THE ROYAL ENGINEERS JOURNAL.

Vol. VIII. No. 4. OCTOBER, 1908.

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STEREOSCOPIC PHOTOGRAPHY APPLIED TO RECONNAISSANCE AND RAPID SURVEYS.

By Capt. F. V. Thompson, R.E.

Applications of photography in the field have hitherto been chiefly confined to record work and map reproduction.

It is proposed to consider in this paper two further applications, viz. :—

1. Reconnaissance work.
2. Rapid surveys.

Before taking these in detail, it will be necessary to briefly describe the principles upon which these applications depend—

A.—Orthochromatic photography.
B.—Manipulation by time.
C.—Extended base stereoscopy.

A.—ORTHOCHROMATIC PHOTOGRAPHY.

The general tendency in modern out-of-door photography is to reduce it to a system of "button-pressing," the remainder of the work being as often as not carried out by the local chemist.

The result is somewhat of a toss-up and, at the best, will be a picture more or less pleasing from a scrapbook point of view, but quite useless for military purposes or survey work.

The essential part of a landscape from a military point of view is the middle and extreme distance (from 500 to 5,000 yards). In an ordinary photograph the middle distance fades off into the sky, whilst the extreme distance is probably entirely lost. The photograph fails to reproduce what the eye can see on the ground.

The reason for this is that the ordinary photographic plate is relatively colour blind compared with the human eye, and the object of orthochromatic photography is to correct this colour blindness, and to reproduce in the photograph all that can be seen by the eye. In other words, to give a correct rendering of colour luminosities throughout the view.

The greatest visual luminosity in the solar spectrum is near the yellow portion ; unfortunately this is the portion to which the ordinary photographic plate is least sensitive. The plate's greatest sensitiveness is in the blue and violet portion, consequently the predominance of bluish rays in the extreme distance, and of green and yellow in the

middle distance, render it impossible to obtain an evenly exposed picture throughout, when using an ordinary plate.

The curves in *Fig.* 1 show approximately the relative sensitiveness of the normal eye and the ordinary plate, to the solar spectrum.

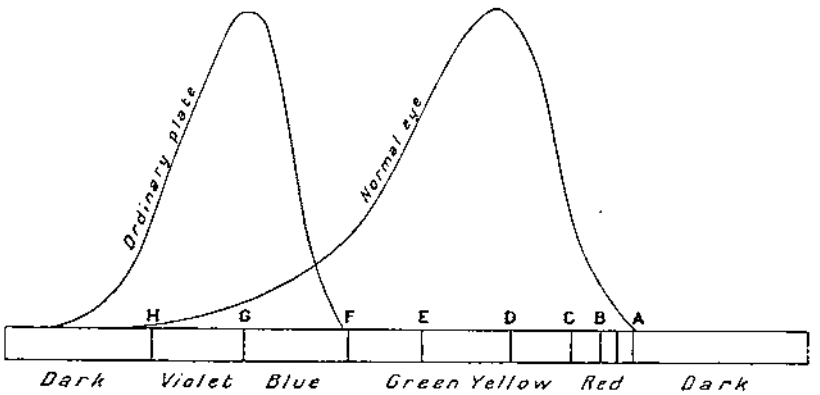


FIG 1.

A corrected result can be obtained by exposing the plate behind a suitable orange-yellow glass (called a "colour screen.") Owing however to the almost complete extinction of the blue and violet rays, and to the feeble sensitiveness of the plate to the yellow rays transmitted, the exposure will be increased more than a thousand times, and this is obviously impracticable.

A partial correction can be effected by the application of certain dyes to the plate. A plate so treated becomes an orthochromatic plate, and can be made moderately sensitive to the yellow portion of the spectrum. To obtain complete correction it is necessary to further subdue the effect of the blue and violet rays; this is effected by an orange colour screen which will increase the exposure from 15 to 20 times. By this combination of orthochromatic plate and colour screen it is possible to obtain correct visual colour luminosities throughout the view.

Half measures must be avoided, but have been encouraged by the manufacture of snap-shot orthochromatic plates and low value colour screens, increasing exposure only 2 to 5 times. The result is a poor compromise, but the existence of such gear is rendered necessary by the prevailing craze for "button-pressing." Useful results can only be obtained by using a moderately slow orthochromatic plate, and a properly adjusted colour screen, giving complete correction.

For this work a tripod or some kind of rest is inevitable, and this being so, it is a small matter whether the exposure is 2 seconds or 20 seconds. The longer exposure is in fact preferable, as it can be more accurately timed. Another advantage of a longer exposure, is that the aperture or stop of the lens can be reduced so as to give the sharpest possible definition. Incidentally a rather cheaper lens can

STEREOSCOPIC PHOTOGRAPHY

be used, as the expensive nature of modern lenses is chiefly due to the "button-pressing" requirement of large aperture combined with sharp definition; the result has however been a considerable advance in lens construction generally.

The orthochromatic result, though truthful, is not always artistically pleasing, and at first sight has an unnatural appearance of contrast and detail, and lacks "atmosphere." Any displeasing effect is partly due to the fact that the normal eye has become demoralized through seeing so many untruthful results, and fails to appreciate truth when presented to it.

B.—MANIPULATION BY TIME.

For reconnaissance and survey work the photographic manipulations have been reduced to a system which, when followed, renders the chances of failure remote, and may be described as "fool-proof."

A systematic procedure is essential, as it may often happen that the officer required to carry out the fieldwork or exposure of plates has had little experience of photography. Ordinary care is the only necessary qualification, though of course a good eye for country is essential for the economical selection of views.

The development and further operations require some skill and greater care, but are quite systematic.

The work may be divided into three stages:—

(*a*). Exposure of plates.
(*b*). Development of plates.
(*c*). Preparation of enlargements or transparencies for the stereoscope.

In reconnaissance work (*a*) would be carried out by an officer, (*b*) and (*c*) by a trained photographer. In survey work (*a*) and probably (*b*) would be carried out in the field by the camera party, consisting of one surveyor and one photographer assistant; (*c*) and the plotting would be done in an office.

Each stage has been reduced to a matter of timing by simple calculation.

(*a*). EXPOSURE OF PLATES.

In the first place no focussing is required. The time of exposure is calculated by means of an exposure meter, the essential feature of which is a strip of sensitized paper placed alongside a standard tint.

The time taken by the light in changing the colour of the sensitized paper to match the standard tint is a measure of the light intensity. The constants are the speed of the plate, the aperture or stop of the lens, and the density factor of the colour screen. A sliding scale gives the required exposure, or the necessary stop for any desired length of exposure.

(*b*). DEVELOPMENT OF PLATES.

The majority of failures by amateur photographers are probably effected in the dark room, with the aid of a ruby lamp. If a dark room is used at all there should be no form of illumination during development, or only one which has been carefully adjusted to, and tested for the plate in use. In the field a dark tent, unless it can be erected in a building or shed, is an abomination and has been discarded in favour of a combined developing and enlarging box. Failing this a collapsible form of changing bag with light-tight sleeves can be used.

Development is carried out by time, which varies with the nature and strength of developer, brand of plate, and temperature of developer. When temperature is the only variable, the time of development can be ascertained from a table of temperatures. Tabloid developer is employed.

(*c*). PREPARATION OF ENLARGEMENTS OR TRANSPARENCIES.

Either of these can be prepared in the field developing and enlarging box, mentioned above, by daylight or by artificial light as required.

These operations (*b*) and (*c*) require more skill than (*a*) and would usually be carried out by a skilled photographer. In skilled hands a pair of finished enlargements $10'' \times 8''$ can be turned out, under favourable conditions, in half an hour from the time the dark slides containing the exposed plates are handed to the operator at the box.

Space forbids a description of the box and its manipulation.

C.—EXTENDED BASE STEREOSCOPY.

It is not proposed here to enter into a discussion on stereoscopic vision, but to describe an application of stereoscopy to landscape photography, which does not appear to have been practised hitherto.

The ordinary stereoscopic prints seen are taken in a camera provided with two lenses mounted about $2\frac{1}{2}$ inches apart, this being the normal interocular distance. The relief effect seen in the stereoscope is consequently no greater than that seen by normal eyes in nature.

Assuming one minute of arc to be the defining or separating power of normal eyes, relief is not appreciated beyond a range of about 250 yards. Beyond this range there is some appearance of relief due merely to familiarity with the objects seen and not to convergence of the optic axes.

By extending the stereoscopic base from $2\frac{1}{2}$ inches to 4 feet, the limiting range of relief effect would be increased from 250 to approximately 5,000 yards. A single lens camera would be used, and moved to one side or the other for the second exposure.

To obtain full advantage of the extended base principle, it is found advisable to use a base varying from 10 to 100 yards, according to the subject and purposes for which the view is required.

A 10-yard base will give at 2,000 yards a relief effect equal to that seen by normal eyes at 14 yards, that is to say the parallactic angle or the angle subtended at the object by the stereoscopic base is the same in the two cases.

The appearance in the stereoscope when properly adjusted should give no distortion of perspective but exaggerated relief, such as would be seen by an individual whose eyes were separated by a distance equal to the stereoscopic base. The appearance corresponds to that of a model of the country viewed from the point on the model occupied by the camera on the ground, thus giving an equal amount of detail and increased relief.

There is, as might be expected, some discomfort experienced in combining stereoscopically objects which are distant less than twice or three times the base length. A sensation of squinting results, similar to that experienced when viewing an object placed only 5 or 6 inches from the eyes. This point need not be considered except in the case of very long bases, or when it is required to view objects at short range.

The relief effect in the distance is very pronounced, small folds in the ground, which cannot be detected by the aid of field glasses, being thrown into marked relief. The contour of the ground is shown in a way unequalled by any other optical instrument.

An important fact stated by Professor Forbes is that a single stereoscopic observation is more precise than two separate monocular observations. This fact was independently noticed in the S.M.E. experiments, the probable errors giving a ratio of 5:3.

The result is equivalent to a proportionate increase in definition, and is very appreciable in the case of a pair of views taken perhaps on a hazy day.

On examining the views separately it might be impossible to determine the shape of distant ground, but on viewing them in the stereoscope, patches of "woolly" and uncertain definition assume definite shape and outline, and are thrown into their respective planes of relief.

APPLICATIONS.

1. RECONNAISSANCE WORK.

It is assumed that this class of work is supplementary to an existing small scale map.

The reconnaissance work usually required may be :—

(*a*). Reconnaissance of an enemy's position and approaches,
(*b*). Reconnaissance of a position for defence, or
(*c*). Route reconnaissance.

Of these it will be sufficient to consider (*a*), as the procedure adopted can be applied to (*b*) or (*c*), though perhaps not so advantageously.

RECONNAISSANCE OF AN ENEMY'S POSITION.

The usual methods of executing this reconnaissance are :—

(1). A rapid prismatic compass or plane-table sketch from a distance by intersections,
(2). Range finder and prismatic compass sketch,
(3). Eye sketch by estimation of distance, or
(4). Panorama sketch.

It is doubtful whether (1) or (2) often go far to elucidate the small scale map, whilst the personal factor must always enter too largely into (3) and (4) to allow either to inspire much confidence.

Where the above methods fail, is in indicating the true shape of the ground, and it is thought that stereoscopic views, taken on the extended base principle, would, by presenting the appearance of an exact model of the country in bold relief, often go further in elucidating the small scale map than (1) or (2) above, and inspire considerably more confidence than (3) or (4).

The stereoscopic method is not advocated as an invariable substitute for the older methods, but as one which would in hilly country often give more useful results and in any case prove a valuable supplement.

The first consideration in selecting gear for this work is the amount of detail or definition obtainable in the views.

It is generally known that an enlargement, to say two diameters, from the best of negatives, though approximately equal to a twice magnified view of a contact print, is much inferior in definition to a contact print from a negative of twice the magnification (*i.e.*, a negative taken with a camera lens of twice the focal length).

This is due to the unavoidable granular structure of the negative film in which much of the finer detail becomes lost. Some detail is lost in the negative itself, more in the smaller negative than the larger. There is a further loss in enlargement owing to diffusion due to grain in the plate.

As there was no standard of definition it was decided to adopt normal vision as a standard for experimental purposes. The object of this was to enable direct comparison to be made between the detail to be found in a negative and field glass or telescope powers.

The defining or separating power of the normal eye is approximately one minute of arc. From experiments made with test screens, a standard combination of lens, stop, plate, and developer was arrived at.'

The conclusion reached was that a good 6-inch focus lens at f.32 gave unit definition, and that an increase in focal length gave a nearly proportionate increase in definition.

From this it follows that if detail in the negative were required equal to that seen in nature with a telescope of say power 4, it would be necessary to use a camera lens of $4 \times 6'' = 24''$ focal length. This would necessitate a camera rather over 2 feet in length. There is however a gain of 5:3 in the stereoscope, so that if the extended base method is employed a lens of $\frac{3}{5} \times 24'' = 14{\cdot}4''$ would suffice. This would mean a camera about 16 inches long.

The next consideration is the size of plate, and for ordinary field use $5\frac{1}{2}'' \times 3\frac{1}{2}''$ is considered the most suitable size.

Having fixed the size of plate, the angle of view included and dimensions of camera are determined by the focal length of the lens, which in its turn depends on the definition required.

The following table gives the definition, angle of view, length of front covered at 3,000 yards, and length of camera for lenses of varying focal lengths, using $5\frac{1}{2}'' \times 3\frac{1}{2}''$ plate and the extended base method :—

TABLE I.

	Focal length in inches	Definition	Angle of view	Frontage at 3000 yds.	Length of Camera
1	5	1·4	57°·40′	3300	·7″
2	6	1·7	49° 20′	2760	·8″
3	7	1·9	43°·	2340	·9″
4	8	2·2	38°·	2040	·10″
5	10	2·8	30°·40′	1650	1′·0″
6	14	3·8	22°·	1176	1′·4″
7	30	8·0	10°·40′	552	2′·8″

Selection of Focal Length.—A short focus lens means economy in time, plates, bulk, weight, and cost of camera.

The economy in bulk and weight can however be effected by using a telephoto lens which is arranged to have an equivalent focal length considerably greater than the length of the camera. The definition

corresponding to the angle of view is however less, *e.g.*, in case (7) above, by using a telephoto lens the length of camera could be reduced from 2 feet 8 inches to about 9 inches, but the definition would be considerably less than 8, chiefly due to optical imperfections.

For the use of officers in the field a camera longer than 9 inches becomes too cumbersome, consequently the most convenient combination is a 6-inch lens and an interchangeable telephoto lens of 30 inches equivalent focus. By this means general views of a position can be taken covering a front of 2,760 yards at a range of 3,000 yards, and showing 1·7 times the detail seen by the unaided eye. By changing lenses a detailed view can be taken of any particular portion covering a front of 550 yards at a range of 3,000 yards, and showing approximately the same amount of detail as seen with the aid of field glasses of power 6.

Selection of Camera.—In exposed situations, and when time is a consideration, focusing is out of the question. Even under favourable conditions it would be difficult, since the focus of the rays transmitted by the colour screen would not coincide with the visual focus, whilst focusing with the screen in position would be difficult on any but bright days.

Any ordinary rigid form of camera could be adapted for stereoscopic work, if provided with a firm tripod.

For Service requirements however where reliability and rapidity are essential, a specially-constructed camera is required. The following are the essential features :—

The camera should be of the fixed focus box type. Sliding parts must be avoided, as extreme accuracy of focus is required, particularly for the telephoto lens. The camera cannot, of course, be used for near objects, and the focus must be most carefully adjusted by the maker, with colour screen and stop in position.

A light metal body is advocated, and metal-faced double dark slides provided with strong internal springs to ensure the film side of the plate being always in the focal plane.

The size of the camera is approximately $9'' \times 7'' \times 4\frac{1}{2}''$. On its upper surface are a circular level and sighting lines (see *Fig.* 3).

On the inside of the camera, and as near to the dark slide as possible, are four small metal triangular projections or pointers, so placed opposite to one another that lines joining them, when the camera is levelled, are respectively vertical and horizontal, and intersect on the axis of the lens. The shadows of these small pointers imprint themselves on the edges of the negatives, and provided the camera is levelled at each exposure, save all trouble in adjusting the views later in the stereoscope.

The rear end of the camera is provided with a leather cap, which fits closely over the dark slide, as the best dark slides will not stand a long exposure in sunlight if unprotected.

The shutter is a simple flap at the back of the lens, and is operated by an antinous release.

The colour screen is attached to the back of the lens.

The tripod should be a stout one, slightly lighter than the 3-inch theodolite pattern, and provided with a ball and socket head, the head being protected by a leather cap.

The advantage of the ball and socket head is that the camera can be quickly aimed and levelled, and admits of a simple subsidiary aiming and levelling attachment for performing all the necessary operations from a lying-down position, a convenience in exposed situations.

The total weight of the apparatus described above, including camera, six double dark slides loaded, tripod and leather cases, amounts to approximately 13 lbs.

For precise work solid gear is essential, particularly in rough weather, and at any time when using a telephoto lens.

THE STEREO-CASE.

The pattern of stereoscope adopted is an extension of that invented and patented in France by M. Pigeon.

The chief advantages of this form are :—

1. Portability. It can be folded up flat.
2. Simplicity. There are no optical parts with the exception of a small plane mirror.
3. Views of any size can be stereoscopically combined.

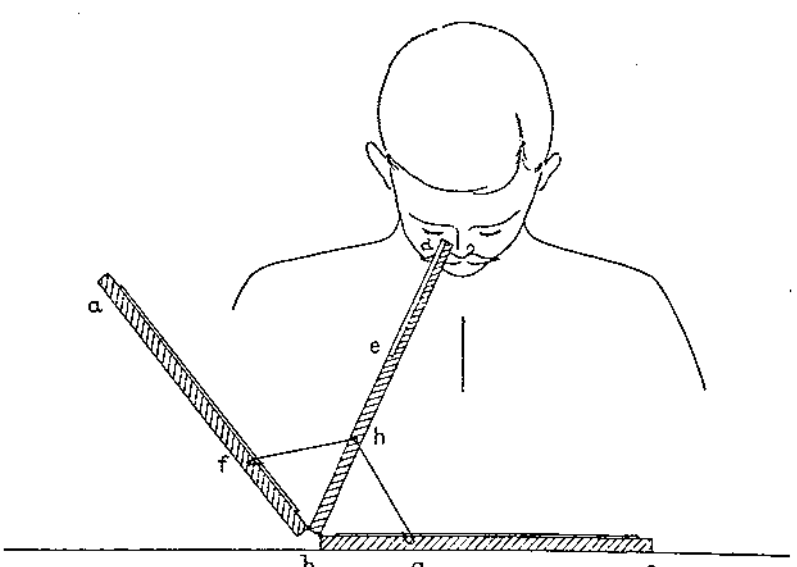


FIG. 2.

ab, *bd*, *bc* are three leaves of wood or aluminium hinged at *b*.

