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Authors alone are responsible for the statements made and the opinions expressed in their papers.

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THE PRESERVATION OF WINCHESTER CATHEDRAL

MANUFACTURE AND USE OF HAND GRENADES.

By Lieut. A. L. C. Neame, R.E.

The diagram shows the form of hand grenade actually used in the attack against the defence position on Mooi Plaatz. It was purposely designed with a view to safety, being loaded with 1 oz. of black powder only, as experiments had shown that more might be dangerous. The grenade consists of four principal parts, the head, the tin cylinder, the handle, and the tail. Into the top of the head and the cylinder two wood blocks about $\frac{7}{8}''$ thick are fitted; the one in the head is fitted with a $1\frac{3}{4}''$ wood screw, the point projecting about $\frac{1}{4}''$; the block in the cylinder has a hole bored in it, into which the S.A.A. cartridge case, cut down to about $1''$ in length, is fitted.

Below this comes the powder charge (enclosed in a serge bag for safety), and the remainder of the cylinder to within $1''$ of the end is filled up with common salt (sand, etc., will do equally well), to give sufficient weight to the grenade. The handle is inserted into the end of the cylinder for a length of $1''$ and is held in position by two tacks or small nails. At the end of the handle a calico tail about $2'$ long is fixed, and this is kept coiled up and held together by a safety pin, until required for use.

The head has two horizontal and two vertical slots cut in it (only one of each is shown in the elevation), and in these the two small $\frac{3}{4}''$ screws (shown in section) engage. A thin metal strip divides the horizontal from the vertical slot. Two metal flaps are also fitted, which prevent the screws passing from one end of the horizontal slot to the other.

The grenade, as shown, is in the safety position, the head being prevented from being driven home by the screws coming in contact with the metal. To turn into the firing position, the two tin flaps are bent back, the head is moved round until the screws come up against the left edge of the horizontal slot, and the flaps are then bent down again. In this position, on impact, the screws break the thin metal strips and are driven down the vertical grooves, the point of the screw in the head strikes the cap of the S.A.A. cartridge and fires the charge.

Materials used in Manufacture.—One of the chief advantages claimed for this type of grenade is that it is made entirely from materials which would always be obtainable on service, and it is considered that it could, without difficulty, be manufactured with the tools carried by a field company, R.E.

The cylinder and head are both made of the linings of S.A.A. tins; the ordinary 1-oz. primer tins would suit admirably for this purpose, but it is improbable that sufficient would be obtainable on service. Other materials used are S.A.A. cartridge cases, wood, screws, tin tacks or small nails, wire, calico, and solder. The wood blocks in the head and cylinder need not be accurately turned to shape; rough work with a chisel would be quite sufficient, the blocks being held in position by screws if necessary. If calico was not available, many suitable substitutes could be found for it. On service the charge would be made up of any suitable explosive available (this is dealt with later).

Time and Cost of Manufacture.—The actual time taken by one man to make 120 grenades was 622 hours, or rather over 5 hours for each grenade. This time however included a considerable amount of experimental work, and on a future occasion the actual time of making the same grenade should be capable of reduction by half. Cost of labour is taken at the 4th rate of Engineer pay, or 1½d. per hour; a less skilled man should however be quite capable of doing the work.

Detail of cost of making 120 grenades is as follows:—

	£	s.	d.
Cost of Material.			
Deal 180′ at 1½d. per f.r.	1	2	6
Red wood, 20′, at 2½d. per f.r.	0	4	2
Screws, iron, 1¼″, 1 gross	0	0	8
Screws, brass, ¾″, 2 gross	0	1	8
S.A.A. tins, old, No. 24	0	1	0
15 yards calico at 3¼d. per yard	0	4	1
120 S.A.A. cases, empty, at 5s. per 100	0	6	0
F.G. powder, serge bags, loading, etc.	1	4	0
Total	£3	4	1

Cost of material for one grenade is 6·4 pence.

Cost of Labour.

622 hours at 4th rate of Engineer pay, viz., 1½d. per hour, £3 17s. 9d.
Cost of labour for one grenade is 7·8 pence.

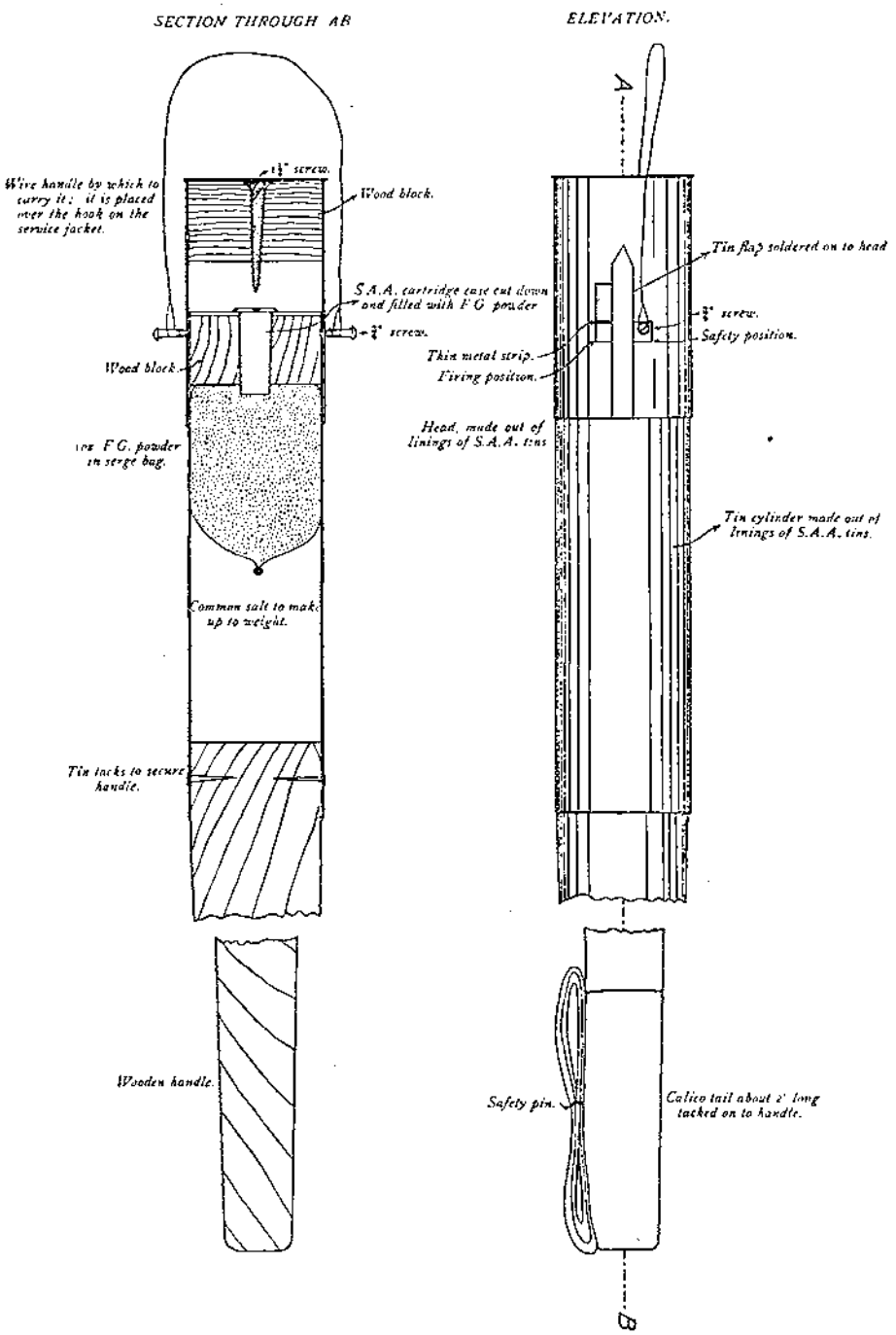
Total Cost of One Grenade.

Material	6·4 pence.
Labour	7·8 pence.
Total	14·2 pence.

This cost should not on a future occasion exceed say 10d. per grenade.

HAND GRENADES.

As Actually Used on Manœuvres.



Method of Using.—The grenade is carried, by means of a wire loop on the head, over the hook of the service jacket until required for use; it is then taken off, the head is turned from the safety into the firing position, and the safety pin is withdrawn from the tail.

The tail should not be allowed to come unfolded, but should be taken as it is, together with the small end of the handle, and firmly gripped in the palm of the right hand. It should be thrown fairly well up into the air in exactly the same way as throwing a stone or a cricket ball; this gives the grenade time to steady itself during its flight and ensures that it strikes the ground head first. Its range if properly thrown is from 40 to 50 yards.

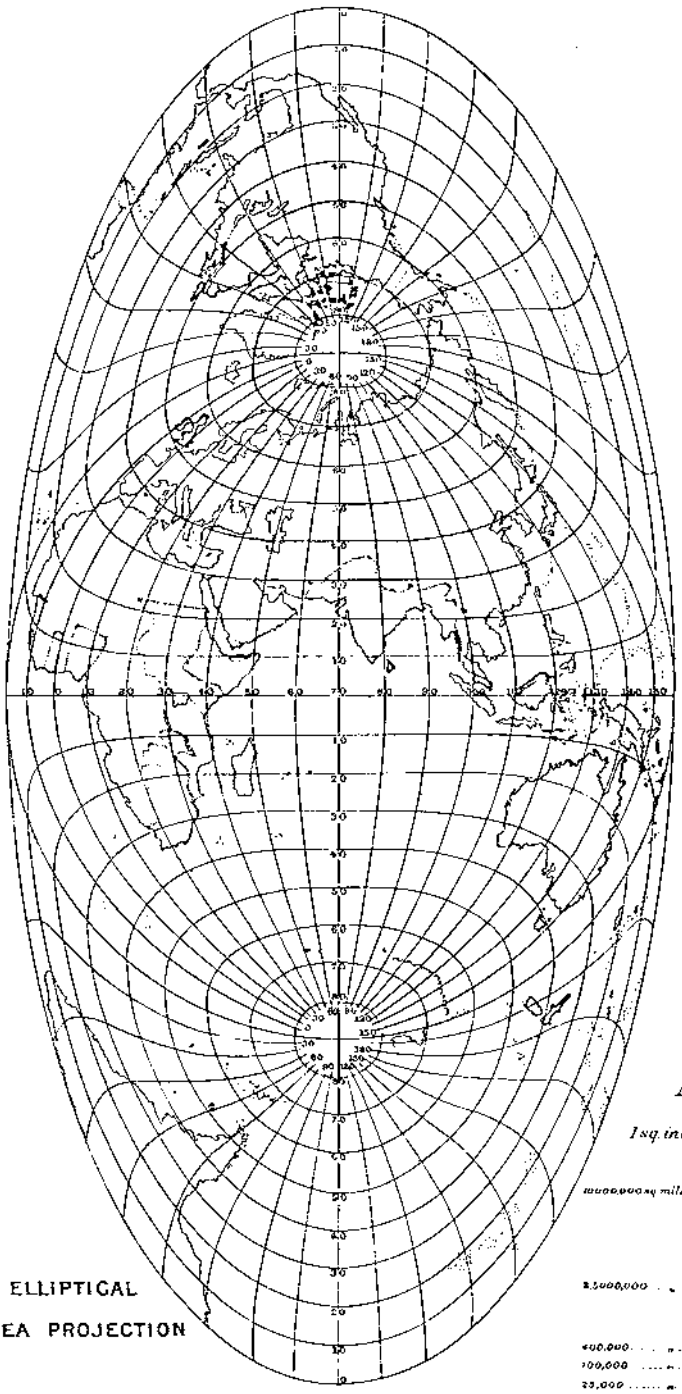
Grenades for Use on Service.—Several modifications in the above would be necessary to obtain a grenade suitable for use on service. Unfortunately, up to the present, time has not been available to carry out any exhaustive experiments. Grenades charged with dynamite and guncotton have been successfully fired by inserting one end of a short piece of instantaneous fuze into the cartridge case and attaching a commercial cap to the other end. The effect of these high explosives is however very local, and it is considered that the most damaging results to *personnel* would be obtained from a grenade made up of two cylinders about 2″ and 1″ in diameter respectively, the one fitting inside the other. The inner cylinder would contain a powder charge; the outer one old nails, bits of scrap iron, etc. It is hoped to shortly carry out some practical experiments with several different types of grenades against dummy targets.

