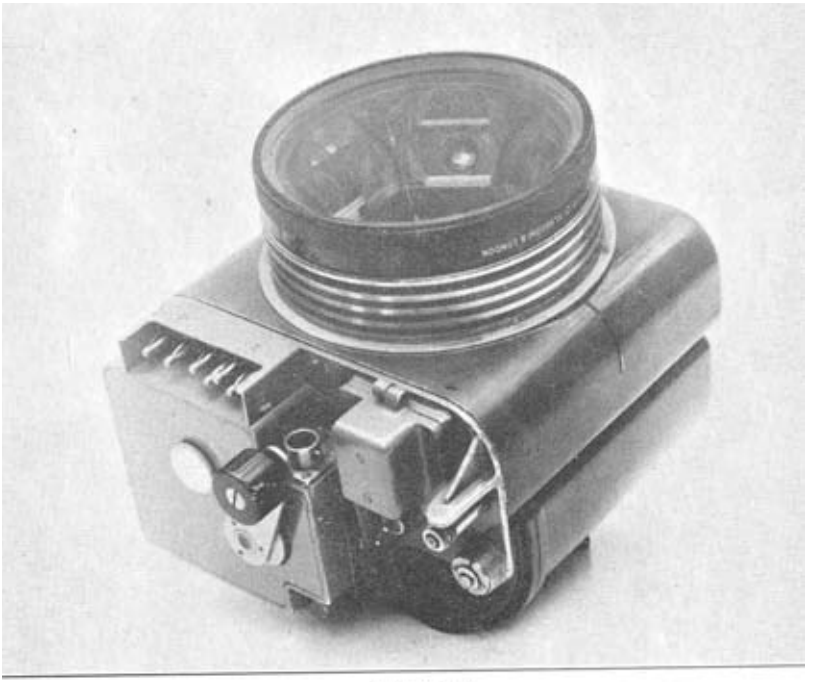


PLATE II.

The seven lens aerial camera Plate 11 & 111

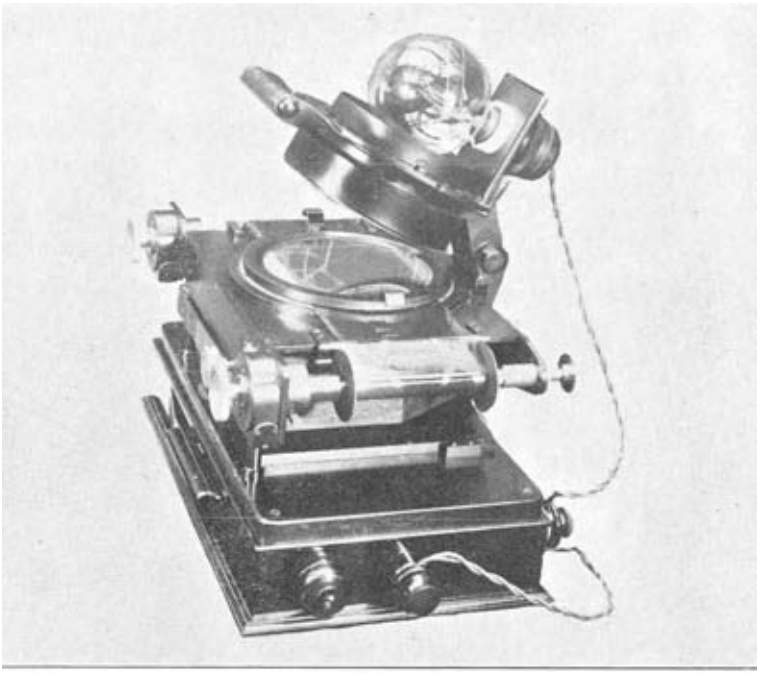


PLATE V.

The seven lens aerial camera Plate V

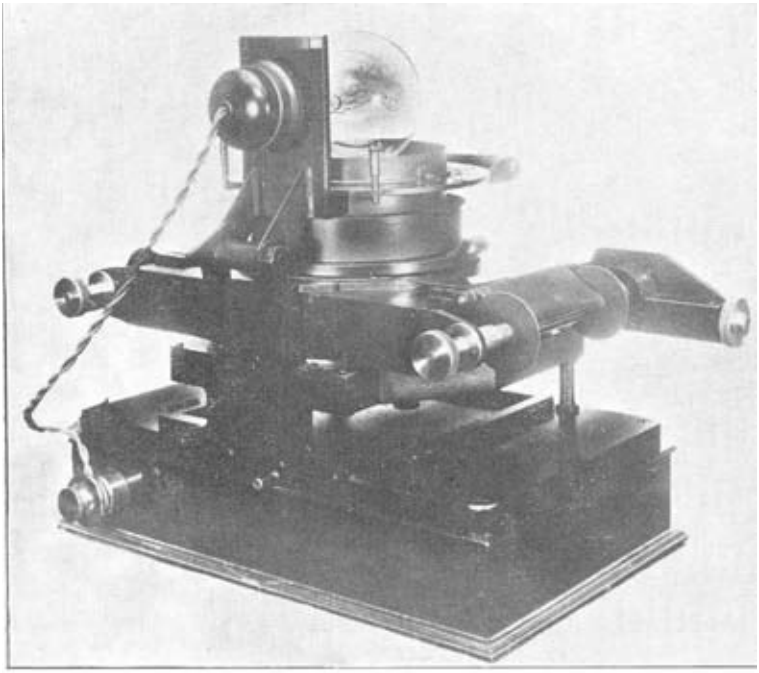


PLATE VI.

The seven lens aerial camera Plate Vi

obtained in most cases. These strips were not, however, used for complete plotting of detail.

It has, unfortunately, not been practicable to print the map with this article, but it is hoped that it will be found possible to issue some copies to the Southern Command. Comparison between this map and the corresponding 1-inch Ordinance Survey sheets will show certain mistakes in interpretation. One particularly bad error was made: a main road was shown as a track in places and was completely omitted in others. Careful examination of the photographs, after this fault was discovered, failed to produce any reason why it should still not be shown as a track. A trick of light had completely obliterated the road from the photograph. The faults show that the seven-lens pictures might be troublesome for mapping in country in which there were many artificial features—the scale of the pictures is too small. Since, however, it was for comparatively undeveloped country that the camera was produced, this cannot be considered a serious drawback.

In order to contour from photographs by the method now standard in the Army, six spot heights must be fixed on every overlap. An overlap is the area of ground common to two successive pictures. If the F.24 camera is used from 12,000 feet, this means the fixing of one point in less than one square mile, but with the seven-lens camera only one point every five square miles is required.

With this amount of control the whole strip was contoured and, to check the accuracy of the work, 16 points of known height were heighted from the photographs. The average error on the 16 points was only 26 feet.

The relief effect, obtained from aerial photographs when examined in a stereoscope, depends, other things being equal, upon the length of the air base, *i.e.*, the distance the aircraft moves between taking two successive photographs. If every point in the area is to appear on two photographs (in order to obtain relief effect), it is clear that pictures must overlap by not less than 50%, and thus a very simple sketch will show the reader that a long air base can only be obtained with a wide angle photograph. For example, at 12,000 feet the base, when the flying is done with the F.24 camera, must be shorter than 6,000 feet. With the seven-lens camera it can be as long as 20,000 feet. The effect of relief is thus considerably enhanced and this increase of air base more than counteracts the smallness of scale which is about half that obtained with the single lens camera. A striking example of this is the way in which the rise and fall of railway tracks can be appreciated.

Conclusion.

The first tests with the seven-lens camera show that it is a practical instrument capable of taking photographs suitable for

mapping at scales of 1 inch to 1 mile or smaller. The accuracy attainable in developed countries should be adequate, but at first sight it appears that errors of interpretation will occur. In undeveloped countries it should be an economical way of producing good maps with limited control.

To enable the reader to obtain an idea of the great saving in photography and flying, the following table gives a comparison with the F.24 camera. The photographs are supposed taken from 15,000 feet—

ITEM.	F.24 CAMERA.	SEVEN-LENS CAMERA
Side of Square Picture	2·9 miles	9·8 miles
Area of Square Picture	8·4 sq. miles	96 sq. miles
No. of Pictures required per 10,000 sq. miles	4,100	320
Flying per 10,000 sq. miles	4,600 miles	1,400 miles

The author of this article must disclaim any credit for the success of the camera. The idea was developed in detail from a German Nine-Lens Camera by J. S. A. Salt, who has since left the Corps. The practical realization of the instrument reflects great credit upon Messrs. Barr and Stroud of Glasgow, who have expended so much time and trouble upon the problem. Many of the difficult optical and photographic problems which have cropped up from time to time have been ably solved by L. B. Booth and H. B. Stringer, both of the Royal Aircraft Establishment at Farnborough. It is to the Photographic Department there that we are indebted for the first photographs taken in the air and used for plotting.

The camera will shortly be sent out East for use on a Survey Project, upon the results of which will be based the future policy concerning the apparatus.

PLATE IV.

The seven lens aerial camera Plate IV

THE SCIENTIFIC METHOD OF REASONING.

By CAPTAIN A. S. WILSON, *Australian Staff Corps.*

UNDER modern conditions of soldiering the ability of all ranks to think correctly is a quality as necessary as physical fitness and a knowledge of the " rules of the game." The application of science and industry to war has introduced so many problems that it is impossible to frame sets of rules to define all the actions of even the most subordinate commanders, and more and more reliance is placed on the assumption that junior leaders will do the right thing at the right time.

An essential part of a military education, therefore, is instruction in the art of correct thinking.

Any endeavour to train ourselves consistently to think correctly is difficult, for the reason that, as a rule, we are convinced that we already possess a full share of this quality, and that our occasional mistakes are due to some accidental cause. This explanation does not, however, dismiss the fact that some people consistently think more accurately and quickly than others.

From time to time professors, scientists and philosophers bitterly attack the loose thinking of their time, and urge the adoption of the " Scientific Method " of reasoning. This method, the wise men say, has given to science the position of authority in its own right which it enjoys at present, and they claim that the method can be applied with equal success to any problem or situation which involves thought or reasoning. If this is so, the method should be included among the working tools of the Service, for, as already shown, the ability to reason correctly is now an integral part of our equipment for war. In peace, it is probably the most important part of our preparation and training, for in peace our ideas cannot be tested except by a theoretical analysis of their probable results.

What then is this so-called scientific method of reasoning; does it require a scientific education as a background; does it give an automatic solution like a penny-in-the-slot machine, or is it another of those attractive syllogistic forms which will prove as barren as its predecessors?

The form of the method will be easily understood with the aid of the following example. In the seventeenth century, Galileo established the nature of planetary motion by proving that the planets revolved about the sun as centre. His method of

investigation may be divided into the following four well-defined steps, which constitute the scientific method, in its simplest form :—

(1) *Observation of a number of facts relating to the problem and their summation into a generalization of a descriptive character—*

For Galileo the known facts were the apparent (*i.e.*, visible) motion of the planets, and the descriptive generalization (already established by Kepler) was that each planet moved on a constant elliptical orbit.

(2) *The formation of an hypothesis, suggested by the empirical generalization above—*

Galileo's hypothesis was that the planets revolved about the sun as centre, and not about the earth, as was generally believed.

(3) *A deductive step in which the investigator infers the consequences that follow from the hypothesis when entertained as true—*

Galileo's deductive inference was that if the planets revolved about the sun, then a planet, the orbit of which lies between the sun and the earth, will show phases—as the moon does.

(4) *The fourth and crucial step is the testing of these deduced consequences by comparing them with the results of a careful analysis of the observed facts. Thus the truth or falsity of the deduction is established, and so of the hypothesis itself. If false, another hypothesis must be formulated and tested—*

In many cases the method becomes one of trial and error, or successive approximations.

Galileo's verification of his hypothesis was delayed until the telescope was invented, but, when it was, Galileo found that Venus actually showed phases. Thus his deductions were substantiated, and so the heliocentric motion was established for Venus and the earth.

This example shows clearly the *form* of the scientific method of reasoning, but it will be seen that the solution depends upon a *clue*, or *right idea*, to indicate the hypothesis. The second essential is to verify the hypothesis by subjecting deductions from it to the test of reality. Outside the scientific field it is often impossible to arrange for a practical test (*e.g.*, a proposed plan of military action cannot be put to a complete practical test before it is accepted), but in such cases the deductions from the hypothesis can be tested by seeing if

they violate any accepted principles, or relevant experience gained elsewhere.*

The first essential of the scientific method of reasoning is the hitting upon the right idea. How can such ideas be obtained?

The ability readily to perceive the right idea, or the keen eye which immediately picks out the correct clue upon which to formulate the hypothesis, is derived from a variety of personal qualities. The most important of these is intuitive knowledge of all matters appertaining to the problem in hand. By intuitive knowledge is meant knowledge which is so mobile and clear in the mind, that every department can be viewed and appreciated alone, and in relation to the whole, as it were at a single glance, and without conscious reasoning. On those occasions when we see a valid solution "in a flash," we have obtained it intuitively, and not by any conscious reasoning at the time. But this ideal is only reached in those subjects which have been first learnt by the ordinary cognitive processes, and then have been so fully digested that the subject matter has become part of one's self. An example of knowledge held intuitively is the ability to write words without a conscious effort as to their spelling, or the formation of the letters.

* The solution of many problems involves some amplification of the four steps given above. For instance:—

"To find the sum of the odd numbers, 1, 3, 5 . . . to n terms, that is, to find the sum of $1 + 3 + 5 + \ldots (2n - 1)$."

A preliminary investigation is necessary to find a promising hypothesis.

Data—For 2 terms; $1 + 3 = 4 = 2^2$

3 ,, $1 + 3 + 5 = 9 = 3^2$

4 ,, $1 + 3 + 5 + 7 = 16 = 4^2$

Hypothesis—A clue is provided by the fact that the sum, in the cases examined, is the square of the number of terms. The selected hypothesis is therefore:

$1 + 3 + 5 + \ldots + (2n - 1) = n^2 \ldots (1)$.

The problem may now be recast as follows:—

"To ascertain if the above equation is true for all positive integers."

1. *Data*—It is evident that the equation is true when $n = 2$, for $1 + 3 = 4 = 2^2$. It is also clearly true when $n = 2 + 1$, or 3.

2. *Hypothesis*—Suppose it is true when $n = k$. That is, suppose

$1 + 3 + 5 + \ldots + (2k - 1) = k^2 \ldots (2)$.

3. *Deduction*—Assuming the hypothesis is true, we can deduce the consequence when the next odd number, *i.e.*, $(2k - 1) + 2$ or $2k + 1$, is added to the series $1 + 3 + 5 + \ldots + (2k - 1)$.

The consequence is

$1 + 3 + 5 + \ldots + (2k - 1) + (2k + 1)$

$= k^2 + (2k + 1) = (k + 1)^2 \ldots (3)$.

4. *Verification*—Now this is exactly what we would get by replacing n by $(k + 1)$ in equation (1). Thus the equation $1 + 3 + 5 + \ldots + (2n - 1) = n^2$ is true for $n = k + 1$, *provided it is true for* $n = k$.

But we know it is true for the particular value 2, hence it is true for $2 + 1$ or 3, hence for $3 + 1$ or 4, and so on for all positive integers.

COGNITIVE PROCESSES.

Knowledge is obtained in the first place by the following processes :

1. By observation.
2. By analysis.
3. By imagination, supposition and idealization.
4. By comparison and analogy.

(1) Observation, accompanied by inference, is the chief means of obtaining knowledge which, if completely grasped and held, enlarges the store of intuitional knowledge. Observation and inference cannot be separated, for everything we observe is interpreted, or its meaning inferred, before classification. If this were not so, different witnesses of the same event would not disagree in their reports.

(2) Analysis consists in breaking down a complex whole into its components, so that these may be critically examined. The elements obtained by analysis may then be synthesized in such a way as to form combinations that have not been previously observed. In this way, general and abstract ideas are reached.

(3) Imagination, supposition, and idealization lead to ideas, the first requirement in solving problems. By idealization is meant the conception of the ideal case.

(4) Comparison and analogy assisted by analysis and synthesis are common aids to knowledge, but they only *suggest* hypothesis.

These four methods are merely cognitive processes and do not necessarily lead to true knowledge. For instance, the correct statement of an observation depends on a correct influence. Similarly, the other cognitive processes depend largely on the ability to draw valid inferences.

INFERENCES.

An inference is the act of reasoning from known facts to their relations, and from these to their consequences, thus reaching knowledge of other facts which have not been observed, and binding the whole into one comprehensive system of knowledge. Inferences can be reached in two ways, by *deduction*, and by *induction*. *Deductive inference* commences with a knowledge of some universal or general relation which covers a whole system, and then proceeds to develop by inference the particular contents of the system. For example :—

(*a*) All modern maps are plottably accurate. This is a modern map. Therefore, it is plottably accurate.

(*b*) To *deduce* the value of x for a particular value of y from the *given* equation, or generalization, $x = 4y$.

$$\begin{aligned} \text{When } y &= 4 \\ x &= 4 \times 4 \\ &= 16. \end{aligned}$$

It will be seen that deduction is a mechanical process, and given the necessary generalization, or general rules, the solution is inevitable. The aim of all investigators is to find generalizations, rules or laws, to embrace the greatest number of particular cases. This provides order and enables standardized systems or methods to be employed. But the majority of facts and particular cases which form the data in everyday life are not already included in any generalizations or explanatory laws, and it becomes our problem to *infer* these explanations. This is induction.

Inductive inference starts with consideration of the facts themselves, and tries to find the general rule describing them. Thus Galileo's hypothesis, that the planets revolved about the sun as centre, is an inductive inference from the known facts at his disposal. All hypotheses are inductive inferences from a set of facts. Herein lies the difficulty of framing an hypothesis, for it involves a mental jump from the available facts, which can only be executed by hitting upon the right scent or idea.* Deduction is clearly the easier process, for, given the generalization or major premise, only one construction, and consequently only one solution, is possible. (The truth of the deduction, of course, is dependent on the truth of the generalization.) It is only in certain branches of mathematics and in technical subjects that deductive inferences play the leading part, for the reason that these subjects are highly developed and contain many accepted generalizations. When breaking new ground, or dealing with a situation differing from those previously encountered, inductive inferences play the leading role, and deductive inferences are made to test the hypothesis. Thus Galileo, in our example, deduced that if his hypothesis were correct, then Venus should show phases.

We have now seen the mechanism of the scientific method, and have indicated that the "right idea" is the spark that energizes the machine, but we have not shown how this spark can be produced at will. It must be admitted at the outset that no formula exists for ideas, for being inductive processes their production is an art and not a science.† They belong more to the province of trial and error, or school of well-informed guessing, than to the logical or syllogistic penny-in-the-slot machines.

It is evident then that those who advocate the employment of the

* See hypotheses in footnote on page 233.

† Certain "Inductive Methods" have been formulated but they are more of the nature of proofs than of methods of discovery.

scientific method should provide us with not only its inanimate form, but with some key to vitalize it. So far as can be ascertained, no writer on the scientific method has indicated how the right idea is obtained, although all admit that it is the crux of the method.

THE RIGHT IDEA.

It is proposed to consider how ideas are conceived. The problem is difficult, but by confining the inquiry to observed facts, some success should result.

In the first place an enumeration will be made of those factors which have been observed to be always associated with the lack of right ideas, and those which are always associated with their presence.

Lack of ideas is associated with :—

(i) Lack of confidence. This prevents exploration beyond the known or given facts.

(ii) Physical disability which causes distraction, prevents abstraction and concentration, and disturbs the judgment.

(iii) Bias, or the obstinate retention of one fixed idea. This acts as a brake on constructive thought and mitigates against holding an open and receptive mind.

(iv) Indecision. This may be due to lack of confidence or physical disability, or to lack of knowledge and experience.

(v) Lack of desire to explore beyond known facts, due perhaps to mental laziness or self-satisfaction.

(vi) Lack of experience in constructive thought, education having consisted of collecting beliefs without subjecting them to critical analysis before acceptance.

(vii) Failure to see that a problem exists in any given situation.

(viii) Failure to state a problem correctly.

(ix) Failure to recognize differences, inconsistencies, likenesses, and analogies.

(x) Inability to deal with abstractions, that is, to separate components and qualities of a thing considered apart from other components or qualities.

(xi) Lack of interest and enthusiasm.

(xii) Failure to draw the full implications from the facts.

(xiii) Unquestioning acceptance of traditional teaching.

(xiv) Lack of precision in defining technical terms used.

The presence of ideas are observed to be associated with :—

(i) An inquiring and critical mind.

(ii) Objective thinking and not mere rationalizing.

(iii) Willingness to change the mind.

(iv) An attitude of expectancy and discovery so that the presence of a problem will not be overlooked.

(v) Perseverance in the search for ideas.
(vi) Confidence obtained from earlier successes.
(vii) Standing away from the problem to get all the factors in clear focus.
(viii) The mixing of study with plenty of practical work so as to test what has been gained in theory.
(ix) Constantly keeping the nature of the problem in view.
(x) When knowledge of the subject is held intuitively in the mind.
(xi) A knowledge of basic principles and subjects allied to the matter in hand.

From this enumeration of the facts relating to the conception of ideas a mental jump is required to provide an explanatory hypothesis. A promising one is that ideas are the result of an education which :—

(1) Trains the mind to hold knowledge intuitively in the mind, and
(2) Provides a means of testing the validity of the ideas conceived.

The second requirement is provided by an education by inference, that is, one which involves finding out and testing, instead of always relying on being told. This gives practice in making inductive and deductive inferences, and early success will stimulate advancement. The first requirement, that is, to hold knowledge intuitively so that ideas flash across the mind, is obtainable by a method of education which has been designed for this purpose.

Before outlining this method of education, the hypothesis that education of some kind is required must be tested for validity, or at least its degree of probability must be ascertained. Now experience shows that ideas are conceived either by conscious reasoning or by an intuitive process. Experience also shows that ideas are not created out of nothing, but result from what has already been absorbed and has become part of the mind. Thus, whether an idea is obtained by reasoning, or is reached intuitively, it is the result of education. (It may be argued by some that certain ideas, such as truth, beauty, etc., are innate in us, but the divergence of opinion on these qualities suggests that they are merely the result of a particular education, or are due to some natural instinct, and so require review before they can be classed as valid knowledge.)

The problem of conceiving ideas thus reduces to finding a suitable system of education. Such a system has been indicated by Descartes,* the French mathematician and philosopher, but his method is not acceptable to modern writers on Method. But strangely enough, the Cartesian Method, as it is called, led Descartes to discover the basis of modern mathematics. The critics prefer

* *Discourses on Method*, Descartes.

the scientific method, but none of them supplies a key to the problem of arriving at the hypothesis.

Now this is actually the chief feature of Descartes' Method. Descartes stressed the necessity for valid inductive reasoning, as opposed to the teaching of his time that only deductions from "Authorities" led the way to discovering knowledge. He relied on "intuition," which he defined as "the undoubting conception of an unclouded and attentive mind, and springs from the light of reason alone." This is, of course, induction supported by deduction, but he so attacked deduction as a primary method that critics have assumed that he would not use it even to test his hypotheses. For instance he says, "I found that, as for logic, its syllogisms and the majority of its precepts are of avail rather in the communication of what are already known, or in speaking without judgment of things of which we are ignorant, than in the investigation of the unknown."

The failure to appreciate the Cartesian Method is immediately clear if we assume that Descartes knew and practised the form of the scientific method, and that in his writings on method he concentrated on the real problem, that is, how the right idea is reached. This assumption is easily justifiable, for after all the form of the scientific method is merely sound common sense and must have been used automatically by him in reaching his mathematical discoveries. The criticisms of the Cartesian Method are also explained by the fact that they have been made by men of letters and not by scientists, and consequently the critics, like their prototypes (the schoolmen of Descartes' time), have been attracted mostly by the form, or logic, of the scientific method, and have failed to see that Descartes supplies the essence of the method.

THE CARTESIAN METHOD.

The Cartesian rules when viewed in the light of the above assumption, may be written as follows:—

(1) Never accept anything as true unless it is clearly known to be so; that is, carefully avoid precipitancy and prejudice, and include nothing in the judgment that is not presented to the mind so clearly and distinctly as to exclude all grounds for doubt. This does not mean that everything must be doubted for the mere sake of scepticism, but that as far as practicable we should verify, once in our lifetime, each of our commonly received beliefs, so as to discover what basis they have in reason and fact.

(2) Divide the subject or problem under consideration into as many simple parts or questions as can be discerned and investigate each. The possibility of understanding or

solving these will generally depend on taking over certain knowledge "on authority" from those who have limited their attention to the science or subject relevant. (It is inadvisable to fall back on such authorities until a serious endeavour has been made to solve the problem by personal exertion, for only by such efforts will the exact type of information required be evident.) In the light of this clearer insight, we shall probably be able to reformulate our initial question more advantageously, remembering that to be able to state a question precisely is often to be half-way towards its solution.

(3) Conduct the thoughts in such order that, by commencing with factors the simplest and easiest to know, we ascend step by step to more complex knowledge, assigning a certain order to every factor. That is to say, consider the problem with a view to discovering the "strategic points" within it, and to grasping the sort of evidence that would be adequate to answer it, without of course assuming that evidence of that sort is necessarily forthcoming.

As each ascending step is reached, verify it by experiment or observation, or by appeal to experience, or accepted principles.

(4) Finally, repeatedly range over the whole subject in thought, speech, or by writing, until the matter can be visualized from any angle or starting-point.

If a breakdown occurs, then the subject is not held intuitively and a fresh start should be made. The work already done will probably enable a clearer statement of the problem to be made, and, as already stated, in most cases to state a question correctly is to have almost solved it.

When these four steps have been completed, the subject should be held intuitively in the mind to an extent dependent on the mental capacity of the student, to the time he had devoted to the method, and to his experience in the subject. Ideas will then be conceived automatically and will pass through the brain continuously whenever a relevant problem or situation is met. The most probable idea will be selected and provide the nucleus for formulating an hypothesis, which will then be developed and tested by the scientific method.

Military Appreciations.

A military appreciation is defined as "a review of the situation based on all available information and culminating in a statement of the measures recommended to meet it." In other words, it is the

determination of a valid solution to any strategical or tactical problem, and so falls within the province of the scientific method.

It is laid down that "Whether appreciations are written or delivered verbally, it is of advantage to follow a logical sequence of ideas as this enables the argument to be formulated and grasped more rapidly. The accepted sequence is :—

1. The object.
2. Considerations which affect the attainment of this object.
3. Courses open to the two sides.
4. Plan."

It will be seen that this is the correct sequence to adopt when submitting the solution arrived at to, say, a superior, for paragraphs 1, 2 and 3 prepare the mind of the recipient for the proposed plan. In other words, it is a persuasive sequence for presenting a solution when made.

To the individual who makes the appreciation, either for himself, or for the submission to his commander, the official sequence is not complete, for the "course adopted" must be tested for soundness before acceptance. The following table shows the sequence expanded to fall into line with the scientific method :—

A Military appreciation.	The Scientific Method.
The Tactical Situation. The Object.	The Problem.
Considerations affecting the attainment of the Object. Courses open to the enemy. Most probable course.	Known facts. Assumed factors.
Courses open to us.	Probable hypotheses.
Course adopted.	The selected hypothesis.
Deductive inference from the course adopted.	Deductive inference from the hypothesis.
Testing against experience, doctrine or principles of war.	Testing the deductions by observation or experiment.
The Plan.	Development of the hypothesis.

The making of an appreciation is often difficult for the following reasons :—

(1) The object is not always immediately evident.

(2) The factors are always incomplete, or have doubtful credibility, so that many assumptions must be made.

(3) The "course adopted" can be tested for validity only by seeing if deductions from it are in accordance with experience. No practical test can be arranged.

The Object: The correct statement and understanding of the problem is, as already remarked, the first essential. It is, of course, quite possible to state it correctly but fail to see its full implications. In most tactical and technical exercises the object is already defined in the orders or instructions of a higher commander, but in cases where the instructions have merely defined a general role for the subordinate, the latter may have to find the specific problem himself. It may be necessary then to carry out a preliminary appreciation to see the situation as a whole and enable the object to be clarified. This is a well-known method in scientific work, and is often used to discover a promising starting-point for an investigation; as a means of limiting the scope of an inquiry within the bounds of the available equipment and data; or of ascertaining the full implication of the problem.

Even if a preliminary appreciation is not made of set purpose, it will always be unconsciously performed as the situation is unfolded. It is advisable, therefore, always to summarize the tactical situation before stating the object.

As soon as the object is correctly stated and its full implications grasped, the problem is well on its way to solution.

Considerations affecting the attainment of the Object: An important question here is whether or not the factors selected are relevant. A difficulty in being completely unbiased in the selection is met by all, for few persons can with perfect fairness register facts for or against their preconceived ideas. Relevancy is apparent only if the object has been correctly defined.

The degree of reliability of the factors must also be determined.

The usual tests for relevancy and reliability of factors, including those assumed, are:—

(*a*) Doubt or deny the validity of the inference from the factor.
(*b*) Doubt or deny the factor, or state the contrary.
(*c*) Doubt or deny both the inference and the factor.

By doubting the inference from the premises we are forced to seek other evidence to support our denial. By stating the contradictory of a proposition the presence of a fallacy in the inference is often discoverable. Furthermore, we cannot be said to have fully grasped

the import of a proposition to which we have assented, unless we have realized precisely what it denies.

In many cases a relevant factor will be apparent only after a solution is reached, but this is of value, for it will act like a principle in providing a crucial argument in support of the solution.

Among the factors in a military appreciation the following are almost always relevant, and inferences from them bear directly on the object in view. These are Time and Space, and Topography, two factors that are generally related, for time and space may limit or define the terrain to be considered. Arms and armament, or relative strengths may be factors when any disparity exists between the opposing forces.

The relevant factors should not be merely enumerated, but each should be followed by the inference from it. If no inference can be drawn which bears on the attainment of the object or on the course adopted, the factor is not relevant, and should be discarded.

Courses open to both sides : The courses open to the enemy should be decided by a separate appreciation in which the investigator places himself in the position of the enemy. When his most probable course of action is decided, it becomes an assumed factor in our appreciation.

The courses open to us are ideas, or inductive inferences from the factors, and in minor tactics should be reached intuitively, as soon as the situation is known. The course adopted corresponds to the right idea and is that which appears to offer the greatest probability of attaining the object. This course, before adoption and development into a plan, should be tested by comparing the deductive inferences from it with a careful analysis of the factors and by seeing that they violate no principles of war. In minor tactics this step also should be intuitive. The degree to which these ideals are reached will depend on the amount of relevant knowledge held intuitively in the mind, and one's ability to reach right ideas without conscious reasoning.

The Plan : The plan is the development of the course to be adopted. In general it is a deductive or mechanical process, for it will depend mainly on applying known rules and generalized tactical procedure. If this procedure is held intuitively in the mind, the main details of the plan will be produced almost automatically.

Certain portions of the plan may raise subsidiary problems and these must be appreciated and in their turn they may raise others, all or any of which may modify the plan, or even the course adopted. Thus the process of appreciating a situation may be a tentative process, and call for a number of successive approximations, the speed with which a balance or finality is reached depending on the amount of one's intuitive knowledge and the difficulty of the problem.

Summary.

The conclusions reached in this paper may be summarized as follows :—

(*a*) that relevant knowledge is the first essential in correct reasoning and in the solution of problems,
(*b*) that the relevant knowledge must be held intuitively in the mind,
(*c*) that knowledge is rendered intuitive by applying the Cartesian rules during study,
(*d*) that the scientific method of reasoning is applicable to problems outside the scientific field,
(*e*) that the scientific method is based on inductive reasoning, in that it depends upon perceiving the right idea in the first place, and
(*f*) that ability to hit on the right idea is dependent upon holding the relative knowledge intuitively in the mind.

Conclusion.

It will be seen from this survey of the mental processes and technical equipment required in solving a problem, or appreciating a situation, that the reaching of a valid solution is partly an art, and partly a science. It is an art in as far as it is necessary to reach a conclusion by a mental jump from an incomplete set of facts. It is a science when it is necessary merely to make a deduction from a given generalization, that is, by applying the " rules of the game." The mental jump or inductive inference is the more difficult and the more important, and this fact is appreciated even outside the fields of science and philosophy, for the world rightly pays much more highly for ideas showing enterprise and initiative, than it does for technical knowledge. When ideas and knowledge are combined, the successful solution is reached.

AN OLD TURKISH BRIDGE REBUILT.

By CAPTAIN E. C. R. STILEMAN, R.E.

THE 42nd Field Company R.E. had occasion to demolish the Ramin rail-over-road bridge in Palestine (see *R.E. Journal* of September, 1936), and four months later the 17th Field Company R.E. was ordered to replace it.

The closing of the Tul Karem–Nablus railway threw such a burden of traffic on the military transport supplying troops in the Nablus area, that, even before the end of the Arab strike was foreseen, a reconnaissance of the bridge site with a view to its reconstruction was ordered.

An N.C.O. of the 17th Field Company R.E. was instructed to measure the gap and to examine the old abutments and the Turkish foundations of the central pier to see if they were fit to be used for the new bridge. He reported that the abutments had not been affected by the demolition of the old bridge, but that it would be advisable to cut back the haunches of the old bridge which overhung the road and *wadi* by 5 ft. (Photo No. 1). He found that only the actual roadway had been cleared and that the *wadi* bed was blocked, and the Turkish foundations covered with debris. He was therefore unable to tell how much the foundations had been damaged.

He was given a party of four Sappers and ten convicts, and told to reduce the haunches and make the abutments ready to take the bank-seats and to uncover the foundations of the central pier. The haunches were cut back by a succession of small gelignite charges, and recesses 13 ft. long, by 3 ft. broad, by 2 ft. 6 in. deep were cleared at the top of the abutments to contain the mass concrete bank-seats. To take the vertical shuttering on the face of the bank-seats, ½-inch round iron bars were let into the stonework of the abutments (Photo No. 2). The foundations were unearthed and it was found that the explosion had loosened the stonework of the pier to a depth of 5 ft. below ground level.

Meanwhile, a survey of the site was made, and it was found that, at this point, the railway was laid on a 10° curve, the rails being given a super-elevation of 0·33 ft.; it was on a 1·5% (1/66) grade, and was laid on a 16-ft. embankment.

The Palestine Railway had in stock four I-girders 21 ft. long by 18 in. by 6 in., made up in pairs with the bridge sleepers already bolted on to the top flanges. The ½-in. bearing plates had round

holes to take the holding-down bolts, and not slots to allow for expansion and contraction of the girders. The bridge was therefore designed with a massed concrete pillar, 7 ft. by 3 ft. by 14 ft. high on the old Turkish foundation brought up to road level with plumb concrete and two plumb concrete bank-seats.

It was decided to put the super-elevation on the pier and abutments rather than on the bridge timbers, as they were already bolted to the girders, and to anchor the girders with holding-down bolts at the pier, but to leave the ends resting on the bank-seats free to move. No lead sheeting or asbestos was obtainable for packing under the bearing plates, so roof-felting had to be used.

Work on the bridge was ordered to begin on October 16th. On October 12th the Arab strike was called off, and by that time permanent pickets had been established on the heights on either side of the road between Tul Karem and Nablus. Work was therefore possible during the hours of daylight.