The views are laid on *ab*, *bc*, and are held in position by clips. They are adjusted by bringing the reference marks into line with corresponding marks on the leaves.

The centre leaf, *bd*, has a piece of plane mirror at its outer end, facing *ab*. This centre leaf is held in a position bisecting the angle between the two outer leaves by means of stays, *fh* and *gh*. The left-hand view of the pair is placed on *bc*.

A reversal of the right-hand view is placed on *ab*. The method of observing is shown in the figure. It is obvious that a reversed image of the view on *ab* will be seen by the right eye, and will be superimposed on the view seen by the left eye. The result is stereoscopic combination.

The view on *bc* is carried on a slide having some lateral play. This allows an adjustment to be made for comfortable combination in the case of abnormal observers and base lines.

The views employed are enlargements, about $10'' \times 7''$, and can be turned out in the field enlarging and developing box from the $5\frac{1}{2}'' \times 3\frac{1}{2}''$ negatives.

The reversal is obtained by reversing the negative concerned in its holder during enlargement.

Contact prints could not be used, but contact transparencies could be employed, and would give finer detail. One view must in this case be placed face down, and the leaves of the stereo-case must be hollowed out, so that the views can be seen by transmitted light.

The negatives themselves can be viewed in this way, but the light and shade is rather confusing at first sight.

For Service requirements, enlargements are considered the most suitable form of view, as they can be quickly prepared from wet negatives. Reversal is simple ; they obviate the necessity for magnifying arrangements in the stereoscope, and a number of views can be packed in the stereo-case.

Transparencies might be used if there was no enlarging gear available.

MAKING EXPOSURES FOR THE STEREO-CASE.

It is desirable to expose the two plates in the same vertical plane, but the human eye possesses such powers of accommodation that considerable latitude is permissible, and elaborate sighting arrangements such as are required in photo-surveying are in this case unnecessary.

It is sufficient if the two plates are exposed in planes which are approximately parallel, and separated by a distance which should be negligible, compared with the range of the nearest portion of the position to be observed.

Fig. 3 shows the necessary sighting lines on the upper surface of the camera.

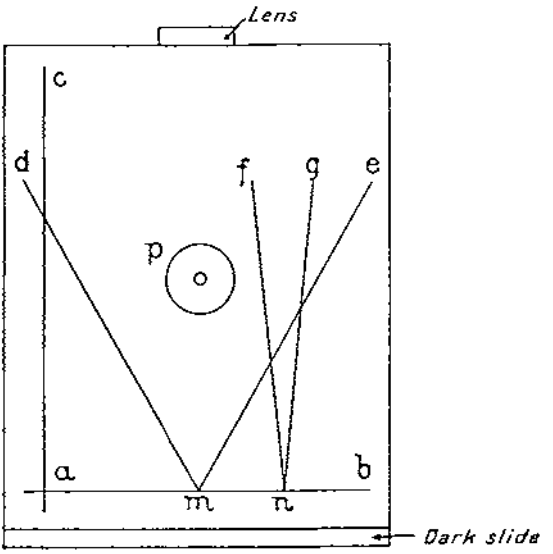


FIG. 3.

ac gives the direction of the axis of the lens.
ab gives the direction of the base line.
dme gives the limits of the view included by the 6-inch lens.
fng gives the limits of the view included by the telephoto lens.
p is a circular level.

The following is the procedure adopted :—

1. Take the light value by exposure meter, using watch or improvised pendulum swinging seconds. In very strong lights place a pale yellow glass of known density over the exposure meter and observe through this. Calculate exposure. If less than 5 seconds at f.32 decrease aperture of lens sufficiently to lengthen exposure to 5 seconds or more.
2. Set up camera, level and direct by means of sighting lines so as to include the required view. Make exposure.
3. Sight along *ab* (*Fig.* 3) and pick up some object as far off as possible, walk along this line and again set up camera, level and again sight along *ab*, turning camera till *ab* is again on the distant point. Make second exposure.

It sometimes happens that owing to obstacles the second camera station must be moved back or brought forward a few yards. Concealment and provision of cover may impose a narrow limit on the choice of camera stations. Sometimes it may not be possible to pick up a distant object to a flank.

In such cases neglect the sighting line *ab* and use *ac* as follows :—

(1). From any possible position make an exposure including the desired view, and pick up some object as far off as possible along the line *ac*.

(2). From the best available position to either flank make a second exposure, seeing that *ac* is again directed on the distant object.

A difference in level between the two ends of the base is immaterial.

If possible avoid a foreground (up to 200 yards) such as an underfeature, trees, houses, etc., which mask or nearly mask any important portion of the distance. Such objects will cause discomfort in the stereoscope, and may by obtrusion make stereoscopic combination difficult in the distance. If such objects cannot be avoided use a short rather than a long base.

In hilly country there is seldom a difficulty in obtaining a view unobstructed by foreground.

In gently undulating country, well covered with trees and hedges, anything approaching a long base (50 yards and over) will be out of the question unless some commanding position is available, and it may be necessary to use short bases, 5 to 10 yards. The relief effect in the extreme distance will then be small.

When using the telephoto lens, presumably detail is required in the extreme distance, and a long base of 100 yards or more should be used.

The Photo shows a pair of views taken with a 6-inch lens and base of approximately 60 yards. The right hand view is reversed.

2. RAPID SURVEYS.

A brief outline only can be given here of this application of stereoscopic photography. A detailed description of the method and an account of some experimental work, executed in the Cumberland Lake District in August, 1907, will be found in *The Geographical Journal*, May, 1908.

The method is peculiarly suitable for small-scale and exploration work in hilly countries. Compared with plane-tabling there is considerable economy in time, but some sacrifice in accuracy.

Fieldwork.—The general procedure is similar to that already described, but more precise. The camera is provided with accurate levels and a small sighting telescope, so that both plates can be exposed in the same vertical plane. The stereoscopic base is measured by a stretched wire or a subtense bar. Where a close network of triangles exists, or when two fixed points can be included in a view, base measurement can be dispensed with.

The total weight of the new field equipment now in course of construction will be approximately 25 lbs. in two equal loads. A camera party would usually consist of one surveyor and one photographer assistant. The triangulation and photography can, if desired, be run concurrently by one party.

On a 1-inch to 1-mile scale an average of 2 square miles per view pair should be obtained. The exposure of 12 to 18 plates in rocky country would be a good day's work if the views were economically selected. Each view pair, including unpacking, exposure, base measurement, and repacking, occupies 20 to 30 minutes in the field. Bases of 200 to 300 feet and more are usual, according to the accuracy required.

It is desirable that the plates should be developed as the work proceeds. This involves a very small increase in weight of equipment, a leather developing bag being used in place of a dark room. The surveyor works with more confidence and can examine the negatives in a stereo-case if desired.

Office Work.—The plotting is done by means of an instrument which has been called a "stereo-plotter." This is a stereoscope and plotting board combined.

Contact transparencies from the negatives are inserted and adjusted. Ranges are read on a spirally-graduated drum on a similar principle to the Forbes Stereoscopic Range Finder. A sliding rule is set at this reading. The position of the point in plan and its height in feet are then automatically indicated on the board.

An adjustment is made in the instrument for any difference in level of the ends of the base.

With practice 150 points per hour can be plotted. In the new instrument this rate should be increased. The speed of plotting depends on the scale and nature of country, as these determine the number of points to be plotted per square mile. Assuming that 12 to 18 plates are exposed per diem by the camera party, plotting at 1 inch to 1 mile should keep pace with them. The slow speed of plotting has hitherto been the chief drawback to photo surveying.

Contouring by this new method is particularly easy, owing to the exaggerated relief effect.

The following table gives some idea of the accuracy to be expected. The new gear should give considerably smaller instrumental errors than those on which this table was based :—

DATA FOR TABLE OF ERRORS.

Camera Lens, 6-inch Focus.

(1). Probable error in alignment = 20 sec. arc.

(2). Probable error in reading of parallax and setting of plates and scale in stereo-plotter = 0·0012 inch.

(3). Probable error in rapid base measurement $= \frac{1}{400}$,

a = error in range due to (1)

$$= \frac{(\text{range})^2 \times 20 \sin 1 \text{ inch}}{\text{base}}$$

p = error in range due to (2)

$$= \frac{0{\cdot}0012\ (\text{range})^2}{\text{base} \times 6 \pm 0{\cdot}0012\ (\text{range})}$$

b = error in range due to (3)

$$= \frac{(\text{range})}{400}$$

$$\text{Mean error} = \sqrt{a^2 + p^2 + b^2}$$

TABLE OF ERRORS.

Range.	Base 100.			Mean Error.	Base 200.			Mean Error.	Error in Height.	
	a	p	b.		a	p	b		Base 100.	Base 200.
500	0·2	0·5	1·2	1·2	0·1	0·2	1·2	0·5	0·2	0·3
1000	1·0	2·0	2·5	3·2	0·5	1·0	2·5	2·7	0·6	0·5
1500	2·2	4·5	3·7	6·2	1·1	2·2	3·7	4·2	1·2	0·8
2000	4·0	8·0	5·0	10·2	2·0	4·1	5·0	6·8	2·0	1·4
2500	6·2	12·6	6·2	15·3	3·1	6·3	6·2	9·3	3·1	1·9
3000	9·0	18·1	7·5	21·5	4·5	9·0	7·5	12·0	4·3	2·4
3500	12·7	25·7	8·7	29·9	6·4	12·9	8·7	16·8	6·0	3·4
4000	16·0	32·2	10·0	37·3	8·0	16·2	10·0	20·6	7·5	4·1
4500	20·2	40·8	11·2	46·9	10·1	20·4	11·2	25·3	9·4	5·1
5000	25·0	50·5	12·5	57·7	12·5	25·1	12·5	30·8	11·5	6·2
6000	36·0	72·5	15·0	82·3	18·0	36·2	15·0	43·1	16·5	8·6
7000	49·0	99·0	17·5	112·2	24·5	49·5	17·5	57·0	22·4	11·4
8000	64·0	130·0	20·0	146·2	32·0	65·0	20·0	75·1	29·2	15·0
10000	100·0	204·0	25·0	228·0	50·0	102·0	25·0	116·3	45·6	23·3

Focal length of camera lens = 6 inches.

(a) *p.e.* in alignment = 20 seconds of arc.

(p) *p.e.* in reading of parallax = 0·0012 inch.

(b) *p.e.* in base measurement = $\frac{1}{400}$.

100 yards on scale 1 inch to 1 mile = 0·057 inch.

Note.—Errors in height are calculated for points at a mean elevation or depression of 10°.

From the above table and formulæ the degree of accuracy for any set of conditions can be determined, or any required degree of accuracy ensured by variation in the length of stereoscopic base and focal length of camera lens.

*ORGANIZATION OF THE MOUNTED UNITS OF THE ROYAL ENGINEERS.**

By COLONEL A. G. DURNFORD, LATE R.E.

IN the *R.E. Journal* for August, an article by Colonel Ward appeared dealing with the First Mounted Units of the Corps organized at Chatham, and the following short sketch of *all* the mounted units up to the present time, may therefore prove of interest, especially to those officers who have served in them.

The first mounted unit was the "23rd or Driver Company of the Royal Sappers and Miners," raised at Woolwich in April, 1855, under the command of Capt. Siborne, its establishment being—5 officers, 130 N.C.O.'s and men, 120 horses.

The company embarked for the Crimea in August, 1855, but peace having been declared during the voyage it was landed at Scutari. Its name was at about this time changed to "R.E. Field Equipment," and subsequently to "R.E. Train." It returned home in 1856, disembarking at Woolwich in September of that year, and proceeded to Aldershot, where it took over the wagons and equipment of the Engineers of the Turkish Contingent. It was employed on ordinary Corps duties, generally at Chatham in the winter, and at Aldershot in the summer months.

On field days small infantry pontoons were carried almost loose in the ordinary entrenching tool wagons, subsequently the heavy Blanshard pontoons were adopted, carried on wagons of the Turkish Contingent Engineers which had been altered into pontoon wagons.

In May, 1863, the formation of an additional troop of R.E. Train and a depôt for the two troops was approved; these were called—

A. Pontoon Troop ...
B. Equipment Troop } R.E. Train.
Depôt ... ...

Capt. R. W. Duff, who had succeeded Capt. Siborne in command of the original A Troop, was appointed to command the R.E. Train.

In August, 1870, the formation of a third, C, or Telegraph Troop was approved.

* Full detailed information as regards these units up to 1889 will be found in the *History of the Corps of Royal Engineers*, by Major-General Porter, Vol. II., Chapter II.

A (PONTOON) TROOP.

The original unit, as already described, continued as a pontoon troop and the only mounted unit, until 1863, when the formation of an additional troop and a depôt was approved.

In 1863 the establishment was :—

1 Captain,
3 Lieutenants,
207 N.C.O.'s and men,
5 officers' horses,
12 riding, 80 draught } troop horses,
12 pontoon wagons (24 pontoons),
1 spare pontoon wagon,
3 general service wagons,
1 forge wagon,
1 boat wagon,
1 artificers' wagon,
1 store cart.

The length of bridge carried was 100 yards, the pontoons being an improved pattern of the Blanshard pontoon.

In 1864 the establishment was raised to :—

4 officers,
217 N.C.O.'s and men,
5 officers' horses,
16 riding, 124 draught } troop horses.

In 1870 the Blanshard pontoon was abandoned and the boat pontoon adopted, the length of bridge carried was 100 yards of floating bridge and 20 yards of trestle bridge, the carriages being 20 pontoon wagons—carrying pontoons and superstructure—4 pontoon wagons—carrying trestles and superstructure—5 store wagons (R.E. pattern), 1 forge wagon (R.E. pattern), 1 office wagon (R.E. pattern).

In 1888 the title was changed to Bridging Battalion, subdivided into A and B Troops.

The war establishment of each troop was :—

1 Major or Captain,
2 Lieutenants,
211 N.C.O.'s and men,
6 officers' horses,
14 riding, 168 draught } troop horses,
20 pontoon and trestle wagons,
7 general service wagons,
1 forge wagon.

In December, 1896, A and B Troops became separate units. In 1899 a third, C Troop, was added, and in 1900 a fourth, D Troop. This latter troop was disbanded in 1902. In May, 1905, A, B, and C Troops, Bridging Battalion, were renamed as 1st, 2nd, and 3rd Bridging Companies. In April, 1907, the three Bridging Companies, strength 314, were reduced, and replaced by three Bridging Trains with a strength of 24. The 1st Bridging Company was mainly transferred to the Telegraph Companies, and the 2nd and 3rd Bridging Companies were converted into the 5th and 4th Field Troops respectively.

B (EQUIPMENT) TROOP.

On the 5th May, 1863, the formation of an additional troop of the R.E. Train was approved to be called the "B, or Field Equipment, Troop."

This troop carried the field equipment for three companies, and was divided into three sections and a Field Park, one section to be attached to a company for field service or as required.

The establishment of the troop was:—

1 Captain,	16 riding	troop horses,
3 Lieutenants,	78 draught	
191 N.C.O.'s and men,	20 pack	
5 officers' horses,		

the carriages being

3 forge carts,	6 general service wagons,
4 store carts,	1 forge wagon,
15 tip carts,	1 miners' wagon.
3 artificers' wagons,	

In 1864 the establishment was raised to:—

1 Captain,	20 riding	troop horses.
3 Lieutenants,	112 draught	
217 N.C.O.'s and men,	30 pack	
5 officers' horses,		

In time the disadvantages of the plan of attaching a section from another unit to a company for purposes of war or manœuvres, became apparent, and in November, 1877, the troop was broken up, its horses and drivers being transferred to four companies of the Corps which were then called "Field Companies." Wagons were substituted for the carts previously used, and the number of pack horses reduced, the equipment of each Field Company being carried in 6 wagons and on 3 pack horses. The Field Park was attached to the Depôt. In 1885 two additional Field Companies were formed, and they have since been increased to fifteen.

C (TELEGRAPH) TROOP.

The formation of "C, Field Telegraph, Troop" was approved from the 1st September, 1870. It was formed at Chatham on one section (Lieut. Tisdall's) of B Troop. Its establishment was:—

1 Captain,	6 officers' horses,
4 Lieutenants,	55 troop horses.
245 N.C.O.'s and men,	

the carriages being

4 office wagons,	1 pontoon wagon,
12 wire wagons,	1 forge wagon,
3 general service wagons,	3 artificers' wagons.

The equipment consisted of 36 miles of insulated cable (each wire wagon carrying six drums with half a mile of cable on each; the wire was three strands of No. 20 B.W.G. copper wire insulated with vulcanized india rubber, over which was laid a layer of canvas and two thicknesses of tape primed with india rubber) and the other instruments and stores. Twenty of the drivers were equipped as mounted signallers. In August, 1871, the troop was transferred to Aldershot, and the establishment of horses raised to 115.

The inconvenience of working with cable alone was felt very early, and experiments as to the lightest and most suitable air-line equipment were carried on for a considerable time, and eventually an air-line equipment was adopted.

On April 1st, 1884, C Troop and the 22nd and 34th Companies (Telegraph Companies employed under the General Post Office) were amalgamated under the name "The Royal Engineer Telegraph Corps," which was formed of two Divisions, C Troop being the 1st, and the two companies the 2nd. Two months later the name was changed to "Telegraph Battalion, Royal Engineers."

In 1889 an air-line section carried 20 miles of overhead wire, 2 miles of outpost cable and apparatus for three offices; a cable section carried 20 miles of cable and apparatus for three offices.

The War Establishment for two army corps was at that time headquarters and eight sections, which, including a strength of 55 for "duty at home," numbered

21 officers,	59 riding	troop horses.
716 N.C.O.'s and men,	248 draught	
20 officers' horses,		

In April, 1900, a 3rd Division of the Telegraph Battalion was formed at Aldershot. In November, 1901, the 1st Division, South African Field Force, was subdivided into two divisions. In April, 1903, the 3rd Division became the 2nd Division, and cadre of new 3rd Division was attached to 1st Division. In May, 1905, the name Telegraph Battalion was abandoned, and the units numbered as Telegraph Companies. In April, 1907, the Telegraph Companies were reorganized into

2 air-line companies	...	strength,	258	N.C.O.'s and men.	
2 cable companies	...	"	144	"	"
7 divisional companies (three are cadres only)	...	"	139	"	"
2 wireless companies	...	"	92	"	"
	Total		633		

FIELD TROOPS.