Generally.—For the attack against the defence position 35 grenades were issued to each of the three battalions in the sub-district. The men detailed to use the grenades had had no previous practice with them, and the result was that they were very badly thrown; several failed to go off owing to not carrying out instructions, but, as far as could be ascertained, there was not a single case of failure where the grenade had been properly thrown.

It would appear therefore that some sort of drill is necessary for throwing the grenades, and that a certain number of men in each battalion (if the infantry are to use them) should be thoroughly instructed in their use.

It is doubtful whether a grenade, capable of being thrown by hand, could ever be made very destructive, but according to reports on the Russo-Japanese War the moral effect is considerable.

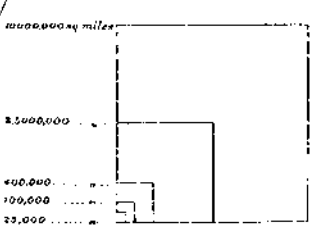
THE WORLD



TRANSVERSE ELLIPTICAL
EQUAL-AREA PROJECTION

Area Scale

1 sq. inch = 10000000 sq. miles



RECENT PROGRESS IN GEOGRAPHICAL WORK.

By Lieut.-Colonel C. F. Close, c.m.g., R.E.

Definition of the Word Geography.—So many definitions of the word geography have been proposed at one time or another that it may be as well to begin with a brief discussion of the meaning of the term.

Dr. Mill defines geography as "The exact and organized knowledge of the distribution of phenomena on the surface of the earth." Prof. Hettner defines geography as "The science of the arrangement of things on the surface of the earth"—a definition of a very nebulous character. Mr. Chisholm puts his definition into this form:—"It is the function of geography, with respect to any class of phenomena that have a local distribution, to explain that distribution in so far as it can be explained by variations connected with place in the operation of causes whose operation varies according to locality . . . especially on human distribution, and hence on the life of man generally." Thus Mr. Chisholm frankly takes the view that the main problem of geography is the adjustment of man to the surface conditions of the earth.*

There is yet a fourth definition which sometimes finds a place in textbooks, and not a bad one either; it is "Geography is the study of man's physical environment on the surface of the planet, and of the interaction between it and the human race."

As the outcome of some of these various definitions we have a list of terms, such as economic-, political-, military-, historical-, geography. Now these terms cannot really be said to represent independent studies; they are rather the results of the application of geographical facts to economics, politics, the military art, and history. They are in fact, not branches of geography, but of the studies indicated by the first term of each compound word. There is an obvious parallel in the application of mathematics to a vast number of human sciences. Take for example the theory of errors; that is a true branch of mathematics. If applied to an anthropometric investigation, this application has no right to be called ethnological-mathematics. In the same way the application of the facts of geography to the military art does not result in military-geography—a term which is very likely to mislead the public.

Acting on the same system, it would be easy to construct a

* See the *Geographical Journal*, January, 1909.

series of terms, such as political-chemistry, or military-meteorology. No one doubts, for instance, the influence of climate on military operations, but such a study is a part of the military art, not of meteorology, and would in no way tend to increase our knowledge of meteorology.

The essence of geography must, in fact, consist in something peculiar to itself, and this is clearly the study of the surface of the earth; all the rest is the application of this study. I am not concerned in this paper with the applications of geography.

Geography, or the study of the surface of the earth, has three main divisions:—

(1). The study of the form of the earth as a whole and allied problems—*Geodesy*.

(2). The study of the details of the surface features of the earth—*Survey* and *Cartography*.

(3). The study of the origin of those features and of the changes which they undergo—*Physical Geography*.

We may say then that *Geography* consists of—

Geodesy.
Topography.
Physical Geography.

I am aware that this differs a good deal from the grouping adopted by my friend, Dr. Herbertson, at the Oxford School of Geography. But I have purposely tried to reduce the meaning of the word geography to its simplest terms, and thereby to define its elements as a branch of human knowledge. It is no doubt, for instance, useful to include the history of geography in a course of study, but the history of geography is no more part of geography than the history of mathematics is part of mathematics.

For the purposes of this paper therefore the subject will be considered under the three main headings—Geodesy, Topography, and Physical Geography, and the intention of the paper is to give, mainly by examples, an idea of the essentially geographical work which is now being carried on.

Importance of the Subject.—In view of the fact that so large a portion of this earth's surface is British territory, we have laid upon us, above all nations, the duty of investigating these subjects, and I hope to show that this duty is not being neglected. It may serve to fix the ideas to remember that the British Empire is practically the same size as Africa,* and only about three million miles less than the entire surface of the moon. The figures, in millions of square miles, are:—

British Empire... ...	11·29
Africa	11·30
Moon	14·68

* See *Plate* "The World."

Geodesy.

It is impossible to attempt to do more than to illustrate by a few examples the geodetic investigations which are being carried on all over the world. I will mention only a few typical instances of such work in India, Africa, South America, and North America.

India's Contribution to Geodesy.—The chief contribution which has been made to geodesy by India, since Everest's time, is Colonel Burrard's investigation of "the intensity and direction of the force of gravity in India," in which he shows that there is a line of excessive density, a "buried chain of mountains," underlying the plains of Northern India, 150 miles distant from the foot of the Himalaya. It is not at present known to what cause this dense line is due, but the parallelism to the Himalaya indicates unity of origin. Burrard's line cannot fail to be an important factor in all discussions of the origin of that great range.

Geodesy in Africa.—In Africa the most important geodetic enterprise is undoubtedly the measurement of the arc of meridian along 30° E. This work, which was initiated by Sir David Gill in 1883, and was carried out, so far as concerns South Africa, mainly by Colonel Sir W. Morris, reached a point within 70 miles of Lake Tanganyika (working from the south) in 1907.

Another portion of this arc is at the present moment being measured. This is the portion in the neighbourhood of the Uganda-Congo boundary, stretching from 1° S. latitude to 1½° N. The party consists of Capt. Jack, R.E., Mr. McCaw, and two N.C.O.'s, R.E., and their Belgian colleagues are Mr. Dehalu, of Liège, and a Belgian officer. The party began work in March, 1908, and will finish about the middle of February, 1909. This undertaking is due to a happy idea of Mr. Read, of the Colonial Office, that advantage might be taken of the presence of the Uganda-Congo Boundary Commission to use a portion of the party, after the boundary survey was finished, to measure the arc. Four learned societies have contributed towards the expenses.

The Uganda Arc commences at the shores of Lake Albert, goes over the slopes of Ruwenzori, past the east shore of Lake Edward, until it reaches German territory on the south. The party have experienced much difficulty from mist and rain, especially in the neighbourhood of Ruwenzori. One of the stations was at a height of 10,000′ above the sea, and the observer found it most uncomfortably cold up there. At the moment of writing there is every reason to believe that the Uganda Arc is practically complete.

The Arc of Peru.—The Uganda-Congo Arc, crossing the Equator, has a rival in South America, the well-known Arc of Peru. In the year 1735 a French scientific expedition left France for the express purpose of measuring an arc in the neighbourhood of the Equator, an

arc which was to settle the question as to whether the earth was a prolate or an oblate spheroid. The expedition returned to France in 1744–45, having completed its labours. The members were Bouguer, La Condamine, and Godin. The length of the arc was about 3° 7′. In spite of its short length it has always occupied an important place in geodetic discussions, but it has long been recognized that, from the conditions of the case, the accuracy of this old arc was not equal to modern requirements.

The French Government therefore resolved, with the consent of the Governments of Ecuador and Peru, to measure the arc, and confided the task to the Service Géographique de l'Armée. Work was commenced in June, 1901, and was completed in July, 1906. The length of the new arc is 5° 53′, or about twice that of the 18th century arc. It is a very fine bit of work, consisting of 74 stations with 3 bases, 54 latitude, and 6 pendulum, stations.

Some accounts of the work have been published, from which it appears that the conditions were by no means comfortable. The work was chiefly on a high irregular plateau between the two cordilleras of the Andes, the average height of the stations being some 12,000′ above sea level. We may take the opportunity of heartily congratulating the Service Géographique on the skill and endurance which resulted in the completion of such an important measurement.

Geodesy in the United States.—To the United States we owe in recent years (i.) many mechanical improvements in geodetic methods and apparatus, (ii.) the execution of an immense geodetic framework covering the United States (which, it may be mentioned incidentally, has been found most useful by the Militia Department of Canada, for tying on the excellent Militia Survey to), and (iii.) the theory of isostasy, due (1889) to Capt. Dutton.

The theory of isostasy is briefly this:—If the earth is not composed of homogeneous matter, but some parts are denser than others, the figure will not be a spheroid; the denser matter will flatten the surface and the lighter matter will bulge. The isostatic figure is thus a deformed spheroid. There is reason to believe that the deposition of sediment on the sea-floor has the effect of causing the sea-floor to sink. Similarly the denudation of the adjacent land surface is accompanied by a corresponding elevation of that surface. Capt. Dutton says: "These subsidences of accumulated deposits and these progressive upward movements of eroded mountain platforms are, in the main, results of gravitation restoring the isostasy, which has been disturbed by denudation on the one hand and by sedimentation on the other." This is another matter which must be taken account of in discussing the difficult problem of mountain building.

Exploration and Survey.

Importance to Soldiers.—One of Napoleon's maxims was "Une carte detaillée est une arme de guerre," and after our comparatively recent experience of the difficulties caused by want of maps in the South African War, there is no need to labour the point that a good map is a military necessity. Now it devolves principally upon our Corps to see that the Army is properly provided with maps of those regions in which British troops are likely to fight.

About 115 officers are now at work on surveys in the United Kingdom, India, Canada, South Africa, Tropical Africa, and elsewhere, and of these 90 are R.E. officers—about one-tenth of the total number of officers in the Corps. To these numbers we must add about 300 N.C.O.'s and men employed on the Ordnance Survey, and about 40 N.C.O.'s employed on surveys abroad.

The largest field of work is Africa, in which are employed 29 officers, 27 N.C.O.'s and a number of civilians. The largest administration is the Survey of India, which employs about 50 officers, of whom 36 are R.E. officers, and next to this in size is the Ordnance Survey, which employs 21 R.E. officers.

It is not necessary to enter into any detailed description of the surveys going on in Africa, because these have been the subject of recent lectures. Briefly, so far as British territory is concerned, topographical surveys are in progress in the Cape Colony, the O.R.C., East Africa, Uganda, and Southern Nigeria, and cadastral surveys are in progress in the Gold Coast, the Anglo-Egyptian Sudan, and most of the other protectorates.