Man-power was drawn from a variety of sources. An officer and lance-serjeant from the 17th Field Company R.E. supervised the work. The 42nd Field Company R.E. had a detachment at Nur es Shams prison near Tul Karem, and supplied a junior N.C.O. and seven men for the work. The 300 convicts work in the stone quarries exclusively for the Palestine Railway, which, after some persuasion, provided 20 convicts daily. These two parties left the prison at 0600 hours and had to be back again at 1300 hours. They, therefore, worked the first shift from 0630 hours to 1230 hours. The 17th Field Company R.E. at Nablus provided a junior N.C.O. and five men, who, with ten natives from Anabta, one of the " hottest " villages during the disturbances, worked the second shift from 1230 hours to 1700 hours. The convicts were commanded by an English-speaking Arab serving a long-term sentence for murder and worked well under him. The task was a pleasant relaxation from the eternal stone-breaking of the quarries, and there was no difficulty in getting 20 men on Fridays when the work was voluntary. The Anabtans were suspicious of their reception to begin with, but they soon responded to kindness and turned out even better work than the pressed men.

A construction train bringing water from Tul Karem and aggregate from the prison quarries had been promised to be at the bridge site at 0630 hours on the 16th. Unfortunately, some hitch occurred in the Palestine Railway and the stationmaster at Tul Karem refused to allow the train to leave the station. The *wadi* bed had previously been reconnoitred and a very good sample of clean-graded ballast was obtainable two miles from the bridge site. Parties of convicts were dispatched to excavate this and water was brought in petrol tins from Tul Karem.

On the first day the concrete foundations of the centre pier were

brought up to ground level and the shuttering of the centre pier and the bank-seats prepared. The end shuttering for the pier was nailed to the 4 in. by 4 in. uprights which were set 2 ft. into the concrete foundations. By next morning the concrete had set and no difficulties were experienced in keeping the pier truly vertical. The side shuttering was nailed to the uprights as required. (Photo No. 3.)

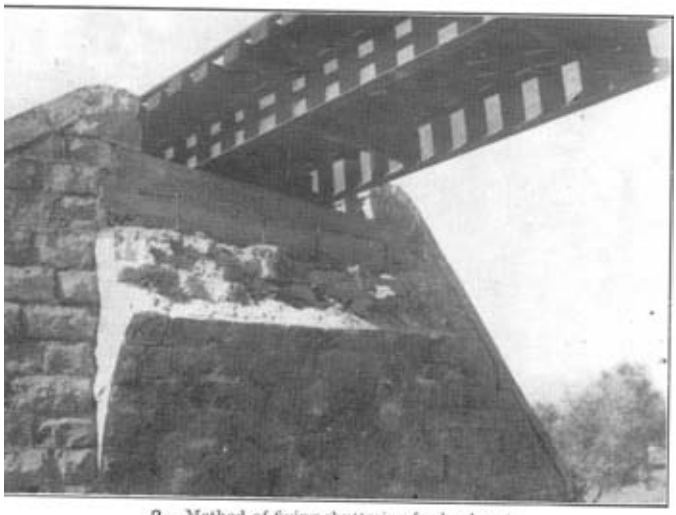
The pier and abutments were completed on Sunday, 18th. The girders were ordered for the 21st to give the concrete two clear days to set and " Transportation " was notified that the line could be reopened on November 1st, thus giving the pier a fortnight to harden. The two days between the completion of the concreting and the arrival of the girders were occupied in clearing the *wadi* of the debris left there after the demolition of the old Turkish bridge, and rebuilding the retaining wall on the central pier side of the *wadi*. (Photo No. 4.)

So far the party had been on tasks which come naturally to a Field Company, but none of us had tried his hand at railway bridge construction. When a unit does its heavy bridging there is a military engineering store from which to draw unlimited supplies of blocks and tackles, spars, park pickets and so on. Our stock-in-trade consisted of four 75-lb. rails, two 2·2 2½-in. tackles, five park pickets, a winch lorry, an engine on the opposite of the gap to the girders and various sorts and sizes of jacks. One jack in particular proved invaluable. It was produced by the driver of the engine, was a home-made affair and consisted of a block of wood 3 ft. long by 1 ft. 6 in., hollowed out to take an iron bar cogged at one side with a steel foot welded to the end. This was raised and lowered by a cog-wheel, also fitted into the block and turned by a handle on the opposite side to the foot. With this machine (known by its owner as " the devil ") a 2-ft. vertical lift could be obtained in about two minutes.

The girders arrived coupled up in pairs and loaded one on top of the other on a flat truck. Each pair weighed 2½ tons.

It was an awkward problem to get the top girder off the truck. We were working on a 16-ft. embankment ; there was a 1/66 slope towards the bridge, and the line was laid on a 10° curve, with a 4-in. cant. The line is laid on steel sleepers, so wooden sleepers for ramps were scarce. The task was accomplished by having a 2·2 tackle on the back as a preventer: the other tackle and the winch lorry as side guys to counteract the effect of the super-elevation, and the engine as a motive power. All went well until the girder reached the critical point, when the back-guy sling, consisting of six returns of a 2-in. lashing, parted. The cable on the winch lorry slipped, but the other side-guy held and the twin-girders launched themselves and came to rest across the railway lines. With the help of plenty of grease it was comparatively simple to launch the girders on to the

1.—The bridge as left by the 42nd Field Co., R.E.



2.—Method of fixing shuttering for bankseat.

An old Turkish bridge re-built 1&2

3.—The first day's work.

4.—Ready for the girders.

An old Turkish bridge re-built 3 & 4

rails across the gap (Photo No. 4) and to slide them across to the far side.

Here the enthusiasm of the convicts all but caused disaster. An N.C.O. was given a party of them and told to move a flat truck, which was brakeless, closer to the gap. Before he could prevent them they had knocked the chocks away from under the wheels and the truck was in motion down the 1/66 slope. Once under way nothing would stop it. The rails had been greased to slide the first pair of girders. Chocks, petrol tins and crowbars were flung from the track before they had time to bind. The rails ended five yards from the gap and a wooden sleeper happened to be lying across the path of the truck. The first wheels of the forward bogies bumped over the sleeper; the rear wheels rode up it, hesitated and rolled back on the safe side and the truck came to rest nine feet from the gap. No further difficulties were experienced and the second pair of girders were quickly off-loaded and launched.

It only remained to remove the launching rails, pack under the bearing plates with roof-felting, grout in the holding-down bolts on the centre pier and build retaining walls behind each bank-seat. Palestine Railway platelayers, supervised by a Sapper from the 8th Railway Company, relaid the rails and the bridge was complete.

The construction train crossed the bridge on October 25th and the first train was run on November 1st.

"*ILEX*," R.E.Y.C.

A History of the Ship from 1926–1936.

By CAPTAIN L. R. E. FAYLE, R.E.

THIS is an attempt to summarize the history of *Ilex* since she has been in the hands of the R.E.Y.C. Much has been written about the ship before now, but it is thought, in view of the fact that memories are sometimes short, that no apology is needed for recapitulating her history, so to speak, in potted form.

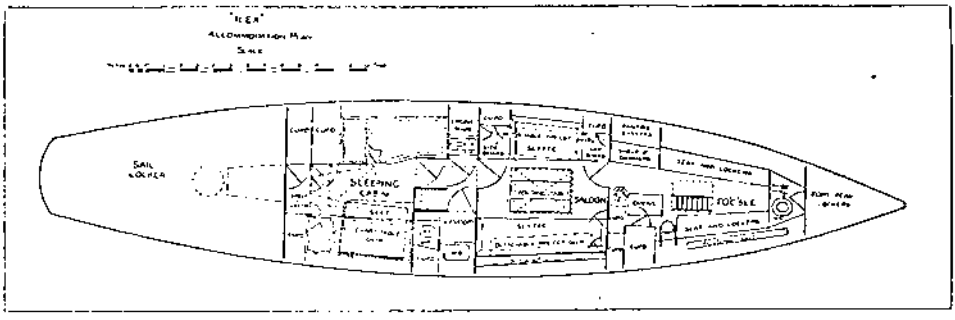
For one thing, *Ilex* has done much to enhance or, at any rate, to keep alive, the prestige of the R.E.Y.C., such as it is, and for another, over thirty per cent. of the serving officers of the Corps have sailed in her at one time or another, and to them, if to no one else, the past performances of the old ship are of interest. Again, some, who are interested in the design of yachts, may not have seen her plans, while others, who have never seen her, may know nothing of what she is like. To satisfy the curiosity of the former, and to enlighten the latter, her plans are published with this article for the first time in *The R.E. Journal.* They have previously appeared in the issue of the *Yachting Monthly* for December, 1935.

In addition to the plans of *Ilex*, small-scale sketches of some of her principal rivals in ocean races have been included for the benefit of those who have sailed in such races, and who may like to know what some of the other ships, against which she has been matched on other occasions, are like. These sketches have mostly been made from details supplied by owners, builders and sailmakers, to whom the writer is greatly indebted. As it is impossible, in the space of this article, to include drawings of every ship against which *Ilex* has raced, a table of leading particulars of all the yachts which have met her is given at the end.

It is proposed to deal first with some details of the ship herself, secondly, very briefly, with cruising, and lastly with her efforts at ocean racing, in which part a summary of each of her long-distance races (as well as of the first Fastnet Race in *Fulmar*) is included. It should be noted that no attempt has been made to give highly coloured or entertaining accounts of these races, most of which have been reported at length in *The R.E. Journal* on previous occasions. Only the bare facts are given, and every attempt has been made to avoid inaccuracies, though naturally it is impossible to eliminate them entirely.

It is hoped that this record may fill a few gaps in the history of *Ilex*, and may help to make those who know little of her realize what

an exceedingly stout old ship we are fortunate enough to possess. Those who know her well need no such reminder, for they themselves will remember days in her when she has shown her quality—perhaps going to windward under a press of sail into a lop, lee rail awash, pitching into it with her own unmistakable action, or perhaps running before a gale and a high sea under reduced canvas, cocking her counter over each hummock of water rising up astern in a manner that is a sheer delight to the senses.



"ILEX"—ACCOMMODATION PLAN.

Reproduced by kind permission of the *Yachting Monthly*

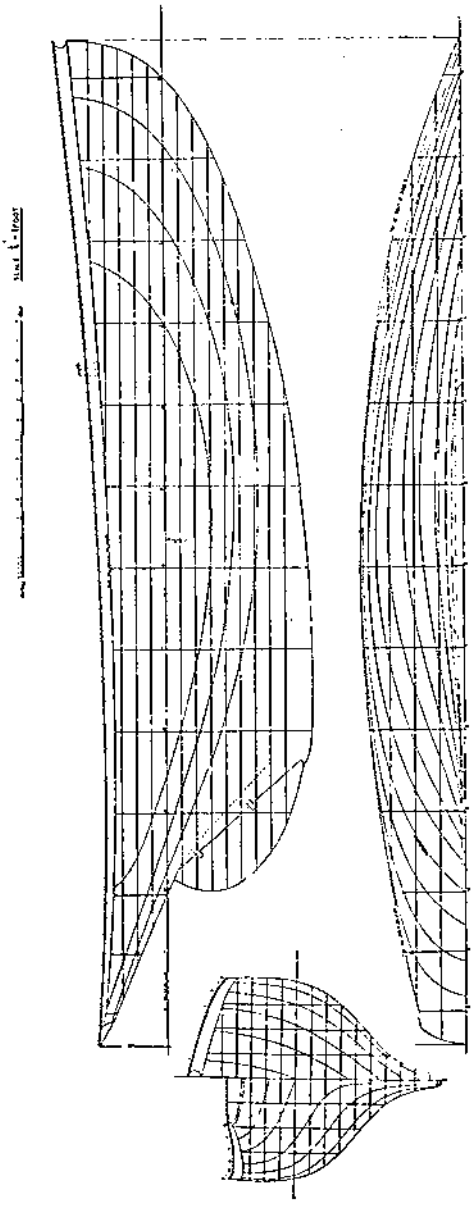
The ship herself.—The main particulars of *Ilex* are given below, and compared with those of her predecessor, *Fulmar* :—

	Ilex	*Fulmar*
Tonnage (Thames measurement)	20.	14.
Gross tonnage	15·08	10·62
Net tonnage	11·21	10·62
Displacement	23·5 tons	?
Length overall	51·0 feet	41·0 feet
Length waterline	41·5 feet	33·0 feet
Beam	10·4 feet	9·7 feet
Draught	7·5 feet	6·5 feet
Rig and Y.R.A. Sail Area ...	Yawl, 1565 sq. ft. Cutter 1420 sq. ft. Bermudian cutter 1290 sq. ft.	Cutter 1050 sq. ft. app.
Engine	7-h.p. Kelvin	None.
Designer	C. E. Nicholson	E. H. Hamilton
Builders	Camper & Nicholsons, Ltd.	W. E. Thomas
Where built	Gosport	Falmouth
When built	1899	1901

Ilex was designed by Mr. Charles Nicholson as an ordinary cruiser, and was very heavily and strongly built: the fact that she has proved herself a fairly fast ship is a tribute to the excellence of her lines. She was originally built as a cutter, but was altered to yawl two years later, and it was with this rig that we bought her in 1926. She became a cutter again before the Atlantic race of 1931, by the removal of her mizen, and in the winter of 1934–35 she was

completely re-rigged as a Bermudian cutter by her builders, her new sail plan having been designed by Mr. Charles Nicholson.

Ilex has a long and narrow hull—briefly, the length of the average

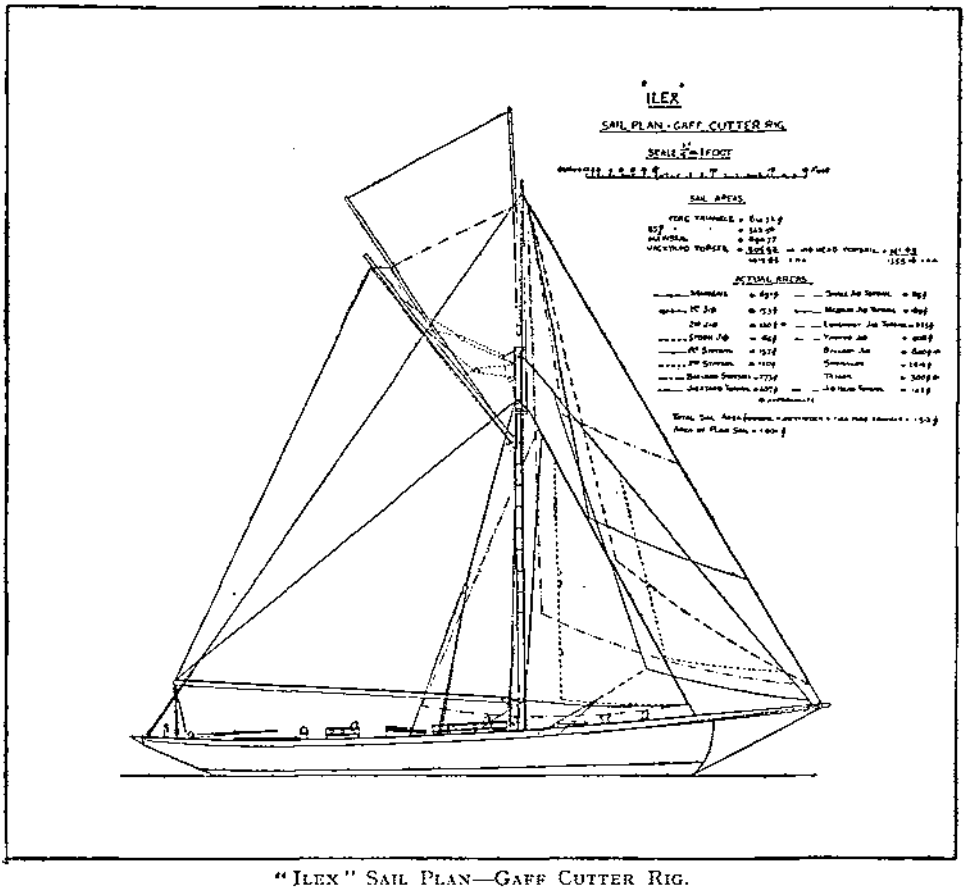


THE LINES OF "ILEX"
as taken off by Messrs. Carnegie & Nicholsons, Ltd., 1934
Reproduced by kind permission of the *Yachting Monthly*

25-tonner and the beam of the average 16-tonner. Her lines are easy, with no trace of hardness, and in spite of her heavy displacement, her wetted area is comparatively small. This makes her a fast ship in

light airs. She is inclined to sail at a great angle of heel, owing to her narrow beam and easy bilges, and she is rather a wet ship in a seaway, though her motion is long and easy.

Her construction is enormously strong, her planking being of Burma teak on double oak frames. Deck beams are of oak, and the deck itself was originally of Quebec pine, though this was replaced by



"ILEX" SAIL PLAN—GAFF CUTTER RIG.

Reproduced by kind permission of the *Yachting Monthly*.

a teak deck at the end of 1934. Part of her lead ballast is on the keel and part inside.

Her accommodation was obviously planned for the owner and his wife, with an occasional guest, and a couple of paid hands forward. Consequently it is not ideal for a club-owned boat. From the bow, there is a fo'c'sle-cum-galley, then the saloon, next the main companion, with the engine-room on the port side and a W.C. to starboard, and abaft this, a sleeping cabin containing two bunks, an excellent chart-table, and a wireless receiving set. Abaft this and reached by a small round hatch on deck, is the sail locker. With a

large crew, sleeping accommodation is somewhat cramped, as, for example, the saloon, which was obviously designed to sleep one, has frequently slept five, the unfortunate bodies being distributed thus: one on the long settee, two in folding pipe-cots, one in a hammock and one on the floor!

The sail plans given should explain themselves to those who are interested in the subject, though it might be mentioned that the new Bermudian mast, 60 feet from deck to truck, is of British Columbian pine, hollow above the boom gooseneck. Reefing was originally of the ordinary pennant and reef point, or lacing variety, but Appledore roller reefing gear was fitted in 1931 and remained in the ship until the end of 1934. With the new rig, ordinary reefing is employed, and there are many who regret the passing of the Appledore gear, including its greatest champion, Carter, the club hand.

No account of *Ilex* would be complete without a reference to Carter. All who have sailed in the ship know of his excellent cooking and also of his inexhaustible fund of entertaining, if improbable, stories. Not so many realize that it is largely due to his labours during the winter, as well as in the season, that the ship's gear is kept in such excellent condition. Carter has been round the Fastnet six times, and has been on board *Ilex* in eleven other ocean races as well, acting, as he always does when the ship is at sea, as cook; so he has an off-shore racing record which few others can equal.

Cruising.—During the 11 seasons, 1926 to 1936, *Ilex* has, in the hands of the R.E.Y.C., made good distances totalling 40,000 sea miles in cruises and ocean races, 18,000 miles as a yawl, 16,000 miles as a cutter, and 6,000 miles as a Bermudian cutter.

During the winters she is hauled up on a slip at Upnor, and her sailing season lasts roughly from the beginning of April till the middle of October. As a rule she starts the year with an Easter cruise of several days, in the course of which she generally makes her way down Channel in a fruitless search for warm weather and sunny skies. She returns to Chatham and settles down to a series of week-end sails in the Thames Estuary. Whitsun follows, a date which formerly meant a cruise over to the Belgian or Dutch coast; but nowadays she goes over to Burnham for the Heligoland Race, leaving the Medway on the Wednesday before Whitsun, and returning about 10 days later. Almost as soon as she is home, she sets off down Channel to Weymouth for a month's use by the Divisions at the Bridging Camp at Wyke Regis. Back again to Chatham in the middle of July, a couple of week-ends, a scrub on the slip, and she is off again to the Wight for the Channel or Fastnet Race. After this, and perhaps another race as well, she returns to Chatham during the latter half of August and settles down to a series of week-ends and day sails which may last well into October, before she finally returns to the slip at Upnor for her winter sleep.

It is impossible to give full accounts of any of her cruises here: those who wish to know more must search in her log-books for the required information. One or two of her records may perhaps be mentioned, as, over the vexed question of speed, there are many inaccurate reports in circulation, for on this subject it is in human nature to exaggerate. In the following details, it should be added, the writer has sacrificed human nature on the pyre of accuracy.

Ilex's absolute maximum speed is probably 9·5 knots, though 9 knots is rarely exceeded. Many claim that the ship has done 10 knots through the water on certain occasions, but there is nothing in the ship's logs to substantiate their claims. Her best day's run was 202 sea miles, done in the Transatlantic Race of 1931. Including certain ocean races, a few of her best passages are given below :—

July	1931	Newport, R.I. to Plymouth. 2950 miles, in 20 days, 20 hours, average 5·90 knots.
May	1926	Gillingham to Ostend. 91 miles, in 11 hours 30 minutes, average 7·91 knots.
June	1935	Burnham to Heligoland. 310 miles, in 1 day 13 hours 4 minutes, average 8·36 knots.
July	1934	Upnor to Dover. 60 miles, in 8 hours, average 7.50 knots.
July	1934	Dover to Portsmouth. 105 miles, in 18 hours 30 minutes, average 5·68 knots.
Aug.	1936	Portsmouth to Gillingham. 164 miles in 30 hours 50 minutes, average 5·31 knots.
Aug.	1933	Portsmouth to Gillingham. 164 miles in 30 hours, 0 minutes, average 5·47 knots.
Sept.	1926	Portsmouth to Gillingham. 164 miles in 30 hours, 31 minutes, average 5·21 knots.
May	1932	Sheerness to Margate. 26 miles in 2 hours 55 minutes, average 8.91 knots.
Aug.	1935	Plymouth to Gillingham. 292 miles in 52 hours, 30 minutes, average 5·56 knots.
April	1935	Gosport to Ramsgate. 119 miles in 19 hours 30 minutes, average 6·10 knots.
May	1927	Burnham to Gillingham. 43 miles in 4 hours, 45 minutes, average 9·05 knots.

These are only a few picked out at random from the ship's logs.

Ilex is a magnificent sea boat and, properly handled, is capable of facing any summer gale to be met with in home waters. Again it is impossible to pick out a particular occasion and say: "That is the worst weather that *Ilex* has ever experienced." However, one or two instances may be of interest, apart from bad weather she has met when ocean racing.

In August, 1931, after the Fastnet Race, she made a passage from Plymouth to Southampton before a fresh south-westerly gale and a high and confused sea. On this occasion, her spinnaker boom, rigged as a topmast, carried away in an involuntary gybe, but she reached port under headsails without further mishap.

In July, 1932, she met very bad south-westerly weather when on passage from Gillingham to Cowes for the Channel Race. The whole trip took over 74 hours and *Ilex* was hove to for a total of about 15 hours. In April, 1935, under her new rig, she put to sea from Portsmouth in another south-westerly gale, and made the passage to Ramsgate, under reefed trysail and storm jib at the start and later, under storm headsails, in less than 20 hours. In August of the same year, when on passage between Plymouth and Gillingham, she met even worse weather over the same stretch, with bad visibility: she had some unpleasant moments on this occasion when trying unsuccessfully to make the western entrance of Dover Harbour, but finally reached the Medway without mishap.

Here it is necessary to leave the question of cruising—it is feared that the more melancholy question of groundings has been passed over, in spite of the fact that *Ilex* has been "puttied" perhaps fifty times when in the hands of the R.E.Y.C. Over this shocking aspect of cruising it is best to draw a veil!

Ocean racing.—The sport of ocean, off-shore, or long-distance racing—call it what you will—was inaugurated in this country in 1925, when the first Fastnet Race was sailed. For the first seven years, the sport grew steadily in popularity. Then came a couple of lean years following the slump of 1931, when there was some doubt if it would survive: with the return of prosperity in this country, however, ocean racing really took a firm hold on the sailing community, and every race brought more and more entries. The future of the sport definitely seems rosy, which is a healthy sign, for not only does this form of racing encourage the building and racing of yachts in which speed and seaworthiness are combined, but also it is producing an increasing number of efficient amateur sailors. It is a curious sport, for though those who take part in it find, at times, discomfort, and even misery, the pleasure far outweighs the discomfort, and there are few who have taken part in an ocean race who do not wish to go again.

For the R.E.Y.C., long-distance racing has a special interest, for *Fulmar* sailed in the first ocean race, and *Ilex* won the second. Since 1926, *Ilex* has been perhaps the best-known figure in these races, for she alone of all yachts has been with the sport since its infancy. The great *Jolie Brise*, so well known from 1925 to 1931, has dropped out, and since the slump, new names such as *Trenchemer*, *Rose*, *Larry*, and Mr. Isaac Bell's beautiful tan sail "hounds" have become familiar; but *Ilex* has gone on through both these periods, even through the lean years of 1932 and 1933.

Up to the end of 1936, *Ilex* had done 10,700 sea miles of ocean racing. In 20 starts, she had won three first prizes, two second prizes, seven third prizes, and one fourth prize. She had been unplaced six times and had given up once. It must be mentioned that ocean

racing has changed in character very greatly since its inception. In the early days, the starters, generally ten or so in number, were mostly cruising yachts of no great speed, with a very small outfit of light weather canvas. Nowadays, there are far more yachts entered for each race and moreover, the entries include a good proportion of yachts specially built for off-shore racing. Thus to get a place in these races is becoming increasingly difficult, and there is little doubt that, but for the re-rigging of the ship as a Bermudian cutter in 1934–35 she would be hopelessly outclassed by now.

For the uninitiated, some explanation may be given of the time allowances and corrected times. As yachts of various sizes and types meet in these races, some kind of handicap must be given to make a fair and exciting race. The system of handicapping on form is not favoured, and the method employed is to give each ship a rating based on length, sail area, beam, depth, and many other particulars. The time allowance naturally depends on the rating. The method of measurement for rating has been varied from time to time, and as based at present, it proves very fair in giving ships of widely differing types reasonable allowances. It may be added that *Ilex* was at one time badly hit by the rating rule, but, as it stands at present, she is very fairly treated.

Now follows a rough outline of all the ocean races in which R.E.Y.C. yachts have sailed.

1ST FASTNET RACE, 1925.

Starters :—*Jolie Brise*, *North Star*, *Saladin*, *Jessie L*, *Banba IV*, *Gull* and *Fulmar*.

Crew of *Fulmar* :—N. A. Blandford-Newson (skipper), J. H. D. Bennett, G. L. Watkinson, P. L. Wilkinson, H. A. Macdonald and Capt. R. M. H. Lewis.

Course :—Ryde—Spithead—St. Catherine's—Fastnet Rock—Plymouth. Distance 605 sea miles.

The first Fastnet Race was in the nature of an experiment, and consequently the yachts entered were healthy cruisers with no pretensions as to speed. *Jolie Brise*, already famous as a cruiser, had her reputation as an off-shore racer still to make.

The race started with a light South Westerly breeze and by the time St. Catherine's was rounded, *Jolie Brise* was well in the lead, followed by *Gull*, *Saladin* and *Fulmar*. For the next three days, there were light airs and it was not until the Longships had been left behind that *Fulmar* found herself once more in company with the leaders. After the four had lain in company for some hours, a discriminating breeze took *Jolie Brise* over the horizon ahead, leaving the others becalmed. The Fastnet was rounded in light airs with *Jolie Brise* twelve hours ahead, and *Gull*, *Saladin* and *Fulmar* in company.

After rounding the rock, the wind steadily increased, giving a quick close reach across to the Cornish coast, where *Fulmar*, too much to the northward, had to make several tacks against a nasty sea to weather the Longships. In spite of this, she worked a lead on *Gull* and *Saladin*, crossing the finishing line second, too late to save her time on *Jolie Brise*, but taking second prize comfortably.

Fulmar's effort in this race laid the foundations of the club's reputation in ocean racing. As smallest boat in the race, she had done well, but it was clear to the committee of the club that some better yacht was needed if the new sport was to be taken seriously. Consequently, at the beginning of the next season she was replaced by *Ilex*.

RESULTS: FASTNET RACE, 1925.

Start at 12 noon, on 15th August, 1925.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Cutter	Jolie Brise	44	E. G. Martin ...	6 2 45 37	6 2 45 37	1st
Cutter	Fulmar	14	R.E.Y.C. ...	6 22 48 5	6 10 28 5	2nd
Cutter	Gull	18	H. F. P. Donegan	6 23 23 15	6 14 13 15	3rd
Cutter	Saladin ...	33	Ingo Simon ...	7 0 54 30	6 18 54 30	4th
Ketch	North Star ...	37	Capt. M. Tennant	7 12 0 0	7 5 30 0	5th
Ketch	Banba IV ...	20	H. R. Barrett ...	8 days app.	Not known	6th
Bm. Cut.	Jessie L. ...	27	C. J. Hussey ...	Gave up	——	—

2ND FASTNET RACE, 1926.

Starters:—*Halloween*, *Jolie Brise*, *Saladin*, *Primrose IV* (U.S.A.), *Ilex*, *Banba IV*, *Gull*, *Altair*, and *Penboch*.

Crew of *Ilex*:—N. A. Blandford-Newson (skipper), W. M. Blagden, J. H. D. Bennett, H. A. Macdonald, Capt. J. J. Carter, P. L. Wilkinson, Capt. R. M. H. Lewis, D. N. B. Hunt, G. N. Russell, and Carter (paid hand).

Course:—Cowes—Spithead—St. Catherine's—Fastnet Rock—Plymouth. Distance 615 sea miles.

The second Fastnet race attracted the usual sturdy cruisers, some of which had sailed in 1925, and also two important additions. *Halloween*, a beautiful Fife designed fast cruiser, brand new, and *Primrose IV*, the first American entry, a three-year-old Alden schooner that had crossed the Atlantic for the event. In general, however, it was still a race for ordinary cruisers.

Conditions this year were favourable for a fast race. A moderate to fresh south-westerly breeze was blowing and this remained fairly constant for the first three days. *Halloween* quickly drew away from the others, and *Ilex*, taking a mid-Channel course in the uncomfortable beat down to Lands End, was lying second at the Longships.

A quick reach brought her round the Fastnet, and a freshening breeze, backing, was met with on the homeward stretch. So much did

it freshen, that the ship was hove to for an hour while a couple of reefs were tucked in the main. This midnight operation involved certain members of the crew in an involuntary bathing picnic which has been described many times in print, both accurately and otherwise. Later the reefs were shaken out, and after rounding the Lizard, a pleasant spinnaker run to the finish followed.

Ilex was second to finish, and won the Fastnet Cup on corrected time, having averaged over 5·8 knots round the course. *Halloween*, scratch boat, was first home and took third prize, setting up a record for the course which has never been equalled. *Primrose IV*, finishing ten hours after *Ilex*, took second prize, and was close to depriving the R.E.Y.C. of their win on corrected time. In addition, *Ilex* beat the redoubtable *Jolie Brise*, boat for boat, without calling on her time allowance, a performance which she has never repeated.

Results: Fastnet Race, 1926.

Start at 11.30 a.m. on 14th August, 1926.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Bm. Cut.	Halloween ...	51	Col. Baxendale	3 21 35 30	3 21 35 30	3rd
Yawl	Ilex	20	R.E.Y.C. ...	4 9 51 22	3 15 44 52	1st
Cutter	Jolie Brise ...	44	E. G. Martin ...	4 16 34 19	4 1 11 49	5th
Schooner	Primrose IV	28	F. L. Ames ...	4 20 18 30	3 15 58 0	2nd
Cutter	Saladin ...	33	Ingo Simon ...	4 22 27 50	3 23 3 35	4th
Ketch	Banba IV ...	20	H. R. Barrett ...	5 15 2 2	4 5 33 2	6th
Cutter	Penboch ...	12	R. Somerset ...	5 20 37 39	4 6 21 39	7th
Cutter	Gull	18	H. F. P. Donegan	Gave up	——	—
Cutter	Altair ...	14	Mrs. Aitken-Dick	Gave up	——	—

3rd Fastnet Race, 1927.

Starters:—*Jolie Brise*, *Nicanor* (U.S.A.), *La Goleta* (U.S.A.), *Tally Ho*, *Morwenna*, *Spica*, *Shira*, *Ilex*, *Saoirse*, *Content*, *Mailenes*, *Thalassa*, *Altair*, *Nellie*, and *Penboch*.

Crew of *Ilex*:—N. A. Blandford-Newson (skipper), G. L. Watkinson, H. A. Macdonald, Capt. G. C. M. Kavanagh, M. T. L. Wilkinson, Capt. B. E. C. Dixon, G. W. W. Morris, E. J. Graham, and Carter (paid hand).

Course:—As for 1926.

Again in 1927, the entries were ordinary cruisers, including the usual hardy annuals, with a couple of fine American schooners, *Nicanor* and *La Goleta*, to give the race an international flavour.

The weather this year was at its worst. The south-westerly breeze met with in the beat down Channel was never less than strong, often reaching moderate gale force and worse. Two days of these conditions forced nine of the fifteen starters to give up. Of the remaining six, *Jolie Brise* led at the Lizard, but finding conditions too bad, ran

back and gave up. *Nicanor* followed suit, leaving *Ilex* in the lead, but with most of her headsails blown out and the ship making water badly, she, too, had to turn back and run for Plymouth. *Nicanor* put to sea again, but casualties to gear put her finally out of the race: *Content* struggled gamely across to Ireland, to give up at Queenstown with defective compasses.

Of the whole fleet of fifteen, only *La Goleta* and *Tally Ho* were left in the race. After a great duel, *La Goleta* finished first, but *Tally Ho*, close on her heels, took the Fastnet Cup on corrected time.

This is the only race in which *Ilex* has yet given up, but there can be little doubt that, under the circumstances, the decision taken was a wise one.

RESULTS: FASTNET RACE, 1927.

Start at 11.30 a.m. on 13th August, 1927.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Schooner	La Goleta ...	29	R. St. L. Peverley	6 2 19 35	5 22 24 10	2nd
Cutter	Tally Ho ...	29	Lord Stalbridge	6 3 1 47	5 18 8 47	1st
Cutter	Content ...	19	R. D'Oyley Carte	Gave up	——	——
Schooner	Nicanor ...	39	D. Simonds ...	Gave up	——	——
Yawl	Ilex	20	R.E.Y.C. ...	Gave up	——	——
Cutter	Jolie Brise ...	44	Dr. B. Smith and W. Ferrier ...	Gave up	——	——
Cutter	Spica ...	22	Mrs. A. M. Hunt and J. T. Hunt ...	Gave up	——	——
Schooner	Morwenna ...	28	W. Curtis Green	Gave up	——	——
Cutter	Shira ...	21	Col. G. B. Sarel and Com. H. P. Wilson	Gave up	——	——
Cutter	Maitenes ...	17	Lt. W. B. Luard	Gave up	——	——
Yawl	Thalassa ...	16	E. Ponsonby ...	Gave up	——	——
Cutter	Penboch ...	12	R. Somerset ...	Gave up	——	——
Cutter	Altair ...	14	Mrs. Aitken-Dick	Gave up	——	——
Cutter	Nellie ...	12	M. S. Solly and Capt H. C. Tetley	Gave up	——	——
Bgntine.	Saoirse ...	20	Conor O'Brien	Gave up	——	——

4TH FASTNET RACE, 1928.

Starters:—*Neptune*, *Niña* (U.S.A.), *Mohawk* (U.S.A.), *Jolie Brise*, *Viking*, *Amaryllis*, *Magnet*, *Noreen*, *Lassie*, *Ilex*, *Mamago*, *L'Oiseau Bleu* (France).

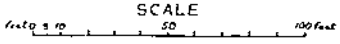
Crew of *Ilex*:—D. N. B. Hunt (skipper), D. R. Crone, H. S. Francis, M. T. L. Wilkinson, Capt. B. E. C. Dixon, Capt. F. J. P. Gibson, Capt. T. W. R. Haycraft, and Carter (paid hand).

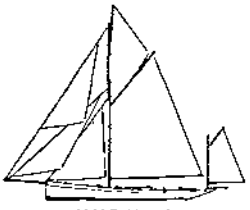
Course:—As for 1926.