The first employment of mounted Engineers was during the Egyptian War of 1885, when a detachment of 1 officer, 1 sergeant, and 26 men taken from the 11th (Field) Company were mounted—30 horses being provided—and attached to the mounted infantry. A short account of the doings of this detachment appeared in the *R.E. Journal* for July, 1885.

This proved so successful an experiment that in 1888, as a result of the recommendations of a War Office Committee (Major-General D. C. Drury-Lowe President), the formation of a Mounted Detachment was approved as a branch of the Field Depôt at Aldershot.

The peace establishment was:—

1 officer,
1 sergeant,
2 corporals,
1 trumpeter,
24 sappers,
8 drivers,
28 riding, 8 draught, 2 pack } troop horses,

with 1 small arm ammunition wagon and 2 forage carts.

In 1889 the war establishment of the Mounted Detachment was:—

1 Major or Captain,
3 Lieutenants,
113 N.C.O.'s and men,
8 officers' horses,
81 riding, 24 draught, 6 pack } troop horses,

with 3 S.A.A. wagons and 6 forage carts.

In 1894 the "Mounted Detachment" was made a separate unit distinct from the Field Depôt. On the 1st July, 1899, the name of "Mounted Detachment" was changed to "Field Troop."

In 1900, during the late South African War, two additional Field Troops were raised, and on the 15th April, 1907, when the Bridging Companies were reduced, two more were formed.

The war establishment of a Field Troop at the present time is:—

1 Captain,
2 Lieutenants,
81 N.C.O.'s and men,
41 riding, 35 draught, 5 pack } troop horses,
2 double tool carts (R.E. pattern),
2 spring wagons, Field Troop,
1 wagon for collapsible boat,
1 wagon, general service, for technical stores,
1 water cart.

Note.—Field troops were employed with conspicuous success in the late South African War. Two striking instances of the use of mounted Engineers were the cutting of the railway lines above Bloemfontein and north of Kroonstad. These are described in *The Times* of June 5th, 1900, and June 9th, 1900.

MILITARY BALLOONS.

The first suggestion for the use of balloons in the British Army is due to Lieut. G. E. Grover in 1862, seconded by Capt. F. Beaumont, and these two officers were made Associate Members of the Ordnance Committee to carry out experiments, etc.

The details of the experiments made, the experience gained, and the growth of the Balloon Establishment are very clearly shown in *The History of the Corps of Royal Engineers*, by Major-General Porter, Vol. II., pp. 189—195, and in a Paper "Military Ballooning in the British Army," by Colonel C. M. Watson, C.B., C.M.G., in Volume XXVIII. of the *Professional Papers*, p. 39. The following notes are taken chiefly from these two sources :—

In 1878 the first military balloon, "The Pioneer," was built, the second and third, "The Sapper" and "The Heron," in 1883. In 1884 a small number of N.C.O.'s and men were trained as a Balloon Detachment, and in the same year a detachment of 10 N.C.O.'s and men, under Major Elsdale, R.E., and Lieut. Trollope, Grenadier Guards, went to South Africa to join the Bechuanaland Expedition, under Sir Charles Warren. In 1885 a detachment was sent to Suakin to join the force under Sir Gerald Graham; this consisted of Major Templer, K.R.R., Lieut. Mackenzie, R.E., and eight N.C.O.'s and men.

In 1887 Major Templer was appointed Instructor in Ballooning.

In 1888 the Balloon Establishment was :—

1 officer in charge,
1 instructor in ballooning.

Balloon Detachment.

1 Lieutenant,
1 sergeant,
15 rank and file.

Balloon Factory.

1 military mechanist,
1 civilian gas maker,
1 „ storeman,
1 „ driver,
10 balloon making hands.

The carriages were :—

1 balloon wagon with hauling down gear,
3 tube wagons each carrying 44 tubes,
1 equipment wagon with spare balloons and stores,
1 water cart.

No horses were provided, the wagons being horsed when required by one of the field companies.

In 1890 a balloon section was authorized as a permanent unit of the Corps, its establishment being :—

3 officers,
3 sergeants,
28 rank and file.

In this year the Balloon Establishment was removed from Chatham to Aldershot.

In 1892 the War Establishment of a section was :—

3 officers,	1 G.S. wagon, R.E. Balloon,
3 staff-sergeants,	1 „ „ „ Equipment,
47 N.C.O.'s and men,	4 wagons, gas reservoir,
6 officers' horses,	2 forage carts.
3 riding, 32 draught } troop horses,	

In 1897 Lieut.-Colonel Templer was appointed Superintendent of the Balloon Factory, directly under the orders of the Inspector-General of Fortifications, the instructional work being taken over by the Officer Commanding the Balloon Section.

In 1899 a second balloon section was formed, and with the first proceeded to South Africa. In December, 1899, Colonel Templer went to South Africa in command of the steam road transport train, and Lieut.-Colonel J. R. L. Macdonald was appointed Acting Superintendent of the Balloon Factory.

Early in 1900 a third balloon section was formed, and, later in the year, a fourth, for service in China, under Lieut.-Colonel Macdonald, his place as Acting Superintendent of the Balloon Factory being taken by Major Trollope.

In 1900 the War Establishment of a section was—

3 officers,	1 G.S. wagon, R.E. Balloon,
3 staff-sergeants,	2 „ „ „ Equipment,
53 N.C.O.'s and men,	6 wagons, gas reservoir,
6 officers' horses,	1 forage cart.
4 riding, 42 draught } troop horses,	

Early in 1901, the balloons being no longer required for service in South Africa, the sections were transferred to other duties, the 1st becoming the 3rd Field Troop, the 2nd the 2nd Field Troop, the 3rd joining the Railway Companies.

In 1901 Colonel Templer resumed charge of the Balloon Factory on return from South Africa.

In 1902 the Establishment was raised to five sections and a depôt. In 1905 the title Balloon Sections was changed to Balloon Companies.

The war establishment of a Balloon Company was : —

3 officers,	1 G.S. wagon, R.E. Balloon,
3 staff-sergeants,	2 „ „ „ Equipment,
62 N.C.O.'s and men,	6 wagons, gas reservoir,
6 officers' horses,	1 forage cart.
4 riding, 44 draught } troop horses,	

In 1906 the Balloon Companies were converted into the Balloon School, capable of turning out three companies on mobilization and two companies for training in peace. In April, 1906, Capt. W. A.

de C. King was appointed Instructor in Ballooning. In May, 1906, Col. J. E. Capper, C.B., was appointed Commandant of the School and Supt. of the Factory vice Colonel Templer, appointed adviser to the War Office. In May, 1907, Capt. A. Carden was appointed Assistant Superintendent.

The present (1908) establishment of the Balloon School is :—

7 officers,	4 riding } troop horses,
1 warrant officer,	32 draught } troop horses,
7 staff-sergeants,	3 G.S. wagons, R.E. Balloon,
129 N.C.O.'s and men,	6 „ „ „ Equipment,
	18 wagons, gas reservoir.

My thanks are due to Capt. Vesey and Capt. King for much valuable information and assistance in compiling these notes.

Lists of names of Commanding Officers of the above units, and of the Adjutants and Riding Masters of the R.E. Troops and Companies :—

COMMANDING OFFICERS OF R.E. TRAIN.

Capt. H. T. Siborne ... ... 1855-1860 (one Troop only)
Capt. R. W. Duff ... ... 1860-1863 (one Troop only)
Capt. R. W. Duff 1863-1871
Colonel FitzRoy M. H. Somerset ... 1871-1873
Colonel Sir H. C. Elphinstone, V.C., etc. 1873-1881. (During Sir H. Elphinstone's period of command the name was changed from R.E. Train to R.E. Troops).
Colonel A. R. Lempriere ... ... 1881-1882. (At this date the Command of the Troops and Companies at Aldershot amalgamated).
Colonel H. Helsham Jones 1882-1886
Colonel R. Athorpe 1886-1889
Colonel W. R. Slacke 1889-1891
Colonel Sir A. W. Mackworth, Bart.... 1891-1894
Lieut.-Col. A. R. F. Dorward, D.S.O.... 1894-1896
Colonel C. A. Rochfort-Boyd, C.M.G.... 1896-1902
Colonel P. T. Buston, D.S.O. 1902-1904
Colonel J. L. Irvine 1904-1908
Colonel A. E. Sandbach, D.S.O. ... 1908

ADJUTANTS.

Lieut. H. Saville (from Sgt.-Maj., R.A.) 1855-1859
Lieut. M. Moore (appointed Q.M.S. to A Troop from the Turkish Contingent, and subsequently commissioned as Adjutant) 1859-1864
Lieut. A. K. Haslett 1864-1869
Lieut. Sir A. W. Mackworth, Bart. ... 1869-1873
Lieut. R. H. Jelf 1873-1878

Lieut. J. C. MacGregor	1878-1879
Capt. H. V. H. Hart-Davis	1879-1883
Lieut. F. G. Bond	1883-1887
Capt. Sir R. W. Anstruther, Bart. ...	1887-1890
Lieut. W. G. Stairs	1890-1891
Capt. J. L. Irvine	1891-1895
„ A. E. Sandbach	1895-1896
„ H. B. Williams...	1896-1899
„ & Bt. Major G. P. Scholfield...	1899-1905
„ C. E. G. Vesey...	1905

RIDING MASTERS.

Capt. D. Gillon	1875-1894
„ J. E. Griss	1894

NAMES OF COMMANDING OFFICERS OF A (PONTOON) TROOP.

A Troop, R.E. Train.

Capt. H. T. Siborne	1855-1860
„ R. W. Duff	1860-1863
„ F. A. Marindin	1863-1865
„ R. N. Dawson (now General Dawson-Scott)	1865-1867
Major E. Micklem	1867-1876
Bt. Lieut.-Colonel R. Harrison ...	1876-1879
Major R. J. Bond	1879-1886
„ J. Gore-Booth	1886-1887
„ G. Barker	1887-1888

Bridging Battalion.

Major G. Barker	1888-1892
„ E. Dickinson	1892-1895
„ J. L. Irvine	1895-1896

**A Troop, Bridging Battalion.*

Major J. L. Irvine	1896-1902
Bt. Major G. A. Travers	1902-1905
„ G. P. Scholfield	1905-1906
2nd Lieut. F. A. Heyman	1906-1907

when the unit was converted into the 1st Bridging Train.

**B Troop, Bridging Battalion.*

Capt. G. A. Travers	1896-1899
„ H. Prentice	1899-1901
„ C. E. G. Vesey	1901-1905
Bt. Major C. B. Thomson	1905-1907
Capt. P. B. O'Connor	1907-1907

when the unit was converted into the 2nd Bridging Train.

* The titles of these troops were changed in May, 1905, to 1st and 2nd Bridging Companies.

**C Troop, Bridging Battalion.*

Capt. G. A. Travers	...	...	1899-1902
Lieut. G. H. Addison	...	...	1902-1903
Capt. D. M. Griffith	...	...	1903-1905
„ E. S. Sandys	...	...	1905-1907

when the unit was converted into the 3rd Bridging Train.

D Troop, Bridging Battalion.

2nd Lieut. F. L. N. Giles	...	...	1900-1901
Lieut. F. R. S. Gervers	...	...	1901-1901
Capt. D. M. Griffith	...	...	1901-1902

when the troop was disbanded.

NAMES OF COMMANDING OFFICERS OF B (EQUIPMENT) TROOP.

Capt. R. N. Dawson (now General Dawson-Scott	...	...	1863-1866
„ M. J. Wheatley	...	...	1866-1868
„ M. Lambert	...	...	1868-1870
„ A. G. Durnford	...	...	1870-1872
„ R. N. Buckle	...	...	1872-1873
„ W. H. Patten	...	...	1874-1877

NAMES OF COMMANDING OFFICERS OF C (TELEGRAPH) TROOP.

C Troop, R.E. Train.

Capt. M. Lambert	...	...	1870-1872
Major A. G. Durnford	...	...	1872-1877
„ A. C. Hamilton (now Lord Belhaven and Stenton)	...	...	1877-1881
Major Sir A. W. Mackworth, Bart.	...		1881-1883
Capt. R. H. Jelf	...	...	1883-1884

1st Division Telegraph Battalion.

Capt. R. H. Jelf	...	...	1884-1884
Lieut. F. G. Bowles	...	...	1884-1885
Bt. Lieut.-Colonel R. H. Jelf	...	...	1886-1889
Major C. F. C. Beresford	...	...	1889-1892
„ R. L. Hippisley	...	...	1892-1898
„ W. F. Hawkins	...	...	1898-1899
„ H. B. H. Wright	...	...	1899-1900
„ H. B. H. Wright	...	...	1902-1903

3rd Division Telegraph Battalion.

Capt. S. H. Powell	...	...	1900-1901
„ G. B. Roberts	...	...	1901-1902
Major H. B. Williams	...	...	1902-1903
Bt. Major E. G. Godfrey-Faussett	...		1903-1903

* The title of this troop was changed in May, 1905, to 3rd Bridging Company.

1st Telegraph Division, Field Force, South Africa.

Capt. E. G. Godfrey-Faussett... ... 1899-1901
Major H. B. H. Wright 1901-1901

Subdivided into two Divisions, November, 1901.

1st Division, 1st Telegraph Division, Field Force, South Africa.

Bt. Major E. G. Godfrey-Faussett ... 1901-1902

2nd Division, 1st Telegraph Division, Field Force, South Africa.

Bt. Major J. S. Fowler 1901-1902

1st Division and Cadre 3rd Division.

Major H. B. H. Wright 1903-1905

2nd Division.

Bt. Major E. G. Godfrey-Faussett ... 1903-1905

1st Telegraph Company and Cadre 3rd Telegraph Company.

Major H. B. H. Wright 1905-1907

2nd Telegraph Company.

Bt. Major E. G. Godfrey-Faussett ... 1905-1906
Capt. A. B. R. Hildebrand 1906-1907

Note.—Lord Kitchener served as a subaltern in the original C Troop from April, 1873, to October, 1874.

NAMES OF COMMANDING OFFICERS OF FIELD TROOPS.

Mounted Detachment.

Lieut. A. E. Sandbach... 1885
Capt. W. F. H. S. Kincaid 1888-1893
„ A. E. Sandbach 1893-1895
„ A. H. Cowie 1895-1899

1st Field Troop.

Lieut. C. O. C. Bowen... March 1899-October 1899
Major A. G. Hunter-Weston 1899-1900
Capt. C. O. C. Bowen 1900-1903
Lieut. E. N. Mozley 1903-1904
Capt. C. M. Carpenter... 1904-1907
„ C. C. de la P. Beresford ... 1907

2nd Field Troop (formed April, 1900).

Capt. F. R. F. Boileau... 1900-1900
„ F. K. Fair 1900-1902
„ A. H. W. Grubb... 1902-1902
„ R. S. Walker 1902-1903
Lieut. A. H. du Boulay 1903-1904
Capt. C. de W. Crookshank 1904-1907
Lieut. H. W. Herring 1907-1908
Capt. C. N. North 1908

3rd Field Troop (formed August, 1900).

Lieut. R. G. Earle 1900-1906
Capt. S. H. Wilson 1906-1906
„ R. E. D. Goldingham 1906-1908
„ A. C. Baylay 1908

4th Field Troop (formed April, 1907).

Capt. E. S. Sandys 1907

5th Field Troop (formed April, 1907).

Capt. P. B. O'Connor 1907

NAMES OF OFFICERS IN CHARGE OF BALLOON ESTABLISHMENTS, ETC.

Major H. P. Lee 1882-1884
„ J. L. B. Templer (7th K.R. Rifles) 1882-1887
„ H. Elsdale 1884-1888
„ C. M. Watson 1888-1889
Lieut. B. R. Ward 1889-1890
„ H. B. Jones 1890-1891
Capt. G. M. Heath 1898
Lieut. Blakeney 1900-1901
„ Spaight 1900-1902
„ Smith 1902
Colonel J. E. Capper 1903

INSTRUCTORS IN BALLOONING.

Major J. L. B. Templer 1887-1897
Capt. W. A. de C. King 1906

SUPERINTENDENTS OF BALLOON FACTORY.

Lieut.-Colonel J. L. B. Templer ... 1897-1899
„ J. Macdonald ... ... 1899-1900 (Acting)
Major F. C. Trollope (Grenadier Guards) ... ... 1900-1901 „
Lieut.-Colonel J. L. B. Templer ... 1901-1906

COMMANDANT OF BALLOON SCHOOL AND SUPERINTENDENT OF BALLOON FACTORY.

Colonel J. E. Capper, C.B. 1906

ASSISTANT SUPERINTENDENT OF BALLOON FACTORY.

Capt. A. D. Carden 1907

THE DEFENCE OF A POSITION WITH REFERENCE TO NIGHT OPERATIONS.

By Brevet Colonel A. W. Roper, R.E.

Though considerable importance is nowadays attached to the practising of night operations, attacks under cover of darkness are seldom undertaken against a properly entrenched and defended position. Moreover, in working out schemes of defence, it is customary to ignore the conditions which prevail at night. There is consequently a risk that certain precautions which should be taken may be overlooked, and that the difficulties of a night attack against a skilful enemy may be underrated.

In close intersected country, like many parts of the South of England, a night attack on a large scale would be so difficult an operation to carry through, that it would probably rarely be attempted. But in open country a night attack is a comparatively easy matter, for there are no obstacles such as hedges to break up the formation of the attacking force.

Consequently it is in open country that night attacks are most likely to be attempted, and the more open the country the more likely is it that any attack made will take place under cover of darkness.

When however one selects a defensive position in daylight, one naturally looks for open ground in front, with a view to reducing as far as possible the chance of the assailant obtaining cover during his advance. But in selecting such a position one not only reduces the likelihood of an attack being made in daylight, but at the same time one increases the probability that the enemy will have recourse to night operations.

Our textbook, *Combined Training*, discourages attempts to drive an enemy out of a very strong position. The losses that must necessarily be incurred in so doing will probably be so heavy that they should if possible be avoided. Consequently *Combined Training* lays down that a commander should seldom attack a strong position if by manœuvring he can compel his adversary to occupy a weaker one.

But it may be impossible to manœuvre the defender out of his position, and yet it may be essential to get possession of it. Under such circumstances it would seem that the assailant must have recourse to night operations.

This happened several times in Manchuria. It will be sufficient however to quote two instances.

Early in July, 1904, the Russians were falling back on Kaiping, followed by the 2nd Japanese Army. On the 7th the Japanese ascertained that the Russians were holding a position some seven miles long and having a wide stretch of level ground in front. Fearing heavy loss from artillery fire if they attempted to traverse this open ground in daylight, the Japanese waited till it was dark. They then advanced, and finally made a successful attack at daybreak.