The Survey of India.—In India the principal event to chronicle is the report of the Committee on the Survey of India, which in 1904–5 investigated the whole question of the mapping of India. The Committee reported that it was necessary to make such arrangements as would ensure the topographical mapping of the whole Indian Empire of 1,780,000 square miles within the next 25 years. The Committee laid the greatest stress on the provision of maps for military purposes, and made recommendations for the improvement of the quality of the published maps.

Major Hedley, R.E., was deputed to reorganize the map-printing office in Calcutta, and was lent by the Ordnance Survey for that purpose. He spent two years in Calcutta and effected a marked improvement, and the maps now printed at Calcutta are greatly superior to their predecessors.

As regards the recommendations of the Committee in the matters of the scales of the maps and the organization of the Department, these have been the subject of much correspondence between the Government of India, the local governments, the India Office, and the War Office. A final decision is, it is believed, almost arrived at.

Sven Hedin.—The most sensational of recent explorations in Asia are the journeys of Dr. Sven Hedin. Brief accounts of these journeys have appeared in all the papers, and it is well known that Sven Hedin left Leh in August, 1906, and for two years carried out a remarkable series of explorations in South and South-West Tibet. He lectured in London on the 8th of February, and those who attended the lecture heard an account of a magnificent piece of exploratory work from an intrepid and accomplished traveller.

Dr. Sven Hedin has explored, during the course of his two years' wanderings, an area of some 50,000 square miles lying between the high peaks to the north of the Brahmaputra (some of which had been fixed by Ryder and Rawling) and the old routes of Nain Singh, Littledale, and of Sven Hedin himself.

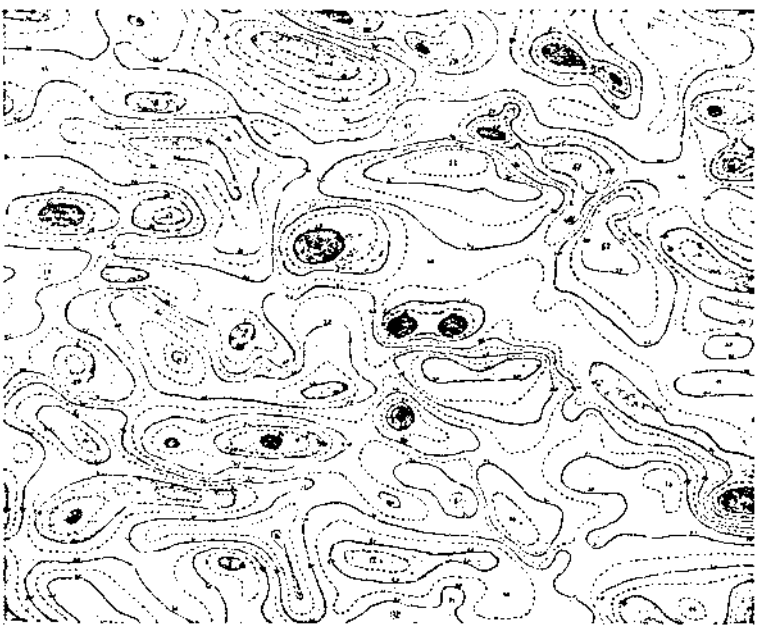
It is doubtful if such great mountain masses should be called a "range." We can get some idea of the complexity of mountain structure by examining photographs of the excellent model of Switzerland which is in the University of Geneva. The only simple lines are the river valleys. It must not be supposed that, even after Dr. Sven Hedin's journeys, we have anything at present beyond an exploratory survey of these intricate mountains of Southern Tibet, such as might be derived, for instance, in the case of an unexplored Switzerland, from four travellers' journeys across the country from north-west to south-east, and from the trigonometrical positions of three peaks overlooking the Rhone Valley.

Dr. Sven Hedin has proposed to call these mountain masses the "Trans-Himalaya." Objection has been taken to this name, and it is understood that Dr. Sven Hedin now proposes "Anti-Himalaya." The question will no doubt be debated by those who have an expert knowledge of the literature of the subject.

Improvements in Survey Methods.—Improvements in methods of survey and in instruments have their importance, but it is an importance which is commonly overrated. They are only of serious value if they render surveying cheaper, or enable work to be done which would otherwise be impossible. This criticism does not apply to photo-surveying, which, though not required for ordinary use, will occasionally enable the explorer to do things which would be otherwise impossible. The most ingenious, as well as most practical, form of photo-surveying is that devised in different ways—by Pulfvich in Germany, Fourcade in South Africa, and Capt. F. V. Thompson, R.E., in England. In this the stereoscopic principle is made use of, and Capt. Thompson has shown that the stereoscopic positions, in which the automatic judgment of the observer comes into play, are about twice as accurate as those determined from the same photographs by independent intersections. Moreover, by using the stereoscopic principle, it is not necessary to observe any definite object; a point may be chosen, for instance, on the side of a grassy

hill, and its distance, direction, and height determined. This is strictly a new principle.

Plan of Sea Waves.—The method has been applied by Dr. Kohlschütter to making a contoured plan of a momentary position of the waves of the sea. He was the first to think of this application of the stereoscopic system, and for the first time in history we can now examine critically and at leisure the form of those waves which cause some of us so much inconvenience.



The First Contoured Plan of the Sea Waves.—By Dr. Kohlschütter, 1907.*

Improvements in Cartography.—The foundation of all modern systems of representing hill features is of course the contour, or the approximate contour. In the case of a highly accurate survey like the Ordnance Survey the contours are actually marked out on the ground by levelling, and are fixed on paper with the same kind of accuracy as the detail. But the Ordnance Survey is in this respect a survey apart. In almost all other national surveys the contours are approximate only. Now in drawing approximate contours the faculty of judgment comes into play, and the more rapid the sketching the more necessary it is for the sketcher to have an eye for hill forms.

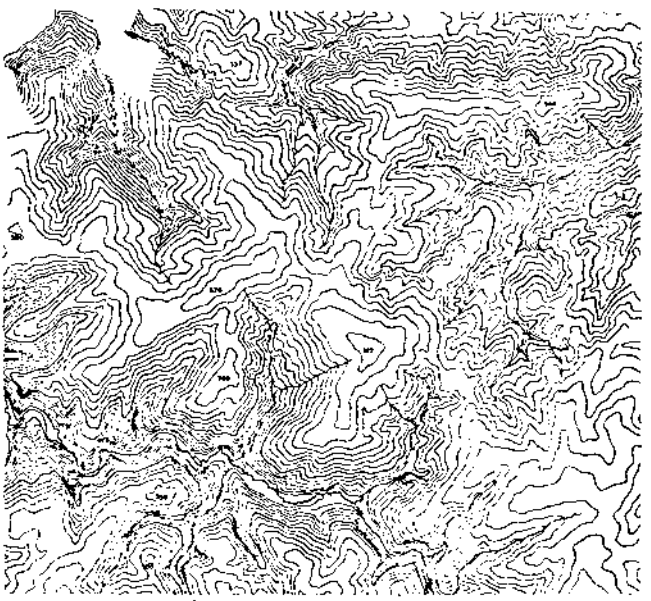
Character in Contours.—In certain foreign maps of Africa the hill features are represented by very conventional, rounded form-lines, and we all of us know how difficult it is to read a map in which the characteristic features are not brought out. The opposite fault is

* Printed by permission of Dr. Kohlschütter.

more rare, the fault of over-emphasis. In maps which fail in this respect too much angularity is given to the features, and the sketch becomes a sort of caricature of nature. However, a good caricature is better than an expressionless sketch.

It is in small refinements that the difference between good and bad hill drawing is shown. Sometimes a good deal can be learnt by reducing down photographically the contours of an accurate map. The attached example is such a reduction. Much also can be learnt from the study of good models.

Every hill contourer should know enough physical geography to understand the different varieties of hill forms.



Example of Nominally Angular Contours.

Legibility of Modern Maps.—There has been a marked improvement in recent years in the legibility of the printed maps. There is a general tendency to use colour freely. Many of us here can remember the time when the only maps purchasable were, in England, the engraved black 1-inch map, and in France the engraved black $\frac{1}{80000}$. Not only is improvement shown by the use of colour, but by the adoption of new methods of representing hill features and relief generally.

The most important advance in the 19th century was the introduction (popularized in England by Mr. Bartholomew) of the method of indicating ground between certain selected heights by special tints; maps printed on this system are sometimes known as "layer" maps.

The next step is to combine the "layer system," which shows the main features, with the shade, which is so useful for showing minor features. This was done (for the first time in a normal topographical

map) in the Ordnance ½-inch layer map of England, of which the publication was commenced in 1908. It is in this direction that progress is probably to be looked for in the immediate future. A new "layer" map of Scotland is being got out by the Ordnance Survey, and, benefiting by the experience gained in producing the English ½-inch, we may expect that the Scotch ½-inch will be in advance, as regards legibility of the relief, of any map hitherto published.

$\frac{1}{1000000}$ *Map.*—Whilst dealing with cartography it will be as well to mention the progress made by the $\frac{1}{1000000}$ map. At the International Geographical Congress of London in 1895 a resolution was passed in favour of the production of maps on a uniform system on this scale. Something, but not very much, has been done by ourselves, the French, and Germans to carry out this intention. A considerable step was taken at the International Congress at Geneva in July—August, 1908. The Congress, at the instance of the American delegates, laid down in greater detail the character of the map. It was decided, for instance, that the names should be in the Latin character, that the map should be a layer map, that the contours should be at intervals of 200 mètres. Many other matters were decided, and if, as is to be hoped, the countries interested adopt the recommendations and come to a complete agreement on the subject, we shall, if we live long enough, find the greater part of the earth's surface mapped in a uniform and systematic manner, and shall be able to purchase maps of the same familiar type in every civilized country. It is a pleasing idea to think of the civilized inhabitants of this small planet agreeing together to depict its surface in a way which all shall understand.

Canada.—Before concluding this very brief sketch of some notable matters in the domain of surveying and cartography, it should be mentioned that the most important survey initiated in the British Empire in recent years is the 1-inch-to-1-mile survey of Canada, now being undertaken by the Department of Militia and Defence. This survey, commenced about four years ago, has turned out some remarkably good maps. The credit of this work is chiefly due to Capt. Anderson, R.C.E. About 14,000 square miles have been completed in the field, and the work progresses at the rate of about 4,000 square miles a year. The survey is at present confined to the Provinces of Quebec and Ontario.

Physical Geography.

Physiography of the Nile.—Perhaps the most important publication of recent years, especially from the practical standpoint, is Capt. Lyons' account of the "Physiography of the Nile." One of the factors dealt with in such a study is the distribution of rainfall, and this is an instance of the way in which one branch of knowledge borrows from another; but the distribution of rainfall is itself,

amongst other causes, largely dependent on the character of the hill features.

All studies which do not deal with life are closely related and allied, but in order to ensure definiteness of knowledge we have to divide them into groups. All such knowledge is essentially one, but the methods of human thought requires its conventional division. The finest results of investigation are arrived at by defining, systematizing, and grouping. A science must limit its field and define its objects; a definition like Hettner's, "the science of the arrangement of things on the surface of the earth," is too vague to be of value.

Amongst other matters in the domain of physical geography, which have attracted considerable attention lately, may be mentioned three practical subjects, viz., the transporting power of rivers, coast erosion, and earthquakes.

Matter in Suspension and Solution in Rivers.—Dr. Strahan, chairman of the Research Committee of the R.G.S., has been investigating the question of the amount of matter carried away from the land by rivers. The Medway is one of the rivers selected for examination, but the results are not yet available. I mention this question particularly to show that physical geography is largely a matter of definite investigation, as every science should be.