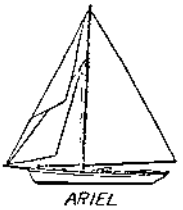
1928 saw a subtle change creeping over the sport. For this year, of the two American entries, *Niña* and *Mohawk*, the former, described by many as a racing machine, was so fundamentally different from

SOME OCEAN RACING YACHTS, 1925-1930

SCALE




AMARYLLIS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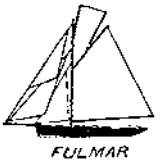
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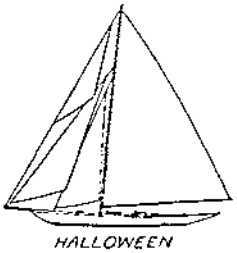
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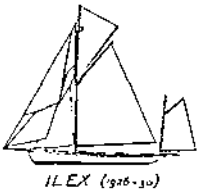
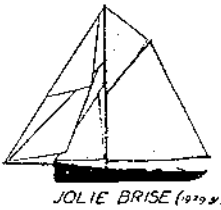
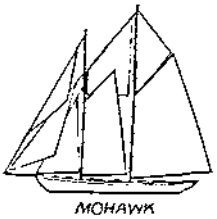

ILEX (1928-30)

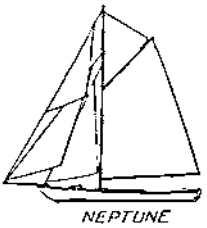

JOLIE BRISE (1929-31)

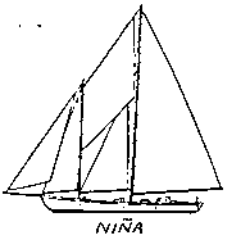

LA RAILLEUSE


MAITENES II (1929)


MAITENES II (1930-31)


MOHAWK


NEPTUNE


NIÑA


PRIMROSE IV


SALADIN


TALLY HO

the accepted type of sea-going cruiser as to arouse a storm of criticism from the die-hards. Yet her unqualified success in off-shore events justified her, to such an extent, that the type of ocean racer and fast cruiser built nowadays is, in a sense, a development of *Niña*. The days of gaff-rig and deep forefoot for ocean racing are past: the new type of off-shore racer with her high rig and lean ends, has proved herself not only able to sail rings round the old type, but also able to stand up to bad weather as well in every way as her more sober predecessor.

1928 was the beginning of the change, yet apart from *Niña* and *Mohawk*, and the old racer *Noreen*, the entries were the usual cruisers with one or two newcomers.

The beat down Channel was against light to moderate breezes, but *Ilex*, due to too much zeal in sheeting the topsail, broke her topmast in the early stages; Francis, with great skill, managed to repair it with a scarfed joint, but the temporary loss of light weather canvas lost *Ilex* all hope of a prize.

Niña walked away from the others from the start, and rounded the Fastnet an easy first: she never lost her lead and won comfortably. *Ilex*, fifth to round the rock, got a splendid free wind to speed her home. It was a real sleighride, for the old ship, carrying a press of sail, logged 9·5 knots steadily for three consecutive hours, and averaged 7 knots from Fastnet to finish. After a great race with *Lassie*, *Ilex* finished ahead of her and took fifth place. *Mohawk* had finished second to *Niña*, but was squeezed out of second place by *Jolie Brise* on corrected time.

On the whole, the weather was kinder in 1928 than in any of the preceding years.

RESULTS: FASTNET RACE, 1928.

Start at 11.30 a.m. on 15th August, 1928.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Bm. Sch.	Niña ...	49	Paul Hammond	4 12 48 20	4 5 58 20	1st
Schooner	Mohawk ...	44	Dudley F. Wolfe	4 22 21 45	4 13 28 45	3rd
Cutter	Neptune ...	62	Lt.-Col. Chambers	5 0 57 30	4 16 25 0	4th
Cutter	Jolie Brise ...	44	Dr. B. Smith and W. Ferrier ...	5 1 35 5	4 11 24 20	2nd
Yawl	Ilex	20	R.E.Y.C. ...	5 11 1 45	4 18 7 0	5th
Yawl	Lassie ...	29	R. A. Thomas ...	5 11 35 25	4 21 24 40	6th
Yawl	Amaryllis ...	37	R.N. College, Dartmouth ...	5 19 44 5	5 9 7 5	8th
Cutter	Magnet ...	34	Dr. W. F. Roach	6 8 57 0	5 5 47 15	7th
Cutter	Mamago ...	19	Capt. F. Stevens	Not timed	Not known	9th
Yawl	Noreen ...	28	H. M. Crankshaw	Gave up	——	—
Cutter	Viking ...	41	Lt. R. Lindsay Fisher ...	Gave up	——	—
Cutter	L'Oiseau Bleu	18	Leon Diot ...	Gave up	——	—

5TH FASTNET RACE, 1929.

Starters :—*Neptune*, *Gueurveur* (France), *Jolie Brise*, *Amaryllis*, *Grey Fox*, *Saladin*, *Cariad*, *Vega* (France), *Maitenes II*, and *Ilex*.

Crew of *Ilex* :—D. N. B. Hunt (skipper), W. G. Fryer, M. T. L. Wilkinson, Capt. R. M. H. Lewis, H. S. Francis, Major J. J. Carter, Capt. F. J. P. Gibson, and Carter (paid hand).

Course :—As for 1926.

The Fastnet race this year, as far as the yachts entered were concerned, was a step back to the conditions before 1928. In fact, in 1929 and 1930 no outstandingly fast yachts came to the line, and the "hardy annuals" formed the backbone of the fleet. An interesting new ship of 1929 was Lieut. Luard's *Maitenes II*, the first attempt by a British yachtsman to produce a real ocean racing craft. She was a pretty 25-tonner, somewhat shorter and beamier than *Ilex*, but carrying a Bermudian cutter rig on a colossal 70-foot solid mast. She was only completed just in time for the race and was not properly tuned up.

The passage down Channel found light and variable breezes, and by the time the Longships were reached, the faster boats *Jolie Brise*, *Neptune*, *Ilex*, *Maitenes II* and *Saladin* were in sight of one another. The last-named had taken a mid-Channel course and gained thereby. On the leg across to the Fastnet, the wind piped up from the west, and big powerful *Neptune* and *Jolie Brise* drew away from *Ilex*, who in turn dropped *Saladin* and *Maitenes II*. A day of unpleasant beating was followed by light airs off the Irish coast.

Ilex rounded the Fastnet second to *Jolie Brise*, *Neptune* having given up, and on the homeward run, which was in lighter airs than usual, with patches of calm, the old Havre pilot cutter, splendidly sailed, increased her lead, winning the race by nearly a day. *Ilex* finished second, but was placed third when a freshening breeze brought *Saladin* in to save her time for second prize. *Maitenes II* was fourth.

It had been a slow race, sailed in average weather.

RESULTS : FASTNET RACE, 1929.

Start at 11.30 a.m. on 14th August, 1929.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Cutter	Jolie Brise ...	44	R. Somerset ...	5 7 5 36	4 21 20 6	1st
Yawl	Ilex	20	R.E.Y.C. ...	6 4 22 30	5 17 47 0	3rd
Cutter	Saladin ...	33	Ingo Simon ...	6 8 39 0	5 15 23 45	2nd
Bm. Cut.	Maitenes II	25	Lt. W. B. Luard	6 0 40 15	5 18 17 45	4th
Ketch	Grey Fox ...	33	N. Newgass ...	6 10 48 30	6 5 10 15	5th
Yawl	Amaryllis ...	37	R.N. Coll., Dart'h	6 18 50 20	6 15 4 50	6th
Yawl	Gueurveur ...	48	Baron de Neufville	7 days app.	?	7th
Cutter	Neptune ...	62	Lt.-Col. Chambers	Gave up	——	—
Bm. Sch.	Vega	29	G. Baldenweck	Gave up	——	—
Cutter	Cariad ...	32	R.N.E.C., Devonport ...	Gave up	——	—

1ST SANTANDER RACE, 1929.

Starters :—*Maria del Carmen* (Spain), *Neptune*, *Ettsi IV* (Germany), *Avocet*, *La Railleuse* (France), *Gueurveur* (France), *Jolie Brise*, *Magnet*, *Grey Fox* and *Ilex*.

Crew of *Ilex* :—D. N. B. Hunt (skipper), Major S. J. Armstong, W. G. Fryer, M. T. L. Wilkinson, G. D. McK. Sutherland, Capt. Rupert L. Brown, and Carter (paid hand).

Course :—Plymouth—Santander (Spain). Distance 435 sea miles.

The first Santander race was a welcome opening for those yacht-owners who felt that they would like to take part in off-shore racing, but who failed to see the attraction of beating uncomfortably down Channel and probably across a short stretch of the Atlantic, merely to round a forbidding rock off the South West of Ireland and return more or less to where they had started from. The attraction of being entertained in a foreign country after the race was considerable : so the race brought to the line many ships new to the game, as well as several of the old die-hards.

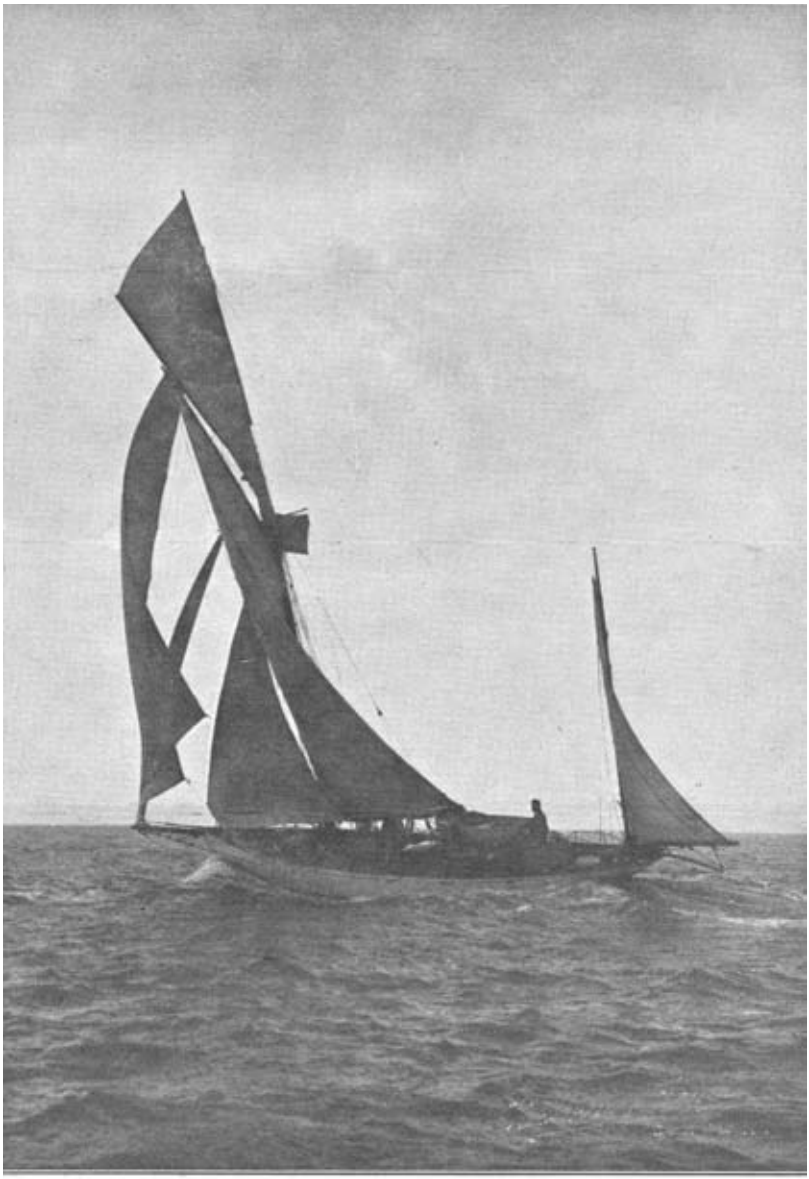
Ilex, the smallest boat in the race, was rather undermanned, and on the first day she fell astern of the others. After a night at sea, however, she found herself well in the hunt, with only *Jolie Brise*, *Neptune* and *Maria del Carmen* ahead and *Grey Fox* in company. Most of the race was sailed in light weather, with warm sun and blue seas, a welcome change from Fastnet racing. *Jolie Brise* repeated her Fastnet success by getting a lead off Ushant which she never lost, but *Ilex* was only a few miles behind her when she got her winning gun. A flat calm followed, so that the last six miles took as many hours to cover ; *Ilex* finished third, just after big *Maria del Carmen*, but took second prize comfortably on corrected time. *Grey Fox* was placed third.

Later followed a race from Santander to Bilbao which *Ilex* won.

RESULTS : SANTANDER RACE, 1929.

Start at 12.30 p.m. on 26th August, 1929.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Cutter	Jolie Brise ...	44	R. Somerset ...	3 9 35 0	2 22 57 0	1st
Schooner	Maria del Carmen ...	68	Conde de Garvey	3 14 26 54	3 14 26 54	5th
Yawl	Ilex	20	R.E.Y.C. ...	3 15 12 0	3 4 5 0	2nd
Yawl	Gueurveur ...	48	Baron de Neufville	3 15 24 0	3 11 46 30	4th
Ketch	Grey Fox ...	33	N. Newgass ...	3 16 6 0	3 8 29 35	3rd
Yawl	Avocet ...	52	E. D. Guinness	3 17 10 0	3 16 41 0	7th
Cutter	Neptune ...	62	Lt.-Col. Chambers	3 19 0 22	3 15 1 7	6th
Ketch	Ettsi IV ...	55	W. Wolfing ...	4 3 40 21	4 0 31 51	8th
Schooner	La Railleuse	50	Jean Lefranc ...	4 23 35 35	4 17 47 35	9th
Cutter	Magnet ...	34	Dr. W. F. Roach	5 20 0 0	5 1 38 0	10th



1.—"Ilex" as a Gaff Yawl at the start of the Fastnet Race, 1930.

Ilex 1

2.—"Ilex" as a Gaff Cutter at the start of the Fastnet Race, 1933.

Ilex 2

6TH FASTNET RACE, 1930.

Starters :—*Neptune, Lelanta* (U.S.A.), *Jolie Brise, Viking, Amaryllis, Magnet, Ariel* (France), *Maitenes II*, and *Ilex*.

Crew of *Ilex* :—D. N. B. Hunt (skipper), H. A. Macdonald, M. T. L. Wilkinson, H. S. Francis, Capt. R. H. Maclaren, T. P. Brown, A. Murray, D. W. Price, and Carter (paid hand).

Course :—As for 1926.

As in 1929, the Fastnet Race did not attract a really hot field of new fast yachts, but the usual well-tried cruisers with experienced crews were there. Ralph Peverley, an American living in England, was racing his new schooner *Lelanta*, successor to *La Goleta*, and M. Baldenweck's *Ariel* represented France. *Maitenes II* was there with a smaller sail plan, and was far less overhatted than in 1929.

The weather this year resembled that of 1927. The beat down Channel was against strong South Westerlies and a nasty sea. By the time the Lizard was reached, only *Jolie Brise, Ilex, Maitenes II* and *Amaryllis* were left in the race. *Maitenes II*, having taken an in-shore course, led at the Lizard, but put in to Newlyn for repairs and let *Jolie Brise* and *Ilex* ahead. After nearly four days of continuous beating in foul weather, at times well reefed down, *Ilex* met light weather off the Irish Coast and rounded the Fastnet some hours behind *Jolie Brise* and three hours ahead of *Maitenes II*.

On the homeward leg, the wind headed again for a time, then went round to the west and breezed up to force 7 or 8 : before the gale *Ilex* ran under full main like a scalded cat, alarming the crew with a couple of involuntary gybes on one occasion. The mainsail was scandalized and later handed, but *Ilex* continued at 8 knots till the wind eased off the Lizard and more sail was made.

Ilex finished second to *Jolie Brise* (who had won again), but *Maitenes II* saved her time for second prize and we were placed third. *Amaryllis* (4th) was the only other boat to finish.

It had been a very hard race in dirty weather.

RESULTS : FASTNET RACE, 1930.

Start at 11.30 a.m. on 12th August, 1930.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Cutter	Jolie Brise ...	44	R. Somerset ...	6 6 47 17	6 0 58 47	1st
Yawl	Ilex	20	R.E.Y.C. ...	6 18 40 16	6 11 19 31	3rd
Bm. Sloop	Maitenes II	25	Lt. W. B. Luard	6 21 20 56	6 6 59 56	2nd
Yawl	Amaryllis ...	37	R.N. College, Dartmouth ...	7 1 16 37	7 1 16 37	4th
Cutter	Neptune ...	62	Lt.-Col. Chambers	Gave up	——	—
Schooner	Lelanta ...	50	R. St. L. Peverley	Gave up	——	—
Cutter	Viking ...	41	Lt. R. Lindsay Fisher ...	Gave up	——	—
Schooner	Magnet ...	34	Dr. W. F. Roach	Gave up	——	—
Bm. Cut.	Ariel ...	26	G. Baldenweck	Gave up	——	—

2ND SANTANDER RACE, 1930.

Starters :—*Neptune, Avocet, Lelanta* (U.S.A.), *Inconnue* (France), *Jolie Brise, Karin III, Hope, Ariel* (France), *Maitenes II, Uraba III* (Colombia), and *Ilex*.

Crew of *Ilex* :—D. N. B. Hunt (skipper), H. A. Macdonald, M. T. L. Wilkinson, H. S. Francis, Major J. A. C. Pennycuick, J. de V. Hunt, E. F. Parker, Ll. Wansbrough-Jones, and Carter (paid hand).

Course :—As for 1929.

The Santander Race of 1930 was, to anticipate, a great triumph for *Ilex* and Dennis Hunt, and a satisfactory climax to the ship's career as a yawl. The calibre of the starters was, on the whole, greater than in 1929, though the days of specially designed off-shore racers had not yet come.

The start was in a fresh Westerly breeze. *Ilex* carried plain sail, though most of the others were reefed, and she was well placed at dusk on the first day. During the night the wind eased and *Neptune* was overhauled. The following day, in fluky and variable airs off the Breton coast, *Ilex* got ahead of *Jolie Brise* and led the fleet for a time.

The rest of the race was sailed in light weather, with smooth seas and no competitors in sight. As in any light weather race, the crew worked hard, sail changing and sail shifting to make the most of the variable airs, while on the last night at sea, a series of semi-tropical squalls from either beam gave the old ship short bursts of speed.

Neptune finished first, with *Jolie Brise* and *Ilex* close behind ; on corrected time, *Ilex* won from the Fastnet winner by four minutes, with *Neptune* third. After these three had finished, the wind obligingly died, so that the fourth boat home—*Lelanta*—did not finish for another seventeen hours.

As in 1929, the crew had a wonderful reception in Santander. But the revolution in Spain caused this very popular race to be discontinued in 1931. It is of interest to mention that, in addition to her cups, *Ilex* won about £200 in prize-money by her two Santander races.

RESULTS : SANTANDER RACE, 1930.

Start at 12.30 p.m. on 23rd August, 1930.

					Elapsed Time				Corrected Time				
Rig	Name		Tons	Owners	d.	h.	m.	s.	d.	h.	m.	s.	Place
Cutter	Neptune	...	62	Lt.-Col. Chambers	4	2	3	2	3	20	44	2	3rd
Cutter	Jolie Brise	...	44	R. Somerset ...	4	2	30	6	3	17	4	36	2nd
Yawl	Ilex ...	...	20	R.E.Y.C. ...	4	3	30	50	3	17	0	5	1st
Schooner	Lelanta	...	50	R. St. L. Peverley	4	21	1	16	4	14	51	31	7th
Bm. Sloop	Maitenes II	...	25	Lt. W. B. Luard	4	21	19	0	4	5	51	0	5th
Yawl	Avocet	...	52	E. D. Guinness ...	4	21	50	34	4	21	50	34	8th
Cutter	Karin III	...	30	Miss E. I. Dorrien-Smith ...	4	22	55	5	4	2	8	5	4th

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Yawl	Uraba III ...	22	R. German de Ribon	5 0 43 50	4 11 48 5	6th
Schooner	Inconnue ...	49	H. Guilberteau ...	5 4 48 20	4 22 47 35	9th
Bm. Cut.	Ariel ...	26	G. Baldenweck ...	Gave up	——	—
Cutter	Hope ...	29		Gave up	——	—

ATLANTIC RACE, 1931.

Starters :—*Landfall* (U.S.A.), *Lismore* (U.S.A.), *Highland Light* (U.S.A), *Mistress* (U.S.A.) *Water Gypsy* (U.S.A.), *Maitenes II*, *Skål* (U.S.A.), *Amberjack II* (U.S.A.), *Dorade* (U.S.A.) and *Ilex*.

Crew of *Ilex* :—D. N. B. Hunt (skipper), Capt. W. G. Fryer, H. A. Macdonald, M. T. L. Wilkinson, H. S. Francis, T. P. Brown, J. de V. Hunt, and H. Carrington Smith (cook).

Course :—Newport (Rhode Island)—Plymouth. Distance 2950 sea miles.

The Atlantic Race of 1931, run jointly by the Cruising Club of America and the Ocean Racing Club, was probably the most successful race of this kind which has yet been sailed. American yachtsmen produced several new fast deep-sea racers for the event, and this country failed to respond. Consequently *Ilex*, when first entered, seemed likely to be the only British starter, though later her old rival *Maitenes II* was added to the entries.

Most of the Corps will remember how the venture was accomplished : how the necessary funds were raised by private subscription and by the Corps Games Fund : how *Ilex* was converted from yawl to cutter by removing her mizen : how her skylights were renewed and roller reefing fitted : and how she was shipped to America on board the Cunarder *Berengaria*.

It was natural that Dennis Hunt should be chosen as skipper, for his experience and his successful handling of *Ilex* during the past three years made him an obvious choice. The rest of the crew had all sailed in ocean races previously, while in place of Carter, who remained behind, Carrington Smith came as amateur cook.

The hospitality shown to the crew in America is not likely to be forgotten. Nevertheless, it was hard work getting the ship ready for the start at Newport in the limited time at their disposal.

Of the eight fine American starters, three were especially interesting : *Landfall*, a colossal Bermudian ketch, specially built for the race for Paul Hammond (former owner of *Niña*, of 1928 fame), was scratch boat. Dudley Wolfe's new Paine cutter *Highland Light* was the successor to his *Mohawk* and was expected to run *Landfall* close. Thirdly there was *Dorade*, a slim, light displacement yawl, built in 1930 for her young designer Olin Stephens. With a hull more like a metre boat than an ocean-going cruiser, she was thought by some critics to be unfit for the race.

The race started in light Easterlies, and all but *Dorade* started close-hauled for the favourable current of the Gulf Stream, while the little yawl checked sheets for the Grand Banks. Of the Gulf Stream contingent, *Highland Light* went slowly into the lead, with *Landfall* lying second. *Ilex*, ill-served with wind, dropped into last place after about a week at sea, but thereafter conditions improved and she began to go ahead. A fortnight out she was lying seventh, *Lismore* having lost her topmast and dropped back into last place. During the latter half of the race, *Ilex* made several records for herself—she averaged 9 knots for 10 consecutive hours, did a day's run of 202 sea miles, and averaged 7 knots for a week.

To turn to the leaders, *Landfall* made the Lizard in the early hours of July 23rd, and sighted *Highland Light* to the Southward. The latter had saved her time on the scratch boat, but there was a great race between the two to be first to finish, and finally *Landfall* crossed the finishing line at Plymouth 14 minutes ahead. But there, lying in the harbour, was *Dorade*, the little yawl the critics had considered unfit to cross the Atlantic. Taking the Northern route and getting winds to her liking, she had finished nearly two days before the scratch boat!

The news of *Landfall's* arrival was heard by radio on board *Ilex*, and a great effort was made in the last two days of the race to save the old ship's time on Paul Hammond's racer. A gale, followed by a light breeze in a nasty sea, fought against the attainment of this object, and *Ilex* finished seventh at Plymouth, losing to *Landfall* on corrected time by less than an hour. *Maitenes II*, *Amberjack II* and *Lismore* finished within the next two days.

Ilex had done well against such a formidable field, for though she was seventh out of ten starters, she was only fifteen hours on corrected time behind *Skål*, which took second prize, surely a close result after nearly three thousand miles of ocean racing.

RESULTS: ATLANTIC RACE, 1931.

Start at 12 noon, on 4th July, 1931.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Bm. Yawl	Dorade ...	20	R. and O. J. Stephens ...	17 1 14 40	15 2 46 6	1st
Bm. Ketch	Landfall ...	91	Paul Hammond	18 23 2 29	18 23 2 29	6th
Bm. Cut.	Highland Light	53	Dudley F. Wolfe	18 23 16 28	18 10 9 40	3rd
Bm. Sch.	Mistress ...	52	G. E. Roosevelt	19 8 48 19	18 14 27 29	4th
Bm. Sch.	Water Gypsy	39	W. MacMillan...	20 1 46 35	19 0 19 28	8th
Cutter	Skal	25	R. F. Lawrence	20 6 26 11	18 8 30 47	2nd
Cutter	Ilex	20	R.E.Y.C. ...	20 20 0 25	18 23 46 24	7th
Bm. Sloop	Maitenes II	25	Lt. W. B. Luard	21 10 46 35	19 6 36 9	9th
Bm: Sch.	Amberjack II	25	P. D. Rust ...	21 14 27 17	18 14 30 0	5th
Ketch	Lismore ...	61	W. Roos ...	22 12 49 35	22 10 23 4	10th

(To be continued.)

MORE WORK THAT IS NOT IN THE TEXT-BOOK.

II.

By MAJOR A. C. BAILLIE, M.C., R.E.

SPURRED on by Colonel Garforth's interesting article in the December *R.E. Journal*, I venture to record certain minor expedients which were used in the campaign in Waziristan in 1919–1920.

The ideas were in most cases not my own, and I hope, if this article should meet the eyes of the officers who originated them, they will not think that I am trying to "steal their thunder."

I.—FLARES.

In common with all the staging camps in Waziristan, Ladha Camp was situated on a plateau at a considerable height above the river valley. The camp water supply was obtained from a series of springs coming from the bottom of a precipice below the camp. Water was, as usual, collected in a number of "Tanks, waterproof, 2,300 gallons" (so-called because they held not more than 1,500 gallons). These tanks were some distance from camp and as a result of their extreme suitability for use as shelters, developed an unfortunate habit of disappearing during the night. A picket was therefore sited on the spur above the tanks, but it was found that the Mahsud thieves were efficient enough to get away with the tanks without disturbing the peaceful slumbers of the picket. A request was accordingly received for an automatic flare to serve the two purposes of arousing the picket and illuminating their field of fire.

The only materials available were such as are usually carried in a Field Company with pack transport. Considerable experiment, with complete lack of success, was carried out in an endeavour to arrange electrical lighting of the flare, but it was found that the iridio-platinum wire contained in the "Box, testing and jointing" was altogether too sensitive for the purpose. Finally this idea was abandoned and the somewhat complicated-looking arrangement shown in Fig. 1 was arrived at. The actual flare consisted of cotton waste soaked in paraffin and held in half a ghee tin, fixed on the branch of a tree. The instantaneous fuse was provided with a tail of cordite at each end to make action more certain. The action is, I think, clear from the diagram: a pull on the trip wire releases the

heavy iron bar, which, in falling, strikes the nail resting on the ·303 cartridge, the cap explodes, lights the fuse and so the flare. The method of release is worthy of note because, besides being simple and adaptable to a number of similar uses, it can be made very sensitive yet still quite safe.

The first night after erection of the flare the usual attempt on the tanks took place and the flare went off with such success that it set the whole tree on fire. The picket saw nothing of the thieves, but the latter were so scared that no further attempts were made.

II.—Booby Traps.

In order to discourage the unpleasant nocturnal habits of the Mahsud considerable work was done on booby traps of all sorts. These usually took the form of a simple guncotton charge provided with a battery and suitable contacts for firing, the alternative method being by means of a friction tube obtained from the R.A.

Whilst on the subject of booby traps, I think it is worth while to give details of a very home-made device which was recently evolved to provide a safely adjustable contact for electrically-operated mines. This is illustrated in Fig. 2 and, as can be seen, consists only of one table (or dessert) knife, one 6-in. nail, a wooden picket and a small wooden wedge. The wedge is quite positive in action and ensures that no premature contact can possibly take place. To make this device weatherproof two knives with stainless steel blades should be used.

III.—Shower-Baths.

The design of shower-bath shown in Fig. 3 was used at Ladha Camp. This may be a standard expedient, but I personally have never yet seen it in a text-book. The baths were erected early in the hot weather and proved exceedingly popular. Some may consider that they would not be so suitable for a European climate. The raised irrigation channels of the North-West Frontier are, of course, particularly suitable for feeding this type of bath. The water supply stream at Ladha was made to supply first, the camp water supply; second, British troops' showers; third, Indian troops' showers; and finally used for irrigation. The showers were opened in style by General Skeen removing a sandbag from damming the irrigation channel. The only adverse criticism the General had to make was that he should have been provided with a silver sandbag for the purpose.

Fig. 3 is, I think, self-explanatory.

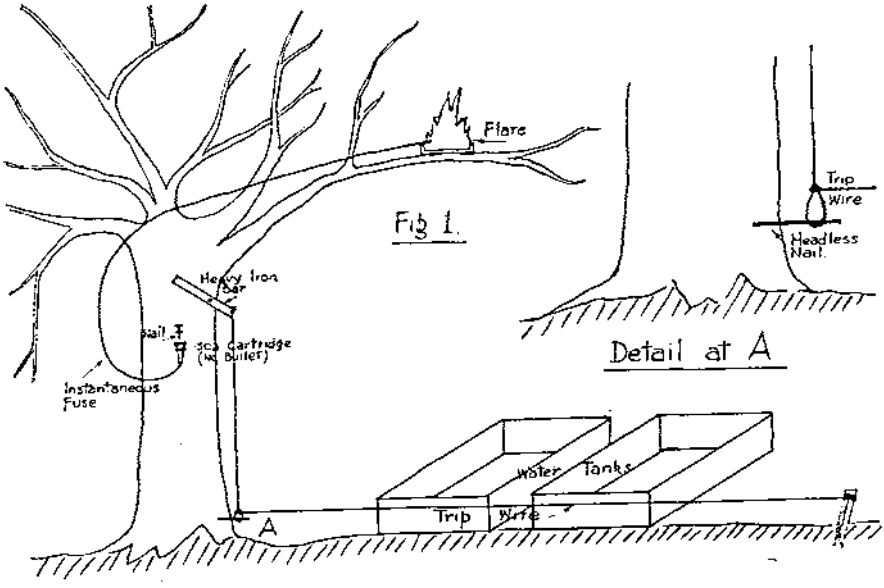


Fig 1.

Fig 2.

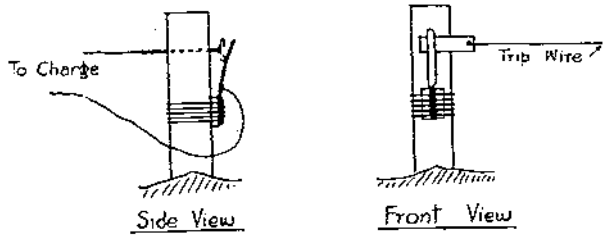
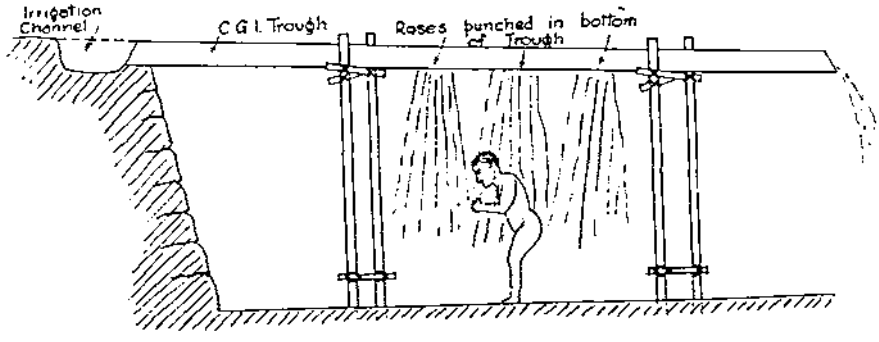


Fig 3.



IV.—De-Lousing.

Whilst in camp at Kaniguram a demand was received for a de-lousing chamber. The specification given was (I think) that clothing should be kept at a temperature of 140° for ten minutes. As usual, no material was available except what we could find. A chamber was accordingly excavated from the hillside and heated by means of braziers of charcoal, forced draught being supplied by the blacksmith's bellows through trenches in the ground. After many efforts the temperature was taken up to 160° and maintained there for twenty minutes. The clothing was then removed and found to be just as lively as when it was inserted. This cannot be considered one of the more successful expedients; however, I was credibly informed that there was no doubt that our little bedmates had had a very severe fright. At the same time the rival school of thought stated definitely that they would merely be infuriated and possibly stimulated.

A SHOOTING TRIP IN ALBANIA.

By SECOND-LIEUTENANT R. A. LINDSELL, R.E.

THE commentator on a newsreel, which I saw recently, described Albania as "the forgotten land of Europe," and certainly the average man's knowledge of that exceedingly interesting country is very limited.

Yet, in the months of December and January, some of the finest rough shooting in Europe may be had there, at a price well within the means of the average Sapper subaltern.

I organized a shooting trip there at the beginning of this year, and met with many unforeseen difficulties, chiefly due to the fact that so few Englishmen have visited that country in post-war years. I have, therefore, written up our journey in the hope that it may be of some help to those who are contemplating a shooting trip in southern Europe in the future.

PRELIMINARY ARRANGEMENTS.

The success of a trip of this kind must primarily depend upon efficient organization at home, since in Albania it is only too easy to waste many valuable shooting days in argument with the local officials over some trifling occurrence, which might easily have been avoided had sufficient foresight been employed.

Firstly, a town must be selected, which can be used as headquarters for the trip. This must lie in Southern Albania, as the shooting is by far the best there, and I have no hesitation in recommending the port of Santi Quaranta (Sarandë on most of the maps), which lies nearly opposite the island of Corfu, and some 30 miles from the Greek frontier. It is very convenient for the shipping of supplies from Italy and is connected with the capital by a motor-road (the only one in Southern Albania), on which it takes 10 hours to cover the 70 kilometres to Tirana.

It lies within easy reach of the best shooting-grounds, and boasts one small hotel, which is very clean and as comfortable as can be expected. The town also contains three cars, one of which can be hired through the hotel proprietor.

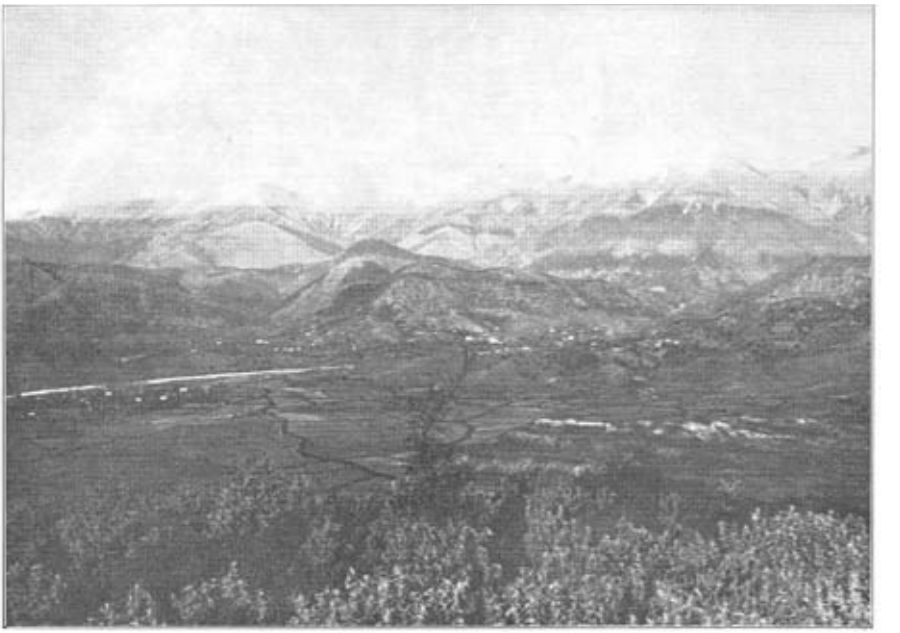
Secondly, a special Albanian *visa* is necessary for your passport. This may be obtained from the legation in London or through any travel agents for the sum of 14s. 6d.