Again, in the advance on Liao-yang, the same Army found its way barred by the Russians at Shou-shan-pu. To facilitate the advance of the 4th Army on the right, it was essential that the Russians should be driven from this position. On the 30th August two attacks were made in daylight and both failed. The Japanese then realized that a position whose front and flanks bristled with obstacles under the close fire of musketry was practically impregnable to assault by day. They therefore decided to postpone the renewal of the attack till after dark.

From this it will be seen that a position which is very strong against an attack made in daylight, to some extent defeats its own object, because the enemy, if he attacks at all, will probably have recourse to night operations. The defenders therefore should consider what additional precautions are necessary to repel a night attack, even if it does not seem necessary to take up another position.

Combined Training devotes some 12 pages to the "Defence of a Position," but they treat the subject almost, if not entirely, from the point of view of resisting an attack by daylight. Similarly the instructions regarding night operations deal principally with the attack.

Let us first consider the question as regards defence against an attack in daylight.

Included in the list given by *Combined Training* of the chief requisites of a defensive position are the following :--

(*a*). "Clear field of fire over the country in front and on the flanks, and no dead or unseen ground within effective range."

(*b*). "Good artillery positions with a clear field of fire to the front and flanks."

Both of these refer to efficiency of fire, and they appear to be based on the following principle laid down in *Combined Training* :— "That all movements on the battlefield have but one object in view, viz., the attainment of superiority of fire." With this idea great stress is laid on the importance of a good field of fire.

Combined Training makes the following statement regarding the attack of a position :—"Within 800 yards of a line of infantry, provided that they are steady enough to take careful aim, and there is a good field of fire, the ground over which the attack must pass is so closely swept by a sheet of lead as to be well-nigh impassable to troops in any other formation than lines of skirmishers, until the enemy's fire has been to some extent subdued."

It will be noticed that this statement contains three provisos. If any one of these is not complied with, the easier it is for the assailant. The three provisos are :—

(1). That the defenders are steady enough to take careful aim.
(2). That the field of fire is good.
(3). Until the enemy's fire has been to some extent subdued.

The result of failing to comply with the first of these provisos is well shown by an incident that occurred in the Russo-Japanese War. On the 11th October, 1904, during the Battle of the Sha-ho, General Okasaki with his brigade attacked a hill called Terayama. The Russian position offered admirable shooting conditions. In most directions there was an almost perfect field of fire up to a range of about 1,000 yards, and this glacis could also be enfiladed by the Russian artillery. In spite of these difficulties the Japanese got close up to the Russian position without suffering much loss. Actually they covered the last 600 yards in one rush. The explanation seems to be that the Russian artillery neglected the attacking infantry and fired on the Japanese artillery, whereas the latter shelled the Russian firing line, with the result that the Russians kept their heads down and did not take careful aim.

The second proviso refers to the field of fire, on the importance of which great stress is also laid in the requisites of a defensive position. The characteristics of a good field of fire are so well known that it is unnecessary to describe them. The kind of country that has these qualifications is however often ideal ground for a night attack, *e.g.*, the St. Privat end of the battlefield of Gravelotte, and also the Boer field of fire at Modder River.

The third proviso points out the difficulty of carrying through an attack before the enemy's fire has been to some extent subdued. This can be brought about by superiority of fire on the part of the assailant, but the better the position of the defenders, and the better they are entrenched, the more difficult it is to accomplish. It can however be also effected in another way, viz., by waiting till it is night. As soon as darkness comes over the scene the fire of the defenders must inevitably be to some extent subdued. In fact the requisites of a defensive position relating to efficiency of fire then become practically valueless.

As soon as it gets dark men can no longer see the sights of their rifles, and the usual result is that they fire in the air. This was often the case in South Africa when there was a scare at the blockhouses along the railways. On such occasions it was not unusual for the telegraph wires to suffer more than the Boers.

Moreover, when it is dark, the enemy will probably be invisible at anything over 400 yards. The most perfect field of fire is thus not only robbed of much of its value, but it becomes positively disadvantageous, as it presents no obstacles to an enemy's advance such as would be provided by, for instance, the hedges in a close intersected country. Consequently to repel a night attack the defenders must be able to destroy the assailants during the last 400 yards or so of their advance, whereas in dealing with an attack in daylight, the defenders should be able to inflict loss on their adversaries while they traverse the field of fire for perhaps a mile or more.

During the Russo-Japanese War many night attacks were made, but as a general rule there was seldom a night march of any length preceding the actual attack. There were therefore no operations similar to those undertaken by our troops at Tel-el-Kebir, Stormberg, and Magersfontein, which involved night marches of several miles. In fact the opposing forces were so close together that there can seldom have been regular outposts between them. Any there were must have been so close to the main body that the latter can have received only very short notice when an attack was made at night, and this must have considerably facilitated the task of the assailant.

Another characteristic of Japanese night operations was the careful manner in which the enemy's position was reconnoitred. During daylight, if the two forces were not in close touch with each other, the position—as far as could be seen from a distance—was examined and its strength ascertained. After dark scouts, under officers, were sent forward to get as close as they could to the enemy's line, to ascertain the nature of the defences and also the best way of avoiding or passing any obstacles. The Japanese attached very great importance to obstacles in night operations, and frequently sent forward sappers with the scouts to cut leads, etc.

The Japanese also used night operations as a means of approaching close to the defenders' position without suffering much loss. They used to push forward a few hundred yards and entrench themselves. After a short time they would advance another few hundred yards. If luck favoured them, they would by such means be entrenched close to the defenders by daybreak.

The defenders must therefore be prepared in the first instance for a careful reconnaissance by the assailant, who will endeavour not only to locate the position of trenches and obstacles, but also to destroy the latter.

If the two forces are not in close touch with each other, the

assailant will probably reconnoitre first in daylight. To prevent his getting much information in this way, it may often be desirable to shift the firing line from the position that gives the best field of fire. The Japanese sometimes did this when they expected a night attack, as for instance during the Battle of the Sha-ho. Their idea was that against a night attack a field of fire of about 400 yards was sufficient, and that by siting the trenches in this way the distant reconnaissance was rendered more difficult.

In undulating country it may be desirable to place the firing line in a valley, so that the assailant may show up against the skyline as he advances.

Again the assailant will probably make a close reconnaissance under cover of darkness, and this must be made as difficult and dangerous for him as possible. The defender therefore should not only make use of patrolling and small ambushes, but also of various contrivances which will give an alarm, *e.g.*, spring guns, land mines, flares, etc. Search lights if available might also prove useful.

Next the assailant may endeavour to push forward under cover of darkness and entrench himself within close range of the defender. The precautions suggested against the close reconnaissance are useful against this form of advance, but something more is needed. It would seem that small counter-attacks should therefore be employed. No doubt it is rather difficult to manage a counter-attack in the dark, but the defenders should at least have the advantage of knowing the ground better than the enemy does.

Finally, the latter may try to rush and overwhelm the outposts or even the main position. To prevent this it is essential that the defender should be able to overwhelm and destroy the attacking troops during the last few hundred yards of their advance.

It is therefore necessary to delay the attacking troops, and this is done by using obstacles. But these are of little use unless they are under the close fire of the defenders. If this has not been provided for, the enemy will be able to cut his way through them without suffering much loss. This condition is rather hard to satisfy at night.

Some means of illuminating the sights of the rifles are required, but, so far as I know, no satisfactory method of doing so has been discovered. Luminous paint does not seem to be much use. You also want means of lighting up the attacking force; and here search lights when available are very useful. But failing search lights—or to supplement them—flares should be arranged to be fired electrically or mechanically. Sometimes star shell may be available and will be useful, as in the Siege of Port Arthur.

Rests are required to prevent men firing in the air. Those employed at the blockhouses in South Africa, to direct fire along the fences, were too elaborate to be hastily constructed, and the amount of transport that would be needed to constantly move them, would be

prohibitive. Consequently such rests would not usually be available in an ordinary campaign.

But various expedients may be used which are a great deal better than nothing, *e.g.*, a groove cut in the parapet will answer the purpose, if carefully made in daylight, or a string stretched along the parapet would keep the muzzles down. A point to be remembered is that machine guns are comparatively easy to lay at night, and that they are consequently particularly useful against a night attack.

In the case, then, of a force which is not liable to be attacked in daylight, it would appear reasonable not to bother about a field of fire of more than about 400 yards. But on the other hand it is then of the utmost importance to strengthen as far as possible, obstacles within a few hundred yards of the position, and also to provide rifle rests and various alarms such as flares, spring guns, etc., and also land mines.

If the force is liable to be attacked both by day and by night, it would seem that two positions should be entrenched, and that for choice the position to be occupied by night should be in advance of that to be occupied by day.

The failure of some of the Japanese night attacks during the recent war was usually due to superiority of fire on the part of the Russians. But this superiority was brought about in various ways. It is often stated to have been the fire of machine guns that decided the struggle; but probably a still more frequent source of disaster was the delaying action of obstacles under fire, especially when the assailants were shown up by search lights.

The South African War provided many examples of night attacks. When these were successful, it will usually be found that there were no obstacles, or very few, and as a rule the outpost arrangements were bad.

I venture to think that on manœuvres the necessity for obstacles round a camp is often overlooked. On active service the omission of these precautionary measures may mean disaster, and they should be insisted on in peace operations. The R.E. should also be trained in cutting through obstacles in the dark.

STUDIES ON THE USE OF FIELD TELEGRAPHS IN SOUTH AFRICA.

By Major E. G. Godfrey-Faussett, R.E.

IV.—WIDELY DISPERSED COLUMNS CONCENTRATING STRATEGICALLY ON AN OBJECTIVE (THE ADVANCE ON PRETORIA).

By the end of April, 1900, three more sections had arrived from England, under Capt. Wright. The relief of Ladysmith also liberated the section which had taken part in the defence,* so that for the combined forward movement of the whole army on the Transvaal eight sections were available.

It will be convenient to extend the lettering system which was used at Bloemfontein to the whole eight sections. There were then :—

A. Lieut. Hildebrand (freed by the relief of Ladysmith).
B. Lieut. Turner (the section which took part in the relief of Ladysmith under Lieut. Jelf).
C. Lieut. Mackworth (formed at Bloemfontein, of four cable detachments only).
D. Lieut. Moir (two air-line detachments).
E. Lieut. Henrici (two air-line detachments).
F. Lieut. Webber (two air-line detachments).
G. Lieut. Macfie.
H. Lieut. Sherrard.

For the forward movement the troops under Lord Roberts' supreme command were divided into five columns :—

(1). The Natal Army, under Sir Redvers Buller, the II., IV., and V. Divisions, with A and B Telegraph Sections.
(2). General Ian Hamilton's column, M.I. and IX. Division, with D and E Telegraph Sections.
(3). The central force, under Lord Roberts, Cavalry Division, VII. and XI. Divisions, with C and F Sections.
(4). Lord Methuen's force, I. Division, with H Section.
(5). General Hunter's force, X. Division, with G Section.

* A description of the valuable work done by the section in Ladysmith, by one of the officers who was present, would be most interesting.

In addition to these columns, the III. Division (Chermside), VI. Division (Kelly Kenny), and VIII. Division (Rundle) were employed in the Orange River Colony, and were kept in touch chiefly on repaired permanent lines by telegraph troops at the disposal of Capt. Fowler, who was in charge of the O.R.C. communications.

The whole of this strategic movement on a front of some 350 miles was controlled by the Commander-in-Chief by means of the telegraphs, which kept each column in communication with its base.

(1). THE NATAL ARMY.

On May 7th the II. Division quitted its camp at Ladysmith and marched to Helpmakaar. It was accompanied by air line run by Hildebrand to that place, where the permanent line was met, and communication opened by it with Pietermaritzburg.

The Helpmakaar position was successfully attacked on the 13th, and the march was resumed to Dundee, the permanent line being repaired and utilized. On the 19th the front of the Boer position at Laing's Nek was reached.

The V. Division followed direct from Ladysmith to Glencoe, following the railway, and the railway telegraphs were put in order.

On June 8th the leading divisions struck off to the left into the Orange River Colony, seizing Botha's Pass. The Battle of Alleman's Nek completely turned the Boer position, and Volksrust was entered on the 12th. This flank movement was followed by air line, and the railway telegraph line to Volksrust was repaired.

The advance along the railway was resumed on the 20th, Standerton was occupied on the 23rd, and hands were joined with Lord Roberts' columns at Vlakfontein on 4th July.

(2). IAN HAMILTON'S FORCE.

General Ian Hamilton left Thabanchu on April 30th with the M.I. Division, supported by the IX. Division, and accompanied by air line run by D and E Sections, under Moir. Winburg (62 miles) was reached on the 5th May, and cross communication with Lord Roberts was opened by the Winburg-Smaldeel permanent line. Moir rejoined the main body with D Section, and Henrici was reinforced by a cable detachment.

On the 11th the line was continued to Twistniet, and a fresh cross line was laid by Mackworth. The section rejoined the main body at Kroonstad on the 13th May.

(3). LORD ROBERTS' FORCE.

This force left Karee Siding on the 3rd May, and followed the railway to Kroonstad. The railway telegraphs were repaired by F Section, three wires being repaired simultaneously. On 13th May

a bivouac at Jordaans Siding held four sections together, for the first time since 16th November, 1899.

The advance was resumed on 22nd May, the railway telegraph line being repaired as before. During this advance a cable cart always went in advance, putting one railway wire through, and coming in on it whenever required during the day, so that Lord Roberts was in constant communication with the rear. The cart carried a telegraph distinguishing flag and was allowed precedence at all drifts.

The Vaal River was crossed on the 27th May, and Johannesberg occupied on the 30th. Henrici's section was left here in charge of the large office and telephone exchange.

During the advance to Pretoria the direct telegraph line over the veldt was repaired. Pretoria was reached on 5th June.

(4). LORD METHUEN'S FORCE.

Lord Methuen's force left Kimberley for Hoopstad on the 14th May, accompanied by H Section, under MacInnes and Sherrard, running cable with headquarters, and replacing it with air line. The air line reached Hoopstad on the 18th (68 miles).

On arrival at Bothaville (29th May) the column was diverted to Kroonstad by Lord Roberts, as the enemy was reported to be threatening that town. The permanent line from Bothaville to Kroonstad was repaired and used. Kroonstad was reached on 28th May.

(5). GENERAL HUNTER'S FORCE.

The X. Division moved north on the 3rd May, G Section, under Macfie, repairing the railway telegraph line as it advanced. Vryburg was reached on the 23rd, and, after the relief of Mafeking, the force left the railway line at Maribogo on the 29th. Connection with the permanent line at Baber's Pan was obtained by air line and cable, and this was repaired to Lichtenburg (June 3rd). From here connection was opened with Mafeking by the permanent line.

By the 8th June a branch partly of air line partly of bare wire laid on the ground had been carried on from Lichtenburg to Ventersdorp, through which place communication with Johannesberg and Pretoria was effected by the permanent lines on the 13th June. This line was the only outlet from Pretoria for some days, during De Wet's raids on the main line at Roodeval.

The five columns as they advanced were kept in good communication. Eight infantry divisions were engaged, or about the equivalent of the six large divisions of the present field army. According to

present organization, 12 air-line detachments and 18 cable detachments would have been available—actually about 12 air-line and 8 cable detachments were employed. The extra cable detachments would have allowed of more constant communication with the various bodies of troops detached from the columns.

No attempt could be made to keep the cavalry division in touch when it made a turning movement to the west of Johannesberg. A wireless company would have been most valuable.

The Wheatstone automatic was used with great success with Lord Roberts' column. While the column was on the move Bloemfontein—the base office—punched up the messages as they came in from the rear, and as soon as the headquarter office bivouacked these were sent through, leaving the line clear for the work from the front. At headquarters the large mass of received work was written up during the night, and the messages were delivered early in the morning. This night work was very heavy on the headquarter operators, but arrangements were made to carry them in wagons during the marches, when they got some sleep. It was found necessary to tell off three wagons for the headquarter office alone, which marched and bivouacked together under a senior N.C.O., independent of the section organization. A small marquee captured at Bloemfontein was carried for this office.

CAPTAIN SIR JOSIAS BODLEY.

DIRECTOR-GENERAL OF FORTIFICATIONS IN IRELAND, 1612—1617.

By LIEUT. W. P. PAKENHAM-WALSH, R.E., R.S.A.I.

JOSIAS BODLEY was born about 1550, probably at Exeter, being the fifth and youngest son of John Bodley of that city, by Joan, daughter and co-heiress of Robert Hone of Ottery St. Mary.

Of his brothers, the eldest was Sir Thomas Bodley the distinguished diplomatist, who founded the Library at Oxford which is named after him. The second and fourth brothers, John and Zachary, were clergymen, but where they lived is unknown; while the third, Lawrence, D.D., was a Canon of Exeter.

In the reign of Mary his parents were compelled, on account of strong Protestant tendencies, to seek refuge in Germany and afterwards at Geneva, where, with his brothers, Josias is said to have studied Hebrew under Chevallier, Greek under Beroald, and Divinity under Calvin and Beza, while in after years we find him and his brothers corresponding with Drusius.*

On the accession of Elizabeth the Bodleys returned to London, where they settled, and in 1562 the father, John Bodley, obtained a license for seven years from the Queen for the exclusive printing of the Geneva Bible.

Josias was further educated at Merton College, Oxford,† of which his brother Thomas was at that time a Fellow; but he appears never to have graduated, and to have adopted the profession of arms instead. He served for some time in the Low Countries, then beginning to earn their reputation as the cock-pit of Europe, and he also seems to have visited Poland, from some casual references to Polish drinking customs in his *Journey into Lecale.*

Tyrone's Rebellion having broken out in Ireland, it was decided to reinforce the troops there by a regiment of 1,050 men, drawn from the forces in the Netherlands, of which Sir Samuel Bagnell was Colonel, and Edward Blayney, Josias Bodley, Jephson, Sidney and Toby Caulfeild‡ were Captains.§ They were first stationed at

* The above is according to the *Dictionary of National Biography*; but some other authorities say he was not born till the return of the family to London, about 1560.

† *Ath. Oxon.*, Vol. I., p. 328.

‡ Afterwards Lord Caulfeild, Master-General of the Ordnance.

§ Fyne's *Moryson's Itinery* (1617), Part II.