It is, of course, very well known that the denudation of the land by water is a fact of primary importance in geology and physical geography, and the effect of the weight of the deposited sediment in disturbing the isostatic equilibrium has already been alluded to. Sir Archibald Geikie many years ago gave some figures which will serve to render the quantitative effect of denudation more definite. Thus the solid matter carried every day by the Mississippi into the Gulf of Mexico is about a million tons; and, as an instance of the amount of matter in solution, the learned Bischoff "calculated that the Rhine carries past Bonn every year enough carbonate of lime chemically dissolved in its water to form 332,000 millions of oysters."

Coast Erosion.—The loss of land due to coast erosion is a matter which is frequently referred to in the Press, and has been recently investigated by a Royal Commission. The evidence was issued a few days ago in the form of a bulky volume. In addition to coast erosion, the Commission considered the very interesting problem of the re-afforestation of the United Kingdom, and this latter subject has rather swamped the former. However, as regards coast erosion, the evidence is briefly to the effect that in about 40 years England has gained, above H.W.M., on the whole, about 30,000 acres, chiefly due to reclamation at Sunk Island, in the Humber, and also in the Wash and in Morecambe Bay, and also to natural accretion at Saltfleet and elsewhere. The principal erosion is on the East Coast and on the Sussex coast. Curiously enough, England has lost 31,000 acres on the L.W. line.

Scotland has gained 4,000 acres on the H.W. line and lost 8,000 acres on the L.W. line, a net loss of 4,000 acres (if the foreshore is counted). Ireland has gained 7,000 acres on the H.W. line and lost 7,500 acres on the L.W. line.

Colonel Hellard, who, as Director-General of the Ordnance Survey, gave evidence on the subject, says that he has come to the conclusion that agricultural land is not worth saving, and that land of higher value must be saved, if at all, by the action of local authorities, always excepting a few cases which might be considered of national importance.

Earthquakes.—A very important branch of physical geography is the study of earthquakes, to which our attention has been especially drawn in recent years by the destruction of San Francisco and Jamaica, and only the other day by the exceptionally disastrous earthquake in Sicily and the adjoining part of Italy.

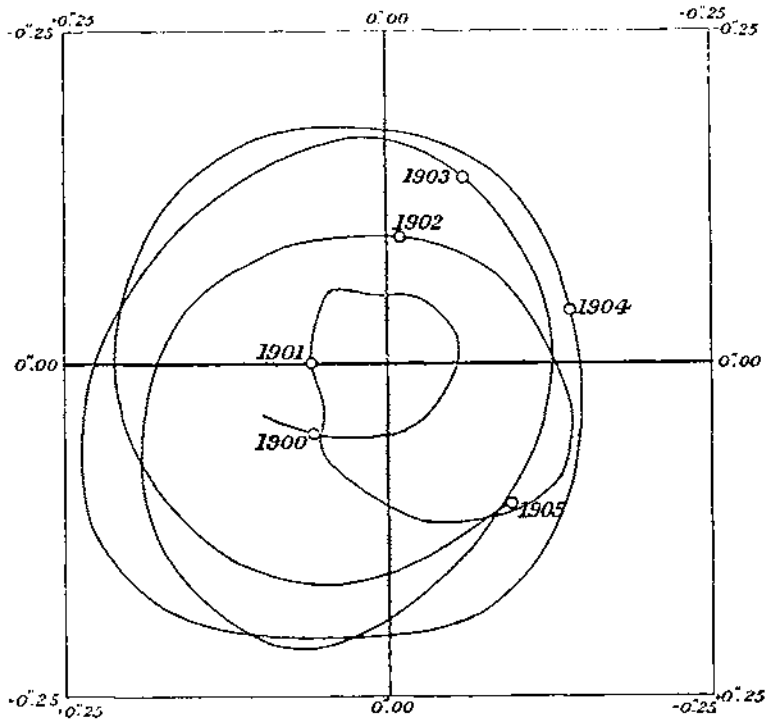
The ultimate cause of earthquakes is not known, although many conjectures have been made, but we sometimes know a good deal about the proximate cause. Perhaps the best earthquake to study is that which happened on 15th April, 1906, at San Francisco.* In this case a slip occurred along an old fault. The movement was entirely horizontal and the average slip was 11 feet, although in some cases there was a movement of as much as 20 feet. "For nearly 200 miles there is a fracture on the face of the land, and everything traversed by the fracture is dislocated, the part on the south-west side having apparently moved toward the north-west, and the part on the north-east side having apparently moved toward the south-east." In some places the line of fracture is inconspicuous, but generally it appears as a large crack. In the Report of the United States Geological Survey an earthquake is described as a jar occasioned by some violent rupture, which may result from an explosion, but more commonly from the sudden breaking of rock under strain. "The great majority of ruptures include not only the making of a crack . . . but the sliding of the rock masses on the two sides of the crack." In the case of the San Francisco earthquake the slip took place on the plane of an old fault. It is obvious that when the crust of the earth is adjusting itself under strain the cracking and slipping is naturally to be expected on old lines of rupture.

In and near San Francisco the earthquake had a duration of about one minute, the motion consisting chiefly of horizontal oscillations. "The motion was jerky and included abrupt phases that were almost blows." The range of the oscillations is believed to have varied from 2 inches to about 6 inches.

Latitude Variation.—It has been suggested, I believe by Dr. Milne, our greatest authority on earthquakes, that there is perhaps some connection between the occurrence of earthquakes and the phenomenon of "latitude variation." But whether this is the case or not,

* See the Reports of the U.S. Geological Survey.

"latitude variation" clearly indicates that the earth is subjected to periodically varying stresses, the effect of which is that the axis of the earth is not a fixed line as regards the earth itself, but moves in such a way that the pole describes an irregular curve in the neighbourhood of the mean pole. Its greatest range is 0″·4, or about 40 feet. Of course this movement has been known for a good many years now. It is one which it is absolutely necessary to take account of in geodetic operations, and, as just stated, it is one to which attention must also be paid in considering the strains which may result in rupturing the crust.



*Track of the North Pole of the Earth Axis.**

Interdependence of the Three Divisions of the Subject.—And this is another illustration of the fact that geodesy and physical geography are intimately allied; and knowing how much topography depends on geodesy, and geodesy on topography, and that the study of physical geography is impossible without topography, and that it is impossible to be a good topographer without some knowledge of physical geography, we may safely say that the three are interdependent, and are in fact the three main divisions of that branch of human knowledge known as Geography.

* Extracted from *Resultate des Internationalen Breitendienstes*, Vol. II., 1906.

RAILWAY SIGNALLING.

By Capt. A. Gardiner, R.E.

Having recently examined a considerable number of the methods of power signalling and interlocking at present advocated in England, I cannot let the remarks made on pp. 363 and 364 of the December *Journal*—comparing the "all electric" and "high pressure" systems unfavourably with the "low pressure"—pass, without putting forward the other side of the question as to which of these systems has the balance of advantages in its favour.

Lieuts. Fenton and Tyrrell's report is open to the interpretation of being the very latest verdict, but, as I do not look upon the "low pressure" system as the best in situations where conditions at all admit of other methods of working, it is only fair on the other systems to record my opinion also.

At the same time I do not wish to be looked upon as rabidly anti-British pneumatic—I am not. It is a very clever system, having very many points of advantage over manual working, but the "low pressure" system, as described, has to my mind two or three serious defects in its principles of working. The first is shown in *Fig.* 8 of the Report, where the point switches are moved by a rod and stud action in connection with a motion plate, and the plate itself—by another rod and stud arrangement—sends back the indication which completes the lever movement, and thus frees the mechanical interlocking of the signal levers. The point switches (either one or both) may conceivably become separated from the motion plate, either by being "trailed through," or by some other accident or neglect; and the motion plate might then send back the "all correct" indication without really having moved the switches. It is true that there is a lock rod and stud, but this may easily be out of order too (and usually would be in the case of a "trail through"). The only absolutely sound principle for such indications is that they shall be controlled directly by the switches themselves, and *not* by the means by which it is intended to operate those switches. This principle is not infringed in the other systems referred to.

Actually there is, I believe, usually an electric check in addition to the pneumatic indication; but a second check should be superfluous, and the pneumatic contrivance, if it cannot be absolutely relied upon, becomes really merely the lever replacer, an operation upon which I do not place any very great store.

The next arrangement, which strikes me as wrong, is that by which the signal is actively replaced to danger by air pressure (*Fig.* 9). Independence of gravity is claimed as a "characteristic" of this system. Personally, I should prefer to rely upon the direct action of gravity rather than upon the correct working of a somewhat elaborate series of valves and air pressures. In this Company's auto-signal the disparaged aid of gravity has admittedly been fallen back upon. There may be some very good reason why a similar arrangement is not adopted in yards, but I suspect that it is chiefly with a view to securing the automatic lever replacement, and if so it seems to me to be too dearly bought. In the penultimate paragraph of the Report reliance upon gravity appears to be eventually claimed for all signals, and not merely for the auto-signal; but even if it be the case that cessation of the holding-off pressure suffices to return any of the signals to danger, the intermediate mechanism—before this cessation can be ensured—is more elaborate than in the electrically controlled systems, where the mere failure of a current causes the reversion of the signal by gravity to the danger position.

The last objection which I will raise to principles is of a somewhat similar nature to the above, and this is to the electric signal "replacement" (*Fig.* 11) being effected through yet another cycle of operations, viz., the train—de-energizing the track relay—opens the circuit of the electro-magnetic cut-off valve, admitting air to a piston which moves the lever *in the signal cabin*, and only then gets us back to the already, to my mind, dangerously long cycle which eventually leads up to the active return of the signal, by air pressure, to the danger position. I would require some convincing before I accepted such a device in preference to that of the Westinghouse "high pressure" (or more correctly "electro-pneumatic") system in which the train, de-energizing the track relay, opens the circuit of an electro-magnetic valve at the signal itself, releasing the pressure that has been holding it "off" and allowing it to revert by gravity to danger. In the "all-electric" systems the arrangements are equally simple and direct.

The statement of characteristics does not seem to me to be entirely beyond comment.

"(1). It requires no force but air."

Is this strictly accurate? I think it we had "*no force* but air" we should have to sit a long time before our points moved! I am not quibbling. My point is that we are simply using our force of steam or other power to compress air, as a means of conveying that power to the points and signals, instead of using it to generate some one of its other transmissible forms. Air-compressing machinery is hardly less complicated than a dynamo; moreover, in some cases, electric current will even be found actually employed in driving a motor to compress air (most of which will subsequently be lost in leakages), instead of—as it could do—directly operating the yard!

"(2). The air pressure is always low. . . ."

See also Claim 1 over the "high-pressure systems."

The air pressure in the distributing mains is anything but low (80 lbs.). These extend for miles, and require provision against condensation, freezing, etc., and then pressure-reducing valves to bring down to 15 lbs., 7 lbs., or 10 lbs., for operating purposes.

"(3). . . . quite independent . . . of gravity."

I have expressed my doubts as to the value of this characteristic.

"(4). Except when a switch or signal is being moved . . . all . . . pipes are subject to atmospheric pressure and no more."

This is doubtless to reduce leakage losses in the elaborate maze of operating and indicating pipes, more especially in stations where movements are comparatively infrequent and the idle intervals correspondingly long; also to avoid the risk of unexpected operations resulting from leaky valves, etc.; but it involves considerable losses of compressed air and also appreciable slowness of operation, since the lengths of piping between the signal box, and the points or signal, have to be charged up again before they can again perform work.

"(5) and (6). The automatic return of the lever."