Thirdly, there is the question of firearms. We were informed that no rifles could be taken through Italy and that the carrying of shot-guns would entail a three days' delay at the Italian frontier. It was, therefore, decided to take only 12-bore shotguns and to send them by air to Athens and thence by boat to our destination. The possibility of sending them on a boat, sailing direct from England, was explored, but found to be impracticable. It was discovered later, however, that, if approached direct, the Italian embassy are willing in certain cases to grant a "*laissez passer*" for firearms to *bona-fide* travellers to Albania. In any case, it is very advisable to insure the guns; the premium worked out at about 10s. per gun for the round trip, including the time spent in Albania.

Cartridges present another problem. It had originally been intended to order Greek cartridges to be sent up from Athens, as they are of superior quality to the Italian makes, and cartridges are not manufactured in Albania itself; however, about a week before sailing we received a cable from Athens stating that new import restrictions had recently been imposed, which rendered the import of cartridges nearly impossible. We hastily cabled to a firm in Rome, only to hear in reply that the necessary formalities would take a fortnight to complete; and finally, we sailed without having obtained any cartridges at all. Luckily, we had a wait of several hours at Brindisi on our journey out, and I was able to visit the Albanian Consul and the Italian customs superintendent and arrange to take with us the necessary supplies, which we were able to purchase locally.

Personally, having experienced several makes of foreign cartridges, I should strongly recommend the shipping of British cartridges, direct from England, if this could be arranged; but they would have to be dispatched many weeks in advance.

The next problem is the choice of route. The quickest and best way (since air travel is impossible as yet) is undoubtedly through France, Switzerland and Italy, via Boulogne, Belfort, Berne, the Simplon tunnel, Milan, Ancona, and then down the east coast to Brindisi. From here, one must go by boat across the Adriatic to Albania. An alternative method is to do the trip by car, and this was actually done by two members of our party, but involved an additional three to four days in travelling. They drove down to Rome and then across to Bari on the east coast of Italy, whence they had the car shipped to Valona in Albania (ships cannot get close in-shore at Santi Quaranta). However, they had only gone some 20 kilometres from Valona, when they smashed the oil sump of their car (a 4½-litre Lagonda) on the crown of the road, and finished the journey in the lorry which provides the bi-weekly postal service to the south. Cars in Albania are nearly all of American manufacture, with a large clearance, and seemingly



Albanian Panorama. Looking northwards from the hills above Santi Quaranta.

Albanian shooting trip

On board a local boat. (Note the "loaf" of bread in foreground.)

A group of beaters and children. The interpreter is reclining on the car's radiator.

Albanian shooting trip 2

unbreakable springs. The cost of travelling is the main item of expenditure; we travelled second-class without "sleepers," the return ticket costing £16, including the boat across the Adriatic. Second-class sleepers are an additional £1 14s. 6d., and, since the journey takes nearly three days, are well worth the extra money.

An international "through" coach runs right through from Boulogne to Brindisi, which makes the journey a very simple one.

Interpreter.

The Albanian language, which is of Illyrian origin, is chaotically difficult to the uninitiated, and since, in the south, most of the population is illiterate, an interpreter is essential if the trip is to go smoothly. We were fortunate in securing the services of an Albanian who had spent ten years in the United States as a waiter. He was absolutely invaluable to us and was possessed of a keen sense of humour and an inexhaustible store of American anecdotes (not all of them repeatable). However hot the weather, he always wore a tweed overcoat and black astrakhan fez, and never failed to address you as "brother." He lives in a small village in the interior, but I have got his address, and will willingly give it to any *bona-fide* inquirers.

Money.

The Albanian unit of currency is the gold franc (worth about 1s. 6d.). This is unobtainable in England, but travellers' cheques can be cashed at any of the Albanian State banks. Our total expenditure (including travelling expenses) worked out at about £50 per head, but this sum could be reduced by exercising strict economy to about £40, inclusive of everything.

The Journey.

We left London at 4.30 on the afternoon of Monday, December 28th, reaching Brindisi at 8.30 a.m. the following Wednesday, the only long halt *en route* being a three hours' wait at Milan.

At midday we embarked on an Italian diesel motor-ship of some 7,000 tons and reached Santi Quaranta about 10 o'clock that night. The passage across the Adriatic takes longer than one anticipates, as Santi Quaranta lies well to the south of Brindisi under the lee of the island of Corfu. Our ship anchored about 200 yards off-shore. The first view of our destination was not promising. Towering limestone crags, silhouetted against a watery moon, seemed to rise almost sheer from the dark water; at their foot gleamed a few scattered arc lamps (Santi Quaranta is very proud of its recently-installed electric light plant), and a few houses were dimly discernible

behind. A couple of small rowing-boats put out from the shore, manned by some exceedingly dirty individuals clad in sheepskins. We clambered down a rickety gangway into one of them, our suitcases were flung in after us, and we were paddled off into the darkness, while the brilliantly-lighted ship turned her bows once more towards the open sea.

THE SHOOTING TRIP.

There are no restrictions of any kind on the shooting of game in Albania; it is therefore advisable to get some expert advice as to which of all the many swamps and marshes are likely to be the most productive at that time, as sometimes the more easily accessible ones have been shot over by Italian shooting parties, of which there are one or two each year. It is quite easy to find completely virgin marshes, where a gun has never been fired.

Many of the best marshes lie some distance from Santi Quaranta, so we hired, for the duration of our visit, one of the three cars that the town boasted, and used this to get us to the vicinity of the marsh. When, however, as was frequently the case, the only motor road did not pass within walking distance of our destination, we used to take the car to the nearest point on the road, and then complete the journey on ponies. Sometimes we found it necessary to hire a local boat and go up or down the coast to the marshes; but the filthy smell which emanated from these boats, combined with the choppy seas which are encountered between Corfu and the mainland, sometimes had disastrous effects on the personnel.

The chief kinds of game are snipe, woodcock and wild duck. There are tracts of thick scrub, which are literally infested with woodcock at this time of the year, but we found it impossible to get at them without good dogs (the ordinary Albanian dog is quite hopeless for this work).

We found that the snipe provided the best sport, especially in the smaller marshes, which were intersected with small watercourses that provided splendid cover for the guns. There were only three guns in our party, and we found the best method was to drive the marsh in sections, sending two guns forward, while the third remained with the beaters. By this means, an excellent variety of shots was obtained; many of the birds going over the guns at a really good height. On our best day at the snipe, we killed 73 between the three guns, which, considering the difficulty of hitting a "rocketing" snipe, gives a fair indication of the number which were about.

The duck also provided us with very good sport; but normally we found them very hard to pick up, when shot, due to the abnormally high reeds (usually up to 8 feet tall, standing in 3 to 4 feet of water). We usually shot them from the native boats during the day, and went ashore for the morning and evening flights.

We often lost nearly half our bag of duck, owing to our inability to find them in the long reeds, despite the gallant efforts of the native beaters (at one evening flight, I lost 14 out of 29 duck that I brought down); a really good spaniel would have been invaluable.

An evening flight of duck in Albania is, to the sportsman who has not had much experience in duck-shooting, an unforgettable experience—it is of very short duration, usually only half an hour to twenty minutes, but during that time great flights of teal come whistling out of the dusk almost continuously with a speed that is breath-taking, while many hundreds of mallard, looking large and ungainly in comparison, come circling in from all directions, and the flashes and sharp reports of the guns are almost ceaseless.

I must add a few words about the larger kinds of game that are found in Albania. Wild pig are fairly numerous in Southern Albania —herds containing up to 50 in number being reported during our visit, but they are all located some distance from Santi Quaranta, necessitating either a 15-mile journey by local boat or a still longer one by pony into the interior near Delvino.

The officer commanding the local gendarmerie, who spoke excellent French, was most kind in arranging several pig shoots for us during our stay, and we managed to kill three pigs. The local dogs were most effective at this work, and seemed quite untiring, although the country was terribly rough and the undergrowth very thick. We used 12-bore shotguns with a so-called "lethal" ball cartridge of Italian make. The bullet consisted of a hollow cylinder of soft lead with wind-vanes in the centre to impart the necessary spin. They were guaranteed to kill at 400 metres, but we found that reasonable accuracy was impossible over approximately 80 yards; but up to that range, they were terribly efficacious. One of our party had a very heavily "choked" left barrel, and a very nasty accident, through trying to fire one of these cartridges through it, was barely averted.

Wolves are also still plentiful in the mountains and come down to the lower levels in the cold weather, but normally a longish trip of two or three days is necessary to ensure good sport.

There were also rumours of some bears that, we were told, lived in some caves near the top of one of the main ranges, and which were credited with the mysterious disappearance of a party of Italians last year.

To one of our pig-shooting trips there is attached a story. We had joined a party of Italians on a pig shoot to a place called Samiel, some fifteen miles down the coast. The local boat, which we hired for the occasion, seemed quite seaworthy, and we had an uneventful run to our destination under a cloudless sky. The day's sport was not good and involved a considerable amount of walking over some very typical Albanian countryside. It appeared, later, that

the ground had been disturbed the previous day by a Greek sportsman, who had landed from a yacht; but we succeeded in bagging one deer, which was carried back to the boat with difficulty, and we re-embarked at about 4.30 p.m. As soon, however, as the boat had got out of the lee of Corfu island, we encountered some pretty heavy seas and she began to pitch and roll rather badly. After this had been going on for some time, the master and owner of the ship said that he was afraid she would capsize, if he continued to sail into such heavy seas, and despite some voluble abuse in English and Italian (the interpreter was *hors de combat* below), he put the boat about, nearly turning her over in the process, and within a short time we were back in the sheltered bay, whence we had started about an hour previously. Having brought his boat to safety, the owner announced his intention of staying there until the weather improved. It was now blowing half a gale and growing rapidly worse, so we all went ashore to inspect the nearest village and see if it could offer any shelter, as the little cabin of the boat would only hold two or three and smelt abominably.

The village proved to be a collection of half a dozen or so "beehive" huts, thatched with grass and reeds and without windows or chimneys, whose small and dark interiors were filled with smoke, women, dirty children, various farmyard animals, and (we guessed) an army of lice. So we inquired how long it would take to walk back over the mountains, a distance of 12 to 13 miles, and were told about 3½ hours.

The Italians said that nothing would induce them to walk all that way and they decided to wait in the rain round a camp fire until the weather cleared. We procured a couple of guides from the village and set off just as it was getting dark. We had assumed that there would be some sort of path back to Santi Quaranta, but as the light faded, so did the path, and we found ourselves taking the first range of hills in the pitch darkness over the most terrible ground on which I have ever walked. Albanian hills are like nothing I have met elsewhere—grey, bare, limestone crags rise from the marshy valleys, and stretch away—range after range of them—into the distance, finally rising into snow-capped mountains on the horizon. They are strewn with rocks and boulders of every shape and size and from the crevices a coarse grass springs, rendering it quite impossible to pick one's footsteps. The guides in their leather moccasins were as sure-footed as the proverbial mountain goat, but the rest of us in our heavily nailed shooting-boots slipped and slithered helplessly. As the night crept on, we progressed slowly and painfully with the expenditure of an immense amount of energy and bad language, but, just as the lights of the town came into view, we ran into a shepherd's encampment. In Albania, this is not a very wise thing to do, as before retiring for the night, the shepherd lets loose a pack

of sheepdogs to deal with wolves or bandits (of which Albania can still boast a few). These sheepdogs are great savage brutes of mixed ancestry, and two or three will pull down a man in a few seconds, but they must never be shot even in self-defence. The blood feud is still very much alive in Albania to-day, and if you shoot a shepherd's dog, then the owner starts a blood feud with you (a young British naval officer lost his life in this way just after the war). When they attacked us, we kept them at bay, by standing back to back and showering them with stones, but we couldn't proceed until the shepherd had awakened and called off his dogs.

About a mile farther on, one of our party sprained his ankle rather badly and the two guides nobly supported him the remainder of the way home. We reached Santi Quaranta at about 11 p.m., feeling rather the worse for wear. It had taken us 5½ hours to cover the 12 miles. We found that the prefect of police, who had insisted that we should take an armed guard with us in the morning (we had taken one gendarme, whom we had left with the Italians), had mobilized the entire gendarmerie and sent them off by boat to investigate. About 8 o'clock the next morning, the Italians turned up looking rather bedraggled, and escorted by a number of gendarmes.

When we inquired for our guides of the previous night we were told that they had walked back over the hills, as soon as we had reached the hotel.

We only spent two nights away from the hotel during our trip, one in a native hut, and one round a camp fire in the open. If it were not for the extra weight, it would be well worth taking out proper camping equipment, as camping out would enable a lot of time to be saved, especially when doing the morning and evening flights of duck. The night spent in the native hut was at least educative, if not particularly comfortable. The hut was not of the usual " beehive " variety, but was a wooden shack, about ten feet by twenty, roofed with pantiles. It had no chimney and the smoke from a large wood fire that burned in the centre of the floor had to find its way out through chinks in the tiles, which made it impossible to stand up without being blinded.

The full complement of the hut that night was roughly as follows :—four of ourselves, the interpreter, two beaters whom we had brought with us, the headman of the village (who was also the owner of the hut), six male members of the latter's family, eight female friends of these, and an unspecified number of children and babies, who kept up an incessant howling most of the night ; not to mention a few stray dogs. We slept on strips of matting, laid on the mud floor, and were all very lousy next morning. The next time that we had to spend a night out, we camped in the open round a camp fire, and found it preferable, despite the cold.

For the first seven days, there were three of us shooting, but thereafter, due to a sprained ankle, one of us had to drop out, leaving only two guns, thus the average number of guns may be taken as $2\frac{1}{2}$. The following is our total bag for the trip of fifteen shooting days :— 252 snipe, 70 mallard, 42 teal, 27 plover, 5 woodcock, 3 wild pig, 3 pigeon, 1 deer, 1 landrail, 1 curlew, 1 widgeon ; making a total of 406 head.

The weather was very good throughout the trip. It was very warm and sunny without being oppressively hot, very like warm June weather in England. We had two days of fairly heavy rain, but it did not interfere seriously with the shooting. Snow fell in the mountains during the last day or two of our visit, making the winds very cold.

The food problem in Southern Albania is a serious one. Due to the mountainous nature of the countryside and the fact that there is no drainage in the valleys, there are no more than two or three small arable fields to each village, while the sheep and goats eke out a precarious livelihood on the rocky hillsides. In consequence, the villagers have very little to eat, but as this has been so for generations past, they have become acclimatized to it, and subsist on one meal a day, consisting usually of maize bread and coffee, without appearing to suffer any bad consequences.

It was astonishing to see the amount of work these wiry little Albanians could do on so little food. Whenever we lunched near a village, the children used to turn out *en masse* and sit round us in a complete circle, watching in awed amazement, while we consumed, rather self-consciously, huge packets of sandwiches. At the hotel itself, however, the food was very good ; we managed to get eggs for breakfast and they used to give us trout and duck, snipe or pig for dinner. The local beer was very good, but the wines were rather coarse and sour. The local oranges we found particularly good.

The hotel was small and rather primitive, but very clean and reasonably comfortable, while the charges, as elsewhere in Albania, were extremely low.

The majority of the Albanians are of the Moslem faith, although in the south, many villages still cling to the Greek Orthodox Church. The position of the women is still unbelievably backward. They are kept in great seclusion, where possible, and are made to do literally all the work, including wood-cutting and ploughing. The men, however, are very good-natured and friendly, and made enthusiastic, if rather unintelligent, beaters. The usual beater's pay was one *lek* (*i.e.*, $2\frac{1}{2}$d.) per day.

The greatest defect in the national character is that of procrastination ; one comes up against it from the moment of setting foot in the country and it drives one to the verge of insanity. "Never do

to-day anything that can be left till to-morrow," is the national slogan, and this infectious spirit of *laissez-faire* permeates all classes and creeds of the country. After the first few days, we discovered that the only way to get things done to time, was to stipulate that they must be completed at least an hour earlier than necessary, and even then we were often met with that unanswerable word " *nessa !* " which being translated, means to-morrow. The time question was still further complicated by the fact that in the interior they still used the old Turkish time, which assumes that the sun rises at one o'clock ; this necessitated adding to the proper time a quantity that varied throughout the year ; but as I never met anyone in the interior who owned a watch, it didn't seem to matter very much.

Albania is a land of high rocky hills and deep watery valleys—mile after mile, as far as the eye can see, the hilltops stretch away into the distance, looking cold and grey against the snowy whiteness of the mountain ranges on the skyline. They form an impenetrable barrier, effectually barring the way to civilization in the south. It will be many years yet before Albania welcomes its first train, when the country will no longer be called " the forgotten land of Europe."

MEMOIRS.

MAJOR-GENERAL GEORGE WALKER, C.B., C.B.E., D.S.O., COLONEL COMMANDANT ROYAL ENGINEERS.

GEORGE WALKER, who was born at Madras on 5th February, 1869, was the son of Major G. R. Walker, R.E., himself a distinguished officer of the Corps, who, after a varied service in India, in Canada—where he was one of the officers responsible for the starting and early organization of the Royal Military College at Kingston—and at home, died in 1889. George Walker's father, whose early death was a great loss to the Corps, was a man of outstanding character and abilities, and there is little doubt that his son derived his sterling qualities from him.

George Walker was educated at Wellington and the Shop, and received his first commission in the R.E. on 27th July, 1888. While undergoing his S.M.E. courses he was attached to the 23rd Field Company, R.E., then quartered in the North Square of Brompton Barracks, and he went with this company, commanded by Major Arthur Dorward, to the Curragh in 1891, and to Aldershot in 1893. He thoroughly enjoyed the life at the Curragh, where the work was not too strenuous and there was a certain amount of practical engineering practice for the company. The people round were hospitable and kind and there was plenty of cricket, tennis and golf, with some fishing in the summer and plenty of hunting in the winter. Aldershot, however, he disliked. He has recorded that he never saw his men and spent his time in what he thought unnecessary exercises in the riding school. Stables, orderly officer duty and "concertina" drill in the Long Valley took up a lot of time, but there was little engineering work. He was glad when he was ordered to India in 1894, where he served with the Bombay Sappers and Miners at Kirkee for over five years, for four of which he held the appointment of Adjutant.

In the spring of 1899 he came home on furlough. While there he was promoted Captain and soon after married Miss Louisa Weldon, daughter of Major-General Walter Weldon. Just before he was due to go back to India he was offered a post in the office of the Inspector-General of Fortifications at the War Office. Thinking that for a newly-married man, England would be a better place than India, he decided to accept this, but had great difficulty in persuading the Indian authorities to let him go without giving the usual six months'

Maj Gen G Walker C B CBE DSO

notice. However, he was successful and spent the next three years in the Barrack Designs Branch of the I.G.F.'s office, then located at the Horse Guards. In January, 1903, he was appointed Commander of a Cadet Company at Sandhurst. The R.M. College had at that time just undergone a complete reorganization. The old system under which all military subjects, namely tactics, field engineering, military topography and military law, were taught by specialist instructors who had nothing to do with the command, discipline or drill of the cadets, had been abolished and the College divided into companies, the commanders and officers of which were responsible for the whole of the instruction, as well as for the command, discipline and drill of the cadets of their companies. Walker was one of the first of the company commanders under the new system and he soon showed, by the way in which he taught personally and controlled the methods of his company officers, that he was a gifted teacher and leader and able to secure the confidence and respect both of the officers and of the cadets under him. After two years of this work, he was appointed Chief Instructor in Fortification at the R.M.A., Woolwich, at which establishment the system of having special instructors for the technical military subjects was still in force. He remained there for two years.

From January, 1907, he held for two years the appointment of Adjutant of the 2nd Lanarkshire R.E. Volunteers, which became during his adjutancy the Lowland Divisional Engineers, Territorial Force. He had therefore to take an important part in the conversion of this unit from a volunteer battalion of fortress engineers, with no engineering equipment, no transport, and practically no connection with any higher organization, into two field companies and a signal company of divisional engineers, with all the stores and equipment necessary for taking the field at short notice. That he carried out this very difficult task with his usual thoroughness and efficiency may be inferred from the excellent services the Lowland Divisional Engineers rendered in the war, for which they were mobilized five and a half years after he left them. He always after maintained an interest in the Lowland R.E. and showed it some years after the war by visiting them during their summer camp and spending two nights under canvas with them.

Three years in Sierra Leone followed his term with the Lowland R.E. and on its completion Walker, who had become a Major in January, 1908, was appointed in January, 1912, to the command of the 59th Field Company R.E. at the Curragh. He had two years and eight months in which to train and prepare the company for its great ordeal in the war. One of the officers who was with it testifies that it was a really well-trained company when it took the field in 1914. He says: "I joined the 59th Field Company at the Curragh in 1912, shortly after Walker had taken over the command, and went

out to the war as the senior subaltern of the company in August, 1914. I have always considered myself extremely lucky to have come under Walker's influence at the beginning of my army career. Whatever he did in the way of training or work had character, and he was of that type you can say is 'straight as a die.' If we committed errors, reproved we were, and Walker had a command of picturesque language that left one in no uncertainty as to what it was all about. . . . Yet we all regarded him as the kindest possible of commanders, and unhesitatingly took any troubles to him for help. Perhaps, too, one of his greatest assets was his sense of humour."

The 59th Company formed part of the divisional engineers of the 5th Division and took part with that division in the battles of Mons and Le Cateau. During the latter of these battles, the company was ordered to dig itself in on the extreme right of the line of battle on a spur overlooking the valley of the Selle. No sooner had they done so than three platoons of a Highland battalion, falling back after an unsuccessful counter-attack, reached the newly-made trench and took cover in it. Major Walker at once gave it up to them, taking his company out and making them lie down in the open under considerable shell and machine-gun fire.

During the withdrawal of the 5th Division that afternoon, Major Walker was leading the 59th Field Company (dismounted personnel only) across country in section parties or columns towards the village of Reumont, where it was to pass the night. Considerable numbers of men of various infantry units were also moving along in the vicinity, without order or formation, in small groups or singly, and without officers. It began to look as if this disordered movement to the rear might degenerate into a rout. Major Walker therefore halted the 59th Company, formed it into line facing the enemy and kept it in that formation for some time. The sight of a formed unit, cool and collected, under its own officers, facing in the proper direction had a marked effect on the retiring parties and individuals, many of whom reported themselves to Major Walker and were ordered to fall in alongside his company. A few officers and N.C.O's who happened to come along also fell in and collected their own men, and the disorderly movement to the rear was stopped. Major Walker then marched off the entire party, which resumed the retirement as a formed body.

Walker remained commanding the company throughout the autumn and winter of 1914–15, during which it took part, with the 5th Division, in the rest of the retirement, and in the advance to the Marne and the Aisne. During the former, their work was mainly the destruction of bridges, including that of the bridge over the Oise at Pontoise, blown up by Lieutenant (now Lieutenant-Colonel) J. A. C. Pennycuick, with Lieutenant West of the Intelligence Corps, and on the Aisne the company did valuable and gallant work in getting the

infantry across the river at Missy. Later on, the company took part in the move of the 5th Division to the Flanders area, in the operations in the neighbourhood of La Bassée and Givenchy and in the fighting south of Ypres in October. It was also in the second battle of Ypres in March, 1915, where it was mainly employed in the construction of bridges over the Yser Canal.

In March, 1915, Major Walker was appointed C.R.E. of the 27th Division with temporary rank of Lieutenant-Colonel. This division was in line in front of Ypres and was engaged in heavy fighting almost continuously till the end of May, when the battle died down. During the summer, the 27th Division was transferred to the newly-formed Third Army under General Munro on the Somme uplands and so took no part in the operations of Loos in September of that year. In November, it was sent to Salonika to form part of the British contingent in Macedonia.

Lieutenant-Colonel Walker continued to serve as C.R.E. of the 27th Division in Macedonia until June, 1916, when he became Chief Engineer XVI Corps for a few weeks and on 20th August was transferred to the XII Corps in the same capacity with the temporary rank of Brigadier-General. Throughout the rest of 1916, and the whole of 1917, General Walker carried on the duties of Chief Engineer of the XII Corps. The conditions were very different from those of warfare in France and Belgium. The theatre of war was of great area compared with the strength of the forces engaged, the frontage occupied by two corps being between 80 and 100 miles in width. The country was exceedingly diversified, parts mountainous and parts valleys or plains, ill-provided with roads and railways. There was consequently a very great variety of engineer work, for which improvisation was necessary as the force was by no means as well supplied with stores as the troops in France. The senior engineers had therefore to be men of great activity, energy and resource. The climate, moreover, was trying and malaria prevalent in the valleys. Walker had an attack in the winter of 1916–17, necessitating his being invalided to Malta for a short period. In December, 1917, while engaged in a reconnaissance of the Struma Valley, preparatory to its occupation by a British division, he contracted a very virulent type of malaria which made it necessary for him to be sent to Malta and thence back to England, and this brought his war service to an end. General Walker's honours received during the war were five mentions in dispatches, the D.S.O., the 1914 Star and clasp, the British War and Victory Medals, the order of the Star of Rumania, 3rd Class with swords, and the brevets of Lieutenant-Colonel and Colonel.

In June, 1918, when he was passed fit for service at home, he was sent to Newark to command the 3rd Reserve Battalion R.E., but after about two months, he was appointed Chief Engineer, London District, a post which he held till February, 1921, when he was sent

to Ireland as Chief Engineer, Irish Command. He had been promoted substantive Colonel on 30th September, 1920. General Walker has referred to the two years which he passed as Chief Engineer in Ireland as the worst he ever spent and as a horrible experience. They coincided with the worst period of the revolutionary movement. A large force of British troops was employed all over the country in the endeavour to suppress disorders. They had necessarily to be housed in buildings of any class, in workhouses, asylums, poor-houses, old prisons, breweries, empty hotels, etc., and in some places in wartime huts. A great amount of work was required to make most of these buildings suitable for military occupation, and to give reasonable comfort to the troops while employed on their difficult and dangerous tasks. Lighting, heating, drainage, sanitary conveniences and bathing facilities were the principal requirements in almost every case. The administration and control of these services under the prevailing conditions were a matter of great difficulty. Speed in the execution of the necessary works was of the first importance, since the troops were actually there and living in conditions of extreme discomfort, injurious to their health and efficiency, and this had to be remedied as quickly as possible. It was, therefore, impossible to follow the normal routine practice by which, in peacetime, funds for works services are provided and contracts made. At the same time, the Government of the day refused to recognize a state of war in Ireland and it was very difficult to persuade the financial authorities in London to relax one iota of the procedure intended for normal times, when rigid economy is the first essential and time a secondary factor. Those who knew Walker will have no difficulty in imagining the lively protests at the strangling effects of such restraints which emanated from him. It is due to him to say that his indignation and forceful demands for a freer hand were based on his personal knowledge of the dreadful conditions in which the troops were living and his desire to improve their lot. It was no doubt reinforced by his natural disposition to chafe at the restraints imposed by administrative authority at any time.

Walker was a man who believed in the necessity for seeing the condition of things for himself. He was, therefore, always travelling, frequently at considerable personal risk. The west of Ireland could not be visited without an escort. Cork had to be reached by sea, generally by the destroyer carrying the military mail from Dublin to Queenstown and thence by an armed launch to Cork city. Berehaven also required a trip by destroyer and there was a time when to get to Belfast it was necessary to go via Holyhead to Liverpool and thence across to Belfast by the usual steamer service. The land journeys had sometimes to be by armoured car, accompanied by a lorry with armed men who picketed the hills around when a halt was necessary. Main road bridges were generally down and the

roads sometimes cut or blocked as well. On one occasion an aeroplane had to be sent to watch over his car during a run from Fermoy to Cork. In Dublin, too, he often went in danger of his life. What he felt acutely was the uncertainty who were friends and who were enemies, and the knowledge that those who threatened his life were men who spoke his own language and were his fellow-countrymen, for he himself was Irish by descent. He was therefore glad to leave the country when the evacuation came.

Many officers will have noticed in the Headquarters Mess at Chatham the fine old Chippendale clock which, as a plate on it shows, was for about a hundred years in the office of the Chief Engineer in Ireland. When the Irish establishments were broken up General Walker saved this interesting relic for the Corps and sent it over to the Chatham Mess.

After a short period of half-pay, Walker was appointed Chief Engineer, Eastern Command, and held that post for the next two years. He again went on half-pay in June, 1925. This time he had to wait for two years before re-employment in a Major-General's appointment, he having been promoted to that rank in November, 1925. During this waiting period, he and his wife took up their residence at Corbridge-on-Tyne (Northumberland). The surroundings there, which gave opportunities for some fishing and shooting, were so agreeable to them, that when the time for final retirement came they decided to settle down there for good.

In June, 1927, he was appointed to succeed Major-General P. G. Grant as Commandant S.M.E., an appointment with which was combined those of Inspector of Royal Engineers and Commander of the Chatham Area. The appointment of Commandant S.M.E., with the additional responsibilities which have been tacked on to it since the war, is a heavy task for any man. He has not only the supervision of the training of the young officers at the S.M.E. itself, but is responsible for their administration while undergoing training in engineering at the University of Cambridge. He has also the command of the R.E. Depot, composed of the Training and Depot Battalions. The command of the troops in the Chatham Area, though not a heavy responsibility, adds appreciably to the calls on the time of a busy man, while the Inspectorship of the Royal Engineers entails a lot of travelling and inspection of units and also makes the holder the official adviser of the Training Branch of the General Staff at the War Office on all questions of engineer training and equipment. General Walker took all these duties very seriously and it would have been difficult to find a man whose experience in peace and war, with troops and in administrative appointments, better fitted him to carry them out. During his time in this appointment the first experiments in mechanization of R.E. field units were in progress and he took great interest in them. He also took a great

interest in the recreations and sports of the younger officers and was responsible for starting the R.E. Drag by arranging that a certain number of "fifteen bobbers" be made available to mount them, and also by making use, as far as the exigencies of the service permitted, of the horses on the establishment. With Lieutenant (now Captain) J. E. Marsh as the first Master, he organized the hunt, worked up a great enthusiasm for the idea, procured a workmanlike pack of hounds, and started the Drag on a footing which soon developed into a great success, providing for young officers facilities for sport and practice in horsemanship, for which in these mechanical times the opportunities are less than they used to be. General Walker was also responsible for the great improvements carried out in the Headquarters Mess during his time. He appointed a committee, with Colonel A. J. Savage as President, to make a comprehensive review of the pictures in the Mess with a view to their re-arrangement to the best advantage, and in order to economize space. In accordance with the report of this committee the pictures were all cleaned and re-arranged as regards their positions, certain of them being cut down. At the same time the Mess was re-decorated and a new and improved system of lighting installed. The results were a very great improvement, the pictures look better than ever and some space was obtained to admit of future acquisitions. Following on these improvements the re-modelling of the front hall and Secretary's office was also undertaken, which has resulted in a more dignified entrance and better accommodation. Altogether, General Walker left the Mess better than he found it. He held these headquarters appointments rather more than three and a half years and in February, 1931, was placed on the retired list on reaching the age limit of 62. He had been awarded the C.B.E. in 1923 and the C.B. in 1925.

After his retirement, General and Mrs. Walker settled down at Corbridge in Northumberland, where they had lived for a while a few years previously. He by no means relapsed into inactivity there, but showed the same zest and energy in public activities of civil life as he had in his military career. He became a member of the County Council, of the Hexham Rural District Council, of the Corbridge Parish Council and of the Area Guardians Committee and took frequent part in their deliberations. He also became a member of the Area Council of the British Legion and showed much interest in its work. In addition to these, he undertook a number of other public activities. One of his last acts was to draw up a scheme for precautions against air-raids, which was adopted by the Northumberland County Council as a model for the organization of air-raid precaution schemes in the county. In 1932, he was appointed Honorary Colonel of the 50th (Northumbrian) Divisional Engineers and in September, 1935, he was made a Colonel Commandant of the

Corps of R.E. He died very suddenly on 5th December, 1936, of angina pectoris.

Those who knew George Walker will probably agree that his outstanding characteristics were a robust common sense, good military judgment and an essentially practical mind. These qualities governed the methods by which he approached all the problems which came before him in the course of his varied service. To these qualities he added a very critical faculty and a habit of frank and fearless expression of his opinions, regardless of whether they were likely to be agreeable to his listeners. It is probable that he was never restrained from giving an opinion which he knew would be unpopular with his superiors by any consideration of the effect on his own prospects or on their feelings. A strong impulsion always to arrive at effective action by the shortest and most practical means made him very impatient of restraints, especially of those arising out of administrative procedure, and it cannot be denied that he was at times given to criticism of the policy of persons in authority. Nevertheless, he was in reality a thoroughly reliable and loyal subordinate with a strong sense of discipline. Once a decision had been given by authority, however contrary to his own views it might be, he would always carry it out with energy and entire loyalty.

By those under him, whether officers, cadets or rank and file, he was always looked up to with genuine respect and affection. He made a point of getting to know personally his men when he was a section and company commander and of caring for their welfare and interests, and it was the same with his Sandhurst and Woolwich cadets and with the young officers under him at Chatham and elsewhere. A kind heart and ready sympathy with those in difficulty was combined with a high sense of duty which prevented him from overlooking faults. He exacted from all under him the same high standard of work and duty that he showed himself. His life and actions were based on a simple and sincere Christianity and he exhibited in his conduct and outlook the characteristics of a Christian English gentleman.

For the impression he made on the Commanders under whom he served, I am permitted to quote from a note kindly given by Field-Marshal Lord Milne, who was the Commander of the 27th Division when Walker was its C.R.E., who was also Commander-in-Chief in Macedonia during the period he was a Chief Engineer in that country, and who again, when Commander-in-Chief, Eastern Command, had Walker under him as Chief Engineer at home. From these long associations in war and peace, he must have known more about his capacities and characteristics than anyone else. Lord Milne writes :—

" George Walker was one of those men whom, in a successful life, one picks up, attaches to oneself and, if one is wise, makes full use of. He was a military engineer, proud of the fact, with no ambitions to pose as anything else. He had no staff training, no ambitions for

high military command. At his own job he excelled. As C.R.E. of the 27th Division, I had one of the best men in the army. Nothing was too hard, nothing too difficult, nothing impossible. He was well served by extraordinarily efficient R.E. companies under him, but his was the driving power. . . . Tact he had none; he never went round a difficulty, he merely brushed it, or him, out of the way. We thoroughly understood each other; neither stood on ceremony, but we both were brutally frank. I loved the man, frank, loyal, steadfast and efficient, he was the *beau ideal* of an engineer in war-time; a great friend. He calmed down in peace; was just as efficient and more tactful, but loathed the restrictions of peacetime methods. He was essentially a war soldier and we shall never see a better at his own task."

To this penetrating and frank appreciation of the character of a Chief Engineer, by the distinguished and experienced Commander who knew him thoroughly, it is unnecessary to add anything. The hope may, however, be expressed that among the younger officers who will in time come up to the higher ranks and appointments in the Corps there may be many who will exhibit similar high military qualities. He was of a type of which the Corps can never have too many.

H.F.T.

Maj Gen F H Kelly C B CMG

MAJOR-GENERAL F. H. KELLY, C.B., C.M.G.