Newry, where Bodley formed a very poor opinion of the food, and while there he was mentioned for good service in the action under the Lord Deputy against O'Neill, October 2nd, 1600, and again at Drogheda, March 31st, 1601.*

At this time also he first showed his ability as a military engineer in an attack on a village called Loghrorcan, which is on a small island five miles from Armagh, of which the following is an almost contemporary account† :—

"The sixth of April, 1601, his Lordship receiued aduertisment from Captaine Iosias Bodley, at the Newry, that he and Captaine Edward Blany, Gouernour of the Forte of Mount-Norreys, purposing to surprise Loghrorcan, could not carrie a boat, which they had prouided to that purpose, but he, carrying certain fireworks prouided in case the boat should faile, went to the Fort, and joyning with Captaine Blany, marched towards that Iland, where they arriued by eight of the clocke in the morning, and leauing their forces behind a Wood, they both went together to discouer the Iland: which done Captaine Bodley made readye thirtie arrowes with wildfier, and so they both fell downe with one hundred shot close to the water, where the shot playing incessently upon the Iland, while the other deliuered their arrowes, suddenly the howses fired, and burnt so vehemently, as the rebels lodging there, forsooke the Iland, and swumme to the further shoare. That after they saw all burnt to the ground, they fired a great house upon their side of the shoare, and killed there sixe kerne (gaining their arms) besides Churles and Calliachs, and after the burning of other houses also, they brought away some Cowes and Sheepe, with other pillage: and they understood by a prisoner, that there were about thirty persons in the Iland, whereof onely eight swumme away (of which foure were shot in the water), so as the rest either were killed or lay hurt in the Iland. Likewise they understood by the said prisoner greate store of butter, corne, meale, and powder, was burnt and spoiled in the Iland, which all the rebels in that Countrey made their magasine. Further, that some forty kerne skirmished with them at places of aduantage, in their retreat for two miles march: but howsoeuer the common opinion was, that the Rebels sustained great losse be this seruice, yet of the English onely two were slaine and seuen hurt."

Meanwhile the campaign against the rebels was being pushed forward in the South of Ireland by Sir George Carew, "Lieutenant-Generall of the Artillery" and Lord President of Munster, afterwards Earl of Totnes, and Master-General of the Ordnance in Ireland.

These operations bear a curious resemblance in many ways to the later stages of the South African War. The country was wild and

* Calendar of State Papers, Ireland, 1600–1.
† Fyne's *Moryson's Itinery* (1617), Part II., pp. 97, 98.

practically unknown to the troops, who were opposed by brave but undisciplined rebels. They were however, unlike the Boers, badly armed, but were assisted by regular troops from Spain, then the first military power in Europe, and as will be seen later had several skilled engineers, mostly Jesuits. The methods adopted were also South African, this being the first really organized use by the British Army of mounted infantry, while the strategical policy was to seize, fortify, and hold lines of castles, thus dividing the country like the blockhouse lines in South Africa into areas which were then cleared by sweeping drives.

A very full account of these operations is given by a contemporary writer in a book* written for the glorification of Sir George Carew, and although Bodley took no part in the earlier operations, the accounts of some of the siege operations are so interesting from a Sapper point of view that they are inserted here.

On the 25th May, 1600, Sir George Carew laid siege to Limerick, and "that night . . . the Armie incamped within little more than a mile thereof. The three dayes next following, wee bestowed in providing things necessary for the mounting and drawing of the Cannon, the Citie being altogether destitute of necessaries thereunto, which at last with many difficulties was effected: Wherein the President shewed himselfe to bee a Master in that facultie; for Canonier or other Artificer (skilfull in the mountures of Ordnance) he had none, the Smiths and Carpenters were onely directed by him, according to the proportion he gave, they wrought, and in the end a demie Cannon was mounted, and drawen towards the gate of the Cittie, that leadeth to the Iland of Loghguire."

After taking Limerick he proceeded to besiege the neighbouring castle of the Glin, the seat of the Knight of Glin, a member of the family of the Earl of Desmond, who were leaders of the rebellion, and on the 8th July—"when wee looked that the cannon should begin to play the Cannonniere found the Peece to be cloyed, all the art and skill which either the smith or himselfe could or did use, prevailed nothing. The President, (who is a man that knowes well to manage great Artillery) commanded that the peece upon her caryage (as she was) should be abased at the tayle, and eleuated at the musle, as high as it might bee: then he willed the Gunner to giue her a full charge of powder, roule a shott after it, and to giue fire at the mouth, whereby the touch hole was presently cleared, to the great rejoycing of the Armie, which of necessitie in attempting the Castle (without the favour of the Cannon) must haue endured great losse. This particular I thought good not to omitt, because it may bee an Instruction to others, whensoever the like accident should happen."

* *Pacata Hibernia*, by Thomas Stafford, 1633. This book is in the Corps Library, and well worthy of study.

While this siege was in progress the rebels besieged the Royal garrison in Liscaghan Castle on the 16th July, and "placed an Engine (well knowen in this Countrie) called a Sow (to the Wals thereof) to sapp the same: But the Defendants did so well acquit themselves in a Sally, as they tare the Sow in peeces, made her to cast her Pigs, and slew twentie seuen of them dead in the place."

On the 30th August Sir Charles Willmott took Ardart, where the rebels had stood a siege "for some nine dayes, made good defence, and had burned with Fireworkes such Boardes and Timber as Sir Charles had placed against the wall of the Castle for his men's safetie as they undermined."

The same Sir Charles proceeded in November to besiege Listoell (Listowel) Castle, the last stronghold remaining to Fitzmaurice, Lord of Lixnaw, and "he sate downe before it upon the fifth of November, attempting to get it by a Myne, in the which after he had wrought fiue or sixe dayes, and brought it underneath the Castle wall, being ready to make a bed for the placing of the powder, suddainly the spring brake foorth in such abundance, as that worke became fruitlesse; thereupon new ground was sought, which proved good, the foundation of the Castle was undermined, as farre as the middest of the Seller, which the Ward perceiving, made humble suit to bee permitted to depart with their lines, which Sir Charles absolutely refused: but if they would simply render themselues, the Castle and all things in it to his discretion, hee would then stay further proceeding in his worke, otherwise they might looke within very few howers to bee blowen up."

The expected Spanish invasion was now becoming imminent, and the Lord President asked the Council in England, on the 13th January, 1600–1, to send the following stores:—

"Victuals for 3,250 men,
"5 lasts of powder with match and lead,
"2,000 shovels and spades,
"500 pickaxes and 50 crowes of iron,"

and again on the 6th August, 1601, he reported as follows regarding the defences of Cork*:—"The rasing of Shandon is to no purpose, for every hill and ditch (neere the towne) commands the Citie no lesse then it, the defences of earth (which by my directions are in making) are onely made to winne time; and I have so provided, that the charge of the workemen is borne by the Towne and Countrey, the Queene's expences is no more, but the use of her Shovels, Spades, Pickaxes and Whildebarrowes, etc."

In the early autumn of the same year the Spanish force, under Don Juan de Aguila, landed at Kinsale, and on the 17th October the

* *Pacata Hibernia*, p. 181.

English Army, under Lord Deputy Mountjoy, with whom were the Lord President and the Earl of Clanricarde, proceeded to besiege the town. The "Sergeant Major General"* of this force was Sir John Barkley, while Capt. Josias Bodley came from Newry as Trench-master and Chief Engineer. The following extracts regarding the siege are taken from *Pacata Hibernia* :—

27th October.—"Wee attended all that day for the landing of the Artillery, and perfected the intrenchment about the Armie, which was left unperfected the day before through the extreame fowlnesse of the weather; and at night Sir John Barkley, Sir William Godolphin and Captaine Bodley were sent to view the most commodious place to plant the Artillery for the battering of the Castle of Rincorran which was situated upon the River of Kinsale, something more then a quarter of a mile from the Towne. . . . October 31st.—The Lord President, misliking the manner of the making of the battery, not being constantly made upon one place, but upon the Spikes of the Castle, requested the Lord Deputie to leaue that service to his care whereunto he easily assented. To show that hee was well experienced in the profession of a Cannonier, wherein hee had beene, (by reason of his imployments) long practised, hee performed the office of a Master-Gunner, making some shot, and that the Artillery might play as well by night as day, himselfe did take and score out his ground-markes, and with his Quadrant tooke the true levell, so as the want of daylight was no hindrance, but in doing thereof hee fairely escaped two Musket-shott: for as hee was standing at the Breech of a Cannon, busie about his worke, the one lighted upon the muzzle of the Peece, the other upon the Carriage close to the Trunnions. . . . November 17th.—Out of an extraordinary desire to effect somewhat, the seventeenth being the most happy day of her Majestie's Coronation, which wee meant to haue solemnized with some extraordinary Adventure, if the weather would haue suffered us to looke abroad: wee sent at night when the storme was somewhat appeased, the Sergeant Major, and Captaine Bodley, with some foure hundred Foot to discover the ground of Castle Ny Parke, and to see whether it might be carried with the Pickaxe, which was accordingly attempted; but the Engine wee had gotten to defend our men while they were at worke,† being not so strong as it should haue beene, they within the Castle hauing store of very great stones on the top, tumbled them downe so fast as brake it, so as they returned with the losse of two men, and proceeded no further in that course. . . . November 20th.—The same day a Platforme was made upon a ground of advantage (not farre from the Campe) that commanded one part of

* This officer, whose title is the origin of "Major-General," would now be called the Adjutant-General.

† Presumably a sap shield.

the Towne, that under the favour thereof wee might the better make our neerer Approaches, which at that time wee could hardly haue done, by reason of the great extreame frost, and a Demy-Cannon mounted vpon it. . . . November 23rd.—The Lord Deputie this night began to make his approaches neerer the towne and for that purpose caused some 1,000 Foot to be drawne out by Sir John Barkley, Sir Benjamin Berry and Captaine Bodley who continued the worke all night, and although the ground were extreame hard (by reason of the frost) and the night very light, yet they brought the worke to very good perfection, the enemy played all the night upon them with great Volleyes but hurt but three men, neither in the Trenches, nor in divers Sallies they made, in the one whereof a Squadron of our new men beat them backe to the gates. . . . November 25th.—This night direction was giuen to haue a Plat-forme made for the Artillery upon the trench which was made on Munday night. . . . December 1st.—This night the Marshall, Sir John Barkley, Captaine Blaynie and Captaine Bodley (the Lord Deputie leaving the President in the Campe being almost all night present) drew out fiue and twentie of every Company, and intrenched themselues on a Hill, on the West side of the Towne, within lesse than halfe Callivers shot of the same, and cast up a small fort to lodge some Foote to serue as seconds for the Artillery (that was to be planted) not farre from it, our men being at worke, the Spaniards about midnight began to play upon them from the wals, and from a trench they possessed close to the West gate, and so continued very hotly till the morning: our men (that guarded the Pioners) playing likewise upon them, and divers hurt and killed on either side. Our men continued still in that worke, and brought the same before night to very good perfection, though the Spanyards (from their high Castles and other places of the Towne) sought to annoy them what they could."

A force of 6,000 rebels, with a regiment of Spaniards, under Tyrone and O'Donnell, attempted to raise the siege, but were heavily repulsed on the 24th December, and Kinsale surrendered on the 9th January, 1601–2, the Spaniards being paroled and sent back to Spain, and the good feeling between the erstwhile foes is shown by the following extract from a letter from the Lord President of Munster to Don Juan de Aguila, "late Commander of the Spanish Forces in Ireland," who had sent him a present of oranges and wine :—

CORKE, *17th September*, 1602.

I haue received profit by the booke of fortification which your Lordship left mee at your departure and hold it as a Relique in memory of yow, and as a good Schollar I haue put some things in practise whereof your Lordship at your returne hither againe (which I hope in God will be never) may be a witnesse whether I haue committed any error in the art or no.

To commemorate their victory the Royal troops subscribed a sum, variously stated as £700 and £1,800, which they devoted towards establishing a library at Trinity College, Dublin, which had been founded by Queen Elizabeth nine years before. It seems evident that the Chief Engineer, Josias Bodley, was consulted as to the form the memorial should take, and that he suggested a library, being fired by the example of his brother Thomas, who had founded the Bodleian Library at Oxford in 1598, to which he (Josias) had presented in 1601 a fine quadrant and a large armillary sphere supported by three lions, which are still there. The present buildings of the Dublin Library were designed and erected between 1712 and 1722 by another Chief Engineer of Ireland, Thomas Burgh.*

An interesting event at this time was the erection of Haulbowline Fort in Cork Harbour, and the following extracts are from the same book:—14th January, 1601-2.—"About this time the Lord Deputie and the Lord President went by Boate to an Iland in the River of Corke, called Halbolin, sixe or seven miles from the Citie, which upon view they thought fit to bee fortified, being so seated, as that no shipping of any burthen can passe the same, but under the command thereof: Whereupon direction was given to Paul Ive (an Ingeneere) to raise a Fortification there and also another at Castle Ny Parke to command the Haven at Kinsale. Furthermore it was resolved in Councell, that Forts should haue been erected at Baltimore, and Beere-haven, as also Cittadells at Corke, Limerick and Waterford, to keepe the Citizens in some awe; but none of these workes were performed; saue onely the Forts at Halbowlyn and Castle Ny Parke aforesayd." On the 15th February the "Lord Deputie and Councell" wrote from Cork to the Lords in England that "Her Majestie must therefore be pleased to bee at some charge to erect Fortifications at Beere-haven, Kinsale and this place, the Commodities and weaknesse of these places being as well knowen to the Spaniards as to us, and further withall to erect Cittadels at Limerick, Corke and Waterford though it bee onely to assure the Townes from revolt."

As stated above, the forts at Haulbowline and Castle Park only were erected, and illustrations of these are given in the *Pacata Hibernia*. From these illustrations it would seem that these forts must have been among the earliest erected in the British Isles on the bastion trace,† which had been introduced on the Continent 60 years before. On the 18th July, 1602, however, the Lord President of Munster was authorized by the Privy Council to commence fortifications at Baltimore, but in the time of Bodley's successor, Pynnar, the

* See the *R.E. Journal* for August, 1907.

† The earliest known bastions now in existence are those of Verona, erected in 1523, though some early Italian writers say they were used 100 years previously. The bastions at Antwerp were erected in 1545.—*Encyclopædia Britannica.*

question of funds for finishing these works became a constant source of trouble.

After the Siege of Kinsale, Bodley went north again, being appointed Governor of Armagh, while the army, under the Lord President, marched into Kerry, and besieged the Castle of Dunboy (Berehaven), which had been fortified by the rebels under the direction of several Jesuits and others, from whose letters the following extracts are taken :—

"A letter from James Archer, Jesuite, to Dominick Collins, Jesuite, Donboy, Thursday, 10th June, 1602. . . . Now to come to more particular matters, understand that there are but two wayes to attempt yow, that is, scaling with ladders, or Battery : for scaling I doubt not but your owne wits needs no direction ; and for Battery yow may make up the breach by night. The higher yow rayse your workes every way the better, but let it bee thicke and substantiall, raise of a greater height that worke Captaine Tirrell made betwixt the house and the cornell : make plaine the broken house on the South side. . . ."

"A letter from John Anias (who conceived himselfe to be a good Ingeniere) to Dominick Collins, Jesuite, at Donboy. Be carefull of your fortifying continually, with a most speciall care rayse in height the West side of your Port, fill your chambers on the South and North side with Hides, and earth ; what battery is made suddenly repayre it like valiant souldiers ; make plaine in the South side the remnant of the broken houses ; make wayes out of the Hall to scower and cast stones upon the Port, and if the Enemy would attempt the like, dig deepe the place wee first begun, and a trench aboue to defend the same, as I haue sayd unto yow. Although wee expect speedie reliefe out of Spaine, yet bee yow wise to preserue the store of Victualls discreetly ; Devise yourselves all the Invention possible to hold out this siege, which is the greatest honour in this kingdome ; with the next I shall prepare shooes for yow, send mee the cord or long line, and the rest of the Saltpeter, with all the yron borriers, seven peeces in all. Salute in my name Richard Mag Eoghegane* praying God to haue of his speciall Grace that careof your successe. From the Campe the —— of June, 1602. Your loving Cousin, John Anias. To Father Dominick, Beerehaven, these."

This John Anias had previously been taken prisoner in 1600 in connection with the rebellion of Florence MacCarthy, who had employed him to raise fortifications at Dunkerran. He was subsequently taken prisoner in October, 1602, by John Berry, Constable of Castle Mange, and was executed by martial law in the next month. "Whether he was a Priest or no, it was held doubtfull."

The latter part of May and the beginning of June, 1602, were

* Rebel Governor of Dunboy.

occupied with this siege, which terminated in the fall of the Castle on June 17th, and it was afterwards blown up. The following are extracts from the account of the siege :—

"The Earle* being gone with his Armie marched as farre as the Abbey of Bantrie, about threescore miles from Corke, and there had notice that Donnell O'Sulivan Beare and his people, by the advice of two Spanyards, an Italian, and a Fryer called Dominicke Collins, did still continue their workes about the Castle of Dunboy; the Barbican whereof being a stone wall of sixteene foot in height, they faced with soddes intermingled with wood and faggots (aboue foure and twenty foot thick) for a defence against the Cannon. They had also sunke a low Plat-forme to plant their Ordnance for a counter-battery, and left nothing undone, either within or without the Castle, that in their opinions was meet for defence: But when it came to tryall, it appeared that their judgements fayled (as after yow shall heare), for the Barbican was not aboue sixe or eight foot distant from the Castle, the height whereof was exceeding high, not remembring that the ruines thereof would quickly fill the voyd space betweene them, and make a faire assault when a breach was made, whereby all their earth and sodd workes prooved vaine and fruitlesse, not so much as one Cannon shott being bestowed upon them, but as neere as the Cannoniers could take their aymes aboue it, as the President had directed." The following reasons were urged to the Lord President for not attacking the Castle; that "hee should find no landing place for his Ordnance neere unto it, and being landed, the wit of man was not able (without an infinite number of Pioners) to draw them unto the Castle; for all the grounds neere unto it, were either bog or rocks, and also that there was no convenience of ground to incamp in, no good water neere, nor wood for necessary use, or gabion stuffe within three miles of it." The Lord President replied "that bogs nor rocks should forbid the draught of the Cannon, the one hee would make passable by Faggots and Timber, the other hee would breake and smooth with pyoners' tooles."