This is a very neat operation. It is very attractive to see the signalman with his hand on the next lever ready to pull it over the instant the controlling lever, or levers, completes its, or their, movements all on their own account. But when one takes into consideration that no physical effort is required to move these levers, that they take up so little width that the whole frame is within easy reach of the operator, with but little delay in shifting his position, and that the return of the lever is *not* instantaneous upon the completion of the point or signal movement, but takes quite an appreciable time while the indicating pipe charges up and operates the relay which works the replacing piston, the real value of this characteristic becomes doubtful. Certainly I should not myself sacrifice one iota of safety to secure it, nor should I be prepared to accept much additional expense or complication of mechanism.

As regards the three chief functions of a railroad switch and signal device, I would put No. 3 of the Report a very long way *first*; and as I have explained, I am not satisfied that this system complies with this requirement as fully as it might do.

The "marked" advantages claimed over the "all electric" are really not overwhelming. As far as (2) and (3) are concerned, if the electric current has to be there at all, it is comparatively immaterial whether it be in sufficient strength to ring a bell or not; in fact, I am inclined to think a more tangible presence would probably be the easiest looked after, while the degree of intelligence required to run air-compressing machinery at the compressing stations, keep pressure-reducing valves in order, add 50 per cent. when occasion demands, and generally maintain an elaborate pneumatic system is probably

not less than that required to look after any form of battery or of simple electric-generating or electrically-operated plant.

As regards lower primary cost, it would be of considerable interest if Lieuts. Fenton and Tyrrell would state the grounds on which this advantage has been urged. I absolutely failed to get anything like a definite comparative estimate of primary costs; but looking at the comparative amounts of mechanism in each, as well as judging by such figures and quotations as I was able at all to get hold of, the electric and electro-pneumatic systems appeared to be quite able to hold their own, while in subsequent working expenses the advantage appeared to lie very heavily indeed with the electric systems, mainly owing to the enormous losses unavoidable with compressed air. That the "electro-pneumatic" panned out better in this respect than the "all air," appeared to be mainly due (1) to the limitation of the compressed air strictly to power purposes, all control being electric, and (2) to the far greater frequency of operation (and consequently less time standing idle except for leaks) on the District Railway as compared with the London and South-Western.

Since writing his article in the December *Journal* Lieut. Fenton has probably had a good opportunity of studying a very carefully worked-out "all electric" installation on the Siemens system, modified by Mr. Sayers, of the Midland Railway; and it would be interesting if he could find time to give us a report on that, and say whether his views as to the advantages over the electric of the pneumatic system have undergone any modification.

To my mind the advantages of the "all electric" lie chiefly in the possibility of direct control of the motive power by the signalman's lever, without the intervention of intermediaries, such as relays, etc.; the advantages of insulated cable over pipes for power transmission purposes (avoidance of leaky joints, condensation, necessity for providing for expansion and contraction, etc., etc.), as also for subsequent alteration; the instantaneous response of the motor mechanism to the signalman's "orders," and the direct control of the back indication by the object itself which is intended to be moved by the motor; the greater fineness of detection for such indication that electric contacts admit of as compared with a somewhat clumsy air valve, and its instantaneous transmission to the signalman; and, finally, the simpler mechanism of a motor or an electro-magnet as compared with air relays, 7-lb. and 15-lb. pipes, and air motors, which must, if out of order, be attended to *in situ*, instead of being capable of being pulled out and replaced in a few minutes, and sent into shops for skilled attention.

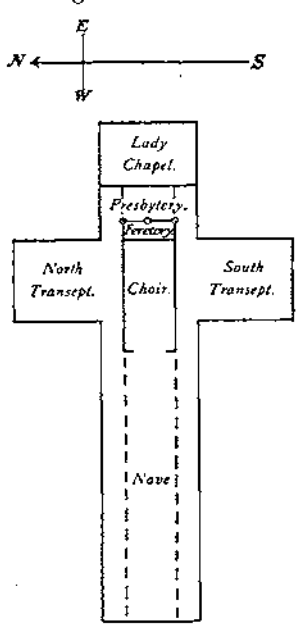
The British Pneumatic Company are, I understand, developing an "all electric" system, which, as being one of the latest devised, should be the most up to date and of great interest to all concerned in railway signalling.

THE PRESERVATION OF WINCHESTER CATHEDRAL.

By 2ND LIEUT. J. M. SMEATHMAN, R.E.

WINCHESTER CATHEDRAL, which occupies a large open space towards the south-east of the town, is at once one of the largest and most interesting in England. According to the *Imperia Gazetteer* it was first completed in 648, but about 870 suffered so much from the ravages of the Danes, that it became almost ruinous. The present structure, commenced in 1079, and completed in 1093, has since received so many additions and undergone so many alterations, that it has lost much of its unity of design, and has assumed a form which makes it difficult to say whether the early Norman or later English is predominant. It is in the form of a cross, with a square tower rising from the point of intersection to the height of 138′, though not more than 26′ above the roof. The whole length, from the west entrance of the lady chapel to the east end, is 545′, the width of the transepts being 186′. The interior

Rough Sketch Plan.



consists of a nave 250′ long and 78′ high; aisles separated from it by a double range of pillars 12′ in diameter, a choir 40′ wide occupying the lower part of the central tower, and lighted by clerestory windows; and transepts containing several very beautiful chapels and altars. The roof is elaborately groined and enriched with delicate tracery, armorial bearings, and other ornaments; the throne, prebendal stalls, and pulpit present excellent specimens of carving. There are also numerous monuments, amongst which those of Hardicanute and William Rufus and Bishops Fox, Gardiner, and Wykeham, possess much historical interest. The most imposing part of the structure is the west front, consisting of three deeply-recessed and highly-enriched porches, with an ornamental gallery above, a large and beautiful window with rich mouldings, several massive buttresses and pinnacled towers, and a gabled termination crowned by a canopied statue of William of Wykeham.

Up to a comparatively recent date the building was thought to be in the highest state of repair, but—owing to cracks and other damage appearing a few years back—the foundations were carefully examined, and a very serious state of affairs was found to exist. It was discovered that the cathedral was originally founded upon a very bad site, which in ancient times was either a bog or a river bed. The foundations were placed in a waterlogged bed of peat, which is of varying thickness, owing to the shelving surface of the gravel beneath it. It becomes deeper from west to east, and its upper surface is about 10′ from the surface of the soil above it. The whole structure has settled down into the bed of peat, and moreover has settled unequally, owing to unequal distribution of loads and inequalities in the depth of the peat. The original builders seem to have been afraid of this settlement, as they placed layers of beech logs under the foundations. As the layer of logs is no wider than the walls, it is evident that it was placed there more to secure an initial foundation than to extend the area bearing on the soft peat. The logs are still in a wonderful state of preservation, some even retaining the bark, but they did not of course prevent the foundations from sinking. The eastern end, being on a deeper bed of peat, has settled considerably more than the western end, which has scarcely moved at all, and the result is that the whole structure leans towards the east. Owing to local differences of loading and depth of peat, this settlement is not regular, but varies all over the building. The ends of the transepts have, for instance, sunk more than other parts, and great cracks occur right across the transepts through both walls and the roof.

Some time ago attempts were made to stop the settlement, which was making itself apparent. To do this without disturbing the existing foundations piles were driven down on the outside and inside of

these foundations and close to them, with the intention apparently of boxing in the peat and preventing it from spreading. There was however another fault which the piles could not remedy. Owing to the softness of the peat, the weight of the walls and of the buttresses did not properly counterbalance the roof thrust. This was due to the buttresses being founded in the soft peat often at a less depth than the walls, causing the inside edge of the wall to tend to become the centre of revolution. As the wall leant outwards the roof sank, and its thrust of course became more horizontal and its turning moment greater. The buttresses were only founded 6′ into the earth, while the walls were founded about 11′.

Below the peat is a stratum of gravel, and the only way of preventing further settlement was by digging out the peat and continuing the foundations down to it; even then, for the gravel to carry the building safely, the foundations require to be 12′ thick. The maximum depth of the gravel below the surface of the earth is about 30′, and concrete footings are therefore being added of a depth varying from 13′ to 19′. Great difficulty is found in some places in placing these foundations owing to the presence of large quantities of water, which rises continually through the gravel, and the method used is described later.

In addition to this, owing to the irregularity of the settlement, the roof did not simply flatten out, but cracked in places right across. This is corrected, as described later, by tieing together the opposite sides of the roof, and so converting the vaulted roof into a truss with iron tie-bars and arched struts.

Approximately in the centre of the building there are three pillars separating the presbytery from the feretory. These pillars are the only part of the building which have remained upright, and the building leans outward from them to the north, east, and south. At the same time individual walls lean outwards, thus distorting the arches connected to these pillars.

Dealing first with the settlement to the east, the first noticeable feature is a large crack across the presbytery. This leaning to the east was noticed some centuries ago, and apparently an attempt was made to stop it by building on a lady chapel as a large buttress at the end. This was very heavily made, and its foundations were not sufficient to hold the load due to the settlement of the presbytery. The result is that the lady chapel and presbytery have sunk together, mostly at the point where they meet, and, as the eastern end of the lady chapel has leant outwards as well, a large crack has been formed across the lady chapel.

The lateral—or north and south—leaning is most noticeable about the transepts, which have settled in a similar manner to the presbytery. The three pillars between the presbytery and the feretory have acted

to a certain extent as an anchor, and so the south transept in leaning bodily to the south has not only cracked right across, forming a gap 2″ wide at the bottom and 12″ at the top, but has also broken away from the south wall of the presbytery, carrying with it part of the south wall of the vestry, and so creating a cleavage of about 6″ at the top of this wall. Owing to the eastern wall of the south transept leaning eastwards at the centre, it has at the top become curved to a very dangerous degree. The north transept has settled in the same manner, but not quite so extensively. The combined movement has tilted the tower considerably out of the vertical.

The following figures will give an idea of the degree of stress to which the walls have been subjected:—

The eastern end of the south wall of the presbytery is 2′ 4″ away from the vertical at the top.

The top of the pillar inside this is 1′ 11″ to the south of the vertical.

The south wall of the presbytery slopes downwards from west to east at a slope of 3″ in 7′.

The eastern wall of the lady chapel at the top is $5\frac{1}{2}$″ to the east.

The tower at the same height is 3″ to the east.

The western end of the south wall of the presbytery leans 6″ to the south and 3″ to the east.

The south wall of the feretory leans 12″ to the south.