MAJOR-GENERAL FRANCIS HENRY KELLY, C.B., C.M.G., was born in 1859. His father, James Kelly, grandson of Roger Kelly of Woodmont (Beagh) of the old Galway family, the Kellys of Mullghmore, ran away to sea as a boy, and by his pluck and determination became a Master Mariner and ship owner. He was lost at sea in 1867.

Frank was then eight years old and his education started at Mr. Halpin's school in Kingstown. To widen it, his mother, who was not well off, moved over to England and sent him to the Elizabethan Grammar School at Bristol, where he spent four useful years under Dr. Caldecott, laying the foundation of his love of all outdoor games and thoroughness in work.

After a voyage to America to try and recover some of his father's investments, and some months' coaching by Dr. Lee of Kingstown, he passed 30th into Woolwich. Two years later he passed out 4th in Winn's batch, and was gazetted to the Corps on 6th April, 1879. As a young officer he revelled in the opportunity to play, though he never excelled in, all games, especially cricket. The river was an added attraction, and he coxed the winning junior and batch fours (Jeffrys, Pollen, Burrard and Sandbach) in 1880. From Chatham he was posted to the 6th Company at the Curragh where, during the troubles of 1881–82, he commanded the R.E. detachment in the Dublin Flying Column, which was composed of a Squadron 21st Lancers and two companies of the Rifle Brigade. This column was employed "On Service" near Edenderry and other parts of Ireland, and his services were brought to the notice of H.Q. in Dublin. His first "Mention."

In 1882, he sailed with his bride for India in the troopship *Seraphis*, having married in the previous year Elizabeth, daughter of Dr. F. E. Jencken and granddaughter of Baron von Lowenstein of Reval, first cousin of Princess Lieven. On arrival he was attached for some months to the Bengal Sappers and Miners at Roorkee, under Colonel E. T. Thackeray, the Mutiny V.C., and then posted to the M.W.S. at Pindi. He now started, small and wiry, at the age of 23 well handicapped in his career. An impecunious subaltern in the M.W.S., with a wife and baby*—without rich relations or powerful friends, but with boundless energy and determination, supported by a loyal and gallant wife. During the next two years he learnt his R.E. work,

* Brigadier E. H. Kelly, D.S.O., M.C. (late R.E.).

temporarily commanded the 6th Coy. Bengal Sappers and Miners, galloped, when he could, for various generals on field days to keep in touch with soldiering and passed his Higher Standard Urdu and Persian. In the spring of 1885, while the Amir Abdur Rahman was being fêted in Pindi, news came through of the Russian attack on the Afghan post at Panjdeh on the Oxus, and the withdrawal of the British Boundary Commission. War with Russia appeared imminent. Troops were mobilized and Kelly warned for active service with the 2nd Army Corps, but the affair blew over and it was not till some months later that he had his chance of active service, in a totally different quarter.

Owing to the arrogant and high-handed treatment of our traders by King Theebaw, an expeditionary force under General Prendergast, V.C., R.E., was sent to Upper Burma, and Kelly was ordered to join the 4th Coy. Bengal Sappers and Miners. They arrived at Rangoon on 8th November, and travelling by paddle-steamer for several days up the Irrawaddi, reached the Minhla Redoubt above the frontier post of Thyetmyo, a few hours after it had fallen. In the pouring rain and devoured by mosquitoes, they began to demolish the fort at Gwejyoung Kamiyo, on the left bank of the river. This fort, constructed by an Italian, was stoutly built and it took three weeks and a great quantity of powder before it was levelled to the ground. Meanwhile, Mandalay and Ava had fallen with very little resistance and on December 2nd, King Theebaw, and his queen, the cruel Soopiyalat, passed down the river as prisoners.

The troops thought the war was over, but Burma was not so easily won. On December 6th, the 4th Coy. left Minhla and after two days in the Palace at Mandalay, where Theebaw had built his tin-roofed spire to mark the centre of the earth, they moved up with the Bengal Brigade to capture Bhamo. This also fell at once, and for the next two months the 4th Coy. was occupied in building huts and stockades.

In February, it was reported that the Chinese had captured Magoun, and a small column, of which a detachment of sappers under Kelly formed a part, moved up through hilly and most difficult country to clear up the situation. After sixteen days' march with boat, pony, elephant and coolie transport they found that the inhabitants had beaten off the Chinese attack. The column then moved to Myitkyina on the northern frontier and returned to Bhamo at the end of March. Desultory fighting with the Punkan Kachins now started, and in June Kelly, in command of fifty sappers, half-company R.W.F. and a detachment of the 5th Bombay Infantry, was ordered to the Ruby Mines near Kyouk Myounsh to deal with dacoits. Having dispersed them and burnt their villages, the column returned to Bhamo.

In July, he returned to India with a medal, a clasp, and a mention to his credit. For the next ten years he lived the normal life of an

R.E. subaltern in the Military Works in Northern India, enjoyed excellent pig-sticking in Agra and duck-shooting in Sind, cursed the hot weather, went home on leave and did a " Wild East " course at Chatham.

In 1888, he obtained a Ballooning Certificate with the balloon detachment under Lt.-Col. Templar, at Lidsing, the birthplace of the Air Battalion, R.E., and Royal Air Force. He found time to keep up his general military knowledge by attendance at field days and qualified for staff employment under Brig.-Gen. Boyce Combe at Karachi; also to pass the Higher Standard Sindi and to become an interpreter in Baluchi.

By now his friendly cheerfulness, soundness and common sense was getting known, and in 1897, Sir George Wolseley, commanding the Punjab Army, applied for him as his Assistant Military Secretary. But Kelly was still a Captain and the Horse Guards had ruled that an A.M.S. was not to be below the rank of Major. Sir George White, C.-in-C. in India, writing personally to General Wolseley—and the last sentence is interesting—said :—

> " Yours of the 5th Feb. about Kelly R.E. acting as your A.M.S. I fear I cannot help you. The rule which forbids Captains being made Assistant Military Secretaries is not of Indian framing but was laid down by the Horse Guards about three years ago. Last year I was anxious to help . . . . I wish I could have sent you a more favourable reply. I do not know Captain Kelly personally but I have a general belief in R.E. officers."

In September, Kelly joined the Mohmand Field Force, under Sir Edmund Elles, as a Field Engineer, and came out of that short and very successful campaign with a mention, a medal and a clasp. He went straight from Peshawar to join General Yeatman Biggs, 2nd Division of the Tirah Ex. Force, as a Field Engineer, but the C.R.E., Col. Wilkinson, falling ill in November, he took over C.R.E. He was present at the actions at Dargai, the successful capture of the Sampagha and Arhanga passes, operations round Bagh, Maidan and in the Dwatoi defile, and the cold, harassed march down the Bara valley. For this campaign he received a clasp, another mention and a Brevet Lt.-Colonelcy. After officiating as D.A.A.G. at Lahore for six months, he was, in November, 1899, appointed C.R.E. at Loralai in Baluchistan; from there, eight months later he went to Quetta to officiate as A.A.G. (in those days the Chief Staff Officer). Thus his chance came. He was confirmed in the appointment and in September, 1902, became a substantive Colonel at 43. For four interesting years he had his fill of soldiering, which he had always loved more than the engineering side of his profession. He served as Chief Staff Officer to Sir R. Hart, Sir A. Gazelee, and General Smith-Dorrien and his subsequent success as a leader was chiefly

due to the help and teaching of these generals and to the practical study of tactics in that wide and varied area of Baluchistan. In October, 1904, Lord Curzon appointed a committee to examine and report on the maps of India. On the recommendation of this committee the future role of the survey of India largely depended and Kelly was nominated by Lord Kitchener as the military member to see that the requirements of the army were not subordinated. The next four and a half months were spent in a very strenuous but interesting tour of 15,000 miles over most of India and Burma. And the committee had the satisfaction, after the report was compiled, of finding that most of their suggestions had been approved of and acted upon, and of receiving the thanks of the Government of India.

In 1905, he had finished his time in Quetta and was appointed to command the Karachi Brigade. There his enthusiasm for musketry and, at that time, novel field firing with artillery and machine-gun covering fire over the heads of advancing infantry, caused, after the first alarm, a great feeling of trust and co-operation.

In 1906, came the visit of T.R.H. The Prince and Princess of Wales, a happy, cheering memory. The following year he was given command of the Ahmednagar Brigade, consisting of a mixed force of cavalry, artillery and infantry, where he found scope for his talents as a leader and a trainer of men. His insistence on night operations and physical fitness enforced by his own personal example was unwelcome to the soft and easy-going, but trained his units for war. His C.B. came in 1908, and in 1909 he was promoted Major-General. "Evidently," wrote General Smith-Dorrien, when congratulating him, "the new C.-in-C.'s report on your whist will only get home in time to stop your promotion to Lieut.-General!" For although a keen player, his standard was a joke.

Two years later his term of command came to an end and he took the opportunity of travelling home slowly, by China, Japan and Canada, where he made many friends.

Then came a long period of unemployment. A sapper, non-*p.s.c.*, who had served most of his time in India, was not to be easily employed, in spite of his fine record. However, he did not despair but increased his knowledge by joining the R.N. War Course at Portsmouth, lectures at the Staff College, training at Aldershot and umpiring on manœuvres. He was present at the famous manœuvre conference at Trinity Hall, Cambridge, when the onlookers thought that Haig must be a poor soldier because he was so inarticulate.

In the spring of 1913, Kelly was offered and accepted the command of the troops in South China, with H.Q. in Hong Kong, and before leaving was warned by the War Office to have a revised defence scheme prepared. The scheme was finished and ready to be put

into operation on the day he dined for the last time with Admiral Graf von Spee on board the *Scharnhorst*, little knowing that Coronel and the Falkland Islands lay just ahead. The outbreak of war found Hong Kong prepared, but the scenes of action were far away, and in 1915 he was brought home.

Appreciations of the work he had done and the way he had carried out his duty on the outbreak of war and the subsequent trying months poured in. From the Governor, Legislative Assembly, the Lord Chief Justice, senior unofficial members of the colony, the Chamber of Commerce, and the China Association. " The population," wrote H.E. " has realized that the protection of the colony was in the hands of a very capable and energetic leader. This has conduced to inspire the calm attitude which all classes have maintained since the outbreak of hostilities." After visiting France he took over command of the 69th East Anglian Division, with orders to push on with its training, as it would be sent out in 1916.

In the spring he carried out a reconnaissance with Colonel Swinton, and selected a training-ground in his divisional area near Thetford, in which to train with the utmost secrecy certain new machines. The secret was well kept and the name tank caused no uneasiness to the Germans until they appeared over the trenches near Martinspuich and Flers in September, 1916. As the year wore on, it became evident from the drain on units and lack of suitable recruits, that there would be little chance of the division as a whole being sent to France. Meanwhile, Kelly, having again visited the front in order to keep in touch with the latest ideas, had brought the division to a high standard of efficiency. His C.-in-C. said " You have had a hard and heartbreaking job, and can take the credit of having done it well," and the C.-in-C. Home Forces wrote of the good and hard work he had done and the excellent way in which he had trained the division. It therefore came as a shock to hear suddenly in August, 1917, that he was to hand over his division to a tired retired officer from France. He was promised further employment and again went to France and Italy, as it seemed impossible that he, one of the most active and energetic of generals on the active list, would be completely passed over by re-employed retired officers. But his long service abroad and lack of practical experience in France during the early stages of the war told against him and he was left. The disappointment was heavy. The greatest war in history had been fought ; he had taken little active part in it and had finished in the same rank as he had started. So that at the end of 1918, he retired with a mention and a C.M.G. to his credit. But undismayed, he determined to see how he could help others, and his worldly loss turned to wider human sympathy and spiritual gain. He joined the Ministry of Pensions as an " Officers' Friend," and a few months later was made Regional Director of Pensions for

the North of England. There for 5½ years his transparent sincerity and friendly sympathy coupled with his amused alertness in detecting a rogue, won him a host of friends. To avoid ostentation and the impersonal aloofness of bureaucracy, he bicycled wherever he could, and helped by his constant energy and personal touch to smooth out many of the local problems and difficulties in the wide area. Not sparing himself he had, while cycling in 1924, a slight stroke and retired from the Ministry, followed by many letters expressing "deep appreciation of his humane and sympathetic manner and of how he obtained a full measure of justice for all ex-servicemen and their dependents." His declining years were spent in Camberley, where he became a District Commissioner of Boy Scouts. He was a member of the Committee of his Club, the J.U.S., and of the Royal Albert Orphanage, and was a well-known figure at Lord's, where he watched his beloved cricket. He loved his profession and as a soldier had the gift of inspiring enthusiasm and trust by his level-headed soundness, quickness in decision and imperturbability in any situation. He had a genius for friendship. By his quiet understanding he was able to smooth away many difficulties and controlled his alertness and intense physical and mental energy under the quiet and unassuming manner. "You always," wrote a friend "make the best of everything and your letter has given me the idea of a man who is contented with his lot." He died peacefully and painlessly on the 18th March, 1937.

E.H.K.

CORRESPONDENCE.

ENGINEER ORDERS.

Army Headquarters,

Melbourne.

28.1.37.

To the Editor, *The Royal Engineers Journal.*

SIR,

Colonel Everett, in his comments on my article on " Engineer Orders " (see *R.E. Journal* June and September, 1936), goes straight to the point in using the term " efficient."

He served for some years on active service under a " very efficient " C.R.E. Practice makes perfect, the fittest survive, and efficient men do not suffer fools gladly, in spite of advice to the contrary; presumably, therefore, the Field Company Commanders were also paragons of efficiency. I served for some months on manœuvres under a Company Commander. Colonel Everett can never remember issuing a written operation order, though I can remember receiving several from my Company Commander. For these to have been intelligible, either my Company Commander should have studied his *F.S.R.* (the article in question was not written at that time) or I should have been a thought-reader.

If both the originator and the recipient of an order are efficient, very brief orders suffice. The less efficient either is, the longer the orders need be. An inefficient recipient will need to have every detail explained to him, while an inefficient originator will need to note down every point he intends to cover, otherwise he will forget them when he comes to issue his " verbal " orders.

Could Colonel Everett explain what form his verbal orders took? Possibly, as he takes such a liberty as to make *F.S.R.II* contradict itself, he will suggest a better form than that given in that revered volume.

On one point at least we agree. Colonel Everett suggests that Major Treblea would be well employed having a drink and a rest. A more careful reading of the order, and a little local knowledge, would show

him that Major T. with the above in view had sited his headquarters at a place where one, at least, could be obtained.

J. H. B. FOOTT,

Captain, Australian Staff Corps.

British Military Mission,
Baghdad.

1.3.37.

To The Editor, *The Royal Engineers Journal.*

SIR,

Having seen Captain Foott's letter dated 28th January, may I be allowed to deal with the points he raises?

Firstly, I am not bold enough, in print, to suggest that *F.S.R.* contradicts itself. Its teaching is plain: orders should normally be issued verbally, and confirmed in writing.

Secondly, as regards the form in which the verbal orders are issued, this, of course, should follow the sequence in which all orders are issued.

F.S.R.II, Sec. 15 (3), is both clear and sound. The teaching in it that "written confirming orders will subsequently be issued whenever practicable," depends for its application on the size of the unit or formation: no one expects the N.C.O. commanding an infantry section to issue them. With a small unit such as a Field Company, the issue of formal written orders in confirmation should be quite unnecessary if the O.C. and his officers make an intelligent use of their notebooks.

M. EVERETT, *Colonel.*

All Reviews of Books on military subjects are included in the provisions of K.R. 535c (*1935*).

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library, Horse Guards, Whitehall, S.W.1.)

HISTORY OF THE GREAT WAR. MILITARY OPERATIONS.

France and Belgium, 1918. March-April; continuation of the German Offensives. Compiled by Brigadier-General Sir JAMES E. EDMONDS, C.B., C.M.G., HON. D.LITT. (Oxon), R.E. (retired), *p.s.c.*

Maps and Sketches compiled by Major A. F. BECKE, HON. M.A. (Oxon), R.F.A. (retired).

(Macmillan & Co., Ltd., London, 1937. Price 12s. 6d.)

"1918," Vol. II, carries on the account of the great German offensive from the 27th March till it petered out on the 5th April, and gives the complete story of the Lys offensive towards Hazebrouck, which commenced on the 9th April and was brought to an end by Ludendorff's order on the 30th. It includes some specially interesting features:—An authoritative account of the supersession of General Sir Hubert Gough by the Government against the wishes of the commander-in-chief in the field, in the middle of a great battle: the facts about the loss of Kemmel Hill; and a final chapter entitled "Some Reflections," in which the official historian demolishes many of the legends about the German offensive, which have almost come to be regarded as facts in the years since the war: goes on to discuss the connection between the preliminaries of the great spring campaign of 1918 and the principles which should govern the relations between the Government of a democratic State and its military advisers: the difficulties of warfare conducted by a coalition: the drawbacks in a national system which forbids adequate preparations for war, and some of the lessons in higher tactics to be drawn from the campaign.

The information now available from the enemy side and from our Allies has enabled the compiler to clear up some of the uncertainty due to inadequate war diaries and the fog of war. His chapter of reflections does not, however, prevent Sir James Edmonds interpolating much useful criticism in the course of the narrative. His comments are very much to the point, but might be missed by a reader bored stiff by the detail necessary for a deeper study of the fighting.

The sketch maps are quite excellent, and so judiciously inserted in the letterpress that it is quite possible for the ordinary reader to obtain a bird's-eye view of the scene without opening the case of maps accompanying the volume. The maps are fully up to the high standard which Major Becke has set up for himself.

As regards the Lys offensive, the compiler has, since the volume was completed, received the comments of the Portuguese Staff on the account of their army's part in the fighting, and these are printed on a separate slip. The corrections and suggestions made by Sir J. Edmonds should be inserted in their places in the letterpress before the narrative is tackled. Leaflets of *Corrigenda* and *Addenda* referring to previous volumes are also provided as usual.

The general situation at the moment when Vol. II takes up the story was as

follows :—The Fifth and Third British Armies pivoting on Roeux (6m. east of Arras), had wheeled back so that the right, originally near La Fère, now stood west of Roye, a retirement westwards of nearly 30 miles. The greater part of the gap thus created on the east-west line, which now formed the southern boundary of the German salient, had been filled by the French, with whom the three divisions of the British III Corps and the remains of the 2nd and 3rd British Cavalry Divisions were now temporarily incorporated. The two British Armies (less these five divisions) were still holding a line only eight miles shorter than that of the 21st March. The front was still intact, but this fact had not always been realized in the back areas, nor even at some of the higher headquarters, for the scene on the roads leading to the rear presented many of the signs of disaster. The reviewer well remembers the shock to a fresh division marching up to relieve a battle-worn division in the front line when, instead of welcoming smiles, they were met with sullen faces and even curses by the civilians, many of them women, and witnessed the demoralization of some of the military inhabitants of their own race, presumably non-combatants, who had hurriedly left their once comfortable billets behind the line and were footing it westwards—armed to the teeth.

It was on the afternoon of the 26th March, when the opening of a breach between the French and British Armies appeared inevitable, that General Foch was charged, as a result of the Doullens Conference, to take steps to secure the co-ordination of the action of the Allied Armies on the Western Front. His first order was to the effect that not an inch more ground should be given up. For the sake of unity of command, all the British troops south of the Somme (Fifth Army), had already been transferred by mutual consent to the command of General Fayolle, commanding the new group of armies of reserve (G.A.R.), consisting of the French Third and Fourth Armies. Parts of twelve French divisions and two French cavalry divisions had already arrived and relieved some British units ; eight more (French) divisions and two cavalry divisions were approaching, and six more were under orders.

No real anxiety was felt for the front of the British Third Army, which had received reinforcements and was fighting on ground where there were plenty of old trenches, relics of the Battle of the Somme in 1916, which could be used for defence. The danger lay between the right of the Third Army and the left of the G.A.R., where, owing to the retirement of the VII Corps on 26th March, the Germans, had they pressed forward from Morlancourt (about 3m. N.W. of the left of the XIX Corps) and managed to cross the unguarded gap of six miles along the River Somme, would have actually found themselves in rear of the British XIX Corps.

The French reinforcements had been used to strengthen their front line, and not to relieve the tired British troops, except the 58th Division and the remains of the 2nd Cavalry Division. It must be remembered that the French cavalry and infantry had been thrown into the fight piecemeal, with no more S.A.A. than what they carried on the person and without their cookers and transport, and it cannot be wondered at that they were hustled back and in retiring had sought to feel to their right and keep touch with the French armies rather than maintain connection with the British on their left. Whether they would stand their ground depended on the speedy arrival of S.A.A., their own artillery and further reinforcements.

However, whether it was realized or not, the worst of the crisis was past. Despite the fact that the French C.-in-C. (General Pétain), still believing that his own front would be attacked on the 26th, if not earlier (see 1918, Vol I, p. 154), had judged it dangerous to send more than a minimum of divisions to assist the British : had issued orders that the French Armies must be kept together in one solid whole, and the G.A.R. in particular was not to be allowed to be cut off from the rest of the French forces : and had added, but only as a secondary object, that liaison was to be kept up, if possible, with the British forces. General Foch, on assuming charge of the operations had made it clear to him at the Doullens Conference that the French and British troops, remaining closely in touch, must cover Amiens, and that further

reinforcements must be brought up to consolidate the position of the British Fifth Army and as soon as possible to relieve it south of the Somme, without for that reason risking the area south of Roye.

This change in the situation was brought about, Sir J. Edmonds writes, first, by the moral effect of the action of General Foch: and secondly, by the arrival of substantial reinforcements in the shape of the 5th Division from Italy, the 1st, 3rd and 4th Australian Divisions and the New Zealand Division from the north, the four last each thirteen battalions strong.

Doubts of complete success had already entered the minds of the enemy. This is proved by an extract from an official German writer (Goes, p. 147), describing the events of 27th March. But Ludendorff had no intention of letting the enterprise fail for lack of impulse from the Supreme Command, and his orders issued on the 26th were for a general advance which, briefly, meant that the Seventh, Eighteenth and Second German Armies were to form a great barrier to keep off the French, while the Seventeenth and Sixth Armies pushed on to defeat the British, and the Fourth Army, the Belgians. Goes, however, says that "all hopes rested on Hutier's Eighteenth Army, which, heavily reinforced, might be expected to push on, the Seventeenth Army having been pinned to the ground and the Second Army reduced to inaction. Chapter I ends with a *résumé* of the British casualties to March 26, nominally 2,500 officers and 72,151 other ranks, figures which subsequently proved to be somewhat over the mark, and a record of the reinforcements available and those actually sent over from England. From the 23rd March, in four days, 39,304 men were actually sent over, and in the first week of April, 73,618. By the 31st August the reinforcements landed in France since the 21st March actually amounted to 544,005. Previous to the 21st March, only scanty reinforcements, barely sufficient to replace normal wastage, had reached the British Armies in France, and no provision whatever had been made to increase the strength of the B.E.F., despite the reiterated warnings of the coming German offensive. Comment is futile. Sir James Edmonds makes none, but he shows in detail what could have been done. As regards replenishing of material—by the end of March, the reserves of material in the theatre of war were just as great as on the eve of the great German offensive, despite the heavy calls on the spare stocks available in France on 21st March. "Mr Winston Churchill had become Minister of Munitions on 21st July, 1917," is Sir James Edmonds' sole remark.

We now come to the fighting on 27th March. Sir James Edmonds summarizes it as follows:—No important success was won by the enemy except against the VI Corps of General Debeney's First Army and the troops adjacent to it at the junction of the Allied Forces. The French Sixth Army on the extreme right was not engaged; from Noyon to Canny the French V Corps (Third Army), held its ground; but Robillot's II Cavalry Corps (one cavalry and two infantry divisions), swung back, pivoting on its right; de Mitry's VI Corps next to it also fell back, carrying with it the right of the British XVIII Corps (Maxse). Thus, folding doors, as it were, were opened to the Germans to enter, and units of the Eighteenth Army promptly did so, advancing to Montdidier, which they occupied unopposed. The German Second Army also made a thrust along the Somme and then across it at Chipilly (opposite Cérisy), through the gap left open by the unnecessary retirement of the British VII Corps from Bray on the 26th March. North of the Somme the enemy made only slight gains of ground, north of Albert near Aveluy, and on the British VI Corps front north of Ablainzevelle. The crossing at Cérisy, behind the left flank of the XIX Corps, was duly reported to General Fayolle but, as he had made arrangements for French troops to relieve the XVIII (British) Corps which was then to become reserve to the XIX (British) Corps, he seems to have assumed that the British Fifth Army could deal with the situation. General Gough had taken steps to move up reserves, but before they could arrive, the XIX Corps had to retire, which it did, after getting General Foch's permission, during the early hours of the 28th March.

The 27th March was regarded by some Germans—at the time—as "the turning point in the great offensive." The progress of their forces had been most unsatisfactory. The right of their Eighteenth Army, meeting with weak resistance from the newly arrived French infantry, alone pushed on in front of Montdidier. Their Second Army, on whose advance the whole operation—of forming a great barrier facing roughly south-west to keep off the French—mainly depended, made no progress against the British, now reinforced by Australians, the New Zealand Division, and Carey's Force (consisting mostly of British and American Engineers, scraped together on 26th March from the back area) in reserve behind the XIX Corps. Farther north their Seventeenth Army, already in some disorder, met with unexpected resistance from the British Third Army and could not gain ground. It had relied on the advance of the Second Army to help its own with flanking fire from the south. When Crown Prince Rupprecht found that neither the Seventeenth nor the right of the Second Army were progressing, he appealed to O.H.L. for three divisions, which were available, to reinforce the right wing of the Seventeenth Army. On hearing between 2 and 3 p.m. that he could not have them, in consternation he cried "Then we have lost the war." Ludendorff had refused, because he proposed to use them on the left wing of the Eighteenth Army with those already massed there to carry the attack forward from the line Chauny-Noyon to the line Fontenoy-Compiègne.

As a result, orders were issued for the attack of the Seventeenth Army to be temporarily stopped.

In the *Militär-Wochenblatt* of 25th July, 1935, General Wetzell, who was on Ludendorff's General Staff in 1918, writes that "the failure of O.H.L. to recognise at "once and exploit fully the gap made in the French front by the German advance "to Montdidier on 27th March, was one of the principal causes of the ill-success "of the great offensive." General Edmonds suggests that perhaps the failure to make more progress on the 27th was due to the fact that the boundary line between the Eighteenth and Second German Armies happened to lie just about the middle of the great salient and rendered mutual co-operation difficult.

For the failure of the enemy to achieve more, the narrative makes it abundantly clear that we have to thank the remnant of the British Fifth Army, and especially the eight divisions (all but one in action since 21st March) of the XIX Corps. Attacked on his nine-mile front by eleven German divisions, Lt.-General Sir Herbert Watts had received orders to maintain the line at all costs until the arrival of French troops. The front might be expected to hold its ground, as indeed it did, but the extreme danger of being outflanked both south and north rendered retirement before daylight unavoidable.

Considering, continues Sir James Edmonds, the weak numbers and the exhaustion of the infantry and the inadequate training of the majority of the regimental officers of the Fifth Army, the troops had exhibited remarkable powers of endurance. It had been a soldiers' battle, mainly directed by the infantry brigadiers. No operation orders were issued by G.H.Q., and practically none by the Fifth and Third Armies—as also was the case with the French. Not only was the enemy's advance held up by the Fifth Army with little loss of ground, but he was often counter-attacked with success. The British soldiers were satisfied that they had inflicted heavy losses on the enemy, and could, given secure flanks, hold their ground. Retirements were made at a slow walk, the Germans following at a few thousand yards' distance and halting whenever the British line lay down and faced them. They, too, were tired, and possibly hungrier, for they had outstripped their transport, there was little artillery support for them, and without it the German infantry did not seem inclined to face fire. They seemed, however, to be ready as ever promptly to recognize and take advantage of weak spots in the line. They had been specially trained in attack and penetration.

It was at this juncture, just when General Gough was organizing a counter-attack

on the left flank, that he was relieved of his command and informed that General Sir Henry Rawlinson had been appointed to take his place on the morrow.

In summing up the results of the fighting on the 28th March, Sir J. Edmonds writes: "Symptoms of the slowing up of the German offensive on the 27th March grew "more marked on the 28th. The great effort bearing the code name 'Mars' (our "'First Battle of Arras, 1918'), failed to accomplish more than a slight gain of ground "and the attacks against the rest of the front of the Third Army were entirely "unsuccessful."

The object of "Mars" had been to break through on both sides of the River Scarpe about the junction of the British Third and First Armies, which was three miles north of that stream, just south of Gavrelle, and to give a new impulse to the waning offensive power of the German Second and Seventeenth Armies. The left wing of the latter, already badly shaken, had achieved little on the 26th March and still less on the 27th, so much so that it had been ordered during the afternoon of the 27th to stand fast until the launch of the "Mars" offensive by its right wing, already fixed for the 28th March, had improved the situation.

It was only south of the Somme, at the junction of the Allied armies, which was still a weak spot owing to the exhaustion of the Fifth Army and the unavoidably slow arrival of French reinforcements, that the situation gave cause for alarm.

The imminence of a great German attack astride the River Scarpe had been emphasized in the G.H.Q. Intelligence summary of March 24th. The success of the defence on the 28th in front of Arras may be held to have justified the previous withdrawal of the British front line (*vide* 1918, Vol. I) from in front of Monchy-le-Preux, but it would have been interesting if Sir J. Edmonds had been able to collect evidence of the correctness of General Byng's decision, and of the effect of the surrender of observation over the whole of the enemy's front given by that commanding position. Curiously enough, the 15th Division, which had shared with the 37th Division the honour of the capture of Monchy-le-Preux on the 11th April, 1917, actually took part in the defence of the area directly west of and behind the remains of the village, and it was its 44th Infantry Brigade that was most heavily attacked, just south of the Arras-Cambrai main road, on the low ground south-west of Monchy. The Division put up a magnificent resistance, and the Germans were only able to make one slight entry on the right flank of the 44th Brigade, where a company of the 7th Cameron Highlanders in the front line had been reduced by the bombardment to only 12 men. The rest of the line held good, the junctions of battalions, so often weak points, being secured by "liaison posts," composed of mixed detachments of the companies and battalions concerned. In spite of heavy losses, however, the Germans reaching the small gap began to appear behind the 44th and 45th Brigades, which fell back to the rear line of the battle zone, the 3rd Division on their right being also involved. An eye-witness records that the German attacks on the second position were an "example of perfect infiltration, and the "way in which light signals met with response by the German artillery was an object lesson." The withdrawal of the 15th Division to the Green Line (its artillery had already been ordered back), was completed by 3 p.m., a little earlier than that of the 3rd Division. The situation appeared to be the most critical of the day, and Sir Charles Fergusson (XXII Corps) sent up all the reinforcements he could scrape together, including a cyclist battalion and a battalion of tanks. The latter were, however, not engaged, and it soon became evident that the combined fire of artillery, machine-guns, Lewis-guns and rifles which had beaten for more than seven hours on the German infantry was beginning to take effect; by 5 p.m. "Mars South" had definitely failed. It would be interesting to know where the German artillery observers who had directed the artillery support of the 12th and 236th, and behind them the 9th Reserve divisions, who carried out this attack, were located—at Monchy-le-Preux.

The Germans made their greatest effort, however, north of the River Scarpe, where

seven divisions, including the two in second line, were launched against the 4th and 56th British Divisions. Despite infiltration at several points, which caused a retirement to the battle zone, and a danger spot in the valley of the Scarpe, which was dealt with by a strong counter-attack in the evening by the 10th Brigade of the 4th Division (the 15th Division co-operating), "Mars North," like "Mars South," failed. What success the enemy achieved was won in the broken ground in the valleys north and south of Monchy, and in both cases must have been greatly assisted by the observation posts on the high ground about that village; but once the Germans showed themselves on the western slopes facing Arras, their fate was sealed by a hail of fire. Sir James Edmonds concludes his account:—"The ammunition expenditure "in the 24 hours from the morning of the 28th to the morning of the 29th was about "750 rounds per 18-pounder and 650 rounds per field howitzer, one of the largest of "the war: the heavy batteries, too, had opportunities to fire on the enemy in mass "formation, never leaving their position though his advanced troops came within "six hundred yards of some of them; but it was generally agreed that it was the "machine-guns, skilfully disposed, which played the principal part on this day in "checking the Germans."

It would seem on the evidence available that Sir Julian Byng was right, as was Sir Herbert Plumer later, in ordering a withdrawal before the battle. Sentiment—the natural feeling to hold on to what has cost immense sacrifices to gain—has to be ignored in war.

Many excuses have been made for the collapse of the Germans on the 28th March. To quote a German account (Schwarte iii, p. 393): The "Mars" attack failed because it had been insufficiently prepared and mounted too hurriedly; some of the commanders of artillery groups and batteries did not know the new attack procedure: the attacking troops encountered uncut wire and became involved in a maze of trenches; much disturbance was caused by enemy artillery fire and aeroplanes, and the artillery did not give proper support. The results of the day (for the Seventeenth Army) were unsatisfactory and did not fulfil hopes as regards the continuation of the general attack. The result was a feeling that the Army, owing to its vanishing offensive powers, had come to a standstill. Of the Second Army, all that is said is that the 28th March brought it no great success in spite of the very greatest efforts.

The present head of the German Historical Establishment writes: With the result of the "Mars" attack the operation against the British had run itself to a standstill. Crown Prince Rupprecht's group recommended its continuation after a few days' interval and renewed thorough preparation of the attack with fresh troops. Ludendorff declined the suggestion, and on the evening of the 28th March, ordered that (1) the "Mars" attack should not be renewed, (2) the attack further north by the left wing of the Sixth Army—"Valkyrie"—be dropped, (3) the Seventeenth Army to make only local attempts during the following days to hold the British: the attack—"Georgette"—in the direction of Hazebrouck to be prepared immediately by the right wing of the Sixth Army on the Lys front (which could not be for eight or ten days, and was further dependent on the weather): and this attack to be followed by an attack against the Belgians by the right wing of the Fourth Army with the object of breaking through across the Loo Canal. Lt.-Col. Foerster, in his *Graf Schlieffen und der Weltkrieg*, pp. 286–7, says: the only direction which seemed to offer prospects of success was where the front was still fluid, *i.e.*, on the southern wing of the German Second Army and opposite the German Eighteenth Army. . . . The French who had not yet been able to build up their forces according to plan, were to be further hindered in doing so. . . . The wheel forward south-westwards of the northern wing of the Second Army against the Somme below Amiens could certainly not now be counted on: it seemed all the more necessary, therefore, to capture Amiens itself by the shortest route and across the lower Avre.

The question of an advance on Paris was considered, but the idea was abandoned

on account of railway and transport difficulties. Orders were given during the afternoon of the 28th briefly to the effect that the Seventh, Eighteenth and Seventeenth German Armies were to stand fast, whilst the left wing of the Second Army pushed on towards Amiens, reinforced by two divisions of the Seventeenth Army, so that it would reach the line Ailly-sur-Noye—Thory, beyond the Avre, by the evening of the 30th, and that the Eighteenth Army should only continue its attack on the 30th.