On June 8th, 1602, Stafford writes :—"Wee also sent souldiers to the Wood to cut Gabion-stuffe, and to bring the rafters of an old Church to make joyces for the platforme to plant the Ordnance on. . . . June 11th the same night wee began our approaches; the care whereof the President imposed upon Captaine Francis Slingsby, a discreete and dexterous Gentleman, making him Trench-master, who performed with commendations the charge which was layed upon him; having all the day before employed a great partie of men to the Wood (which was a long mile and halfe distant from the Campe) to fetch more wattle to make gabions. The fourteenth and fifteenth, our men were busie making of gabions and drawing the

* The Earl of Thomond, the loyal head of the O'Briens.

trenches neerer the Castle, Captaine Francis Slingsby being (as aforesaid) Trenchmaster. . . . The sixteenth the Gabions, Trenches and Platformes were finished and in the night the Demy-Cannon, and the two Culverins were drawen downe, and planted against the castle within 140 yards. . . . 17th June.—The Lord President's colours and the rest did clime up, and placed their Ensignes upon a turret of the barbicon, reinforced with earth and faggots of great thicknesse, unto which was added a large spurre on the South West part of the Castle of the height of sixteene foote as in like manner all the Turrets and Curtains of the Barbicon were reinforced, at the top whereof they barricadoed themselves with barrels of earth, and at the first approach there was within it, some of the Enemy with a Faulcon of Iron, whom our men forced to quit the place, and to retreat themselves into a Turret adjoyning upon the South side which was rampiered with earth some sixteene foote high. . . . They resolved to bestow the Powder which was recovered in the Castle to blow up the same, committed to the charge of Captaine Slingsbie. The two and twentyeth the Castle of Dunboy was accordingly blowne up with Powder, the out-Workes and Fortifications utterly destroyed."

To return to Bodley, who, as has been already stated, was now Governor of Armagh. The next we hear of him is that he intended to spend Christmas, 1602, in Lecale (Downpatrick), with his friends, Capts. Jephson and Toby Caulfeild, at the house of the Governor there, Sir Richard Morrison; but they were ordered by the "Sergeant Major," Sir Arthur Chichester, to fight Tyrone in Glenconkein, in Derry and Tyrone.

Having successfully concluded this "week-end war," they set out for Lecale, although it was eight days after Christmas, and of their adventures there is a most amusing account in Latin* by Bodley himself.

At midsummer, 1603, Bodley was in Waterford with Sir Richard Morrison, who was Governor there, and on the 21st March, 1604, he received the honour of knighthood from the Lord Deputy† at Reban, co. Kildare. On the 28th May of the same year he was appointed Governor of Duncannon Castle,‡ a post which he resigned in June, 1606, while in 1605 he was engaged on the fortifications in Munster, by which he further increased his reputation as an Engineer. He was in England in 1607, and returned with the appointment, granted him by the Privy Council, of "Superintendent of Castles," which however he held on the Establishment of the Army, and not

* Additional MSS. No. 4784, British Museum.

† In the Middle Ages the Viceroy of Ireland was a figurehead, usually a Royalty, who seldom was resident. The true Governor was the "Lord Deputy," or, more familiarly, the "Lord Lieutenant-General."

‡ Privy Seal Order, 5th January, 1604-5.

by Patent. His stipend was 20s. Irish per diem, and he states that in that and the following year he rode over 700 miles on duty.

At this time the office of Surveyor-General was held by Sir William Parsons, afterwards Chief Secretary for Ireland, but on his fall from power in 1644 the office was joined with that of the Director-General of Fortifications. Bodley, however, assisted Parsons in 1609 with the survey of the Ulster Plantation, which he performed so well that we find a letter from the King to Chichester, now Lord Deputy, dated March 25th, 1615,* of which the following is an abstract:—"Acknowledges the care and industry of Sir Jos. Bodley and his men in the accurate and orderly survey they have lately made of the Ulster Plantation by his (the King's) command . . . And that no man may pretend ignorance of what is expected of him, Sir Jos. Bodley is to take a review of his last survey and shall signify to the Londoners, and to every undertaker, servitor and native their several defects and omissions that they may be all reformed or performed against next survey, which he (the King) has appointed to be taken of the Plantation there."

These "Plantations" were an attempt to colonize Ireland with English and Scotch settlers, who were called "undertakers." "Servitors" were pensioned Government servants, who were given favourable terms. The County of Londonderry was planted chiefly from London, and the Corporation of that city still owns large property there. Outside of Ulster the Plantations were not successful.

In 1611 Bodley complained that he had received no share in the division of land, and prayed for a "competent allowance" for the rest of his life. The result was that in 1612 a new office was created by Patent with the title of "Director-General and Overseer of the Fortifications and Buildings," with which was incorporated the old Patentee Office, dating from the time of Henry III. under various titles, but latterly styled "Clerks General of the Works and Buildings," and also Bodley's former Establishment office of "Superintendent of Castles." Sir Josias Bodley was appointed first incumbent of the new office,† receiving his former stipend of 20s. Irish a day.

He was again in England in 1613, having probably gone over for his brother's (Sir Thomas') funeral in March, and remained there till November. In 1615 he is given in the *List of the Army* as for "Overseeing the Fortifications."‡ Several of Bodley's official reports are among the Irish State Papers, and the very exhaustive "Observations concerning the Fortresses of Ireland and the British Colonies in Ulster" was in the Ware MSS., but is not now available.

* *Carte Papers*, Vol. XXX., Nos. 64–65.

† Privy Seal, Royston, December 23rd, 1612. 10. 11. f. R. 28. Patent, Dublin, January 29th, 1612 (1612–13). 11. Jas. I. 1a. pars. d. R. 14.

‡ Calendar of State Papers, Ireland, Vol. 233. 2. p. 11.

On June 15th, 1615, Bodley wrote a letter* to the Lord High Treasurer of England, of which the following is an abstract, which shows that even in those days there was sometimes a difficulty in getting a travelling claim passed by the Accounts Department :—

"Apologises for pressing a humble suit upon him. Has served above three continued prenticeships in the wars, for his last refuge has betaken himself to the practise of fortification wherein it has pleased His Majesty to make use of his skill in this country with the entertainments of 20/- Irish by the day, besides which from other employments at other times, not unknown, (as he supposes) to his Lordship, somewhat accrues to him out of His Majesty's Gracious Bounty, these only being the means of his maintenance. Now it often happens then, when to his great charge he has made painful journeys in His Majesty's service, for which some allowance by concordatum is granted him from the State here, there are such delays of payment as to throw him into extreme want. It being now about a twelvemonth past since he received any penny of His Majesty's Treasury, beseeches his Lordship, in commiseration of his poor estate, to grant his warrant, either to the undertakers of the Customs, or masters of the imposts in this country, to pay him for the time past and from henceforward such moneys as he shall make appear to be due to him from His Majesty." The reply to this was that on January 19th, following, Sir R. Winwood directed Sir Thomas Ridgeway to pay Sir Josias Bodley "all his arrears either out of the subsidy or revenue of Ireland."†

Sir Josias Bodley died in Dublin, apparently unmarried, August 19th, 1617, and was buried in Christ Church Cathedral in that city. He was succeeded as Director-General of Fortifications by Capts. Sir Thomas Rotheram, Knt., and Nicholas Pinnar, who held the office jointly at a reduced salary of 10s. English per diem.‡

I am indebted to Mr. H. Tapley Soper, City Librarian, Exeter, for much valuable information. I have endeavoured to obtain a portrait of the Director-General, but without success.

* Calendar of State Papers, Ireland, Vol. 233. 30. p. 71.

† Calendar of State Papers, Ireland, Vol. 234. 3. p. 115.

‡ Privy Seal, Westminster, February 9th, 1617–18. R. 2. Patent, Dublin, February 27th, 1617–18. 15. 6a. pars. d. R. 4.

THE R.E. HEADQUARTER MESS.

By LIEUT.-COLONEL B. R. WARD, R.E.

THE R.E. Mess at Brompton Barracks dates as an independent Corps Mess from the 1st September, 1848.

For many years previous to this, there had been a joint R.A. and R.E. Mess at Chatham, and early records show that in 1806 the number of R.A. dining members was six or eight, the corresponding number of R.E. dining members being three or four. At this time the Mess was located at Chatham Barracks, but on the 1st August, 1807, a new Mess Room—doubtless the present ante-room—was opened in Brompton Barracks. Although after the authorization of the R.E. Establishment in 1812 the numbers of R.E. officers increased very largely, Sir George Leach, the *doyen* of the Corps, writes that up to the time of joining it in 1838—when it was still under the Directorship of its founder, Sir Charles Pasley—there had not been more than two or three Engineer dining members of the Mess. His own batch was a large one, numbering 13, and together with the Honourable East India Company's Engineers from Addiscombe and the Staff of the Establishment, they brought the number of dining members up to about 26. In 1848 there were 41 R.E. officers and 23 East India Company's Engineers who were members of the Mess, as against 10 R.A. officers.

Colonel Sir Frederick Smith, Director of the R.E. Establishment, writing to the Master-General of the Ordnance on the 16th June, 1848, explains the desirability of forming an independent Mess in the following terms :—

"I need hardly remark that the officers employed at this Institution are very differently circumstanced to those who are engaged in the current duties of the Corps at the ordinary stations either at home or abroad.

"Here the officers are required to study after, as well as before, the hour of dinner, and that hour requires occasionally to be altered, according to the nature of the duties on which the young officers are engaged. For instance, at the season when the pontoon practice is being carried on the Mess hour is fixed so as to suit the tides, and is generally later than the ordinary Mess hour of other Corps. On the other hand, when 'night tracing' is the subject of instruction, or when a large number of officers are employed in the 'Astronomical Course,' the Mess requires to be fixed at an earlier hour than for the rest of the Garrison, so that in these respects it is desirable that the

officers of the Engineers under instruction should be members of an independent Corps Mess, and bearing in mind also the youth and inexperience of the students, I conceive it would be very conducive to their benefit that the whole of the operations and machinery of the Mess in regard to the rules, regulations, and economy should emanate from the Director of this Institution.

"For these various reasons, I beg respectfully to suggest that measures may be taken for making the Mess for the officers of this Establishment and at this station an independent Corps Mess, in the same manner as that of the Royal Artillery is at Woolwich, which is the general wish of the officers under my command."

As a result of this report, and under instructions from the Master-General of the Ordnance dated 8th August, 1848, Major J. Walpole, Brigade-Major, Royal Sappers & Miners, was requested to place himself in communication with Major-General Lacey, R.A., and to make a joint report with him as to what they might consider a just and reasonable arrangement for the division of the Mess property.

General Lacey and Major Walpole in due course submitted their joint report, and on the 1st September, 1848, the Mess was placed directly under the orders of the Director of the R.E. Establishment as an independent Corps Mess.

In 1856 the headquarters of the Corps were moved from Woolwich to Chatham, and the Brompton Barracks Mess became the Corps Headquarter Mess. In 1861 the present Mess Room—including the south annexe, but exclusive of the northern annexe—was erected, the old Mess Room, now used as an ante-room, being too small to accommodate the increasing numbers present at the R.E. Establishment. The south annexe was originally divided into three parts. The centre portion formed the band room or annexe, at the western end was a butler's pantry, and the east end was used as a serving room. About the same time the billiard room was built, funds for the purpose being raised by means of debentures.

The eastern wall of the present ante-room was originally an outside wall in prolongation of the front wall of the officers' quarters on the west side of the square. The present entrance hall was designed by Capt. A. G. Clayton as Assistant Instructor in Estimating and Construction in 1882, and was erected by Lieut. J. A. Ferrier as Officer in Charge of Workshops in 1883–84. The north annexe and lavatory were added by Capt. H. W. Renny-Tailyour as Assistant Instructor in Charge of Workshops in 1887 and 1888. Soon afterwards the present serving room was built, the three rooms in the southern annexe were thrown into one in order to increase the dining accommodation of the Mess Room, and a lift room was added.

A number of oil paintings and busts—principally of Corps celebrities—have been collected during the last half-century, as shown in the following lists.

Oil Paintings.

Subject.	Artist.	By whom Presented.
His Majesty King Edward VII., Colonel of the Corps.	H. Macbeth-Raeburn, after Luke Fildes, R.A.	The Corps.
Queen Victoria ... ... } The Prince Consort ... }	Kobervin, after Winterhalter. }	The Corps.
Field Marshal H.R.H. the Duke of Cambridge, Colonel of the Corps.	H. G. Herkomer ..	The Corps.
Major-General Sir William Denison, K.C.B.	C. Lutyens ...	The Corps.
Brevet Lieut.-Colonel Charles George Gordon, C.B. (as a Mandarin).	Val Prinsep ...	The Corps.
Major-General Lord Kitchener of Khartoum, G.C.B., K.C.M.G.	A. S. Cope ...	The Corps.
Field Marshal Sir John Burgoyne, Bart., G.C.B., R.E.	H. W. Phillips ...	The Corps.
General Sir Charles Pasley, K.C.B., R.E.	E. U. Eddis ...	The Corps.
Lieut.-General Sir Harry Jones, G.C.B., R.E.	E. U. Eddis ...	The Corps.
Lieut.-General Lord Napier of Magdala, G.C.B., R.E.	Sir F. Grant, P.R.A.	The Corps.
Major-General Sir J. W. Gordon, K.C.B., R.E.	C. H. Lutyens ...	The Corps.
Colonel Henry Yule, C.B., R.E. (late Bengal).	Blake Wirgman.	
Major-General Sir John Thomas Jones, K.C.B., R.E.	Bord, after Lane...	Sir Willoughby Jones, Bart.
General Sir Henry Drury Harness, K.C.B.		
Lieut.-General Sir Gerald Graham, V.C., G.C.M.G., R.E.	Poynter.	
Colonel Sir George Elliott, K.G. (First Lord Heathfield).	—	Lieut. C. M. Watson, R.E.
Field Marshal Lord Napier of Magdala, G.C.B., G.C.S.I., R.E.	Lowes Dickinson	Amy Francis Yule.
General Sir J. L. A. Simmons, G.C.B., R.E.	F. Holl	The Corps.
Colonel Charles Cornwallis-Chesney, R.E.		
General Sir Lothian Nicholson, K.C.B., Colonel Commandant, R.E.	—	The Corps.
Major-General Sir W. Green, Bart., Chief Engineer, Gibraltar, 1765—1783.		
Lieut.-General Sir Richard Fletcher, Bart., R.E.	F. Barwell ...	Field Marshal Sir Lintorn Simmons, G.C.B.

Oil Paintings—continued.

Subject.	Artist.	By whom Presented.
Lieut.-General Skinner, R.E., Chief Engineer of Great Britain.		
Major-General Sir James Browne, K.C.S.I., C.B., R.E.	Blake Wirgman ...	The Corps.
General Sir Frederick E. Chapman, G.C.B., Colonel Commandant, R.E.	—	The Corps.
Field Marshal the Duke of Wellington, K.G.	—	Colonel Sir Francis Bolton.
Colonel Sir John Bateman-Champain, K.C.M.G.	—	Members of the Indo-European Telegraph Dept.
Colonel Landmann, R.E. ...	—	Ed. J. Castle, Q.C., late Lieut., R.E.
Major-General Sir Henry Durand, K.C.S.I., C.B.		

In addition to the above, the Mess contains the following busts :—

Field Marshal Sir John Fox Burgoyne, Bart., G.C.B.
General Sir Arthur Cotton, K.C.S.I.
General Sir Richard Harrison, G.C.B., C.M.G.
Lieut.-General Sir Andrew Clarke, G.C.M.G., C.B., C.I.E.
Major-General Charles George Gordon.
Major-General Sir John T. Jones, Bart., K.C.B.
Capt. Thomas Drummond, R.E., Under-Secretary for Ireland, 1835.
Vauban.

Of the foregoing oil paintings, six are hanging in the ante-room. Over the north fireplace is a fine portrait of General Sir Lintorn Simmons, G.C.B., by Frank Holl.

The following short account of his life is principally taken from the obituary notice by Colonel C. M. Watson, C.M.G., which appeared in the *R.E. Journal* for 1st September, 1903 :—Sir Lintorn Simmons was born in 1821 and died on the 14th February, 1903, and was one of the three Engineer officers who have up to the present time attained the rank of Field Marshal, the other two being Sir John Burgoyne and Lord Napier of Magdala. Although he eventually obtained this high military rank, Sir Lintorn's war services were entirely confined to his earlier career, his only employment on active service in the field being while he was a Captain in the Corps, when he was appointed British Commissioner with the Turkish Army

during the Crimean War. "The episode of his work with the Turks during the Crimean War," writes Colonel Watson, "is really remarkable . . . He showed a knowledge of strategy and power of command, which makes one regret that he never had an opportunity of leading a British army in the field."

He was Director of the R.E. Establishment from the 1st September, 1865, to the 1st October, 1868, and immediately succeeding as he did Sir Charles Pasley and Sir Henry Harness, was the last of the three great Directors who between them made the School of Military Engineering an institution of national importance.

Sir Charles Pasley was the founder, Sir Henry Harness reorganized the schools and system of instruction, and lastly Sir Lintorn Simmons continued the work of the first two and added his own great military knowledge and experience.

He subsequently held the post of Lieutenant-Governor of the Royal Military Academy, and later that of Inspector-General of Fortifications. His last appointment whilst on the active list was that of Governor of Malta, which he held from 1884 to 1888, retiring from the Army on the 28th September of the latter year with the rank of General.

He was gazetted Field Marshal on the 21st May, 1890, and died on the 14th February, 1903.

On the west side of the ante-room are portraits of the two distinguished brothers, Sir John and Sir Harry Jones. The portrait of Major-General Sir John Thomas Jones, Bart., K.C.B., is a copy of a picture by Lane, and was presented to the Corps by his brother, Sir Willoughby Jones, the second Baronet. A short account of his life, written by Colonel R. H. Vetch, is contained in the *Dictionary of National Biography*, Vol. XXX., p. 141. He is now chiefly known by his *Journal of Sieges in Spain*, an invaluable work of reference for all students of the Peninsular War. He was *aide-de-camp* to General Leith in 1808 in Spain, and was present with Sir John Moore's force during the retreat to Corunna in 1808–09. He was in charge of the works at Torres Vedras in 1810, and on the 17th November of that year he was appointed Brigade-Major of Engineers in the Peninsula. He held this appointment until May, 1812, and was present at all the sieges undertaken during that period. He was severely wounded at the Siege of Burgos in that year, and was incapacitated for the next two years, during which time he published his famous *Journal of Sieges in Spain*.

His duties on the Headquarter Staff brought him into contact with Lord Wellington, with whom he became a great favourite.

In 1816 a convention was signed between England and the Netherlands, authorizing the expenditure by the Duke of Wellington of 6½ millions in constructing defensive works for the protection of the Netherlands. The Duke was given power to nominate as many

inspectors as he might think necessary, and appointed Jones, who had only just been promoted Lieut.-Colonel in the Corps, as the sole inspector, sticking to his choice in spite of considerable pressure on behalf of a senior officer. Wellington generally made two inspections annually of the forts under construction in the Netherlands, and was always accompanied on these occasions by Colonel Jones.