The above clearly shows the dangerous condition of the cathedral, and the following is a short description of the steps which are being taken to preserve it. In the first place solid foundations resting on the gravel are being provided, and this is being done as follows:—As previously mentioned, concrete has to be filled in to a depth of between 13′ and 19′, and of a width varying from 12′ to 14′. In every case water continually rises through the gravel and is pumped out where possible, but in many places about 8′ of water are met with, and a diver has then to be employed. The process is similar in all parts excepting where in deep water it is necessary to form a watertight layer, and the following is therefore a description of the work where this has to be done. First of all piles are driven round a section of about 5′, which is to be underpinned. The earth and the peat are next excavated down to the level at which the diver becomes necessary. He then digs out the remainder of the peat and places concrete in layers of bags over the gravel. The bags of concrete are laid to a depth of about 3′, and this forms the watertight bed upon which the workmen build the footings, after all the water has been pumped out to enable them to work in the dry. The new foundations are first built of concrete blocks, 2′ × 1′ × 9″, laid with 6″ bond between blocks. This work is done from the centre, and where possible the inner half is excavated and underpinned, first in the hope that the excavation may tend to get

the wall back to the vertical. Above the concrete five courses of brickwork are put in just below the level of the crypt floor, and the top course is grouted with cement to the flint rubble masonry above it. Above the level of the crypt floor the old walls are built of a stone consisting chiefly of chilmack and chalk. No attempt is made to get the walls back to a vertical position before putting in the new foundations. In some places it was found necessary to place a $4' \times 4'$ brick pillar between the floor and ceiling of the crypt to assist in holding up the walls, and in such cases lengths of 10′ were underpinned at a time. Before underpinning is attempted, the walls themselves have been propped up by temporary shoring to prevent inclination. The shoring is made up chiefly of baulks of Baltic fir, 1′ square, founded on concrete blocks extending at least 18″ on every side of the timber, and with their bottom edges below the ground level to a depth of 4′ when inside the building and 3′ when outside. In some cases two shores are founded on the same block, and the block may then be as much as 9′ long. All cracks are grouted up with neat cement, and the surface is made to resemble as much as possible the surrounding stone. The building has been carefully examined for cracks, and they have all been numbered and catalogued. There are in all over 100 cracks. Cement fillets, about 1″ deep and $\frac{1}{4}$″ thick, are placed over every crack, and the dates of application are marked on them and catalogued. They are inspected every three weeks to see if settlement is still occurring, and if cracks appear, fresh test fillets are put on them, and attention is paid to the shoring and underpinning of the faulty part. The north and south walls of the nave were originally founded about 20′ down, and the buttresses along them were only founded to a depth of 6′, but as the settlement of this part is very slight, it will probably be necessary to underpin all the buttresses of the north nave and aisle and some of the buttresses of the south.

Owing to the widening of the building by the outward leaning of the walls, the roof became considerably flattened, and, as it was considered dangerous to leave it in that state, the arches had to be raised in several places in addition to the use of ties. First of all centering was placed underneath most of the ribs of the vaulting, and these ribs were raised on the centering by means of rows of small wooden wedges. Cracks were then filled in with fresh stone and cement. The ends of ribs, where roughened, were renewed. The feet of some of the ribs are tied together with 2″ iron bars. Four of these bars tie together the south wall of the south transept and the north wall of the north transept, and two of them tie together the north and south walls of the presbytery. They are also used across the lady chapel and the transepts. The repairs to the roof are not made until the walls have been underpinned and grouted, and the test cement fillets show no signs of fresh cracking.

The works have been going on during the past three years, and so far the lady chapel and presbytery have been underpinned, and the work is being continued under the transepts. Further building is necessary, as the central pillar of the three between the presbytery and feretory is built on an arch which is giving way. The concrete used in the new foundations is $4\frac{1}{2}$ to 1, and the work is so far successful that the finished foundations permitted a universal settlement of $\frac{3}{8}''$, after which no further settlement has been detected. It may be noted that although the nave shows little or no leaning east or west, the columns are inclined outwards to the north and south, although not to so great an extent as other parts of the building.

THE MAIN UNDERGROUND TELEGRAPH SYSTEM OF GREAT BRITAIN.

A Paper Contributed by MAJOR W. A. J. O'MEARA, C.M.G., *Engineer-in-Chief British Postal Telegraphs, at the first International Conference of Telegraph and Telephone Engineers, Budapest,* 1908.

Translated from the French.

A CONSIDERABLE sum of money has been voted by the British Parliament in recent years in connection with the provision of underground cables for long-distance telegraph circuits, and I have thought that a short account of the underground cable scheme which the British Telegraph Administration is carrying out might be of interest to our colleagues attending the Engineering Conference at Budapest.

EARLY HISTORY.

The first experiments with underground conductors carried out in Great Britain appear to have been made so long ago as 1816 by Sir Francis Ronalds in his garden at Hammersmith, but it was not till 1837 that subterranean wires were first utilized in London in connection with the commercial telegraph system of the country. In that year five copper wires, covered with cotton and afterwards coated with a preparation of resin, were buried between Euston Station and Camden Town—a distance of 1·2 kilomètres. A 5-needle instrument was used at this time, and consequently five wires were required to provide a single circuit. These wires were placed in grooves cut in pieces of timber, with a tongue of wood fitted over them to secure them, and it is not surprising that this experiment did not prove a success.

In the years which followed endeavours were made to produce insulated conductors suitable for subterranean work, and various descriptions of insulated conductors were laid underground in short sections in and near London. The experience thus gained and the progress made in the manufacture of insulated wire encouraged the Submarine and European Telegraph Company to lay six gutta-percha covered wires from London to Dover, through Chatham and Canterbury, distance approximately 116 kilomètres, the line being completed by the 1st November, 1852. In the following year the Electric Telegraph Company put down a line of eight underground wires on the London and North Western Railway from London to Manchester —distance 294 kilomètres—and the British Telegraph Company com-

menced to bury six gutta-percha covered wires along high roads from London to Liverpool *viâ* Birmingham and Manchester, distance 370 kilomètres, the wires to Liverpool being brought into use in 1854 and those to Manchester a year earlier.

This underground system was also extended to Scotland by means of a line of 10 wires in troughs laid as far as Glasgow, and in Ireland, Belfast and Dublin, the two principal towns, were similarly linked together.

Unfortunately, all the underground wires laid from London to the provinces failed, and were in consequence condemned in 1857–8, after a very short life. These failures appear to have put a considerable check on the development of long-distance underground circuits in our country, and the matter does not appear to have been taken up again until 1870, in which year an underground line was provided between Liverpool and Manchester—distance 57 kilomètres.

In 1870 the British Telegraph System was acquired by the State. From an early date of State ownership the serious inconveniences arising from the interruptions caused to the telegraphic service by the storms which periodically visit our shores was forced on the attention of the Telegraph Administration, but it was not found possible to undertake the provision of long-distance underground lines out of the moneys voted annually for the telegraph services, as the demand for the general extension of the telegraph system was being much pressed for by the public at that time.

On the occurrence of each serious interruption caused by storms the public Press directed attention to the loss occasioned and inconvenience suffered by the public during the dislocation of the telegraphic communications, and urged the provision of underground cables in order to reduce as far as possible such disorganization and delay. An exceptionally severe snowstorm visited the British isles in October, 1881, and caused an almost total suspension of the telegraphic service, and in consequence the Postmaster-General called for a scheme for the provision of a fairly extensive underground telegraph system.

A scheme was prepared by the Engineer-in-Chief of the Post Office in 1881, involving cables from London to Penzance, in Cornwall—distance 510 kilomètres, London to Aberdeen, in Scotland—distance 803 kilomètres, and also providing connecting links between the important centres of Ireland. The number of conductors which it was proposed should be provided in each section is shown on the map. This scheme involved the provision of 65,000 kilomètres of subterranean wire at an estimated cost of £1,720,320. After careful consideration, the Postmaster-General decided that so large an expenditure could not be incurred on the telegraph system at that time, and the question remained in abeyance until 1887. In the latter year another severe storm swept over the country, and caused such

serious dislocation of telegraphic traffic that the Associated Chambers of Commerce made urgent representations to the Postmaster-General, who again caused the question of the provision of underground conductors to be referred to the Engineer-in-Chief.

Since the first scheme was drawn up fresh developments had been taking place, and new factors were introduced into the problem. The number of wires to be carried on aerial routes out of London and other large cities had increased to such an extent that it became evident that it was no longer possible to provide a sufficient number of pole lines in the localities referred to, to meet the growth of wires occasioned by the ordinary increase of traffic. The change of policy inaugurated by the introduction of the new rate of 6d. for 12 words on inland telegrams on the 1st October, 1885, further increased the difficulties in connection with provision of open routes for the additional channels required. The seriousness of the situation can be understood when the fact is stated that the introduction of the lower tariff increased the number of messages handled from 33,000,000, in the financial year 1884–5, to 50,000,000 in the following year.

The foregoing factors were taken into consideration in connection with the proposals put forward in 1887, and provision was made for an increase in the number of telegraph circuits between important towns proposed in the 1881 scheme. In consequence, the new scheme involved the provision of 101,500 kilomètres of underground wire at an estimated cost of £2,480,000. It was again considered that the expenditure of so large a sum of money was out of the question, and no action was taken.

The growth of the telegraph system continued, and in 1895 the British Post Office purchased the telephone trunk lines of the country, which had been built by private enterprise. The difficulty of providing open routes for the additional telephone trunk circuits required to meet the increasing traffic now began to be acutely felt, and attention was once more drawn to the question of the provision of underground cables for long-distance telegraph circuits. Accordingly, in 1896, the Postmaster-General obtained a grant of £165,000 for the provision of an underground telegraph cable between London and Birmingham, a distance of 188 kilomètres. It was decided that the cable for this work should be of the paper-insulated lead-sheathed type, a type which had not up to that time been much used in this country.

In the years which have followed since 1896 further grants have been obtained from Parliament, and in consequence many important centres in Great Britain have already been connected by means of underground telegraph circuits, provided wholly in lead-sheathed cables. A schedule is included (Appendix I.) showing the total cost and the cost per mile of the principal long-distance cables laid since 1896, the routes of these cables and those which it is now proposed to lay being shown on Map I.

MAP 1.—*The System of Underground Telegraphs either existing or under construction in the British Isles in* 1908.

The figures show the number of wires in each section.

Survey of Routes.

The construction of telegraph works on public highways is, in our country, regulated by various Acts of Parliament, which lay down the procedure to be followed in dealing with the local authorities responsible for the maintenance of these highways. These Acts also legislate for the manner in which cases in dispute, between the Postmaster-General and the local authorities, shall be tried in the event of a failure on the part of the two parties to come to an amicable understanding. Briefly, the Telegraph Acts provide that, in respect of roads situated in urban areas, the permission of the local authority shall be obtained to lay the pipes, which it is required to use, in positions to be agreed upon, but in respect of roads situated in rural districts such permission is not necessary. In the latter case the Postmaster-General is required to serve a notice of his intention to lay pipes, etc., but before any work can be commenced it is necessary to come to an agreement with the local authority as to the depth, course, and position of the pipes and cables to be buried. It naturally follows that at times, before the exact route and particulars of a telegraph line can be determined, negotiations have to take place with the local authorities, as the proposals of the Telegraph Engineers are not always acceptable, and the local authorities occasionally attempt to impose conditions in connection with the execution of the work to which the Postmaster-General cannot agree. For instance, the local authorities at times desire a longer route to be adopted than the one proposed, and sometimes request that the pipes shall be buried at a greater depth than that desired by the Telegraph Engineers. Further, it is not unusual for onerous conditions to be proposed in connection with the restoration of the road surface, and when the local authority undertakes to make good the surface of the road by its own workmen, it is sometimes necessary to challenge the prices which it is proposed to charge for such work. These matters frequently involve a considerable amount of correspondence and delay. Sometimes it becomes necessary to decide that the works shall be commenced before all particulars concerning the whole route have been settled, and in such cases a gap, which has to be bridged at a later period, is left in the disputed section. Difficulties of this kind had to be overcome in connection with the works dealt with in this Paper, but as they have only a local importance, I do not propose to make any further reference to the matter.

After the details in connection with the exact route to be followed, have been settled as far as practicable by the Engineers with the local authorities, schedules giving particulars of the route, mileage of each kind of road surface under which pipes will be buried, etc., are prepared, and submitted to the Engineer-in-Chief.

PIPE LAYING BY CONTRACTORS.