Sir J. Edmonds summarizes the reasons why the German attack on 28th March against the defenders of the Arras front met with less success than that on 21st March against the Fifth Army :—(1) On the 28th, the defences were much stronger owing to their having been held much longer by the British : for instance, deep dugouts had been provided for the crews of machine-guns close to the emplacements : (2) divisional fronts were slightly shorter at Arras : (3) the front trenches at Arras were more lightly held, though, on the whole, the forward zone was more strongly garrisoned : (4) enemy bombardment, owing to shorter time available for preparation, was less accurate : (5) there was no fog. One would have imagined that the excellent observation afforded by high ground about Monchy-le-Preux would have made up for lack of time for preparation ; and it would seem, from the narrative, that accurate observation during and following the bombardment must have aided the early progress of the German attacks north and south of the Monchy ridge. On the other hand, the weather may have favoured the defence. It was changing to rain, and if, as is probable, the wind that brought the rain in the afternoon was westerly, the rain would have been in the faces of the attackers and observers. The reviewer remembers an occasion in 1900, during the South African War, near Lindley, O.F.S., when an attack over open veldt on a two battalion front (the column consisted of two battalions and 1,600 mounted rifles, one 4-gun battery and two pompoms) was successfully carried out, and with trifling loss, against 1,600 Boers and five guns under Christian De Wet, holding a position on the rear edge of a plateau, which would have been a far different proposition had it not been that a thunderstorm, coming up behind the attack, broke as the infantry deployed. The heavy rain, straight in the faces of the defenders, blinded them. "As the sun set behind rain clouds," writes Goes (p. 161)—"'Mars,' to whom so much blood was offered, was unable "to break open the Arras salient, and give a fresh aspect to the great battle on the "northern wing (of the Seventeenth Army)."

At 5 p.m. (28th) Sir Douglas Haig received from General Foch two "Notes" in his own handwriting, neither of which are reproduced in the French Official Account, to the effect that in consequence of the battle still raging on the front facing Montdidier, the French would be unable to extend their front beyond Quesnel (*i.e.*, nine miles south of the Somme instead of up to that river), and that the British Fifth Army (which should have been already relieved) would have to be reconstructed where it stood and hold its ground at all costs, as the necessity to prevent the enemy separating the Allied Armies was still the paramount consideration. He added that a reserve of about eight French infantry divisions ("infantry divisions," be it noted, probably without artillery), would be assembled in the neighbourhood of Amiens during the first days of April, and another group would probably be formed later between Beauvais and Amiens. It is worth noting that the three reinforcing French divisions moved up to the Montdidier front could so far muster only eight battalions between them, and that the British had handed over 75 locomotives to help the French railways.

The British C.-in-C. naturally expected that the enemy would renew his attacks on the 29th ; he was not to know, writes Sir J. Edmonds, for some time, that on the evening of the 28th, Ludendorff, recognizing that his plan of crushing the British had failed, had already changed his plans. Ludendorff had cause to regret that he had ignored the advice of his strategist, Lieut.-Colonel Wetzell, that a "second act" should be prepared to take place immediately the first had run its course : it would

now take ten days or more before the battering train of guns and trench mortars with the necessary ammunition could be in place for the Lys offensive ("Georgette") against Hazebrouck.

Rain fell during the night of the 28th-29th, icy cold, filling the shell craters and enormously increasing transport duties. The 29th was dark and the sky covered with rain clouds. It was the quietest day since the offensive began, but between Montdidier and the Luce the First French Army was again driven back a short distance. On this day, General Pershing placed four American divisions absolutely at the disposal of General Foch, who, however, still declined to send any French troops to support or to relieve the British Fifth Army, giving as his reason that it was impossible to relieve large formations in the midst of battle, and ordering that all reinforcements as they came up should be assembled in reserve. General Pétain now began to take a more favourable view of the general situation, and cancelled the plan of operations he had issued on the 27th March, in which he had forecast the assembly of two armies near Beauvais for the purpose of recovering Amiens, if the town were lost, by a counter-offensive. The gist of his new orders was "hold the "present position at all costs, drive the enemy, as soon as possible, to a distance "from Montdidier and Amiens, and, in any case, ensure liaison with the British "Armies." Sorting out units and reorganization was the gist of General Fayolle's orders. General Foch ordered the First French Army to place a strong reserve behind its left, so that it could, if need be, assist the British XIX Corps. In the end, however, it was the left of the First Army which received assistance from the British, who had already taken over more of the line, down to Moreuil.

H.M. The King visited Sir Douglas Haig at his G.H.Q. on the 29th March and was informed by him that the strength of the British infantry in France on 21st March had been about 100,000 less than a year before: that there were now three times as many Germans opposite the British front as there were in 1917: and that the British —by order of the British Government—had extended their line by one fifth more than its length had been the previous autumn. He had also been given to understand that the French Army relieved by the British was to remain in rear of the left flank of the French, ready to furnish support at the point of junction, whereas its divisions had been dispersed. This information did not fall on deaf ears, for in H.M.'s message of appreciation to Sir Douglas Haig on his return to England, is the passage—"We at home must ensure that the man power is adequately main-"tained. . . . Thus may you be relieved of any anxiety." The actual result was the arrival of over half a million reinforcements in France by the middle of August!

On receiving the formal O.H.L. orders to abandon the "Mars" offensive, the German Seventeenth Army gave instructions that the enemy must be led to imagine that the attack was to be continued; but, actually, a great deal of artillery was withdrawn and several divisions (in preparation for "Georgette"). Ludendorff's grandiose schemes for the overthrow and capture of the British Armies were dwindling down to the scale of a local operation to seize a railway centre, Amiens; for the Eighteenth Army was told—"French reinforcements are said to be approaching "*via* St. Just-Compiègne: they must not be permitted to engage according to plan: "the army will attack to-morrow (30th March) with all possible force!" The Second Army was directed to push forward its two left corps and reach the Avre, near Amiens, one division (of XXIII Corps) north of the Somme to support the attack by moving on Corbie. Goes (p. 169) summarizes the plan—"Amiens is now "the objective; to secure that place all the efforts of this and the following days will "be directed; the attacks near Montdidier and eastwards are only diversions to detain "enemy forces."

Sir James Edmonds compares this with what happened in 1914, when Falkenhayn under the compulsion of the Allied resistance had gradually reduced the scope of his plans. Instead of a grand operation, which he hoped would have led to the forces between Arras and the sea being enveloped on both flanks and driven to

surrender, his object, to save his face by a minor success, became no more than the capture of a single locality—Ypres.

On the 30th March, briefly, the XIX and XVIII British Corps (the latter now also under the command of Lieut.-General Watts, and the VII Corps, north of the Somme, but now transferred to Fifth Army), holding, with a few reinforcements, a 19-mile front, far from being annihilated, had not only brought the Germans to a standstill, but after ten days' fighting were still in line. North of the Somme, the Germans made no progress. Space does not admit of describing the very gallant and effective cavalry action of the Canadian Cavalry Brigade and 3rd Cavalry Brigade at Moreuil Wood, which earned for Brigadier-General Seely (now Lord Mottistone) a letter written by General Foch—to be communicated to the survivors of the Canadian Cavalry Brigade, in which he said: *En grande partie, grâce à elle, la situation, angoissante au début de la bataille, était rétablie.*

General Foch now considered that the battle was going well and was already considering the possibility of passing to the offensive. General Pétain, too, was now optimistic and ordered the assembly near Beauvais of a Fifth Army of twenty divisions (including one American, and four French divisions from Italy).

The Germans have placed on record that "the results of the 30th March, were "widely behind expectations." A German regimental account says—"the power "of attack was exhausted: spirits sank to zero; the division (18th) suffered a "reverse the like of which it had not yet experienced." (This division had been moved up from support against the 10th Australian Brigade of the 3rd Australian Division opposite Morlancourt on the afternoon of the 29th March.) Various regimental histories ascribed the failure to insufficient preparation, lack of effective artillery support, and "to the fire power of the British, who were so well hidden "that their machine-guns could not be spotted and knocked out."

On the 31st March (Easter Sunday), the only serious attack was between Moreuil and the Luce. Part of Moreuil Wood was lost by the 8th British Division, and, in consequence, the right of the 20th Division enfiladed from the wood began to withdraw. This movement spread to the left and led to the loss of Little Wood and Rifle Wood; but this was the limit of the German success. There was no attack north of the Somme.

On the evening of the 30th, Ludendorff had issued orders that the Second Army was to attack along its whole front, even if its left wing could not make headway: the two left corps of the Seventeenth Army were to co-operate opposite Hébuterne and Bucquoy. But the Second Army at once protested, and the operation was cancelled on reports coming in, showing that the results of the day's fighting had been even less successful than at first believed.

At midday on the 31st, Ludendorff evidently apprehended a counter-offensive, and issued orders to both the Crown Princes that the Eighteenth Army should be organized to repel a French attack, but that the right wing, with strong forces concentrated on a narrow front, should push forward westwards from Moreuil with the line Thory-Ailly as its objective (six and ten miles respectively S.W. of Montdidier), and that this extension of the Eighteenth Army front westwards should be reinforced at once by the Second Army, which itself was to press forward on Amiens. The attack was fixed for the 4th April. During the 1st, 2nd and 3rd April, there was a lull, but there was some successful "nibbling" by the 4th Australian Infantry Brigade at Hébuterne, and by the 32nd Division (now commanded by Major-General Shute from the 63rd Naval Division), which by a night attack, followed by an advance on the following evening, eventually captured the whole of Ayette.

On the 4th April, the Germans made their last great effort south of the Somme. Driving back part of the First French Army about two miles west of Moreuil, and farther north the 18th Division, 9th Australian Brigade and 14th Light Division of the XIX Corps (astride Amiens-Brié main road) nearly that distance, they met in both sectors with such obstinate resistance that the German Crown Prince reported that

evening that it was "no longer possible to throw the enemy back over the Noye . . . " and that the continuation of the attack on the 5th April was not to be thought of." Ludendorff puts it: "The battle was over by the 4th April. The enemy's resistance " was beyond our powers. We must not get drawn into the battle of attrition. . . . " In agreement with the commanders concerned, O.H.L. was forced to take the " extremely hard decision to abandon the attack on Amiens for good." Kuhl has written: "The great tactical successes had cost heavy sacrifices, some ninety " divisions in all having been engaged. The conclusion of the fighting left our troops, " especially on the Avre, in very unfavourable positions, which led to extraordinary " wastage." Villers Bretonneux still lived, to see another attack fail on 24th April, which Ludendorff describes as "an attempt of the Second Army to improve its " position."

At 8 p.m. Lieut.-General Watts and his staff were relieved in the command of the XIX Corps by the General (Butler) and staff of the III Corps. They had more than earned a rest: for they had been continuously in action since the 21st March and had had under them from the 28th March to the 1st April from nine to eleven divisions besides large detachments. The Official Historian perhaps did not know the late General Watts as well as the writer. He had made his name as O.C. of a Regimental District in Essex, five or six years before the war, but not being *p.s.c.* he regarded his army career as finished. He had a wonderful eye for country, and there can be no doubt that it was this quality that was responsible for the fame that he won in the March retreat in command of his magnificent Corps. Nothing could shake his belief in his own judgment, no orders written at an office desk from a map would influence his choice of where he would fight. He never failed to see things for himself; once he had seen the terrain, he could be relied on to fight on the right line. He was the ideal commander for the Retreat. The nation owes him a debt that can now never be repaid.

For the 5th April a general offensive by the Second Army, the left of the Seventeenth Army co-operating, had been ordered by O.H.L. against the fronts of the VII, V and IV British Corps north of the Somme, but actually only isolated attacks took place. These were carried out by picked troops, and designed mainly to extend the very shallow bridgehead across the marshy valley of the Ancre: to break in south of Hébuterne: and to capture Bucquoy. Possession of this last objective would deprive the British of the good observation which the village afforded and secure on the Artois plateau a footing, which was then to be exploited. The German successes were very small, too small to be shown on the map, writes Sir James Edmonds.

West of Bernoncourt there was a particularly determined attack on the 4th Australian Division, the 12th Brigade of which was forced back to the crest of the forward slope, where it successfully consolidated a position 500 to 1,000 yards in rear of its original front, after a heavy day's fighting. On the V Corps front in three places the enemy gained a little ground at heavy cost.

On the IV Corps (Lt.-General Sir G. M. Harper) front there was also heavy fighting. The New Zealanders lost La Signy Farm, held by a post of only 14 men. Farther north, at the junction of the 37th and 42nd Divisions, part of Bucquoy was lost. In the centre, between Hébuterne and Bucquoy, the enemy's attack, timed as we now know, for 9 a.m. after a bombardment commencing at 6.30 a.m., was forestalled by an attack by the 63rd Brigade of the 37th Division to capture Rossignol Wood, lying on the forward slope east of the British line. The night of the 4th-5th April was very wet, and at 2 a.m. the Brigadier, 63rd Brigade, appealed for the operation to be deferred or cancelled, as several of the eleven tanks allotted to him had failed to reach their starting line. This being refused by the Divisional Commander, two battalions attacked as ordered at 5.30 a.m. accompanied by three tanks, one of which actually made almost a complete circuit of the whole objective and was greatly instrumental in the capture of most of the wood and 199 prisoners of eleven

different units. The forward trenches were evidently filled with men, in anticipation of an advance if the attacks south of Hébuterne and at Bucquoy met with any success at 9 a.m. There were numerous trenches and some deep dugouts in the Wood. Before it could be properly cleared and mopped up, the Germans, who had been strongly reinforced, counter-attacked covered by a heavy barrage on the Wood, and the attacking troops were driven back to their original trenches. While this fighting was going on, news was received of the German attack at Bucquoy at 9 a.m., and the Brigadier held back his support battalion to deal with any enemy success in that direction on his left. There the Germans, who had quickly gained the north-eastern and eastern edge, eventually occupied the eastern half of the village of Bucquoy and a knoll on the high ground which enabled them to overlook the British front, but could progress no farther. The total losses of the 37th Division were 8 officers killed and 26 wounded; 61 o.r. killed and 276 wounded; and 5 officers and 164 o.r. missing. A poor exchange for a couple of hundred German prisoners, but possibly the diversion at Rossignol Wood saved the defenders of Bucquoy.* Thus ended the Great Offensive known as "Michael," so far as the British front was concerned.

(*To be continued.*) H.B-W.

THE FAR EASTERN CRISIS. (RECOLLECTIONS AND OBSERVATIONS.)

By HENRY L. STIMSON.

(Published by Harper & Bros. 1936.)

The author in his "Foreword" states that "the assault upon the Chinese Government in Manchuria by the Japanese Army in September, 1931, was the first major blow at the new system of war limitation and prevention built up by the nations which had suffered in the Great War." He claims that he was in a unique position to understand the attitude of the United States of America towards this conflict and the efforts which that country made to co-operate with the League of Nations towards reaching a settlement of the dispute. Notwithstanding the failure of the League to settle this and subsequent vital problems, he still believes that the development of effective methods of co-operation between the League and the U.S.A. "is an underlying international problem of the most urgent importance in the world to-day." It is largely in order to set out the difficulties that arose in this first effort at co-operation that Mr. Stimson has described in careful detail the history of the recent Sino-Japanese dispute and the attempts made by the League and the U.S.A. to promote a settlement.

The author's claim to write with authority are undoubted. As Governor-General of the Philippine Islands in 1928–1929, he had perforce to make a close study of Far Eastern questions, and as Secretary of State from 1929 to 1933 he was responsible for American foreign policy during the whole period of the League's efforts to deal with the dispute. His legal training has enabled him to set out his facts without bitterness and with studious fairness.

In describing American co-operation with the League of Nations, of which she was not a member, two interesting points emerge. When, early in January, 1932, Mr. Stimson considered that the League was not taking strong enough measures to restrain Japan, he, without previous consultation with any League members, issued his famous note, in which he declared that the American Government did not intend to recognize

* It was from this line that, just before dawn in a thick mist, visibility 5 yards, on the 21st August, the 37th Division went literally "over the top" at Bucquoy, in the first stage of the final advance which ended on the eastern edge of the Forêt de Mormal on Armistice Day, 1918. It had its revenge—300 prisoners in Bucquoy, with hardly a man hit. In the interval it had earned two V.C's in an attempt to regain the knoll it had lost on the 5th April.

any agreement which was brought about by means contrary to the Pact of Paris (the Kellogg-Briand Pact) of 1928. Mr. Stimson expresses some surprise that members of the League, who had never been consulted on the point, not unnaturally did not immediately subscribe to this doctrine. Mr. Stimson, however, can justifiably claim that his policy was the correct one, for it was followed unanimously by the League two months later, when Japanese action at Shanghai startled the rest of the world. The other point of great interest is that Mr. Stimson was sounded as to the possibility of economic sanctions being imposed on Japan jointly by the League and the U.S.A. In this case, though Mr. Stimson favoured such a course, statutory authority of the U.S. Congress would have been required, and as it was not likely that this would have been granted, the proposals came to nothing.

The book describes with great moderation, knowledge and sympathy the conditions in the Far East that led up to the dispute. It gives a clear and detailed account of the clash between the two countries, early attempts by the League at conciliation, China's appeal to the League Assembly for judgment, and the League's final adjudication of responsibility. The book is completed by the very useful inclusion of the following appendixes. I. The Covenant of the League of Nations. II. The Nine Power Treaty. III. The Pact of Paris. IV. The Finding of the League Assembly.

The writing is refreshingly clear and persuasive, and the whole treatment of this difficult dispute is lacking in all offence, a model for those who write on controversial international problems. The book is one which all interested in the Far East are strongly recommended to read.

E.A.J.

RHODES GOES NORTH.

By J. E. S. GREEN.

(Messrs. G. Bell & Sons, Ltd. Price 12s. 6d. net.)

The volume under review deals with events and incidents connected with the expansion of British territory in South Africa: Cecil Rhodes played a very important part in securing this result.

In 1884, the Transvaal Government set up the Republics of Goshen and Stellaland in British territory. This action of the South African Republic caused a great protest to be raised in Cape Colony, and the British Government was called upon to intervene by force of arms. Lord Derby, after seeking the Cape Government's advice, decided with the concurrence of the British Cabinet on military operations to safeguard the British trade route to the north.

Colonel Sir Charles Warren was entrusted with the task of protecting British interests in Bechuanaland and a sufficiently overwhelming force was placed under his command for this purpose. Sir Charles arrived at the Cape on December 6th, 1884, with instructions to remove the filibusters from Bechuanaland "to restore order in the territory, to reinstate the natives on their lands, to take such measures as may be necessary to prevent further depredation, and finally to hold the country until its further destination is known!" For these purposes he was invested on the civil side with the rank of Special Commissioner, and, on the military side, with the rank of Major-General. So far as military operations and military duties were concerned, Sir Charles was not accountable either to the High Commissioner or to the Cape Government. The High Commissioner was requested to leave him a very large discretion as regards local matters.

Sir Charles proceeded north in January, 1885; Kruger met him at Fourteen Streams on the 24th of this month and endeavoured, without success, to get him to turn back with the expeditionary force. Sir Charles arrived in Goshen during March, 1885, and on the 23rd of this month a British Protectorate was proclaimed

over Bechuanaland and the Kalahari and he was able in June, 1885, to report that he had pacified South Africa. Sir Charles was recalled in the year last mentioned, and left the Cape on September 30th.

In the succeeding chapters the story is told of the Empire's acquisition of the territories that now make up Southern Rhodesia—Mashonaland and Matabeleland. The steps taken by Rhodes and his friends to obtain the Charter on which the British South Africa Company was eventually founded are described at considerable length: many difficulties had to be overcome and they are fully dealt with. Several disputes took place between King Lobengula and his warriors, Rhodes and the Cape politicians, Kruger and the Boers, whilst the Imperial Government stood in background at this time.

The author of the book, who lives in South Africa, has consulted many original sources for his material, and has written an extremely readable volume which should prove of much interest to all desiring to acquire a knowledge of the period of South African history which has been dealt with by him. The climax of the situation was a "peaceful" invasion—and Rhodes went north.

W.A.J.O'M.

TOWARDS ARMAGEDDON.

By Major-General J. F. C. Fuller, C.B., C.B.E., D.S.O.

(Lovat Dickson. Price 6s.)

In this book General Fuller has set himself the task of analysing the defence problems of the Empire in all their aspects. His criticisms of existing conditions cover our system of Government, our machinery for the direction of war and the role, constitution and organization of our fighting services. In each case he advances constructive proposals for sweeping reform. Few of us are altogether satisfied that our defence organization and policy are, or indeed can ever be, fully adapted to our requirements and General Fuller's criticisms have support in many quarters. I doubt, however, if his constructive proposals will have at all the same number of backers.

It would be unfair in a short notice to attempt to indicate the nature of his proposals, but they are based on what he considers experience shows that twentieth century civilization demands in war and in peace, viz.: Increasing necessity for:— (1) Political Authority. (2) National Discipline. (3) Economic Self-Sufficiency. (4) Scientific Weapons.

He admits that the components of the Empire are unlikely ever to accept a full-blooded Dictatorship and therefore seeks to construct an acceptable and effective substitute.

In presenting his scheme, one may perhaps accuse him of dealing himself too many trumps, inasmuch that he appears to credit the personnel of his Directive organization with a standard of capacity he denies to those who operate our existing system. Moreover, he credits new weapons with powers not yet completely proved.

To whatever extent we may agree or disagree with him, General Fuller is always interesting and on this occasion he has been content to write throughout in language comprehensible to the ordinary man.

C.W.G.

EUROPE IN ARMS.

By Liddell Hart.

(Faber & Faber. Price 12s. 6d.)

This book is largely an edited collection of a number of articles which the author has from time to time contributed to *The Times* or the American Press. Of the

twenty-four chapters, not more than five or six are original. Notwithstanding this, the book is an important addition to the literature dealing with the military situation in Europe, and that of England in particular. It suffers, however, in spite of editing, as a result of its origin from the faults of repetition and lack of logical sequence, and this makes a general survey of the theme or themes none too easy.

After an introductory chapter on the "Defence of Freedom," which is so well treated that it alone places the book in a very high class, the author has divided the book into four parts. Part I labelled "Forces," is concerned with the present state of the forces of the Great Powers. Here the author has given in a reasonably condensed form a sketch of the forces of Europe, finishing with the rearmament of Britain. He criticizes, as he has not ceased to do in *The Times* and elsewhere, the tendency to expand all services without due consideration of the probable role of each in a major war of the future.

In Part II, "Problems," he deals with a variety of more detailed questions of warfare and defence problems. Here there is little new to those who follow Captain Liddell Hart's articles in the Press; "The Capital Ship," the "Role of the Army," "Higher Direction of Forces" and the "Education of the Officers" are all old friends. Here the author is getting on more contentious ground and one may begin to criticize.

Part III discusses measures that are being, or might be taken to improve our situation. These mostly concern the organization of our defence services as a whole and the man power situation, recruiting and the Territorial Army.

Finally, in Part IV, the author ventures into the future. Many will find the last chapter, we believe a new one, the most interesting in the book. Here he asks the question "Would another war end civilization?" He is among those writers, to be found in most of the Greater Powers, who are doubtful that the next war will open with concentrated air attacks on the rival capitals. He foresees at first, air forces being used against the communications of armies, till the war on land ends in a general farce. Then air forces may turn their attention to the civil population, only to be themselves reduced to a state of stalemate by attacks on their own ground organizations. The war may then peter out in an atmosphere charged with a sense of futility.

While everyone has a right to form his own conclusions on such matters, and many will in doing so agree with much of what Captain Liddell Hart has written, all conclusions must be based on a very thorough examination of the facts. The author does not fail throughout the book to stress the importance of a scientific training for officers. But it must be confessed that in some respects Captain Liddell Hart fails to deal with his subject as scientifically as one would wish. Scientific investigation demands an unprejudiced investigation of all known factors before any theory is formed, followed by equally unprejudiced cross-checking of the theory by all available evidence. He tends to form a theory, often represented by a catch-phrase, and then to present only confirmatory facts in such a way as to support his theory. Examples from the book could be multiplied, but one minor example early in the book may be quoted in illustration. The author condemns as archaic the prominence of horsed cavalry in the Russian Army. He may be right, but before drawing a scientific conclusion the bearing of the snow-covered plains in winter, and of the forests in certain areas of Russia, on the relative value of horse and machine must be given due consideration. Again the reader must remember that a scientific theory is only a theory, and is liable to be upset by fresh evidence. A good deal of the conclusions made on the Abyssinian War in 1935, as quoted in Chapter XXIII, needs reconsideration in the light of the more recent books by Marshals de Bono and Badoglio and General Dall'Ora. Captain Liddell Hart recognizes this continuous change in the interplay of facts and his inability, as an onlooker, by whistle to check the game.

Finally, it may be said that Captain Liddell Hart (we give him his rank, though he

has shed it himself), has given us a work of the very highest value, and one which every thinking man, whether of the fighting forces or of the public, should read and ponder deeply. His views are challenging, his arguments in the main convincing, and it is unnecessary to add that his historical knowledge is of the highest order.

R.P.-W.

ROAD THROUGH KURDISTAN.

By A. M. Hamilton.

(Faber & Faber. Price 12s. 6d.)

From the engineer's standpoint it would have been better had Captain Hamilton been less modest about his great achievement in driving a motor road through Kurdistan by way of the Rowanduz and Berserini gorges and told us more in detail of the difficulties that he had to meet and how he contended with them. Four years of such work, with no trained assistants whatever and with labour that was entirely unskilled when the job was started, offered a task that falls to few in this mechanical age. That the author succeeded is a tribute not only to his efficiency as an engineer but also to his character as a man and a leader of men.

To most of those who now drive in comfort from Arbil to Diana in under four hours it is perhaps not too hard to realize the immensity of the task of bringing up all material and equipment over sand and mud tracks to roadhead, for they will at some time or other have suffered from having their cars firmly embedded in the alluvial mud or the valley clay during other journeys in Iraq. But it is to the experienced eye that becomes apparent the difficulty of surveying, aligning and constructing this easily-graded and well-bridged road through the mountain gorges.

These profound fissures in the earth's surface are more impressive each time that they are visited and in that they resemble the Pyramids of Egypt, whose size and majesty are too vast for the human mind to appreciate at the first or second view.

The hope that this road would lead to an increase of east-west trade has so far been frustrated by the rigidly national economic policy of Iran, but it has brought a great measure of prosperity to the part of Kurdistan it traverses and has lightened the task of administration.

Fortunately for the police and the troops, Captain Hamilton's opinion of the marksmanship of the Kurds is somewhat exaggerated. Had they the skill with their weapons of the tribesmen of the North-West Frontier, the casualties among the police during the hunting down of the occasional bandit, and of the troops during the Barzan campaign of 1932, would have been infinitely greater, as is borne out by the experience of British officers who took part in the latter operations.

The author's interesting and often amusing anecdotes are selected to illustrate the character and habits of the people and the problems confronting their rulers. General Rowan-Robinson's foreword offers a sound comment on the Assyrian question and an appreciation of Captain Hamilton's work and character that cannot be bettered.

This eminently readable book is completed with a series of excellent photographs (whose titles might, however, be more conveniently placed) and two sketch maps, so bound as to be easily accessible to the reader.

G.G.W.

THE HISTORY OF THE UNITED SERVICES CLUB.

By Major-General Sir Louis Jackson, K.B.E., C.B., C.M.G.

(Published by the Committee of the Club. Price, 7s. 6d.)

The Senior is the oldest of the big Service clubs, having been founded in 1815 by Lord Lynedoch, and its history reflects the club life, the character and the prejudices of the sailors and soldiers of the last 120 years. As Sir Louis Jackson says, the

nineteenth century was the period in which the Empire was made, and of the men who made it, there is scarcely one whose name does not appear on the rolls of the club. It may be added that the manners of some of these empire-builders, as recorded by Sir Louis, left much to be desired.

It is interesting to note that, in 1815, the Prime Minister (Lord Liverpool) objected to the founding of the club and refused a lease of Crown lands. Some of his successors who have freely used the club as honorary members, have perhaps been grateful that his objections did not in the least deter Lord Lynedoch.

The book is very well got up and contains reproductions of many of the famous portraits in the club, as well as plans and drawings. It is a real history dealing with the origin, the early homes in Albermarle Street and Charles Street, the building of the present club-house and its structural development, and the general vicissitudes of the club till it has reached its present state, which, the author thinks, is much in accordance with Lord Lynedoch's original ideas. The tale is told methodically, but with insight and humour. There was a time when an older generation obstructed every proposal towards modern comfort and convenience, and the wishes of members generally could not prevail against their prejudices. The members of to-day, who find the club run for their convenience and can freely entertain their friends of both sexes, owe a great debt to those who overcame the obstruction.

Sir Louis Jackson has known the club for over forty years, and has taken a considerable share in its administration; and he has shown himself undefatigable in research. The book has been for him a labour of love; and it could not have been done better. The Senior is to be congratulated on its historian, and the Corps can congratulate itself on having produced him.

E.V.B.

MATHEMATICS FOR THE MILLION.

By LANCELOT HOGBEN.

(George Allen & Unwin, Ltd. Price 12s. 6d.)

Mr. Hogben wrote this book in hospital for his own fun, and it certainly is a most fascinating book, though in places distinctly irritating.

The method of approaching can be compared with the method used in *The Calculus Made Easy*, in that the author endeavours to appeal to the common sense and reasoning power of his readers, but a great deal of the book consists of the history of the different branches of mathematics and some rather obstruse and even hair-splitting philosophical reasoning on such matters as the precise meaning of the statement that two and two make four (page 28). We read on page 640 the slightly bitter statement that the bright boys of this world accept what they are told, and in due course become professors. Surely in the world of affairs it is necessary to take many things for granted. The man who never says "Why?" is a dull person, but anyone who is always saying "Why?" is a nuisance, and will never make a good Sapper, at any rate.

The book is unsuitable as a text-book for the Corps, and doubtless the author has never contemplated its being so used. Having said this, one can recommend every Sapper officer to read it as an education, as a mental exercise, and for his own amusement. Many will be irritated by the book, and will devote themselves to searching for fallacies. One can only hope that their gloomy outlook will be brightened by reading of such matters as Diderot and the wily Euler (page 1), of Peter Bungus and his book of seven hundred pages on the number 666, and of the remarkable effect of that number on Stifel (pages 194–5). There is also a remark by Voltaire, which the reader will find if he perseveres.

F.W.T.H.

RECOLLECTIONS AND REFLECTIONS.

By Sir J. J. THOMSON, O.M., D.SC., F.R.S., etc.

(G. Bell & Son, Ltd. Price 18s.)

This book is divided into two parts, the first containing the autobiography of the author and short accounts of all the distinguished men he had met while at Cambridge; the other part of the book is devoted to interesting treatises on the many scientific discoveries of modern times.

This book should prove of great interest to both young and old readers, to the latter because he describes in a delightful manner the changes that have taken place in the social and educational side of life at Cambridge during his day; to the younger generation as a very interesting account of the heritage bequeathed to them.

He describes in a most delightful way the changes in the methods of education since he was a boy, and how sport has gradually come to permeate the life of the undergraduate as it does in these modern days. He also gives an interesting account of the difficulties experienced by women in gaining admittance to the advantages of a university training and how the final victory was won.

His accounts of all the distinguished men he met are vividly and amusingly told.

His visits to both Germany and America give a vivid account of his impressions and experiences.

The book holds the reader to the end.

G.A.B.

THE BRITISH ARMY—ITS HISTORY, CUSTOMS, TRADITIONS AND UNIFORMS.

Pay-Lieut. Commander E. C. TALBOT-BOOTH, R.N.R.

(Sampson Low, Marston & Co., Ltd. Price 7s. 6d.)

It seems an ungracious action to criticize this book. It sets out to record and classify a mass of information concerning the army in general and units in particular—origins, uniform, special customs and privileges, nicknames, etc.; and the author brings to it immense enthusiasm, a great admiration for the army and interest in details. One cannot help feeling, however, that the book required "vetting" by someone familiar with the service from within; it ought to be a standard work of reference, but unfortunately it contains far too many inaccuracies.

What can be said for this extract? (p. 11).

"Here are the figures for the peace-time units of the old 1914 Army.

* * * *

"A *Brigade* was 2 regiments or 4 battalions.

"A *Division* was 2 brigades or about 38,000 men.

"An *Army Corps* was made up of 3 Divisions, 1 Cavalry Division, 3 Horse Artillery, 2 Field Artillery Batteries (each battery being of 6 guns) and Royal Engineer units.

"One Infantry Battalion consisted of 8 companies, each of about 90 men, giving a total of 30 officers, 91 N.C.O's, 975 rank and file and regimental transport."

Then Chapter III gives the Constitution of the B.E.F., 1914, and mentions only 3 infantry divisions.

Again, in a list of outstanding battles (Chapter LXII), we find:—

ALBUHERA—Defeat of French by Wellesley in 1811.

BHURTPORE—Defeat of Afghans in 1839,

and many more "howlers," if we follow the alphabetical list through.

And, unfortunately, the number of such inaccuracies is very large.

E.V.B.

SHIPS.

By HENDRICK VAN LOON.

(Harrap. 1935. Price 10s. 6d.)

Mr. Van Loon has a genius for getting to the root of his subject and explaining its underlying principles so easily and readably that no technical knowledge is needed to understand them. His book is a history of maritime exploration and migration, but though the facts are there, he makes out of their narration an exciting story of the developments of navigation that made these expansions possible. He places the cradle of sea-keeping craft in the Pacific, and describes the Polynesian method of exploring from island to island with their catamaran canoes strung out in a line from horizon to horizon. From this stage there are three great phases in the evolution of navigation.

The first, the era of moving ships at sea by man-power, had the same foundation as the current structure of society, that of slaves. It started in Greek and Roman times about the fifth century B.C., and lasted in the Mediterranean until after 1685, when Louis XIV revoked the *Edict of Nantes* and sent all Protestants to the galleys. Galley navigation depended on constant touch with the coast in order to water and feed the human motive power, whose conditions of life were so intolerable that any galley harbour could be recognized by its distinctive smell. Galleys carried auxiliary sail to assist their speed in favourable winds, were in size up to 105 ft. long and 15-ft. beam; they were suitable for use only in enclosed seas and never had much effect on developments outside the Mediterranean. From their nature they could mount only three guns, one forward, one amidships and one aft, without seriously diminishing the number of rowers and the introduction of gunpowder therefore marked their decline. Four of the 132 ships of the Spanish Armada were galleys, though the roughness of the Atlantic was unsuitable to them.

The era of moving ocean-going ships by sail-power was started about the eighth century A.D. by the Norsemen, who developed the art of sailing against the wind by tacking. Their vessels of thirty tons carried a crew of ninety men and were light enough to beach in order that the crew might rest, forage and make repairs. In 1892 the Norwegians made a reproduction of a Viking ship and sailed it to the Chicago Exhibition, logging 9 to 10 and at times even 11 knots, and confirming the speeds claimed by the old Scandinavian sagas. The Vikings were the first people from Europe to reach the North American coast, and their failure to maintain their discoveries was due not to the difficulty of conditions but to the Teutonic system of blood feuds lasting from generation to generation. To quote from page 88, "The "history of these Viking colonies in different parts of the world is one endless tale of "murder and revenge and of the bitterest and most far-fetched quarrels that would "frequently exterminate entire villages and colonies for no particular reason, as "seems to have been the case in Greenland. For it was apparently a domestic feud, "and not an attack on the part of the Eskimos, that put an end to a colonial experi-"ment that had lasted for more than four hundred years. In the year 1410 the last "of the Viking vessels returned from Greenland to Norway."

The Northern and the Mediterranean methods of navigation were brought into contact during the Crusades, but it was the invention of gunpowder that caused the next radical change and converted the ship into a floating fortress with its "fore castle" and "hind castle" or poop, each bristling with cannon. It is at this stage that the galley disappears, and from the time of the Spanish Armada the design of men-of-war and of merchant ships tended to differ more and more as the Dutch and English developed their regular navies. The biggest ships in the Armada were about 100 tons, but during the succeeding period of English-Dutch rivalry, between 1600 and 1700, size advanced rapidly to 600 tons. Next the invention of the chronometer, enabling ships to chart their way about the ocean, gave a further impetus to increase in size and put the Dutch out of the competition by reason that their shallow harbours

could not take the larger ships. During the English-French rivalry of 1750 to 1815 size increased to 1,200 tons, and after 1815, it becoming no longer necessary for merchant ships to carry guns, the merchantman became entirely different from the man-of-war. In Chapter XII the author gives a comprehensive account of conditions of life at sea in Nelson's time.