In 1831 he was created a Baronet for his services in the Netherlands, and at the Duke's suggestion adopted a castle for his armorial bearings, with the word Netherlands as an addition. Sir John Jones died in 1843, and a statue, executed by William Behnes, was erected by the Corps to his memory in the south transept of St. Paul's Cathedral.

The portrait of Sir John's youngest brother, Lieut.-General Sir Harry David Jones, G.C.B., was painted for the Corps by E. U. Eddis. A sympathetic account of his career, written by Lieut.-General H. Sandham, occurs in the *R.E. Professional Papers* for 1868 (Vol. XVI., New Series, p. ix.). See also the *Dictionary of National Biography*, Vol. XXX., p. 105.

His earlier career in the Peninsular War from 1810 to 1814 was a most brilliant one. An interesting diary kept by him from the 20th October, 1812, to the 28th February, 1813, is published in the *R.E. Journal* for January and February, 1890 (Vol. XX., pp. 3 and 30). One "hairbreadth 'scape i' the imminent deadly breach" in 1813 at San Sebastian, where he was Adjutant of the Right Attack, is commemorated in the portrait itself. The sword in the picture is copied from the original now in the Model Room.

This sword was presented to the Corps in 1889 by the Rev. Cecil Albert Jones, last surviving son of Sir Harry Jones. Sir Harry was the Engineer officer who led the first unsuccessful assault on San Sebastian. He was wounded in the breach and taken prisoner. At the time of the second and successful assault he was in hospital with a French officer as his companion. On hearing our troops enter the town, he seized the French officer's sword, and putting it on and telling him he was his prisoner, he proceeded to cut his way out to rejoin the British forces.

The services of Sir Harry were hardly, if at all, less brilliant and remarkable than those of his elder brother.

In one respect Sir Harry Jones deserves especial commemoration, for he was the first Royal Engineer officer to be appointed to an independent command in the field. It was in 1854, when a Colonel in the Corps, that he was appointed Brigadier-General, and placed in command of the forces to be employed in the Baltic in land operations. He sailed from England in H.M.S. *Duke of Wellington*, on which ship Admiral Sir Charles Napier had hoisted his flag, and in August he landed on the fortified island of Bomarsund, in command of the

British portion of the combined French and English force. The place surrendered after breaches had been made without waiting for an assault, and the garrison were made prisoners of war.

On his return from the Baltic he was ordered, in January, 1855, to the Crimea, where he took up the duties of Commanding Royal Engineer of the Army. "He entered upon the arduous duties of the siege," writes General Sandham, "with the same indefatigable energy and devotion that he had exhibited throughout his life in whatever service he had ever been engaged—civil or military; not a day passed that he did not visit the trenches himself, furthering by his example the devoted exertions of every member of the Corps who was employed in that memorable but lingering siege." He was severely wounded at the unsuccessful assault on the Redan on the 18th June, and although not recovered from his wound, he was carried on a stretcher to the trenches at the last general assault of the place on the 8th September.

In consequence of his wound, and of the incessant fatigue he had undergone, his general health gave way and he was invalided to England. His active career was not however at an end; the relaxation and quiet which he needed were never granted, and he died in harness as Governor of the Royal Military College, Sandhurst, on the 2nd of August, 1866, at the age of 75 years. A marble tablet is erected to his memory in the vestibule of the Royal Military College, Sandhurst, and a memorial brass in Beverley Minster, which is reproduced in the *R.E. Journal* for May, 1890 (Vol. XX., p. 119), commemorates his long and varied services.

A half-length portrait of Colonel Sir Henry Yule, K.C.S.I., C.B., LL.D. (1820—1889), hangs on the south side of the ante-room, opposite the portrait of Sir Lintorn Simmons. The portrait is an excellent piece of work, and is painted by T. Blake Wirgman. It was presented to the Corps by some of Colonel Yule's brother officers and friends in 1881. A memoir, by General T. B. Collinson, occurs in the *R.E. Journal* of the 1st February, 1890 (Vol. XX., p. 41). See also the *Dictionary of National Biography*, Vol. LXIII., p. 405, for a memoir by Mr. Coutts Trotter, and another by his daughter, Amy Frances Yule, which forms part of the introduction to the 3rd (1902) edition of her father's translation of *The Book of Ser Marco Polo*.

Yule's services in the Bengal Engineers from 1840 to 1861, including service in the first and second Sikh Wars, gained him the honour of a C.B., but it was not until he left the Service and settled at Palermo (where he resided from 1862 to 1875) that the foundation of his world-wide reputation was laid. Here great facilities existed for investigating the histories of old Italian missionaries and travellers in Central Asia, and in 1871 he brought out the first edition of his famous *Marco Polo*.

The work earned him the gold medal of the Geographical Society of Italy, and later the founder's medal of the Royal Geographical Society. The publication at once placed the author in the front rank of geographers, and the fame of the book has increased with the lapse of time. A second edition was published in 1875, and a third was brought out after Sir Henry Yule's death by Professor Henri Cordier, of Paris, in 1902.

The book is the most famous one ever published by any member of the Corps, and the author's unique position in regard to Central Asian geography is recognized by continental writers. The style of Yule's writing, combining as it does, in the opinion of a great German geographer, elegance of form with a groundwork of scientific accuracy, in other words, indicating that the author was a literary artist as well as a scientific historian, accounts for Yule's wide influence on scholars throughout the world.

The following sonnet by Mr. E. C. Baber, a famous Chinese scholar and traveller, indicates something of the charm to be derived from Yule's *Marco Polo*, not unlike that experienced by Keats "on first looking into Chapman's *Homer*."

Until you raised dead monarchs from the mould,
And built again the domes of Xanadu,
I lay in evil case, and never knew
The glamour of that ancient story told
By good Ser Marco in his prison-hold.
But now I sit upon a throne and view
The Orient at my feet, and take of you
And Marco tribute from the realms of old.

If I am joyous, deem me not o'er bold;
If I am grateful, deem me not untrue;
For you have given me beauties to behold,
Delight to win, and fancies to pursue,
Fairer than all the jewelry and gold
Of Kubla on his throne in Cambalu.

The last honour received by Yule was his nomination by telegram from Paris as Corresponding Member of the Institute of France (Académie des Inscriptions). It was received by him on the 27th December, during his last illness, only three days before his death. On the 28th he dictated to his daughter his acknowledgment, also by telegraph, of the great honour done him by the Institute. Sir M. E. Grant Duff has justly characterized his reply as a "stately message." The message was in the following words:—

"Reddo gratias, Illustrissimi Domini, ob honores tanto nimios quanto immeritos! Mihi robora deficiunt, vita collabitur, accipiatis voluntatem pro facto. Cum corde pleno et gratissimo moriturus vos, Illustrissimi Domini, saluto.

"YULE."

Sir Henry Yule died on the 30th December, 1889. A bibliography of all his separate works and contributions to magazines is reprinted from the *Scottish Geographical Magazine* in the *R.E. Journal*, Vol. XX., p. 53, and a fuller and more complete bibliography occurs on page lxxv. of the Introduction to the 3rd edition of *Marco Polo*.

Next to the portrait of Sir Henry Yule hangs that of his friend and brother officer in the Bengal Engineers, Field Marshal Lord Napier of Magdala, G.C.B., G.C.S.I. (1810—1890). Although Lord Napier never touched the imagination of the English people in the same way that General Gordon did, he is one of our national heroes, and therefore needs nothing more than the barest mention. Sir Henry Yule, his junior by 10 years, could have recorded, as no one else now can, the life and deeds of his old friend, but, by a strange fatality, Lord Napier attended Sir Henry Yule's funeral only 10 days before his own death.

A memoir of his life by General R. Maclagan, another old Bengal Engineer, will be found in the *R.E. Journal* for March, 1890 (Vol. XX., p. 61), and another by Colonel R. H. Vetch in the *Dictionary of National Biography*, Vol. XL., p. 75. A portion of the *Times* obituary notice is reprinted in the *R.E. Journal*, Vol. XX., p. 27.

Lord Napier, like many another distinguished man, was one of those to whom fame came comparatively late in life. On his return to India in May, 1857, before news had been received in England of the Indian Mutiny, it was his intention to retire after three years' further service. His brilliant services during the Mutiny however paved the way for his appointment to the chief command in the Abyssinian War of 1867–68, and from that time onwards throughout the seventies he would undoubtedly have been selected as the leader of the British forces in a great European war.

In the opinion of Outram he was the finest soldier he had ever met. He was undoubtedly the greatest General the Corps had ever produced, and in military genius and charm of character he more nearly resembles that greatest of all military engineers, General Robert Lee, than perhaps any soldier in history. An equestrian statue by Boehm was erected to him by public subscription in Calcutta when he relinquished the appointment of Commander-in-Chief in India in 1876, and on his death a replica of this statue was erected by public subscription in Waterloo Place.

His funeral in St. Paul's Cathedral on the 21st January, 1890, was probably the most imposing accorded to any soldier since that of the Duke of Wellington in 1852.

Next to the portrait of Lord Napier is another full-length portrait of a famous Crimean officer, Major-General Sir John William Gordon, K.C.B. (1805—1870). During the early days of the Siege of Sebastopol he was Director of the Right Attack, the first artillery

position of that attack being generally known as Gordon's Battery. While still a Captain in the Corps he found himself soon after the siege began, owing to several casualties, Acting C.R.E. of the Army. This position he held until the arrival of Sir Harry Jones. He was severely wounded in the sortie of the 22nd of March, 1855, a wound which gave him incessant suffering until his death in 1870. Nicknamed "Old Fireworks" by the Naval Brigade in the Crimea, he was indefatigable and almost Napoleonic in his capacity for continued exertion.

An interesting account of his character and career is given in C. C. Chesney's *Essays in Military Biography*, and another memoir by Colonel R. H. Vetch appears in Vol. XXII. of the *Dictionary of National Biography*.

(*To be continued*).

VOLUNTEERS IN THE 18TH CENTURY.

THE following document is probably one of the earliest to refer to volunteers for Harbour Defence Work, and as such will prove of interest to the Corps. Its date is between 1780 and 1790.

We whose Names are hereunto Subscribed (Inhabitants of the Town and Port of Dover) from a Consideration of the Danger to which the Coast is exposed of Invasion by the Enemy, and of the Situation of this Town and Port in particular, do hereby Agree, promise, and Engage, that We will at all times Necessary, stand forth in defence of Dover Town and Harbour and the Works there Erected, and to enable us for such Service, will at convenient times to be appointed for that purpose, Assemble to learn the Exercise of the Cannon and small Arms under the Command of the Officers under mentioned and Agreeable to the proposals following

1st. That this Association shall with all speed be encreased to Six Companies of Sixty Men Each; every Company to be Commanded by a Captain and two Lieutenants (Members of the Association).

2nd. That such Captains and Lieutenants be Authorized by Commissions to be Obtained from His Majesty for that purpose.

3d. That these Proposals, or the Acceptance of such Commissions shall not render the Association or any of them, liable to be called forth on any other Service than for the Defence of the Town; or to the Controul or Command of any other Officer or Person Civil or Military Save that of a Superior Military Officer in time of Action, but that the Association and Services to be performed by them, shall at all times be considered as Voluntary and Independant.

North Battery.

Captains.	1st Lieutenants.	2nd Lieutenants.
Thomas Solly.	Alexr. Veale Ridley.	Thomas Huntley.
Edwd. Thornton.	Edward Godier.	Benjamin Easter.

Pier Battery.

Thomas Wilkison.	Edwd. Atherden.	Joseph Luddington.
Brook Samson.	William Wallace.	Willm. Luddington.

Pilot-house Battery.

Henry Ladd.	Edwd. Ladd.	Henry Ladd Junr.
Thomas King.	Christopr. Friend.	Michl. Becker.

NOTICES OF MAGAZINES.

JOURNAL DES SCIENCES MILITAIRES.

September 1st, 1908.

The number opens with the third instalment of a "Strategical Criticism of the Franco-German War," by L. C. Grouard. The period under consideration is from August 7th to August 12th, 1870. The movements of the French are given, and the plan adopted—together with several alternatives—is criticized. The Emperor is described as being unable to make up his mind, and as finally deciding, against his own judgment, in favour of the ideas of the leading engineer and artillery officers. Their advice is ascribed to the doctrines of General Brialmont (whose system has been specially criticized in Sir George Clarke's *Fortification*).

A continuation of an article on "Dagsbert, a Military Author," gives a review of a book published by him in 1790 entitled *L'Ordonnance Francaise*. Among the points touched on are the establishment of a military college; the institution, for the Prussian system of flogging, of rewards or punishments appealing more to soldiers' patriotism and sense of honour; heavier penalties for desertion. Leaving troops in garrison at the same place for many years is condemned, as leading to desertion from sheer boredom. More fresh air in hospitals and some form of "first-aid" instruction for the men is recommended. The part restoration of armour in order to give more confidence to the men, and the substitution of a heavy sword or short pike in place of the officers' court swords is also suggested.

An article by Lieut. Archer on "Dirigible Balloons," begins by quoting opinions for and against their use as a method of offence. A discussion follows on the various forms of projectiles, and the question of the equilibrium of the balloon on losing the weight of the projectiles, is considered. The conclusion arrived at is that a dirigible can, without any exaggeration, render considerable service. The moral, rather than the material effect, is counted upon, though there should be many opportunities of damaging docks, magazines, etc. Captive balloons are looked upon as the special prey of the dirigible. A short criticism of Zeppelin IV. follows, and the conclusions arrived at are somewhat different to those of Mr. Newcomb in the *19th Century*.

A short article on the "Natural History of Discipline," considers it to be the "condition which renders the maintenance of life possible." From the first, rules have been imposed on the mind, and have become natural by heredity. "Example is the foundation of all good education."

In the "Prolongation of School in the Regiment" a list of suitable subjects for lectures is given, together with some hints on lecturing. Abstract words should be avoided—use those which awake associations in the popular mind. A series of popular textbooks is suggested, to be

chosen by a committee, and to be published anonymously so as to avoid jealousy. Finally, the danger is pointed out of the destinies of the state being decided by ignorant voters.

The "Campaign of Styria in 1809" contains in this number the Siege of Gratz, by Macdonald and Broussier, from the 1st to the 21st of June, when the movements of Giulay caused the siege to be raised.

H. L. WOODHOUSE.

REVISTA DE ENGENHERIA MILITAR.

June, 1908.

REORGANIZATION OF THE ENGINEER TROOPS.—By Capt. A. Filippe da Costa.—Recent events have shown the necessity for the reorganization of the Portuguese Army. New engineer units are required in connection with wireless telegraphy, ballooning, search lights, and mechanical transport.

The period of service with the colours of engineer non-commissioned officers and men is too short and should be increased, as it is impossible to instruct them thoroughly in their duties in the time now available.

The existing regiment of engineers, formed of companies of sappers and miners, telegraphists, pontoniers, and railway engineers, should be divided up into homogeneous groups, stationed at places possessing special facilities for the instruction of the rank and file.

The three additional companies required to complete the establishment of 1901, should be formed, or, if this is not possible, at least one company—for which the necessary material already exists—should be raised immediately.

CENTENARY OF THE PENINSULAR WAR.—The programme of the celebration of the centenary of the Peninsular War has been issued. The following are the more important events:—

1908.—Civic commemoration of the national rising for the re-establishment of independence, held at Oporto on the 19th June. The centenary of re-establishment of the national government at Lisbon will be celebrated on the 15th September in that city.

Commemoration of the Battle of Vimeiro on the 27th August.

1909.—Commemoration of the defence of the Minho. Erection of a memorial to General Bernadine Freire and to Champalimand at Caminha on the 16th February.

Commemoration of the siege and capture of Chaves, 20th—25th March.

Commemoration of the defence of the bridge of Amarante, 18th April—2nd May. Erection of a memorial at the site of the bridge.

Commemoration of the passage of the Douro and the recapture of Oporto by the Anglo-Portuguese Army on the 12th May. Foundation stone of a memorial to be laid.

1910.—Commemoration of the Battle of Bussaco. Grand celebration at Bussaco and Lisbon on the 27th September.

1911.—Commemoration of the defence of the fortresses of Abrantes (9th October—7th March) and of Campo Maior (12th—22nd March). Erection of memorial tablets at these places.

1914.—A large money prize will be given to the author of the best work on a subject connected with the Peninsular War, written during the period of the commemoration, and honorary distinctions will be conferred on the authors of other essays favourably mentioned by the committee. Competitors must send in their work before the 31st October, 1913. The King will be asked to present the prizes on the 10th April, 1914, the centenary of the Battle of Toulouse.

The dates of other celebrations have not yet been fixed, but it is proposed to send a general officer to London to place a bronze wreath on the tomb of the Duke of Wellington, to hold an exhibition of maps, books, and documents relating to the war, the publication at the public expense of all documents relating to the war, etc., also commemorations of the defence of the lines of Torres Vedras, and of the Battles of Talavera, Fuentes de Honor, Albuera, Salamanca, Vitoria, Nivelle, Ortez, and the Sieges of Badajoz, San Sebastian, and Ciudad Rodrigo.

HARMONIC SYNTHESIS OF THE TIDES (*continued*).

SOME PROJECTS AND WORKS EXECUTED IN THE PROVINCE OF MOÇAMBIQUE (*continued*).—Contains a description of the construction of three light-houses, viz., (1), at Ponta Vermelha, Lourenço Marques, of brickwork; (2), at the Ilha dos Elephantes, at the entrance to Lourenço Marques, of iron; (3), at Ponta Macuty, at the entrance to Beira, of brickwork.

'M.'

REVUE DU GÉNIE MILITAIRE.

June, 1908.

THE FOREIGN MILITARY ESTABLISHMENTS IN CHINA.—A continuation of the previous articles. The writer describes the British barracks at Tientsin. These were built by a civil company under the following terms: (1) the lease to be for 2½ years certain, and (2) the rent to be $2,800 (silver) a month. It is hoped that after the barracks have been evacuated by the troops they will be taken by Chinese tenants. The writer considers this a very practical and economical arrangement from the British taxpayer's point of view, but not so satisfactory for the troops, as the barracks have been built to Chinese rather than European standards.

Then follows an account of the Austrian barracks in the Legation quarter at Pekin. The most noteworthy detail is the defensive wall which protects the Legation. At the back of the wall is a thick earthen parapet, which in the first instance forms a banquette for the defenders of the wall. As the wall is demolished by the attacker's artillery the *débris* will fall forward and unmask the earthen parapet, which forms the true line of defence.

THE MILITARY TRAINING OF AN ENGINEER COMPANY.—A continuation of a previous article. The author suggests various exercises in scouting, outposts, and other minor tactical operations.

July, 1908.