All large works in connection with pipe laying, are carried out for the British Post Office by contractors. The contractors excavate the trenches, joint and lay the pipes, fill in the trenches, and are required to make good the surface of the metalled or paved roadways and footpaths in those cases where the local authority does not elect to act as contractor to the Post Office for such work. For the purpose of inviting tenders it has been found convenient to divide the route to be followed by the pipes, into sections each about 16 kilomètres long, the boundaries of towns and villages being adopted as suitable dividing points. Invitations to tender are issued to selected contractors only, who are furnished with the particulars contained in the schedules compiled by the Engineers (to which reference has been made), in order to assist them in quoting prices for excavations in different kinds of soil, and for the restoration of the various descriptions of road surface, etc. A contractor may, of course, tender for and obtain the contract for one or more of the 16-kilomètre sections of pipe track. The contractors, whose tenders are accepted, have to undertake the responsibility for the maintenance of the road surface in good order to the satisfaction of the local authority, for six months after the date of the completion of the work. This provision is stipulated in the contract owing to the fact that the Telegraph Acts have placed this responsibility on the Postmaster-General.

In the case of the underground line between London and Birmingham which was commenced in January, 1897, the contractors were invited to supply as well as to lay the pipes. It was naturally necessary to ensure that the pipes were good, sound, of full gauge, and free from projections on the inner surface; with this object in view they were examined on delivery at the site of the work. This examination had to be carried out very strictly, and much inconvenience was caused by the fact that nearly 30 per cent. of the pipes had to be rejected as unsuitable. Largely owing to this experience, the British Telegraph Administration now purchases all pipes required for underground cables direct from the makers, and employs officers to examine the pipes at the foundries, where those found satisfactory are marked on the flat face of the socket with two arrows, so as to be easily identified. Pipes which are bent to the extent of more than 2·5 cms. in a length of 2·7 mètres length or 1·8 cms. in a length of 1·8 mètres are rejected.

A schedule (Appendix II.), which gives particulars of the works carried out since 1896, shows that cast-iron pipes having internal diameters of 5 cms., 7·5 cms., 8 cms., and 10 cms. have been used in carrying out the scheme represented in Map I., whilst the following Table states the maximum diameter of cable which can be drawn into these pipes:—

CAST-IRON PIPES.

Table of Standard Sizes and Weights.

Minimum Internal Diameter.	Lay (Length exclusive of Socket).	Minimum Weight.	Maximum Diameter of Cable that can be drawn in.
Centimètres.	Mètres.	Kilogrammes.	Centimètres.
5	1·8	19·3	4·375
7·5	2·7	47·2	6·875
8	2·7	51·7	7·5
10	2·7	74·7	9·375

Pipes of the smallest diameter mentioned have been used only on those branch lines where it is known that a comparatively small number of conductors will be required. Pipes having a diameter of 7·5 cms. were for many years almost exclusively employed on all our important works, but in connection with the development of the main underground system it has been found advisable to make provision for a certain number of conductors for telephone trunk purposes. In order that the electrostatic capacity of the conductors required for telephone purposes may be kept low without diminishing the number of conductors hitherto provided in main cables, it has recently been decided to use pipes 8 cms. in diameter on the principal long-distance underground routes. Pipes of 10-cm. diameter have been used in a few exceptional cases when very long-distance telephone trunk lines are involved, again with the main object of reducing the electrostatic capacity of the conductors.

At the time when the first long-distance underground cable was laid, it was considered that it would not be advisable to attempt to draw into pipes lengths of lead-sheathed cable longer than 137 mètres, and this circumstance naturally determined the normal length of the pipe sections, *i.e.*, the distance between the centres of two consecutive cable joints. When the cable was extended northward from Birmingham, the length of 137 mètres was adhered to as far as Carlisle. It was naturally recognized that the cable joints were the weak points in the system, and the question of reducing the number of joints was reconsidered when the latter place was reached. Experience had shown that cables on drums, the total weight of which did not exceed 3,600 kilogrammes, could be conveniently transported by rail and road, and did not offer any difficulty in handling in connection with cable operations. Since it was ascertained that the weight of the cable, designed to bridge the distance between Carlisle and Glasgow, was such that a length of 201 mètres of the same, together with its

drum, would not exceed 3,600 kilogrammes, the length of the pipe sections north of Carlisle was increased from 137 mètres to 201 mètres. More recently the tenth part of an English mile has been adopted as a convenient length for pipe sections where 8-cm. pipes are used. In the case of 10-cm. pipe lines the length of the sections is 108 mètres.

Wherever possible, pipes have been laid under recognized footpaths, or under the roadside wastes and grass margins, metalled and paved portions of roadways being avoided as far as possible. The trenches are of such depth as to provide a covering of 35 cms. measured from the upper side of pipes laid under footpaths, and a covering of 60 cms. similarly measured where pipes are under grass margins or metalled roadways.

The actual methods employed in laying the pipes do not call for special comment. Every precaution is naturally taken to ensure the inner surface of the pipe line when laid being perfectly smooth, so that no injury may result to the lead sheath during the process of drawing the cable into the pipes. For this reason, and to ensure that all the pipes are of the requisite diameter to admit the type of cable which it is proposed to draw in, an iron mandrel, 3 millimètres less in diameter than the specified minimum diameter of the pipe, is drawn through the completed section of pipe work, and any obstruction or irregularity discovered is rectified.

Taper plugs of hard wood are inserted into each end of every pipe section on its completion, to prevent the entry of soil, etc., into the pipes. These plugs are well soaked in water before being inserted into the pipes, so as to provide against the pipes being split by the swelling of the plugs should the soil become water-logged after heavy rains or floods. At the positions where the cable joints will occur gaps are left in the pipe work; the length of these gaps varies from 1·25 to 1·5 mètres, and is determined by the character of the protection to be provided for the cable joint in each particular case.

As the work progressed a sketch of the route was prepared, giving landmarks and measurements, and at every joint opening an oak stake, branded with the distance from the opening, was driven into the hedge bank to act as a temporary marking post.

The rate at which the pipe laying proceeded under each contract varied considerably. On some of the more recent works, pipes have been laid at the rate of about 11 kilomètres per month, but 8 kilomètres per month is considered to be good progress under one contract.

The prices at which the pipe laying has been carried out by contractors has naturally varied according to the locality and to the nature of the soil which has had to be excavated. I have thought that it would be a matter of interest to you to have some information on this subject, and I accordingly include a schedule (Appendix III.)

giving the prices paid for trenching and pipe jointing in the case of some of our more recent works, and separately the cost of the reinstatement of metalled and paved roadways.

Joint Boxes and Test Boxes.

Three methods have been adopted for protecting cable joints on the main underground routes, viz. :—

1. Joint boxes.
2. C.I. flanged couplings with groove.
3. C.I. solid slides.

Joint boxes are employed at points where cable joints fitted with air-nozzles have to be made under pavings which it would be costly to disturb when access to the cable is required. I have included drawings showing two of the types of joint boxes generally used. In *Fig.* 1 is shown the extra large joint box used under normal circumstances, and in *Fig.* 2 the double junction which is used at sharp angles and also when the pipes have to be buried at a depth greater than 45 cms. The "terminating pipes" shown in the drawing are to accommodate the lead joint sleeve whilst the conductors are being jointed, and thus enable the dimensions of the boxes to be reduced to a minimum.

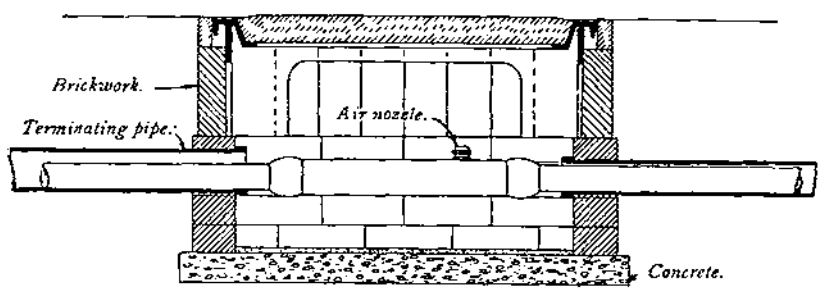


Fig. 1.—*Extra large Joint Box with Terminating Pipe.*

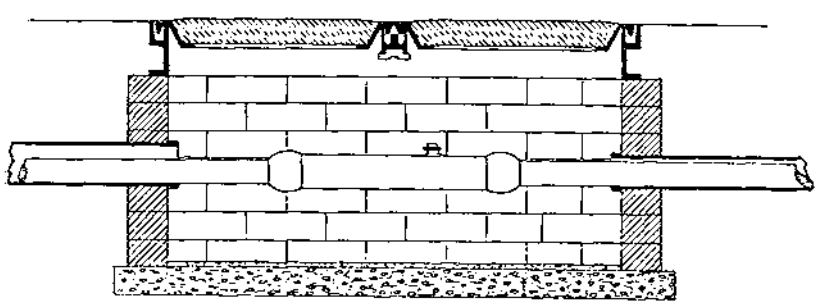


Fig. 2.—*Double Junction Box.*

The C.I. flanged coupling with groove is employed at points where the cable joints are provided with air nozzles, and can be conveniently buried under light soil, involving small cost for excavation and reinstatement, the C.I. solid slides being employed under similar conditions at cable joints where no provision is made for desiccating the cable. The usual practice is to provide an air nozzle at every fifth joint of the cable.

At intervals of approximately 8 kilomètres pillar test boxes are fixed, into which cable connection boxes are fitted. The cable conductors are led into these cable connection boxes, which form convenient points for making all ordinary electrical tests, and also facilitate the air drying of the cable should moisture obtain access to the paper and lower the insulation of the conductors.

WORK PARTIES.

Some parts of the country traversed by the pipe tracks are very sparsely populated, so that the men employed by the contractors had to be accommodated in tents, and occasionally it was found difficult to keep the men together. For instance, whilst work was in progress in Scotland, the numbers of men employed daily on a particular section of the work varied from 15 to 40 men.

Each contractor's gang was closely supervised by a clerk of works, on behalf of the Post Office. The duty of this man was to see that the conditions of contract were strictly adhered to, and also that the pipes were set in the proper alignment, especially round curves in the road. He also took note of all deviations from the contract, such as extra depth, concreting over pipes where they had to be brought near the surface, etc. The clerks of works were frequently visited by the Engineer, to whom all matters were reported. The checks employed made it possible to certify the contractors' accounts promptly, as all particulars relating to extras were always recorded up to date.

At the time that the underground works were first commenced it was felt that, as the security of the telegraphic communications depended in such a large measure on the uninterrupted use of the long-distance underground circuits, too much care could not be bestowed on the operations in connection with the laying and jointing of the cables. It would have been very unsatisfactory to entrust this class of work to men in the employ of contractors, whose employment with the Post Office Engineering Department could only be of a very temporary nature. In consequence it was decided that all the work in connection with cable laying and jointing should be executed by workmen in the direct employ of the Postmaster-General. The advantages arising from the adoption of this course will be evident when it is realized that the services of the

men thus employed have been practically permanent with the Telegraph Administration since the commencement of the work. Further, the freedom from interruption arising from faults due to bad workmanship, to which a reference will be made later, may in a large measure be traced to the procedure adopted.

It has been already stated that along some parts of the route the contractor's men engaged on pipe laying had to be housed in tents. This was also the case with the men engaged by the department in connection with cabling operations. Tents and other articles of camp equipment were obtained on loan from the War Department, and camps were formed and arrangements for cooking food were made by the Telegraph Administration free of cost to the men employed.

Types of Cable.