And now steam. It was not until the 1850's that steam came into its own, for as long as competition was restricted to the trade-wind routes the clipper ship held her own. Here one is led to reflect that the British Admiralty had good cause, with steam engines still inefficient in performance and fueling resources limited, to hold on to the strategic radius of action of sail. In the 1850's the first iron ship as large as 3,500 tons was launched by the P. and O. and used later as a transport in the Crimean War: at about the same time emigration across the Atlantic on a large scale began to offer quick returns and the invention of mechanical cold storage intensified the advantage of steam: but it was the completion of the Suez Canal that finally marked the end of sail, by moving away from the trade winds the main trade artery to the East.

In his descriptions of life at sea Mr. Van Loon leads one to compare conditions with those of the present day instead of with contemporary conditions on land. But the pleasantness of his style and his numerous illustrations make the book an attractive one, and it should appeal strongly to those interested both in history and in ships.

C.C.D.

MURDER ON MANŒUVRES.

By S. C. Mason.

(Bell & Sons. Price 7s. 6d.)

Writers of detective fiction must be forever seeking new backgrounds against which to set their murders, and inevitably the army must provide its share of them. It has been suggested that anyone staging an armed outbreak in India might well time it for *Diwali*, when a little extra noise need not attract much attention; on the same principle the fatal shot of this book fired during a night attack in tactical training attracts none. The unravelling of the mystery is left by Scotland Yard to the Brigade Intelligence Officer and provides a good yarn. The military technique seems accurate, though the troops, who form a dim background to the story, seem to sleep uncommonly hard; while the Intelligence Officer seems to need no rest. The intrusion of the brigade commander's daughter provides a feminine complication and the interest of the story is well maintained to the end.

E.V.B.

MAGAZINES.

RIVISTA DI ARTIGLIERIA E GENIO.

(*December*, 1936.)—1. *Riserve di uomini e riserve di fuoco.*

General Vercellino discusses the employment of reserves (of men and of fire) in higher units, with special reference to an army, in an encounter battle, and shows how reserves contribute to the success of an action.

2. *Considerazioni sull'addestramento dell'artiglieria.*

Brig.-General Zanghieri suggests methods for the employment of Italian artillery in mobile warfare.

3. *Meccanizziamo gli artieri.* By Major Cappuccini.

A discursive article on mechanizing sapper units.

The proportion of engineers to infantry in a division has increased from 1 in 40 at the time of Napoleon to 1 in 25 in modern times, and the tendency nowadays is for the proportion of technical troops to continue to increase.

The writer quotes some historical instances regarding the use and misuse of engineers.

During the first few days of September, 1914, the French completely destroyed all the bridges over the Marne between the Ourcq and La Ferté, but left those between Château Thierry and Sacy standing. In their subsequent retirement, the Germans failed to destroy these bridges, although a whole regiment of engineers was standing by, awaiting orders, only 30 km. away. To their surprise, the British found all the bridges intact when they advanced.

On the other hand, on the eastern front, the German Army at Tannenberg, when retiring from the attack of the Grand Duke Nicholas, made such good use of demolitions that it was able to secure its exposed left flank completely.

In summing up, Major Cappuccini dwells on the importance of adapting engineer equipment to modern requirements. The Italian Army will probably be required to fight in the rocky fastnesses of the Alps, and its engineers should be equipped accordingly. Some of the articles they will require will be: means of electrifying wire entanglements, materials for camouflage, machinery for working up wood and iron for bridging purposes, rock drills, excavators, pumps and water-supply materials.

4. *Sono tornati i cannoni di Adua.* By Lt.-Col. Molinari.

An account of the self-sacrifice of the Italian artillery in the disastrous battle of Adua on the 1st March, 1896. The guns captured by the Abyssinians on that occasion have been recovered and are now in the colonial museum in Rome.

5. *Intercettazione telefonica campale.*

Major Petrella investigates the means (1) of intercepting the enemy's telephone messages and of turning to account the information so obtained, (2) of making it difficult for the enemy to intercept friendly messages and to make use of them.

6. *Nota sul trasporto del tiro.* By Major Morricone and Captain Cavicchioli.

A technical article on gunnery.

(*January-February*, 1937.)—1. *Accentramento delle artiglierie, decentramento del fuoco.*

Colonel de Stefanis explains the general principles of centralizing artillery under a single command, and decentralizing fire by transferring it to subordinate or local commanders.

2. *La densità degli schieramenti d'artiglieria in relazione al problema dei rifornamenti.*

Colonel Zauli deals with the question of ammunition supply and shows how it may impose limits on the distribution of artillery.

3. *Sul calibro delle artiglierie controaeree.*

Captain Piacquadio considers that the best calibres for anti-aircraft artillery firing from fixed positions on the ground are the 100 mm. gun, the 37/40 mm. gun, firing shell bursting on percussion, and the 20 mm. machine-gun. He is not in favour of tracer projectiles, except at short ranges, viz., less than 1,000 metres.

4. *Studio del rifornimento munizioni di una grande unità in zona pianeggiante.* By Colonel Orsi.

A concrete case, illustrated by a map, to show the system of ammunition supply to an army corps operating in a district in the plains.

5. *Idrogenazione e sintesi nella produzione di carburanti per motori a combustione interna.* By Major Tatti.

The processes for the manufacture of liquid fuels by artificial means can be divided into two categories. In the first process hydrogen is added to solid and liquid fuels that do not contain enough of this element: this is known as *hydrogenation*. In the second process, starting with the elementary components of hydrocarbons—carbon and hydrogen—these elements are combined in suitable proportions to form the fuels required. This is known as *synthesis*.

The writer describes the Bergius process of hydrogenation. This process was not applied industrially until 1926, when it was combined with the use of catalysers.

In 1930, the patents were taken out at the Hague by the International Hydrogenation Company. Under this system an output of 65% of petrol is obtained, weight for weight, from the coal employed, as against 35% by the Bergius system.

For producing fuels by the synthetic method the Fischer system has so far given the best results industrially. The first operations are: water-gas is produced in a suitable container; after purification it is mixed with hydrogen and passed over a catalyser in the contact furnace. The gases are condensed, and water is separated from the hydrocarbons, which remain in the form of crude oil.

One of the drawbacks to the Fischer system is the low "octane" figure obtained in the petrol. This can, however, be remedied by the addition of lead tetra-ethyl or alcohol.

Hydrogen is necessary, both in the hydrogenation and the synthetic process. It can be obtained (*a*) by electrolysis of water, (*b*) from water-gas, (*c*) from methane. (*a*) is expensive and will probably be dropped in future.

The writer concludes with a description of what can be done in Italy, which is severely handicapped by the absence of coal-fields, and the poor quality of its mineral oil. Albanian oil offers good prospects, and the writer points out the advantages that would accrue by an increased adoption of the Diesel engine, in preference to the petrol-driven engine.

6. *Considerazioni circa la balistica e lesioni delle armi da caccia e circa le perizie giudiziarie.*

Artillery officers are often called upon to give expert opinion in medico-legal cases relating to accidents with firearms. In this article General Mattei describes the ballistics of shotguns and shows how accidents may happen in handling them.

7. *Studio sulla meccanica delle spolette istantanee nei proietti di caduta.* By Captain Ravelli.

A technical article on the action produced by impact on instantaneous percussion fuses.

(*March*, 1937.)—This number is devoted entirely to engineer matters.

1. *L'Arma del Genio negli anni XIII e XIV dell' era fascista e durante la campagna in Africa Orientale.*

This is the first of four articles describing the engineer arm during 1935 and 1936 (the 13th and 14th years of the Fascist era), and the work that it carried out during the campaign in East Africa.

The article is accompanied by a number of illustrations.

In a rapid division the engineers carry, amongst other equipment, a light floating

bridge (*passerella*), 28 metres long, to carry mounted troops and motor-cycles, as well as a length of medium bridge.

Motorized divisions have a mixed battalion of engineers.

The engineers of an Alpine division carry 20 metres of light girder bridge (*passerella da montagna*), capable of taking mountain guns and light cars. A squad of 38 men can erect the bridge in two hours.

Amongst recently adopted equipment may be mentioned :—

(1) The light and medium bridges already referred to. The equipment of the old regulation floating bridge, suitably modified to take heavier loads. The normal bridge will carry 5 tons on two axles : the heavy bridge 10 tons on two axles.
(2) Heavy regulation bridge, to carry 20 tons on two axles, with wooden boat piers, steel joists, and tubular elements.
(3) Light and heavy pneumatic drills.
(4) Alternating current generating sets.
(5) Portable turn-tables to admit of a lorry being turned round on a narrow road.
(6) Fast bridge car, carrying parts of a bridge for armoured cars, to enable the latter to cross a gap 7 metres wide or obstacles up to 4 metres high.

During the operations in East Africa the strength of the engineers was as follows :—

1,500 officers.
1,150 under officers.
35,500 other ranks.

A list of the main engineering stores used is given, and includes defence stores, bridging material, light railway stores, hutting material, water-supply stores, etc.

2. *Strade e reparti del Genio per la guerra di movimento.*

Lieut.-Colonel Steiner deals with the problem of the construction of the military roads of the future. Speed in construction is essential. In mountainous country two narrow roads, each capable of carrying a single line of traffic, will require less excavation than one road wide enough to take a double line of traffic. A width of 2½ metres (8 ft. 2 in.) is sufficient for light motor-vehicles (*autocarrette*). By the adoption of steep gradients (20% or even 25% in places) a considerable saving can be made in length, provided that the road is not required for pack animals.

Bridges should be of the lightest material available. In Italy, the materials usually employed are : Avional, Chitonal, Duralite and Anticorodal—all alloys of aluminium. Bridges of these materials have great advantages over the standard types of steel bridge. They should be easy to erect and to take to pieces, and capable of being carried in divisional lorries. The weight of such a bridge should be about 200 kg. per metre run, as against 1,400 kg. in a standard steel bridge and 400 to 600 kg. in a wooden bridge.

For road construction the writer proposes to adopt the latest types of plant and machinery, provided the weight is not excessive. These include : circular saws, pneumatic drills, pile-drivers, mechanical excavators and stone-crushers. Electric drive is preferable to pneumatic drive wherever it is possible to use it, and the plant is lighter. But, however much road-work is mechanized, there will always remain some work, such as surfacing, to be finished by hand.

3. *Le microonde.* By Lieut.-Colonel Gatta.

Micro-waves are electro-magnetic radiations between ultra-short waves and infra-red radiations, and vary in length between 1 metre and 0.0008 millimetres. Of the three methods of producing them, the most economical is by means of the acorn valve, made for the first time in 1933.

As regards the military value of micro-wave stations, the writer does not think that they will ever entirely supersede stations with longer waves, nor photo-telegraphic or photo-telephonic stations. They have, however, two great advantages where the

ground is suitable for their use: the messages are practically secret, and there is no interference between the operating stations.

4. *Protezione delle strade dall'insabbiamento.* By General Maltese.

This is a study of the theory of sanding-up of roads, based on observations made on roads in Libya, where the sand is blown many hundreds of miles from the south towards the shore of the Mediterranean. The article does not tell us much that is new. The fine particles of sand drop and accumulate behind any obstacle that retards the force of the wind. A sunk road is bad, and anything in the way of a parapet wall, a mound of earth, or a bush causes an accumulation of sand on the leeward side. It is an advantage, of course, if the road passes through cultivation, especially if artificially irrigated, as the soil tends to absorb the sand.

The new high road along the Libyan coast, leading from the border of Tunis to that of Egypt, opened in March, passes through sandy tracts, but we are not told whether any steps have been taken, beyond asphalting the surface, to keep sand off the road.

5. *Meccanica delle Mine.* By Lieut.-Colonel Borelli.

A study of the theory of mines, of which a large part is devoted to the pressure of materials.

6. *Nota sull'impiego delle stazioni d'angolo nelle teleferiche militari.* By Major Vaudagna.

When it is not possible to construct a ropeway in a straight line between the terminal stations, it usually pays to put in one or more angle stations. By doing so, the erection of separate ropeways is avoided, as well as the installation of separate power stations, which involve extra staff and fuel consumption. The types of angle station illustrated and described in this article are suitable for any of the three standard mono-cables. The illustrations show an angle station giving a horizontal change of direction, one giving a vertical change of direction, and one giving both a horizontal and a vertical change.

An angle station consists of:

(*a*) Two couples of switches with pulley-rope guides and contrivances for automatic coupling and uncoupling of the carriers to the rope, as well as pulleys for changing direction of the rope.

(*b*) A wooden framework.

A.S.H.

REVUE DU GENIE MILITAIRE.

(*November-December*, 1936.)—*Gustave Umbdenstock.* By Lieut.-Colonel Metz. An account of the work of M. Umbdenstock, professor of architecture at the École Polytechnique, who has recently been elected to the Institute. He is one of the most outstanding of modern architects. He has been responsible for many remarkable works since 1900, and reconstruction in Northern France after the war abounds in examples of his art. Several photographs of his recent work are given; and they show how even a provincial railway-station can be made attractive to the eye.

Aménagement des terrains d'atterrissage. By Captain Nectoux. Deals with levelling ground for aerodromes, with practical notes on balancing *remblai* and *deblai*.

Travaux exécutés par un detachment du 4e regiment du genie à la suite d'un glissement de terrain à Serrières-en-Chautagne. By Lieut.-Colonel Croux. Describes work carried out by a detachment of the 4th Engineer Regiment, called upon to assist the sufferers from a serious landslide at a village on the road from Geneva to Aix-les-Bains, in January, 1936. Many houses were swept away and others engulfed in mud. The damages were made much worse by the destruction of a reservoir above the village.

Three hours after the mishap, a small detachment of the Engineers at Grenoble, consisting of two officers and twenty-nine other ranks, in motor vehicles, were sent to the spot, where they found eighty Chasseurs Alpins already arrived from Chambéry.

Two enormous blocks of limestone were left out of the mud, threatening to fall on the village. The first tasks for the troops were to open up passages for the water, destroy the two blocks of limestone, and to clear the debris from the roads, in order to re-establish traffic. It took three days to get the water under control—it rained almost incessantly—and another three to clear a passage sufficient for single-line traffic through the mud piled up on the main road. The men were working in mud up to their knees, but the inhabitants were generous, and goodwill prevailed. The blocks of stone were broken up by melinite charges.

A typical case where early action by men accustomed to improvise prevented further disaster, and alleviated immediate distress.

(*January-February*, 1937.)—*Une guerre de mines en 256 A.D.* By R. du Buisson. A reconstruction of the story of the siege of Doura-Europos by the Persians. The city was founded on the Euphrates, just within the borders of the present territory of Syria, by the Macedonians in the third century B.C., after Alexander the Great's conquest. The Romans conquered it in 116 A.D., and were holding it at the period now described. The first discoveries of the ruins were made accidentally by the British Army in 1921, and since then excavation on a large scale has been carried out under various auspices, chiefly American. Photographs show the very extensive nature of the discoveries; one of them shows the skeleton of a Persian soldier with his chest still covered with his coat of mail.

The story of the siege has been carefully compiled, and is well illustrated.

The site of the city lent itself to mining and countermining, and the discoveries show the development of this method of warfare. Entries for the besiegers' mines were facilitated by the two deep watercourses, or *wadis*, which flanked the city walls. The Romans met the Persian tactics with countermines, but it appears not with much success; where they met underground, the Persians drove them back.

Le fonctionnement et la conduite des installations de ventilation avec surpression. By Captain Roubinet. A long article, well supported by diagrams and formulæ, on the subject of high-pressure ventilation. The application of this system to underground accommodation such as concrete dugouts, and mine galleries and to gas-proofing is discussed, and a great many details as to motor-driven ventilators are given.

L'exploitation des carrières d'alluvions. By Lieut.-Colonel Rousseau. The opening up and exploitation of a quarry in the neighbourhood of an army for the purposes of obtaining road material is usually an operation requiring much labour and heavy plant. The quarrying of alluvial deposits, on the other hand, involves much less in the way of plant; and is, therefore, to be preferred whenever its proximity to military operations makes it practicable. Such alluvial deposits are very often composed of rounded pebbles, which no amount of binding material will hold together for road purposes, but the author observes that quarries of ancient alluvions may frequently be found in which a mixture of sand and stones sufficiently irregular in shape would be suitable.

For the exploitation of such material, a mobile plant is necessary, but this may be of quite moderate dimensions, even consisting only of screens, wheelbarrows and the like. A gang of 50 men, turning out 100 to 150 cubic metres a day (30 to 50 five-ton lorry-loads), is taken as a working example, and a list of tools given.

W.H.K.

REVUE MILITAIRE GÉNÉRALE.

(*January*, 1937.)—This is the first number of the re-appearance of the *Revue Militaire Générale*, which was supplanted in 1925 by the *Revue Militaire Française*. There is little apparent difference between the two; the make-up is the same, and the same high standard is promised. The new editor, General Paul Azan, explains

that the title "Générale" in place of "Française," will open its pages to foreign contributors and thus widen its horizon.

This number is made up of short contributions by many famous French generals and admirals, offering a welcome to the newcomer. Marshal Pétain writes that it is the younger generation who should lead off; his own patronage, "a trifle solemn," might discourage them. Marshal Franchet d'Espérey pleads for independence and imagination; we are faced with entirely new problems of war, and we must bring to them the freest expression of thought and the utmost elasticity of mind.

Admiral Lacaze puts in a word for the inclusion of the Navy in all doctrines of war, since its functions cannot be dissociated from those of the Army and the Air.

General Weygand, at greater length, plainly says that France must be strong as well as wise. The idealism of Geneva will not suffice for protection. The frontier protection, sufficient for the purposes, possibly, of meeting the *attaque brusquée*, does not lessen the vital necessity for complete and rapid mobilization of the whole nation. Unity throughout the whole military machine is urged; the forces consecrated to the protection of the frontiers must not weaken the forces of the general mobilization. "Not with formulæ does one protect the country, but with forces."

General Debeney writes on the "Mysticism of the Corps of Officers," pointing out that his generation, entering the service on the morrow of the disasters of 1870, lived to see the triumph of the re-entry into Strasbourg and Metz; while to-day, the ideal for the Army is the preservation of peace. Never were there more dangerous elements of political dissension. Amidst them all, the corps of officers must live for the one ideal which must unite every party and every class—the tricolour flag.

General Gamelin's welcome takes the form of a further exhortation to keep pace with the times, to take advantage of every new development, and to bring the whole machine up to the highest perfection in all its parts.

Admiral Durand-Viel, General Féquant, Admiral Castex, and Generals Billotte, Armengaud and Berger all contribute short articles.

(*February*, 1937.)—*France, souvenir.* By General Gamelin.

Some extracts from a speech delivered by General Gamelin at Metz on January 17th last; they call upon Frenchmen to unite in the face of the grave crisis which confronts the nations, and to preserve a steady faith in the country.

Considérations sur la campagne Italo-Éthiopienne, by General Bollati. An Italian review of the Abyssinian campaign. The author recognizes that military critics in general were at first sceptical of the Italian chances of an early triumph, and says that the French critics were the first to appreciate the importance of the Italian preparations, the difficulties which confronted them, and the valour of the leaders and their troops. The author queries the title "Colonial war" for the campaign, because the force employed by Italy was on a European scale; it numbered hundreds of thousands, organized in divisions and army corps, and equipped on the most modern lines; but in other respects, the quality and characteristics of the Abyssinians, their organization and means, put the war into the colonial category.

Italy's experience of colonial warfare dates from her first occupation of Eritrea, 1885. She suffered severely at Adowa in 1896, but recovered her prestige in Libya in 1911–12. The Great War gave her further experience of overseas expeditions, for she sent nearly 200,000 men to Albania and Macedonia, between 1915 and 1918.

The writer makes no excuse for the political enormity of Italy's attack on a fellow-member of the League of Nations (she prepared for the campaign while backing Abyssinia's entry into the League); he describes the campaign and its preparations purely from the view-point of the military critic.

Italy sent 400,000 men to East Africa, including about 100,000 labourers; 80,000 baggage animals, 18,000 motor vehicles, 800 guns, and 11,500 machine-guns. There was no room for half-measures in Mussolini's plans for the conquest. The success was the reward of preparation; but it was won against a practically unarmed resistance.

Nécessité de l'union aérienne de défense Anglo-Franco-Belge. By General Armengaud. The author insists on the necessity of an Anglo-Franco-Belgian union for air defence as the only means of preserving the integrity of Belgium, which is itself the prime necessity for European peace.

The new development of air forces has opened up a new development of strategical mobility. The Air Force of Great Britain, utilizing air bases in France or Belgium, can reach the furthermost parts of Germany; similarly, the Air Forces of France can co-operate with those of Czecho-Slovakia, Poland or Jugo-Slavia. Reciprocal use of air bases will make it possible to have a much more effective co-operation between allies than the old uncertain methods of badly synchronized offensives on land. A nation can no longer assure its own security by limiting its defence to its own borders, or even the borders of its empire. It must participate in a system of collective security.

The growing menace of Germany's Air Force, combined with that of Italy, constitutes a very serious danger in the middle of Europe. Even if Germany respects Belgian neutrality on land, she is unlikely to do so by air, thinks the author; and it will be easier for her to pretend that France has been the first to transgress, than it would be in the case of land forces.

L'offensive et la défensive avec les engins blindés. By Colonel Mainié. A general article on tank operations. The most effective obstacle to hostile tanks, apart from natural obstacles such as rivers, swamps, forests, etc., is the minefield. This is difficult to reconnoitre, and very hard to destroy by artillery. In fact, if the land mines are exploded by artillery fire, the state of the ground is quite likely to be made impassable for tanks; or the tanks would be slowed down sufficiently to make them easy targets. On the other hand, if the defender sows his front with mines, he is debarred from using his own tanks freely. Mine-sweeping on land is not yet a practicable proposition. Ground reconnaissance is, therefore, more necessary than ever, and this precludes a sudden attack on a prepared position.

Réflexions sur l'éducation morale de l'officier. By Captain Tabouis. The author is of the opinion that the young officers of the French Army are not taking sufficient advantage of the opportunities for wider experience by more frequent transfers or by service abroad. They are too often attracted by the easy comforts of home garrison life; they marry too soon, and encumber themselves. They prefer security to adventure. There is a paucity of temperaments like those of Joffre, Foch, Franchet d'Espérey or Pétain.

This defect of the present day is not confined to the subalterns of armies. Is there not a general unwillingness to go out into the world on the part of many young men?

Le système fortifié allemand de 1871 *à* 1918. By Lieut.-Colonel Montigny. A review of Germany's fortifications during the long period of preparation for the Great War. This period is divided into five epochs:—that of Moltke (the elder), 1871–88; of Waldersee, 1889–90; of Schlieffen, 1891–1905; of Moltke (the younger), 1906–14; and of the war, 1914–18. Under Moltke the elder, Germany prepared for a defensive war in the west, and an offensive in the east. The war of 1870–71 had given Germany ten French fortresses, the chief of which were Metz and Strasbourg. Many of the German fortresses were scrapped by Moltke, who refused to be tied to locking up garrisons; he preferred railways to forts. Waldersee, who had a very short term of office, followed Moltke's plans.

Schlieffen controlled Germany's strategy for fifteen years, and was able to ensure continuity. He was a vigorous supporter of the offensive. He changed Moltke's plans, and projected an offensive in the west, a defensive in the east. He was continually revising his schemes, aiming always at strengthening his left by fortification, in order to find more troops for his right wing. Metz was the chief of the strongholds.

Moltke followed Schlieffen, and he is blamed for having weakened the latter's

plans, owing to his fear that the French attack in Alsace-Lorraine might reach a crisis before his right wing reached Paris. He increased the German forces in Lorraine, and modernized the forts on Germany's eastern frontier.

During the war, only the fortress system of Boyen, on the eastern frontier, was attacked. All the rest of Germany's expensive fortifications were untouched; they furnished great quantities of guns and stores to the field armies.

(*March*, 1937.)—*L'aviation et la décision de la guerre.* By General Niessel. The author thinks it possible that future air attacks may cause such physical and moral damage to civil populations that their Government may be forced to demand peace. To this extent air warfare may prove decisive, and in a very short space. But, *pourvu les civils tiennent*, it is unlikely that air victory without land victory will bring about a decision. Certainly, air attack may cause a crisis in the enemy will-power much more rapidly than land attack, but the two actions must support each other.

L'appui de l'infanterie dans l'offensive en guerre de mouvement. By General Brossé. This is a well-reasoned article, bringing out clearly the fact that infantry alone cannot support their own attacks. The author sets out to determine what may be expected, in a war of movement, from the employment of the various arms developed since the Great War, as regards the support of the infantry in attack. He first studies three cases: infantry supporting their own attack with the weapons with which they are now provided, without recourse to the other arms; infantry supported by artillery, but without tanks; and infantry supported by tanks and artillery.

He shows that the infantry, although furnished with weapons of flat trajectory as well as of high-angle fire—*e.g.*, the Brandt mortar—cannot alone achieve success. It was hardly supposed that they could, but the author's reasons are clearly stated, and are worth study. The tactics of infiltration break up the fighting line, and render the action of the artillery inoperative. Once launched, such an attack cannot well be checked for a fresh disposition. The author points out that in the opening battles of a future war there will never be enough ammunition at hand to emulate the great attacks of 1918.

La France doit être forte sur mer. By M. Le Bail. A short reminder, by a Deputy from a coastal province, that naval strength is still of vital importance to France.

L'attaque avec engins blindés d'une position sommairement organisée. By Colonel Mainié. A long and very detailed working-out of an imaginary action by a corps of two divisions, well equipped with extra artillery and tanks, and supported on either flank by other corps. The action is very thoroughly visualized, and a full discussion is given of the successive stages of the modern battle. On the corps front, the author computes his requirements at 200 tanks of all sorts for the first echelon, and a reserve of 50%. He discusses the obstacles likely to be met with, and how he proposes they should be overcome. The preliminary work of cutting lanes through the enemy's barbed wire, and through his minefields is, of course, given to the artillery, but it seems that it is only by subsequent air reconnaissance that the effect on the minefields can be ascertained, and therefore, if visibility is bad, several hours might elapse after the attempt to clear the lanes before the tanks could be sent to pass through. Meanwhile, under smoke-screens, the defenders might well re-sow their gaps with fresh mines. The passage of tanks through lanes means a column, and a column of tanks may be stopped by only a few disabled tanks at the head.

The author considers that in the struggle of tank *v.* tank, the better armed and better armoured vehicle will dominate the field, and we may see an era of heavier and still heavier guns, armour and tonnage put into tanks. A reversion to the ponderous tank wallowing in the mud at Passchendaele does not commend itself as a likely solution.

À propos de la fortification de la Suisse. By Lieut.-Colonel Montigny. A short article based on one by Colonel Rebold, which appeared in the November, 1936,

number of the *Journal Militaire Suisse*. The Swiss Government has recently strengthened its frontier barriers, especially between Bale and Lake Constance. Colonel Rebold asked the question whether they should be given permanent garrisons, or whether they should be supplemented by a further system of fortifications. He wished to have a fortified front serving as a base of operations for the field army, resting its flanks on natural impassable obstacles. A fortified frontier for Switzerland on the Maginot scale is out of the question, on account of the great cost; moreover, such a frontier, in the Swiss case, might be easily turned. The Swiss could not afford the men to permanently garrison such a system. Colonel Rebold therefore advocates a system allowing free play to the field army, while making full use of the great natural obstacles afforded by the mountains. It is not conceivable that an enemy would seek a passage through Swiss territory unless he was prepared to carry out very expensive operations on a large scale.

The author of the article, Colonel Montigny, shares the views of Colonel Rebold, but goes further, and asks why, since we have passed through an era of armoured turrets and cupolas, we should not come to a system of movable armoured weapons transportable to previously-prepared emplacements. Ideas seem to be tending in this direction, in view of the necessity of opposing sudden attack by armoured vehicles without any warning whatever.

Le Transsaharien. By Major Jarrix. An article on the long-projected railway across the Sahara, linking up the French possessions in North Africa with those on the west coast. (A good account of this project was given in *The R.E. Journal* for June, 1928, under the title of "The Next Great Railway," by Lieut. C. A. de Linde.)

The author is very enthusiastic for the scheme, and points out that the great desert is no more than a sea separating two fertile and populated coasts, and that the daily communication across the waters and the expenditure of large sums on harbours and ports is not begrudged, so why should there be any further hesitation in carrying out the railway project? He argues that the railway would itself develop commercial intercourse, and that the great transcontinental lines built in America often traversed great areas just as arid and forbidding as the Sahara.

The author has arranged his study of the question in methodical order, and begins with an historical sketch showing that the project dates as far back as 1859.

He admits that motor transport has now successfully made the journey from Colomb-Béchar and Laghouat to the Niger, but this method is extremely costly, and of only very limited capacity. Motor transport can compete successfully with railways where it finds good roads already made and can obtain its own supplies of fuel and oil brought within reach by rail. Motor transport relying solely on itself is not yet an economic proposition.

He compares a train of 1,500 tons ("such as those likely to be used"), with its equivalent of 500 lorries, with their 500 drivers, 500 mechanics, etc. The author's picture of trains of 1,500 tons capacity for a line in a sandy desert, or indeed anywhere, may be no more than a slip of the pen, but his argument will serve.

The possibility that sand might bury the line has been carefully studied by various investigators in previous years and has been found to be surmountable. The water difficulty would be overcome by using Diesel electric locomotives and carrying sufficient water for personnel.

There is not sufficient space here to refer to the arguments put forth so clearly by the author, but it must be said that the project is much nearer practical solution than it was a few years back, and its realization would prove of enormous benefit to the French exploitation of her African possessions.

Impossibilities of to-day become the probabilities of to-morrow.

(April, 1937.)—La "Stratégie générale" affaire de gouvernement. By Lieut.-Colonel Fabry. The author, who was a former French War Minister, enlarges on the definition of general strategy, given in the first number of this review by Admiral Castex, "as the art of conducting in war-time and in peace-time, the whole of the

forces and warlike resources of a nation." Political strategy must be the dominating factor. Ought we to have the army to fit the policy, or the policy to fit the army? Governments are sometimes tempted to explain away a lack of boldness or firmness by insufficiency of armed strength. The term "army" to-day must envisage not only the formed military bodies, but the fit men of the whole country. The army must be the nation.

The author refers to the situation of May, 1935, when the Stresa agreement consolidated—or seemed to—the political front of England, France and Italy; and the French military machine adjusted itself to the new situation. Only a few months later the Abyssinian outrage completely changed the situation, and if policy could be adapted to meet it, the military arrangements could not be so easily re-adjusted. In other words, if policy is to be so constantly changed, how can we have the "Army of our policy"?

La co-opération aérienne et antiaérienne pour la défense de la Belgique. By General Armengaud. The writer points out that a future adversary may leave Belgian territory outside the theatre of his land offensive, but use the air over Belgium for his aerial offensive, by preventing that country from using its aerial and anti-aerial defences, and from transmitting any information. The threat to Belgium remains a menace to England as well as to France, but in much greater degree to-day than in 1914; and in face of this common peril, the three countries should ensure beforehand the full co-operation of all their air forces and anti-air defences for the defence of Belgium.

The possibility of violation of Belgium by air opens up to Germany a wide field of advantage; she has a longer starting-base, and her air-bases, being thus more numerous and more dispersed, will be less vulnerable. Her own front to be covered would only be increased by the 100 kilometres from Maestricht to Luxembourg. The French front, on the other hand, would be greatly increased; their aerial resources vastly disseminated. Their communications and flanks would be subjected to heavy attack from the air during the height of the frontier battles; and, the Belgian outpost being stifled, the attacks would come as a surprise.

What would be Belgium's position, not actually invaded by land, but her "air" used to launch heavy attacks on her neighbour? She would be suffering, perhaps, no actual damage; she would not even be in the conflict. Would she allow France and England to take any measures for her defence? She would most certainly be warned by Germany that terrestrial invasion would follow any attempt to use her means of aerial self-defence. The dilemma of Belgium remains. What would be England's position? The author considers that it would be identical with that of 1914. Germany would count upon gaining the decision against France by attacking through Belgium—without necessarily violating the latter's territory by land—before England's intervention could be effective. But in place of England's "contemptible little army," much smaller now than in 1914—there is England's Air Force. Is this of such a strength as to deter Germany from such a project?

The aerial attack on England offers immense results—greater than those offered by any other country in Europe—owing to her vulnerability, if hostile air forces are established on the Belgian or French coasts. The danger to England lies in the establishment of German air bases in Belgium. Is England fully alive to this danger? The author fears that the prime necessity of England's participation in the defence of the Belgian frontier is overlooked. The importance of an expeditionary force ready to cross the Channel immediately is much more serious than in 1914. Safeguarding measures must have the same speed and precision as the instrument of aggression against which they are designed.

L'évolution de la cavalerie vers la machine. By General Boucherie. The author has played an important part in the development of mechanization in the French cavalry. He briefly describes the evolution of cavalry towards mechanization; the various forms of machines which have been developed, from the folding bicycle, the lorry

and the caterpillar, to the light Citroen-Kégress " dragons " with which the cavalry divisions are now provided. All the more recent appliances have their uses; even the motor sidecar; but there are in practice two types of vehicle required; one to provide the means of rapid transit over existing roads, the other to provide the means of carrying men and weapons across all types of ground into the battle.

Motor machine-gun units with the French cavalry did good service in 1918, and they will certainly play a conspicuous part in future mobile warfare. There are four principle problems to contend with: armour-protection; the weight of the vehicle; its speed; and its armament; and the author reminds us not to be impatient with progress, while fresh developments are taking place so continuously.

Bonaparte: avait-il, ou non, grande valeur? By Lieut.-Colonel Gallini. An Italian historian, Signor Ferrero, has recently published a book on Bonaparte's campaign in Italy in 1796–97, in which he maintains that Napoleon's part in devising the plan was merely secondary; his renown due to a myth; and that he was only executing the orders of the Directory. It seems rather idle to raise the question now as to whether Napoleon was a great man or not—it will be difficult to shake the universal opinion that he had a genius for war—and Colonel Gallini has no difficulty in showing Signor Ferrero that he is mistaken in his verdict. The article is of historical interest only, and those of us who are believers in the genius of Napoleon need not be disturbed.

Les débarquements de vive force. By Lieut.-Colonel Liberos. A general article on landings in force in the face of an enemy. Two examples, among others, are enlarged upon: the French landing at Algiers in 1830, and our own expedition to the Dardanelles in 1915. The former is indicated as a guide to follow, the latter is condemned as an example to avoid. In the impatient hurry of 1915, our ships were wrongly loaded, and the effect of ill-preparation was felt all through the first stages. The element of surprise had gone by the board.

The article forms a clear review of the problems which beset such an operation.

W.H.K.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(*January*, 1937.)—*La coupole du réduit du fort III à Anvers.* By Lieut.-Colonel Beaupain. A short description of a relic of Brialmont's days; an iron cupola built in 1863, and still preserved at Antwerp.

Thèmes tactiques. By Major Wanty. The seventh, eighth and ninth studies of this series. The subjects dealt with are the defence by a regiment of an extended front (7 to 8 kilometres), the action of a flank guard, and a rear-guard fighting a delaying action. Detailed orders and good maps illustrate the article.

Utilization d'un groupe de D.T.C.A. au profit d'un C.A. en marche. Extracts from an article in the *Militar Wochenblatt*, July, 1936. The abbreviations—so characteristic of this hustled age—used in the title refer to the anti-aircraft detachment accompanying an army corps on the march. It describes a concrete case of an army corps marching on two parallel roads, and having an anti-aircraft defence consisting of three 75mm. batteries, each battery having a section of anit-aircraft machine-guns, a battery of 37mm. guns, two companies of anti-aircraft machine-guns (20mm.), one company of what we may call anti-aircraft scouts, a battery of searchlights and sound-rangers, and a headquarters with signal detachment. The tactical dispositions of the anti-aircraft units are discussed.