THE MILITARY TELEGRAPH IN MOROCCO.—About 300 kilomètres of air line were constructed by the French Engineers in the spring of 1908, to connect Casa Blanca with posts in the interior. The line consisted of 3-millimètre galvanized iron wire supported on 18-foot poles. The rate of construction averaged about 4 kilomètres per working day. In many places the soil was so rocky that the holes for the posts could only be made by blasting.

Visual signalling was used in the first instance, until the telegraph line was laid. The apparatus employed was apparently a heliograph fitted with an acetylene lamp for night work. The visual signalling apparatus is now held in reserve in case of interruptions to the telegraph line, and also for the use of field columns.

Before the construction of the telegraph line considerable use was made of wireless telegraphy. One station was installed at Casa Blanca and the other at Ber Reshid, 40 kilomètres distant. Communication was perfect. At night the Ber Reshid station was able to receive messages from the Eiffel Tower. The mast used for the Ber Reshid station was 91 feet high. A mobile wireless station was also organized and used; it had a range of 25 to 30 kilomètres. The current was supplied by a portable dynamo. A 97-foot portable steel mast was employed. The largest traffic dealt with was 2,000 words a day.

Various short telephone lines were used for the internal communication of the more important posts.

THE FOREIGN MILITARY ESTABLISHMENTS IN CHINA.—A continuation of the previous articles. This number is devoted to the Japanese. The commissariat is responsible for the building and maintenance of barracks in the Japanese Army, and the work is done entirely by civilian contractors. In the Pekin Legations the Japanese officers are each provided with two rooms, no matter what their rank. In addition there is an Officers' Mess containing an ante-room, dining room, reading room, billiard room, etc. In the men's barrack rooms the beds are arranged in two tiers with a horizontal distance of only 2 feet between the beds. A shelf is provided for the men's kits. The furniture consists of tables, benches, and a few cupboards. In the verandah is a shelf for the men's boots; they are not allowed to wear them in the barrack room. All cooking is done by steam, which is supplied from the electric light boilers. The general upkeep of the buildings leaves much to be desired.

At Tientsin the Japanese troops are quartered in the Western Arsenal, and most of the material for the barracks was furnished by the ruins of the Arsenal buildings. These barracks are more spacious than those at Pekin.—*To be continued.*

J. E. E. CRASTER.

RIVISTA DI ARTIGLIERIA E GENIO.

June, 1908.

MISCELLANEA.—THE MILITARY BALLOON SERVICE IN THE AUSTRO-HUNGARIAN ARMY.—Under the title "Das Luftschifferwesen in Oesterreich-Ungarn" the official journal *Allgemeine Schweizerische Militärzeitung* of 21st May has published an article on the military balloon service of the Austro-Hungarian Army.

In the Austro-Hungarian Army the balloon service is entrusted to separate detachments, which, according to their employment, are distinguished as field balloon detachments and fortress balloon detachments.

In peace time some of the regiments of fortress artillery have small squads attached to them, which on mobilization of the army are capable of being organized into eight fortress balloon detachments; three field balloon detachments are further employed directly under the military aeronautical section.

At Vienna, at the end of 1893, an establishment for military aeronautics was formed and attached to the 1st Regiment of Fortress Artillery (in the Vienna arsenal). The permanent *personnel* of this establishment consisted of:—1 commissioned officer as commandant, 1 under officer, 3 selected artillerymen, 3 ordinary gunners, and 1 attendant. At this establishmnet a special course of military ballooning, lasting for a few months, is held every year.

The *personnel* for the field balloon detachments is recruited from the officers of all branches of the service and from men of the artillery and technical troops who have attended the said course. The saddle horses for the officers and under officers, as well as the draught horses, are supplied from the artillery. In time of war the balloon detachments are distributed among the army corps and divisions. In field warfare the balloon detachments are employed essentially for tactical reconnaissances, and only in exceptional cases for artillery service.

The commandant provides according to circumstances for the dislocation of the balloon detachment on the march, arranging for the transport by the best roads available on account of the heavy wagons employed by the detachment.

During the march previous to a battle, the balloon detachment is to take post with the advance guard of the leading division. The order for the ascent is given by the commander of the troops, who also determines the place and the moment of ascent, and who arranges for the manner in which the results of the observations are to be communicated. The aeronaut, before the ascent, should be made acquainted by the chief of the general staff or other staff officers with the general situation and the views of the commander-in-chief.

During the battle the balloonist should be employed in carefully communicating details of the opposing force and of the dispositions of the enemy's columns. In an attack on an enemy in position the balloon should be located conveniently for making observations of the dispositions of the enemy's reserves, and also of what is going on behind the firing line.

In the defence the balloon ascent should be made near the front of the position, telephonic communication being kept up between the observer in the car and the commander of the troops. The inflating stations should be located out of range of artillery fire, sheltered as much as possible from the wind. In field warfare it is not often possible to avoid the place of ascent being within range of the enemy's fire.

The commander of the balloon detachment should keep himself in continual communication with the commander of the troops. On the march the former, together with his observers, are placed on the staff of the latter. When the balloon is in the air the commander of the detachment should not be far from the place of ascent. The time during which the balloon is to remain in the air is decided by the commander of the troops.

The fortress balloon detachments are attached to the artillery corps stationed in the fortified places, and are at the disposal of the commander of the fortress, to be used partly for purely tactical work and partly for observation service for the artillery.

It is necessary to establish a convenient station for the inflation of the balloon and a place for its ascent. In view of the great quantity of water required—about 30,000 litres—and for the transport of the material for inflating a balloon of 600 cubic mètres, the station should be in the immediate vicinity of an abundant supply of water, and also of good communication roads.

The place of ascent should be distant about 4,000 mètres from the enemy.

During the attack the balloonists for the defence should furnish the commandant of the fortress with information as to the strength and dispositions of the attacking force, the railway stations where material is unloaded, the field railway lines, and other lines of communication, and the position of the parks, etc.

Free balloons are used for the transport of persons, letters, and pigeons travelling from a blockaded fortress to places not occupied by the enemy. The pigeons are used for the transmission of messages from the outer world to the interior of the place.

The attacking force is also able to reconnoitre parts of the fortress, which otherwise they would not be able to explore, by means of free balloons.

The despatch of a free balloon naturally means its loss to the fortified place, and it can only take place by order of the commandant of the fortress.

The material of the balloon detachments consists of cylindrical balloons (Drachenballons) and of spherical balloons. The cylindrical balloon of 600 cubic mètres consists of the outer envelope and the rigging with car attached—it weighs 322 k.g. The balloon is of cylindrical form with hemispherical ends. It is furnished with a kind of rudder at the back of the balloon. Two bags are carried in the car containing instruments, maps, an aneroid, a knife with hook, two signalling flags, two bags of ballast, a securing rope, and various tools.

The spherical balloon of 600 cubic mètres (M. 96) consists of the outer envelope, and weighs 214 k.g. with netting and car complete; that

marked M. 98 weighs 235 k.g. For rapid inflation the balloon is furnished with a special apparatus. A square mètre of the outer envelope weighs $\frac{1}{2}$ k.g., and costs $4\frac{1}{4}$ marks.

For free ascents other spherical balloons of 600 cubic mètres are used. Some of these, constructed at the time at which they are required, may be of 1,000 and 1,300 cubic mètres.

For restraining the fixed balloon a hollow steel wire of 500 to 600 mètres and diameter of 8 millimètres is used. The isolated conductor for the telephone is within the wire. Telephonic communication is carried on between the observer in the balloon and the stations on the ground. For signalling during the day two hand flags are used, one red and the other white; during the night an electric signalling apparatus is used, consisting of a battery and an electric incandescent lamp connected with a conducting wire. With a charge to the battery of 0·23 litres of solution the lamp can work for eight hours.

EDWARD T. THACKERAY.

THE GEOGRAPHICAL JOURNAL.

WADE'S METHOD OF DETERMINING LONGITUDE.—*The Geographical Journal* for July, 1908, describes a new absolute method of determining longitudes by observation of lunar distances, devised by Mr. E. B. H. Wade, M.A., of the Egyptian Survey Department. An illustration of the special "Field Longitude Instrument" is given. This may be briefly described as follows:—A suitable telescope, mounted horizontally, and capable of rotation both in azimuth and about its own axis, bears in front of its object glass a "field mirror" which reflects the line of sight through 90°. Attached to the field mirror is a box sextant which can be rotated about the reflected line of sight as axis. The sextant mirrors are so designed that when the line of sight is directed towards a star, the ray from the star reaches the eye without being reflected by the sextant mirrors*, while at the same time these mirrors can reflect the rays from the moon, *viâ* (in succession) the index, horizon, and field mirrors, to the eye. The index, on the index mirror, reads on a small scale graduated to degrees as no more exact reading on the scale is needed.

Attached to the telescope is a "finder," a small telescope whose axis is parallel to the line of sight of the main telescope as reflected by the field mirror.

To make an observation two stars are selected near the ecliptic, one preceding and one following the moon, and nearly equidistant from it. (For this purpose a programme is prepared similar to that required for observation of occultations of stars).

The telescope is laid on to the first star by the finder, the index mirror being clamped at the estimated angular distance of the moon from the

* The construction of the sextant, whereby the star and moon are observed simultaneously, is not described, but it is inferred that the index and horizon mirrors are translucent, and permit of the passage of the direct light from the star, while reflecting the brighter image of the moon.

star. The sextant is next rotated till the images of both moon and star come into the field of the telescope. The observer then waits for the star and the moon's limb to make contact, and notes the L.M.T. Keeping the index clamped at the same angle, the telescope is laid onto the second star, and the moment of contact of moon and star is again noted. The local times of a pair of lunar equidistances so obtained which are not simultaneous are used for the computation.

Three observations of contact with each of the stars are made at each operation without shifting the index. This is done by means of a prism, which can be interposed between the horizon and index glasses. This prism deflects the ray from the moon through a very small angle, and, according as it is placed into one of three possible positions, three different deviations of the ray are obtained, and three moments of contact can be observed. The mean of the times of the three observations is taken for the computation, and the chance of error is thereby greatly reduced. The manipulation is said to be quite simple.

The computation consists in assuming a value for the longitude, and calculating the apparent distances of the two stars for this assumed longitude, at the local times as noted. If these two apparent lunar distances are not equal to one another, then the difference is halved, and the half-difference is the measure of the correction to be applied to the assumed longitude. If the differences are very great (*i.e.*, if the assumption was very incorrect), then it will serve as a guide for a more accurate assumption, working with which the operation can be repeated.

The calculation is generally similar to that used for calculating longitude by occultations.

As the opportunities for taking observations are numerous, and as these have not to be made at any one particular moment, the method described possesses manifest advantages.

After allowing for errors due to the inaccuracy of the lunar tables, or of the clock time and for known personal or instrumental error, the residual probable error in the determination of longitude from a single pair of lunar equidistances is said to be as little as 22·5″ of longitude.

A. H. D. RIACH.

VOËNNYI SBÓRNIK.

May, 1908.

THE RAILWAY ALONG THE AMUR.—Russia's importance in the Far East is dependent on the means of communication between Europe and the Pacific Ocean. At present there are four routes:—

(*a*). The route by sea along the southern coast of Asia.
(*b*). The Arctic Ocean.
(*c*). A mixed route by the Siberian railway as far as Stretensk and thence by water along the rivers Shilka and Amur.
(*d*). By rail along the Siberian and Eastern Chinese railways.

From a military point of view the first two are impracticable. As regards the third, navigation is possible during five months of the year; during other four the rivers are frozen and communication can still be carried on, but any traffic during the remainder of the year is impossible. This route might have serious disadvantages in time of war, because the Amur for a considerable distance forms the boundary between Siberia and China; its right bank is not therefore Russian property.

The fourth route (*d*), so far as the Eastern Chinese railway is concerned, is now barred for strategical purposes by the Treaty of Portsmouth, and moreover—since the war with Japan—the prestige of Russia has declined and the line is in danger of being destroyed; the number of troops for its protection is limited by the same Treaty to 15 men per kilomètre.

An unbroken line of railway from Europe to the Pacific passing entirely through Russian territory is an economic and military necessity, and the first surveys for a railway along the Amur were carried out in 1893—1896. It was then proposed to carry it along the beds of the Shilha and Amur Rivers. This line however presented many difficulties; it would have involved the construction of 20 tunnels up to 2 miles in length and one of 3 miles, and of many large embankments.

Later surveys were made in 1906—1907 under great climatic and physical difficulties. The projected line lay at some distance from the frontier—a better course than the first from a military point of view.

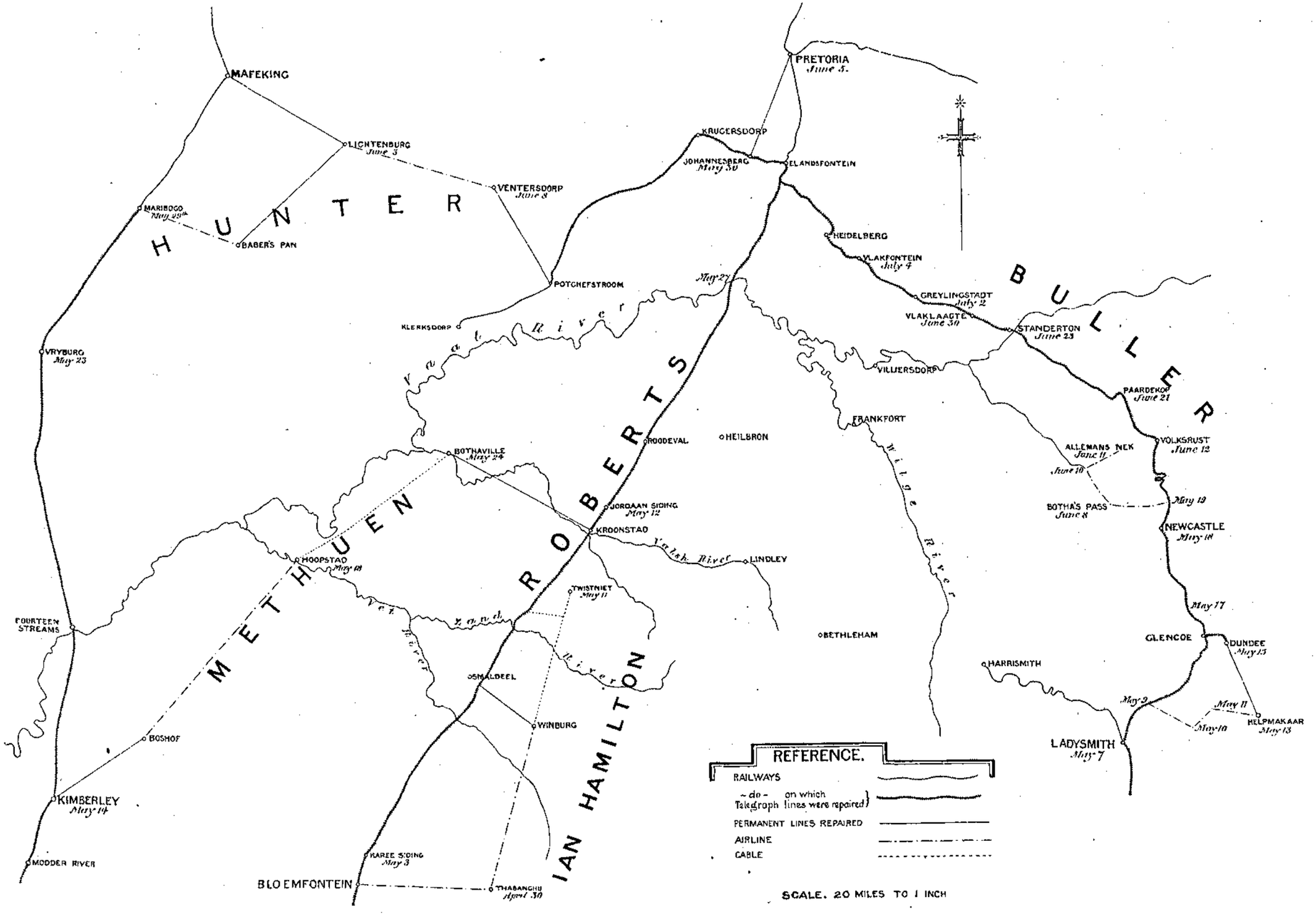
The question of the construction of the line was discussed in the Duma; it has been decided that the new line is to start from the station Kueng, on the Trans-Baikal line, and to extend as far as Khabarovsk,* at the junction of the Amur and Usuri Rivers, with a branch to the town of Blagovyeshchenk, on the Amur, along the bank of the Dzeya.

A sum of 750,000 roubles has been voted this year for carrying out additional surveys from the Bureya to Khabarovsk, and for investigating the best means of crossing the Bureya and Amur at Khabarovsk. Also for making detailed maps of the whole of the area along the Amur for a width of 84 miles.

The railway is to have the same carrying capacity as the rest of the Siberian line. The limiting gradient is to be $\frac{1}{100}$; the smallest radius of curve, 1,400 feet, occasionally 1,050 feet. The weight of the rails is 73 lbs. per yard run. The total length of the line from Kueng to Khabarovsk will be about 1,850 versts (1,226 miles).

A. H. BELL.

* A line between Khabarovsk and Vladivostok already exists.—A.H.B.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LICHTENBURG June 3
VENTERSDORP June 8
MARIBOGO May 29th
BABER'S PAN
HUNTER
PRETORIA June 5.
KRUGERSDORP
JOHANNESBERG May 30
ELANDSFONTEIN
HEIDELBERG
VLAKFONTEIN July 4
GREYLINGSTADT July 2
VLAKLAAGTE June 30
STANDERTON June 23
BULLER
POTCHEFSTROOM
May 27
KLERKSDORP
Vaal River
VRYBURG May 23
VILLIERSDORP
PAARDEKOP June 21
FRANKFORT
ROODEVAL
HEILBRON
BOTHAVILLE May 24
ALLEMANS NEK June 11
June 10
VOLKSRUST June 12
BOTHA'S PASS June 8
May 19
NEWCASTLE May 18
JORGAAN SIDING May 12
KROONSTAD
METHUEN
ROBERTS
IAN HAMILTON
Valsh River
LINDLEY
Wilge River
HOOPSTAD May 18
TWISTNIET May 11
Vet
Zand
River
FOURTEEN STREAMS
BETHLEHAM
May 17
GLENCOE
DUNDEE May 13
HARRISMITH
OSMALDEEL
WINBURG
May 9
May 11
May 10
HELPMAKAAR May 13
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THE NAVAL & MILITARY PRESS, 5, Arundel Street, W.C.

HUGH REES, Ltd., 119, Pall Mall, S.W.