Problème de la direction de la guerre dans les coalitions. By Lieut.-Colonel Dendal. The concluding instalment. Describes the Austro-German relations, and finishes with general remarks on the difficulties of all coalitions.

The Central Powers had much the same problems confronting them with regard to

unified command as the Allies, but their case was simpler inasmuch as there were fewer colleagues to reconcile. Conrad would have liked to conduct his war according to his own lights, but he needed German help too badly. The entry of Italy on the side of the Allies did not bring about the unified command. An understanding was arrived at in September, 1916, and it was agreed that the German Emperor should have the supreme direction of the operations of the Central Powers and their Allies, the Bulgarians and Turks. But this state of affairs only lasted until November, 1916, when the new Emperor Charles asserted his claim to direct the Austro-Hungarian forces.

The author concludes by reminding us of the unfailing lesson of history—the weakness of all coalitions; and asks whether the Covenant of the League of Nations is going to prove any more successful in achieving unity, when it comes to the point of combined action against an aggressor.

(*February*, 1937.)—*Les conceptions militaires du Roi Albert au cours de la campagne de* 1914–18. By Major Mersch. A short account of the many sound decisions taken by King Albert as Commander-in-Chief of the Belgian Army. When Belgian G.Q.G. was hastily preparing to retreat on Antwerp on 12th August, the King counselled delay, and thereby gained time for the Belgian Army to withdraw in order. Later, when he was faced with the problem whether to retire to Antwerp or fall back on the Allied Armies, he decided, in spite of Joffre's advice, on Antwerp. He thus preserved his base, and, without doubt, his army, for he could never have reached the Allied left wing at that period. This wise step obliged the Germans to detach large forces to invest Antwerp, and this weakened their right wing at the most critical moment.

The next decision, to withdraw the army to the Yser before the coastal route became finally closed, was also taken at the opportune moment. No mention is made of the help given by the British Government, which sent the Royal Naval Division, the 7th Division and the 3rd Cavalry Division to aid the Belgian withdrawal. Where the French had promised help, the British appeared with substantial forces.

The King was an heroic figure, a commander-in-chief of sound judgment, and a man who led his countrymen throughout with great courage, dignity and success.

Les 210*e et* 211*e Regiments Allemands aux combats à l'Yser*, 1915. By Commandant Corvilain. A transcription from the historical accounts of these two reserve regiments of German infantry, relating to the fights at Drie-Grachten (1st to 9th April, 1915), and at Steenstraat (22nd to 28th April, 1915). The former of these took place amongst the inundations, often waist-deep, which surrounded the Belgian outposts. The latter formed part of the German gas attack in the Ypres Salient, which began on 22nd April, 1915. The gas cloud did not actually reach the Belgians, but their resistance at Steenstraat played an important part in checking the big attack farther south.

Les exercises physiques préparant directement aux fonctions de combattant. By Commandant Darrien. A description of the physical training course prescribed for recruits. Illustrated with photographs.

Nouvel exemple d'étude du terrain au point de vue de la défense antichars. By Lieut. Duysens. A tactical study based on a situation selected on a bend of the Semois river between Izel and Florenville. The defence consists chiefly of a dozen 47mm. anti-tank guns. The terrain is distinctly adverse to mechanical vehicles.

Pour hâter l'intervention de l'A.D. I. By Colonel Verhaegen. Deals with the ever-important question of artillery support for the infantry.

Le cours de fortification à l'École Royale Militaire. By XXX. Describes the course at present in use at the Belgian Military School. The students are divided into three sections: infantry and cavalry, artillery and engineers. The course is divided into two parts; a general fortification course common to all the sections of students, and special instruction in demolitions, improvised communications, inundations, employment of engineers, etc., arranged for the individual sections.

The general course in fortification includes an historical outline, a course of field fortification, and a course of permanent fortification. The historical review covers six periods; from antiquity to the advent of artillery (fourteenth century); from thence to the wars of the French Revolution; from the Revolution to the advent of rifled artillery (1859); from 1859 to high explosive shells (1885); from 1885 to 1914; and lastly the war period, 1914–18.

The features of the Great War period which are studied are:—the attack and defence of Liège, Namur, Maubeuge, Antwerp and Verdun; the fortification system of Belgium, of the French north and north-east frontiers, and of the German Western frontier; the organization of the ground in the defence and attack of the stabilized fronts; and the defence of the Belgian coast by the Germans.

(*March*, 1937)—*Le Lieut.-Général Baron Ruquoy.* By Lieut.-General Denis. An address by the Minister of National Defence at the funeral of Baron Ruquoy, who was at one time during the war Chief of the Belgian General Staff. He also commanded the 5th Division.

Les yeux et les oreilles de l'artillerie. By Comdt. Errera. A short general account of flash-spotting and sound-ranging.

Comment la pièce allemande de Leguenboom s'est tué définitivement le 17 Octobre, 1918. By Comdt. Rousseau. An account of the silencing of a Big Bertha situated at Leguenboom, which used to fire on Dunkerque. The author claims that his flash-spotting section, working with a sound-ranging section next door to him, was responsible for a direct hit on the gun emplacement by a French heavy battery. The German gun, after a long immunity, was silent from that moment. A photograph shows the damage done by a shell. The episode did not take place until 17th October, 1918, by which date the Germans were being rapidly driven back; the author himself was on the spot a few days afterwards.

Les préliminaires de la bataille offensive. By Major Rosa. The three cases of an adversary strongly established in a well-organized and well-supported position, an adversary poorly posted, and an adversary on the move are discussed, and the preliminary measures required in attacking such forces are well described, following the Field Service Regulations of the Belgian Army. The opening phases of a campaign will always be a matter of extreme importance, and provide the test of the training and equipment on which so much time and money have been expended in peace-time.

Considérations sur les vols en altitude. By 3 Aé. The improvement in anti-aircraft weapons and the development of anti-aircraft defence generally are driving airmen to greater heights, and consequently experience in flying at high altitudes under very trying physical conditions is becoming of more importance. The author reminds his readers of the physical dangers, and gives some recommendations as to how these can be met, both by bodily training and by special apparatus. The machines can be made capable of much greater altitudes than the human crews.

La défense antichars. By Comdt. Xhaet. A lecture given to reserve officers from various garrisons.

The next war will be a matter of aircraft, gas and tanks. The machine-gun has made it impossible for unarmoured troops to cross its field of fire.

In the development of tanks, two tendencies have emerged: one aiming at a heavily armed vehicle to fight in close co-operation with infantry; the other preferring speed and wide range of action, fitted for independent operations. The French incline to the former, while the English prefer the latter.

The present-day tanks are classified—more or less arbitrarily—by weight: very light tanks, 2 to 5 tons; light, 6 to 9 tons; medium, 10 to 30 tons; heavy, over 30 tons, and special tanks for raids, 5 to 12 tons, with a speed up to 120 kilometres per hour.

New methods and new materials are diminishing the defects of tanks, but there remains the fact that tank crews are heavily handicapped by lack of vision. This

important defect limits their action, and the author is careful to remind his readers that the advertised capabilities of the new arm must not lead to exaggerated expectations of its achievements.

Anti-tank defence is the main theme of the lecture. Every unit, whether in quarters, on the march or in the battle, must at all times be prepared against tank attack. The author describes the various means of defence against tanks—natural obstacles, special banks and ditches, mines, and anti-tank weapons. He concludes by saying that the defender, if he is cool and vigilant, and has organized his defence to the utmost, should defeat the tank onslaught.

This is a clear and straightforward account, and stands out amidst the flood of literature on this subject.

Le tir des armes portatives sur but mobile. By Comdt. R. A short article on firing at moving targets.

Repertoire d'études tactiques relatives à des faits de guerre. By Major Wanty. He gives a classified list of articles which have recently appeared in the Belgian military journals, relating to incidents in the Great War.

(*April*, 1937.)—*Une contribution nouvelle à la Campagne des Dix-Jours de* 1831. By Colonel Verhaegen. The Keeper of the Royal Army Museum at Antwerp having recently exhumed the memoirs of Baron de Wauthier, who commanded the small group of Belgian forces collected between Antwerp and the sea in 1831, the author recalls the brief revolution of those days, which resulted later in the guaranteed independence of Belgium under a king of her own.

Le caisson pneumatique de l'Aéronautique militaire belge. By Colonel Sillevaerts. A long technical account of the special testing chamber used by the Belgian Air Service, for determining the effects of altitudes, speeds, etc.

Le rôle social de l'officier. By M. de Vincennes. A lecture in a very conversational tone.

Au Musée Royal de l'Armee : Inauguration des souvenirs de deux glorieux régiments russes. By M. Leconte. The author is the Keeper of the Royal Army Museum at Antwerp. He writes about some recent acquisitions, which include important collections of relics and souvenirs of two famous Russian regiments, the Emperor's Cossacks and the Emperor's Lancers. Photographs are given of some of the show-cases.

La Cour permanente de justice internationale. By Sous-Lieut. Gaumier. A short résumé of the institution of the International Court of Arbitration at the Hague.

W.H.K.

MILITÄRWISSENSCHAFTLICHE MITTEILUNGEN.

(*January*, 1937.)—1. *The Fortifications of the Austro-Hungarian Monarchy at the time of Conrad von Hötzendorf.* (Concluded.) By Major-Generals v. Steinitz and v. Aarenau.

In this final instalment the writers describe the fortifications on the Balkan front, and the part they played in the Austrian campaign against Serbia and Montenegro during the World War.

The article closes with some general remarks. In the event of a crisis in the Balkans it was always thought that Russia would be the chief enemy, and that, in such an event, an offensive campaign against Russia, in collaboration with Germany, would be the correct strategy to follow. The possibility of conducting a campaign by Austria against her southern neighbours without causing the intervention of Russia came to an end in 1909 with the annexation of Bosnia and Herzegovina.

The experiences of the World War indicated that only a connected line of forts such as those in the southern Tyrol or on the eastern front of France were of real value. In future the existence of isolated girdle-fortresses would seldom be justified.

Leading Austrian engineer officers have, for some time, opposed the principle of large concentrated forts, which offer an excellent target to the accurate plunging fire of modern artillery, and are in favour of scattered *points d'appui*. Costly deep ditches and flanking arrangements are to be avoided. All buildings not required for fire purposes should be removed a little distance away or sunk deep underground, and connected with the fighting part of the fort by means of underground passages. The main principle to be followed will be a series of zones of defence not unlike those of field fortification.

2. *Reflections on the Tactics of Military Incendiarism.* By Dr. Kastner.

The development of the air arm in recent years has caused a revolutionary change in our views on fire as a means of destruction of material that is vital to the enemy. Hitherto fire-fighting and protection against fire have played a subordinate part in military organization. They must now be regarded as matters of extreme importance.

In considering an incendiary project, the writer makes a distinction between "fixed" and "variable" fire elements. The fixed elements are (*a*) the general theory of incendiarism, (*b*) the material, (*c*) the locality; the variable elements are (*d*) the available means of extinction, (*e*) weather conditions, (*f*) the duration of the fire.

Water is the chief means of fire extinction; other methods are of negligible importance. Means of extinction, *e.g.*, pipe-lines and fire-engines, are not easily put out of action. A method of circumventing fire-engines is to divert them away from the main objective by starting fires elsewhere.

Dealing with fires requires great experience and practice; and it is noteworthy that in Germany and Italy all methods of fire protection have been militarized and brought under state control.

3. *New Guns of the Italian Army.* By Major-General Rieder.

An illustrated article, describing the latest additions to the Italian artillery, viz.: (*a*) the 210/22 howitzer (firing a shell of 102 kg. and having a maximum range of 16,000 m.), (*b*) the 149/40 gun (firing a 46 kg. shell, and having a maximum range of 22,000 m.), (*c*) the 75/46 anti-aircraft gun, with a maximum elevation of 90°, and a mounting for all-round fire (firing a 4·5 kg. shell, and having a maximum range of 13,000 m.)

4. *Political Review.* Major-General Paschek continues his political review of the world situation (*vide* the July, 1936, number of the *M.M.*), and brings it up to the 20th December, 1936.

(*February*, 1937).—This number commences with two obituary notices (1) of Field-Marshal the Archduke Frederick, cousin of the late Emperor Francis Joseph, and Commander-in-Chief of the Austro-Hungarian forces during the World War, and (2) of General von Seeckt, of the German army.

1. *The Austro-Hungarian Technical Troops and Staffs.* By Major-General von Aarenau.

In describing the development of the Austro-Hungarian technical troops, the writer considers four separate periods. In the first period, commencing from the thirty years' war, the three corps of engineers, of miners, and of sappers, were kept separate, but were finally combined in 1851. Pioneers and bridging units were separate formations, but were combined to form a pioneer corps in 1843.

Various changes took place during the second period (1851 to 1893), and a railway and telegraph regiment were formed in the early eighties.

The third period takes us up to the World War. In 1893, the all-round pioneer was introduced, but later on, the lessons of the Boer War and the Russo-Japanese War taught the necessity for greater specialization, and a reversion was made to separate units, *i.e.*, sappers, pioneers, a bridge-building cadre, a river-mine unit, and communication troops (railway and telegraph troops).

During the World War, specialization reached its height. At the end of 1917, there

were 3,400 technical units. Amongst the new formations were tunnelling companies, water-supply companies, electro-technical companies, as well as many others.

In future wars there will be no time for the hasty improvisations of new units, and specialists will be in greater demand than ever. This will be a matter of great importance for Austria, now a small inland state, which will need a higher proportion of technical troops in relation to its fighting units than larger and more favourably-placed countries.

2. *Parachute Troops.* By Lieut. Hackl.

The employment of aeroplanes to drop troops at suitable spots by means of parachutes is a new development of the air arm. After giving a brief history of the parachute, the writer describes a modern parachute and the method of using it. There are two types in common use, one in which the pilot controls the opening of the parachute by means of a rip-cord, and the other, which opens automatically. Both have advantages and disadvantages. The normal speed of descent to be aimed at is five metres per second.

There are many ways in which parachute troops can be employed. There are numerous tasks that they can carry out behind the enemy's front line, particularly the destruction of bridges and important points in the enemy's communications. Parachute troops need not necessarily be regarded as "forlorn hopes." Their action will be one of surprise, and it will often be possible to get them back safely.

Parachute troops are specially selected men with qualifications of the highest order. They should be trained as scouts, as sappers—with regard to demolitions, etc.—and as signallers and observers from aeroplanes. They should be light weights and gymnasts.

If there are difficulties, in a small country, to train sufficient men as parachute troops, the subject is one well worthy of study, if only to discover suitable counter-measures to their employment by an enemy.

3. *Political Review.* By Major-General Paschek. Concluded in this number.

4. *The Civil War in Spain.* By General Wiesinger.

This instalment brings us to the state of affairs on the 20th January, 1937. The main operations during the period under review were those at and around Madrid. Conditions of stabilized warfare had prevailed on that front, when Russian influence prevailed upon the Government command to endeavour to turn the Nationalist flanks. The sudden change to field warfare took the Nationalists by surprise and made things difficult for them. They began to show greater energy in their naval operations.

(*March*, 1937.)—1. *Warfare in the Future.*

General Eimannsberger speculates on the form that warfare will take in the future, in view of the mechanical developments that have taken place in recent years, and the progress and expansion of the air force in all countries.

Great Britain's operations against the Kurds, north of Irak, in 1931, with an air force alone, would seem to justify Douhet's theory. On the other hand, the French success in Morocco in 1934, by means of mechanized columns, bear out Fuller's principles of mechanization.

The machine-gun was the weapon that held up attacks during the Great War.

In a future war, an infantry attack of the pre-1914 pattern is, in ordinary circumstances, no longer possible. An artillery attack on a large scale pre-supposes stabilized warfare. Neither an infantry attack with tank accompaniment, nor a tank attack on a large scale, is likely to bring about a decisive result.

The writer inclines to the opinion that a struggle between two forces of approximately equal strength will eventually develop into stabilized warfare. Where one force is decidedly stronger than its adversary, the struggle is likely to be over in a much shorter time than formerly.

2. *A miscarried "Caporetto."* By Colonel von Hubka.

An account of an incident in the Austro-Italian War, that occurred five weeks

before the Caporetto disaster on the south Tyrolean front. In September, 1917, the Austrian dispositions in the Trentino were betrayed to the Italians by a Slovene officer named Pivko. The Italians took advantage of their information to carry out a surprise attack at Carzano on the night of the 17th-18th September. For various reasons the attack miscarried. Not only were five battalions repulsed with heavy loss, but a force of 40,000 men was held up. It is a moot point whether the success of this attempt would have saved the Italians from their subsequent disaster at Caporetto.

3. *The Employment of Artillery in Mountainous Country.* (*Upper Isonzo*, 1915.) By Major Heydendorff.

An account of the services rendered by the Austrian mountain artillery in the autumn of 1915, in holding up the Italian advance.

4. *Wire Ropeways. Experiences of the War and Technical Military Requirements.* By Major Krüpl.

The main differences between a ropeway constructed for military purposes and a civil ropeway are that in the former case rapidity of erection is essential, and economy in working and saving of wear and tear are secondary considerations.

Experience gained on the Austro-Italian front indicates the following points as being of great importance in a military ropeway :—

1. An endless ropeway system for gradients steeper than 100% : if possible, elimination of the uneconomical to-and-fro system.
2. Saving of time :

   (*a*) in the survey and tracing of the line,
   (*b*) in working out details,
   (*c*) in construction.

3. Design of new types of light ropeways.
4. Utilizing experience gained in the war for the design of an ideal single-rope ropeway and a type for use in high mountains.

Double ropeways on the endless system are suitable for gradients up to 100%. With steeper gradients the to-and-fro system is necessary. In this arrangement the carriers are fixed to the hauling rope, and gradients up to 275% can be negotiated. On the other hand, the to-and-fro system is very slow for long ropeways.

The usual method of obtaining a constant tension on the carrying rope is by means of heavy counterweights. But in some field ropeways the counterweights are dispensed with, and the rope is anchored down at both ends. This latter method is, however, unsuitable for short lines.

The lighter the type of ropeway, the shorter is the time needed for erection. The lightest practical type is one carrying 60 kg. loads, requiring a carrying rope of 12 mm. diameter.

In a double-rope cableway of the endless rope type the minimum economical load is 120 kg. The writer makes a comparison between the ropeways provided during the war by the firms of Bleichert and Heckel, and, after some remarks on the necessity for concealment of ropeways, he concludes with a description of a ropeway on the to-and-fro system constructed by the firm of Girak.

5. *The Propulsion of Motor Vehicles with Home-produced Fuels.* By O. Schreiber.

The absence of oilfields and of brown-coal mines in Austria limits the field of selection of home-produced fuels. In war time the only indigenous source of supply is timber. The hard woods, mainly beech, which only form a small proportion of the forests of the country, can provide wood gas, or charcoal gas.

Of liquid fuels, ethyl alcohol is likely to give the best results. Italy has made a success of this form of fuel. The Scholler process, in which sawdust is treated with hydrochloric acid, has been introduced into several countries with good results.

A.S.H.

WEHRTECHNISCHE MONATSHEFTE.

(*January*, 1937.)—1. *The Military Significance of Mineral Raw Materials.* By Major Hedler.

The most important mineral raw materials are (*a*) coal, (*b*) crude oil, (*c*) iron. The writer has prepared a series of tables showing the distribution of these materials amongst the nations of the world.

The United States, Great Britain and Germany hold the largest supplies of coal; most other countries are, to a greater or lesser extent, dependent upon imports. Whereas the world's supply of coal is estimated to last for hundreds, possibly thousands of years, the world's supply of oil is likely to give out within twenty years, if the present rate of consumption continues. But coal promises to prove an efficient substitute: oil and benzole can be obtained from it by special processes. The mining of coal, however, requires a large supply of timber for pit-props. In this respect the U.S.A. and Germany are well supplied, but Great Britain depends upon imports.

The world's supply of iron-ore is assured for several centuries. But Germany's supply has been severely curtailed by the cession of Alsace-Lorraine to France and of a portion of Upper Silesia to Poland.

The writer concludes that, thanks to the extraordinary development of its chemical industries, and the manufacture of rubber from coal products, Germany is, on the whole, in a favourable position as regards its supplies of raw materials.

2. *Mechanical Fuse v. Time Fuse.* By C. Weninger.

A discussion on the relative merits of mechanical and time fuses for artillery projectiles.

3. *Anti-aircraft Defence.* By Major-General Rieder.

The ineffective defence put up by the Abyssinians against Italian air attacks is attributed to the absence of anti-aircraft artillery of medium or heavy calibre.

In European countries air attacks are likely to be made on buildings of considerable military importance, and these will be provided with anti-aircraft defence. As a rule, a surprise attack is only likely to succeed if it is undertaken at a height of over 5,000 metres, or else under cover of clouds, or at night. The attacking aeroplanes will only drop down to a low altitude when they are nearly over their target, and they will rise again as soon as possible when they have released their bombs.

Small anti-aircraft guns and machine-guns are only effective at short range, and can only be used when enemy aircraft drop to a low level. For higher altitudes guns of medium or heavy calibre are necessary.

The writer shows, by means of sketches, suitable distributions of anti-aircraft batteries round an important centre, indicating the areas that can be swept by one, two or more batteries.

4. *French and British Motor-car Exhibitions.*

Dr. Steinitz describes the motor-car exhibitions held in Paris and London in 1936.

(*February*, 1937.)—1. *Chemical Research from the Point of View of Defence comprised in the Four-Year Plan.* By Prof. Müller.

An account of the progress made in recent years in chemistry in Germany to supply the country with the materials required for defence, and to render it independent of foreign supplies.

2. *The Financing of a "Total" War.* By C. Ostermann.

A criticism of certain publications on the financing of war. The writer maintains that Germany found no very great difficulty in paying for the World War. It was paid for by the 39 million owners of war loan. The trouble was to prevent prices from rising unduly.

3. *The Soldier-Engineer, a new Type of Technician.*

Captain Wesemann points out the existence of three types: soldiers pure and

simple, technical soldiers, and soldier technicians. He discusses the question which of the two latter types will make the best military engineers. The conclusion appears to be that technicians will fit in best with the Nationalist-Socialist system, and that it is easier to make a technician into a soldier than a soldier into a technician.

4. *Politics, Geo-politics and Technics.*

Dr. Ruprecht presents a study of the influence of geography on the politics of a nation. Great Britain is taken as a notable example. The submarine, the aeroplane, and the long-range gun had such an influence on her insular position that she can never permit the Channel ports to be in the hands of an unfriendly nation. Hence she must work in collaboration with France.

The Suez Canal has become one of Britain's most vulnerable points. Farther east there is the danger that if the Kra Canal should ever be cut through the Malay peninsula, Singapore would lose its value almost entirely.

(*March*, 1937.)—1. *"Total" War and Technics.* By K. Metzel.

All military powers are now preparing for a "total" war, which they hope to win by the utmost exertion of their technical and organizing skill. The writer, in referring to the four-year plan in Germany, dwells on the importance of raising the standard of work and responsibility of the engineer and technician to the highest point.

2. *Reflections on Defence Organization.* By H. Bobbert.

With regard to the question whether armament industry should be state-owned or privately owned, the writer considers that most of the industry should be in private hands, but that the state should retain control over a portion of it.

Technical preparations should be made in peace-time for the armament industry in war-time. The change from peace to war conditions takes time to carry out.

It will greatly assist matters if a supply of half-fabricated material is collected in peace-time. A large capital expenditure will be saved if this is done in preference to accumulating stocks of finished products.

Skilled workmen should be trained in peace-time: their training is a lengthy one. Nowadays a workman in the home-land is worth as much as a combatant in the front line.

3. *The Losses in the World War.*

Dr. Fischer analyses lists of German casualties in different actions and different portions of the front during the World War, and concludes that in future wars it will only be possible to reduce losses by having a preponderance of artillery and making the utmost use of machine-gun fire.

4. *The Military Value of Non-ferrous Metals.* By Major Hedler.

No country is entirely independent of imports of non-ferrous metals. Russia is the most favourably situated of all European countries as regards mineral ores, but she has to import a certain number of metals.

Copper is the most important of non-ferrous metals. Germany produces a certain amount, but not enough for her requirements. Lead comes next, and here Germany is independent of imports. Zinc is available in large quantities. England is the only country in Europe that produces tin. The only European countries that produce nickel are Norway and Greece, and the amount available is small.

5. *The Interruption of Railway Communications in Communistic Ideology.* By W. Conrad.

The writer maintains that there is a Bolshevist railway organization in all so-called capitalist countries. In case of emergency it will be used to disorganize the railway system by destroying important bridges, tunnels, workshops, water-towers, signals, etc. The destructive personnel is a Bolshevist civil staff organized by the enemy.

As a rule, each destructive gang consists of a leader and two to four men. The smallness of the gangs in relation to the magnitude of their task gives them first-rate prospects of success. The severest counter-measures are therefore necessary.

A.S.H.

VIERTELJAHRESHEFTE FÜR PIONIERE.

(*February*, 1937.)—1. *Engineers and Troop Leaders.* By Major von Ahlfen.

A series of schemes, with maps, illustrating the method of employment of engineers in critical situations, and the orders that a divisional commander should issue in each case.

2. *The Fight for River Lines in Retirements.* By Major Günther.

An attack across a defended river is one of the most difficult of military operations, but a tactical retirement following hard on a successful crossing is more difficult still. Apart from technical difficulties, the withdrawal, in succession, of large bodies of troops while severely engaged with the enemy, day and night, requires several nights to carry out, and give an enterprising enemy opportunities for taking advantage of an awkward situation.

In this article Major Günther describes the passage of the Marne by the right wing of the 7th German Army in July, 1918, east of Château Thierry. The infantry of the 7th Army crossed the Marne on the 15th, after a heavy preparatory bombardment, and advanced on the 16th to the French advanced position, only to find that the enemy had retired to a strong second position. Unable to advance farther without artillery support, and exposed to French counter-attacks in front and in flank, the 7th Army was compelled to fall back across the Marne.

The retirement was carried out in an orderly manner on the nights of the 18th-19th and 19th-20th, unperceived by the French, who advanced cautiously, and concentrated their drum-fire on the abandoned German positions.

The writer describes in detail the bridging and ferrying work carried out by each of the eight divisions taking part in these operations. The lessons to be learnt from them are described at length; it is only possible to mention a few here.

Rivers can be divided into two classes, those over 100 metres, and those under 100 metres wide. 100 metres represents the limiting length of assault or footbridges, and this limit may have to be reduced if the velocity of the stream is high. Heavy vehicles and the mass of the artillery must be got across first.

Three or four crossings should be established and maintained for each division. A plentiful supply of repair material is necessary, and it is better to ensure having one bridge maintained in good condition than to have a number of bridges that do not escape damage or destruction.

Crossings in continuation of main roads should be avoided. The importance of obstacles to delay the enemy's advance is emphasized, and no bridging equipment should be left behind on the enemy's side of the river.

3. *Bridge Approaches and Exits.* By Captain Hartung.

Manœuvres carried out in 1936 show that bridge construction with prepared material can be effected without a hitch, but that approach roads, which are as important as the bridge itself, are often neglected for want of time. It is probable that in warfare, bridges will be constructed away from main roads, and approaches may have to be taken through swampy ground.

In reconnoitring a bridging site and its approaches, the commander of the bridging

column, whose vehicles will be the first to use the approaches, will have to determine: (1) the place where approaching traffic will leave the main road, (2) the place where the officer in charge of the traffic control will stop vehicles, or allow them to proceed (this place should be under cover from view), (3) the place where laden vehicles will give way to those returning empty.

Notice boards will be erected in suitable places, and side-tracks blocked. There should be a telephone connection between the officer in charge of bridge construction and the officer controlling the traffic.

The approach roads should be taken in hand in good time, so as to be ready by the time the bridge is completed. They may be made up in three different ways:—

(1) With raw material found on the spot, such as fascines, logs, or stones. The method is slow and employs a great deal of labour.

(2) With prepared material carted to the site, such as logs, beams, planks, stones, bricks, slag, etc. This method is slow and employs much labour and transport.

(3) With specially prepared material carted to the site.

The last method, recommended by the writer as rapid and requiring little labour, consists of the employment of specially designed steel sheets. These sheets are 4 metres (about 13 ft.) long, 0·70 metres (2 ft. 4 in.) wide, and 3 mm. ($\frac{1}{8}$ in.) thick, weighing 70 kg. (154 lbs.) each. The edges are turned up, to form hollow troughs, 0·60 metres (2 ft.) wide overall. The sheets have cross-corrugations, at intervals, to give lateral stiffness.

In swampy ground the bed of the roadway is made by laying the sheets, crosswise, as sleepers, touching one another at the edges, alternately singly and in pairs (end on). Over the sleepers two rows of similar sheets are laid longitudinally, spaced apart, centrally, at the width of the wheel track. The sheets are fixed together, securely but simply, at the ends.

If the ground is firm, the bottom layer of sleepers is omitted, and the two lines of longitudinals only are laid.

100 sheets, weighing 7 tons, will make 200 metres of normal road, or 33 metres of swamp road. The weight is a little over a third of that of planks.

4. *Training of Engineers for Battle. Part I.*

Captain Meltzer gives his views on a proposed system of training for engineers. In this first part he describes training without a rifle. The course includes instruction in the following subjects: Description of a stretch of country, training men to have an eye for country and to take advantage of the configuration of the ground, judging distances, transmission of orders, finding one's way across country, outpost duty, concealment, route marching, throwing hand-grenades, etc.

5. *Reflections on the Training of an Engineer Company.*

Lieut. Beierlein expresses his views on the training of an engineer company, from the recruit stage onwards. The recent increase from one to two years' service in the army necessitates a modification of the old system.

6. *The Verdun Forts.* By Colonel Jesse.

General Benoit, of the French Corps of Engineers, died in 1935. His services in connection with the Verdun forts were described in a monograph that appeared in the *Revue du Génie Militaire*, and an article in the *Revue Militaire Française*. The writer has collected the information contained in these articles and has added some comments from the German point of view.

A.S.H.

THE INDIAN FORESTER.

(*January*, 1937.) In the January, 1936, number of this periodical, reviewed in the June, 1936, number of *The R.E. Journal* is an account of the phenomenal growth of some *shishams*. In this number is a photo of the same, average height 33 feet at six years of age. Another photo shows six-year-old *casuarina*, which has reached 62½ feet and is 8 inches in diameter.

In the editorial notes we have a reference to asbestos cement reinforced plywood, which is not only fireproof, but is claimed to be shrapnel-proof. We also learn that Japan has produced a waterproof raincoat of paper at a cost of twelve annas, designed for emergency sales at race meetings and the like.

Finn's Baya is a bird which builds nests shaped something like a pistol, the entrance to the nest, which hangs from a tree usually over water, being the barrel. The presence of mud pellets in the interior of the nests was for long a mystery, but a letter from Mr. Hart, D.F.O., Anantapur, states, apparently as an accepted fact, their purpose, to wit, that the birds prey on fireflies and bring them into their nests, where they stick the luminous portions of the insects on to previously prepared pellets, in order to light the happy home during supper.

Forest Record, Vol. I., No. 4, Utilization, on the protection of Indian structural timbers against fire, termites, borers and fungi, of which a summary is given, seems to be a most useful production.

(*February*, 1937.) Capt. Edney's article on "dowsing" in a recent number of *The R.E. Journal* has already been noticed once in *The Indian Forester*, and the subject comes up again in this number under the heading "Can you use a divining rod?"

Last year, a prize was offered for the best design for a Forest Officer's bungalow at a cost not greater than Rs. 10,000. The accepted design is illustrated herein, and shows a useful residence. As regards the cost, it should be said that the total includes no outhouses, the designer considering that servants prefer to live in the *bazaar*. The P.A. of the building works out at around 4470 sq. ft., and hence the P.A. rate comes to about Rs. 2.4.0. This would be considered rather optimistic in the M.E.S., but for the fact that a Forest Officer could reckon on getting timber at a very low figure.

(*March*, 1937.) "Exotics in Kulu" include larch and Douglas fir (a North American tree). The results as shown by some excellent photos show a good growth for the former, a height of forty-five feet in nineteen years being recorded.

The forestry court at the U.P. Exhibition at Lucknow, in the cold weather of 1936–37, had some useful exhibits. One was a model house, made of Ascu-treated *chir*, proof against earthquakes, storm, termites, borers and fungi. Another was a working model displaying the evils produced by erosion consequent on tree-felling and over-grazing. The model showed two landscapes side by side, one of forested land in the hills, with flowing water and prosperous villages. The other showed the same area denuded of trees, the water scarce and disappearing underground after a very short course with miserable habitations. Artificial rain, which was turned on several times a day, showed the course of erosion to an admiring multitude, who, we will hope, will benefit by the instruction. A bridge of Ascu-treated *sal* to take a uniformly distributed load of 35 tons over a span of 48 feet, was another exhibit.

F.C.M.

INSTITUTION PUBLICATIONS

For sale in the office of the Secretary, Institution of Royal Engineers, Chatham.

Notes for Officers Proceeding to India (1930). (3s. 6d. each; to members 2s. 6d.).

Descriptive Accounts of other Foreign Stations.—These are not being revised. Instead, copies of the N.A.A.F.I. pamphlets of *Useful Information* may be obtained from the Institution of R.E., at the cost of sixpence, post free, with R.E. Addenda supplied by Chief Engineers, etc. These addenda are now available for Malaya, Malta, Jamaica, Bermuda, Ceylon and Iraq; Mauritius (on loan only) and Sudan (on loan only).

The following old descriptive accounts are also available:—*Gibraltar* (1922), *Hong Kong* (1927), *Jamaica* (1928), *Notes on the China Command* (1930-1) at 1/- each; and the *Official Handbook for British Troops in Egypt and Cyprus* (1931) with R.E. Addenda (1/4).

An Outline of the Egyptian and Palestine Campaigns, 1914 to 1918.—By Major-General Sir M. G. E. Bowman-Manifold, K.B.E., C.B., C.M.G., D.S.O., *p.s.c.*, late R.E. Seventh Edition, 1929. With 17 maps and sketches. Price 4s. 6d. (post free).

History of the Corps of Royal Engineers.—Vols. I and II, by Major-General Whitworth Porter, R.E. Vol. III, by Colonel Sir Charles M. Watson, K.C.M.G., C.B., M.A., late R.E. Three Vols. £1 10s. (to members, 7s. 6d.) (post free).

History of Submarine Mining in the British Army.—By Brig.-General W. Baker Brown, C.B. Price 5s. (to members, 3s. 4d.) (post free).

A History of R.E. Cricket.—By Captain R. S. Rait Kerr, D.S.O., M.C., R.E. (with 8 plates). Price 2s. 0d. post free.

Histories of Companies:—7th (Field) Co., R.E. 1s. 6d., post free. 12th (Field) Co., R.E. (Illustrated). 3s. 2d., post free. 65th (Field) Co., R.E. 5s. 4d., post free. 20th (Field) Co., R. Bo. S. & M. 2s., post free.

The Early Years of the Ordnance Survey.—By Colonel Sir Charles Close, K.B.E., C.B., C.M.G., Sc.D., F.R.S. (illustrated). Price 6s. (to members 4s. 6d.) post free.

General Sir Charles Pasley, K.C.B., F.R.S., D.C.L., Colonel Commandant, R.E., 1780-1861.—Price 1s. 6d., post free.

The Temporary Roads Department. By "Roadsurvey." 2s. 6d., post free.

The Individual Training of A.A. Searchlight Units. By Lt.-Col. M. F. Grove-White, D.S.O., O.B.E., R.E. 2d. each, plus postage.

Foolproof Finance for Part I Services. By Major W. G. R. Nutt, M.C., R.E. 4d. each, post free.