As might be expected, our administration has not adhered to the type of cable which was laid over the first section of the northern route, but we have continually endeavoured to effect improvements in the type of cable as the system has been extended. This is exemplified by the fact that no less than three different cables have been used on the main line to the north, London to Glasgow, a total distance of 650 kilomètres, with a total length of wire of nearly 60,000 kilomètres.

The first type of cable was laid between the years 1897 and 1900, and is 187·6 kilomètres in length. The conductors, which are 76 in number, are laid up in quadruple form for a distance of 48 kilomètres, and for the remainder of the distance are in twisted pair formation. Electrical and other data relative to this cable are as follows :—

Weight of conductor per kilomètre	68 kgs.
Resistance	3·638 ohms.
Wire-to-wire electrostatic capacity	·042 mfd.
Thickness of insulating paper	·0635 mm.
Thickness of lead sheath	4·06 mms.
External diameter of cable	6·667 cms.

In the interval between the laying of the first and second cables the type of cable for long underground circuits had undergone considerable change. The second section of cable consists of 103 conductors, 74 of them being laid up in twin formation, the remaining 29 being single conductors, paper insulated, and served with a spiral wrapping of soft copper foil round each conductor. The copper foil is ·076 mm. thick and 7·62 mms. wide, and is taped with an overlap of 30 per cent.

The wrappings of copper foil round the several conductors are in contact with each other, and are also in contact with the lead sheath

of the cable, as they form the external layer of conductors in the cable. Each conductor so treated is thus surrounded by an earthed screen, which completely shields it from the electrostatic action of currents rapidly rising and falling in neighbouring conductors. To some extent the copper foil acts also as an electro-magnetic screen, and the conductors, though adjacent in the cable, are nevertheless capable of working over long distances without appreciable mutual inductive interference. The 74 wires laid up in twisted pairs form the central portion of the cable, the screened wires surrounding them. They are arranged so that different "lays" or lengths of twist are given to the groups of pairs in the several layers. This procedure prevents the mutual interference which would take place if pairs of the same length of lay were revolved together.

Particulars of the second section of cable, which is 128 kms. in length, are as follows :—

(*a*). Weight of screened conductors per km....	31·78 kgs.
(*b*). Weight of twin conductors per km. ...	45·4 „
Resistance of (*a*) per km....	7·796 ohms.
Capacity of (*a*) „ „	·09 mfd. (wire to earth).
Resistance of (*b*) per km....	5·457 ohms.
Capacity of (*b*) „ „	·04 mfd. (wire to wire).

The thickness of the paper insulation is ·063 mm. and that of the lead sheath 3·94 mms., the external diameter of the cable being 6·854 cms. The weight of the copper foil is approximately equal to the conductor which it encloses.

The third cable marks a still further development in trunk cable manufacture. In this case the inner or central portion of the cable consists of 68 wires, twisted in pairs. Surrounding these are 29 screened conductors. The characteristic of this type of cable lies in the peculiar method adopted in twinning the groups of pairs. Of the 68 conductors, 56 are formed into seven groups, each group consisting of eight wires. The method known as successive twinning is adopted, that is, two twisted pairs are twisted together to form a 4-wire group or core, and two such groups are twisted together to form an 8-wire group or core. The seven groups thus formed are arranged with one group in the centre, surrounded by the remaining six groups. In each of the six spaces between these six 8-wire groups and the outer layer of 29 screened conductors is placed a twisted pair of conductors. These are known as worming pairs. The complete cable thus consists of one 8-wire multiple-twin core as a centre with six similar cores surrounding it, then six twisted pairs, and finally 29 screened conductors.

Particulars of this cable, which is 335 kms. long, are as follows:—

(*a*). Weight of conductors in the 8-wire cores per km.	45·4 kgs.	
(*b*). Weight of worming conductors per km. ...	68	„
(*c*). Weight of screened conductors per km. ...	31·78	„
(*d*). Resistance of (*a*) per km.	5·457	ohms.
Capacity „ „ „	·040 mfd. (wire to wire).	
(*e*). Resistance of (*b*) per km.	3·638	ohms.
Capacity „ „ „	·040 mfd. (wire to wire).	
(*f*) Resistance of (*c*) per km.	7·796	ohms.
Capacity „ „ „	·090 mfd. (wire to earth).	

The thickness of the paper insulation is the same as in the two previous cables, and that of the lead sheath 3·81 mms., the external diameter of the cable being 6·858 cms.

Fig. 3 gives a diagrammatic representation of the cable.

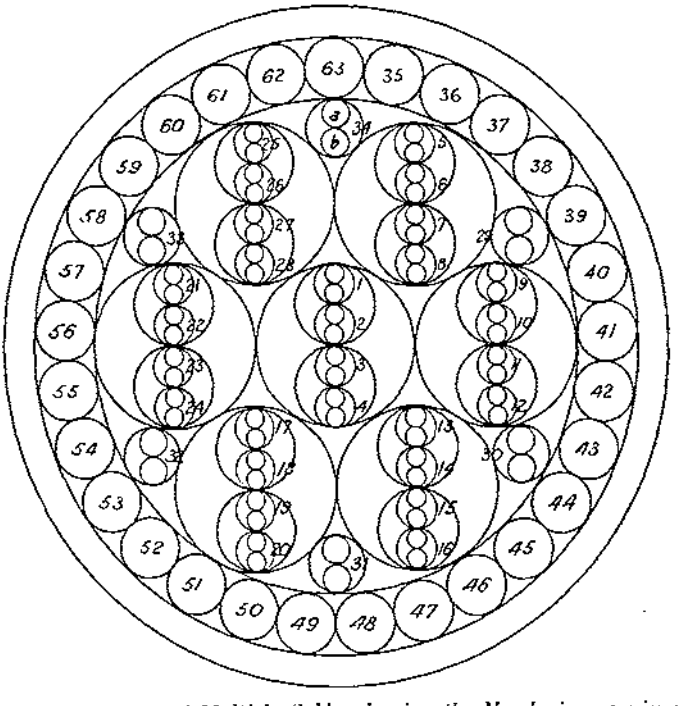


FIG. 3.—*Diagram of Multiple Cable, showing the Numbering as viewed from the London Side.*

The object of multiple twinning is to secure that conductors may when necessary be bunched, that is, joined in parallel to any desired

extent. By this means circuits of great conductance are obtained without anything like a proportional increase in the electrostatic capacity. For instance, an 8-wire core will furnish four loops with conductors of 45·4 kgs., two loops of 90·8 kgs., or one loop of 181·6 kgs. The loop or loops thus formed will furnish a pair, or pairs, of twisted conductors, and so possess the advantage of freedom from inductive disturbance. The system also admits of the provision of additional circuits by superimposing upon the twisted pairs, whether of single loops or bunched loops. A further reference will be made to this.

The completion of the Northern Underground system between London and Glasgow may be regarded as the first step in our programme for the provision of an underground cable system. The second step was the laying of a cable through the West and South West of England. This is known as the Western Cable, and connects up London, Bristol, Exeter, Plymouth, and Penzance, a total distance of 532·8 kilomètres. The work has been in progress for the past two years, and the cable has now been laid between London and Bristol, a distance of 192 kilomètres. The type of cable adopted for this route deserves some notice, as it is different from either of the four sections yet described.

It is obvious that upon a route which passes through many large cities, and through areas which are widely different in character and in local telegraph traffic requirements, the number of wires will necessarily not be the same throughout. For instance, the number of conductors required in the remoter sections will naturally be less than in the sections nearer London. Between London and Reading, a distance of 67·2 kilomètres, 169 conductors are provided in the cable; this number drops to 104 to Bath, which is 109 kilomètres farther on. Between Bath and Bristol, a distance of 19 kilomètres, the circuit requirements increase considerably, and the cable contains 162 conductors. Beyond this, to the extreme end of the cable, the number of conductors will be less. It should be observed, however, that notwithstanding this fact, the type of cable is uniform throughout, the only difference being in the number of conductors. The cable is of a composite order, as is the third section of the Northern Underground Cable just described, but there is this important difference, that in addition to ordinary twinned pairs of conductors and single-screened conductors there are a number of groups composed of four twisted pairs, forming quadruple cores of eight wires each. The essential difference between this arrangement and the multiple twin core is that, in the latter, two groups of two twisted pairs (eight conductors) are twisted together in the manner already described, whereas, with the quadruple-pair core, the four twisted pairs are all twisted together in quadruple form. The arrangement can perhaps be gathered by referring to *Fig.* 4, which shows, diagram-

matically, the actual cable laid in the section between Reading and Bath, a distance of 108·8 kilomètres.

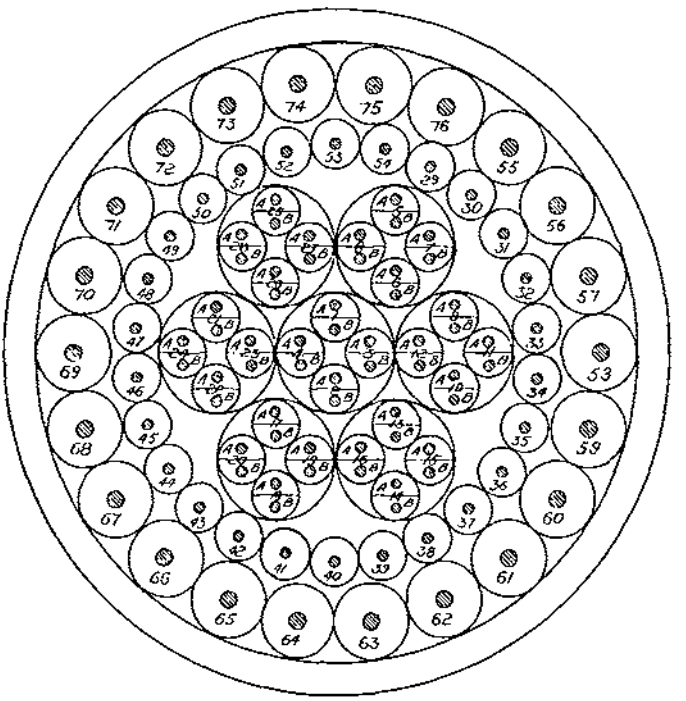


FIG. 4.—*Diagram of Quadruple Pair Cable.*

It will be observed that the more central portion of the cable consists of seven complete quadruple core groups, each group comprising four twisted pairs. Surrounding these are 26 single copper-screened conductors, and in the outer layer are shown 22 screened conductors. Further particulars of the cable are as follows:—

(*a*). Weight per kilomètre of Q.P. conductors...	45·4 kgs.
(*b*). Weight per kilomètre of inner layer of screened conductors	31·78 „
(*c*). Weight per kilomètre of outer layer of screened conductors	90·8 „
Resistance per km. of (*a*)	5·457 ohms.
Capacity „ „ „	·04 mfd. (wire to wire).
Resistance per km. of (*b*)	7·796 ohms.
Capacity „ „ „	·09 mfd. (wire to earth).
Resistance per km. of (*c*)	2·728 ohms.
Capacity „ „ „	·09 mfd. (wire to earth).

The thickness of the paper insulation is ·063 mm., and that of the cable sheath 3·81 mms. The external diameter of the cable is 7·4168 cms.

It should be mentioned that in the case of screened conductors three layers, as a minimum, of insulating paper are required, the first of which is longitudinally and the others spirally wrapped.

The advantages to be secured by the quadruple-pair type of cable are somewhat similar to those offered by the multiple twin. Diagonal pairs in the same quadruple core can be bunched in order to secure ncreased conductance without a proportional increase in the electrostatic capacity. The provision of additional circuits by superimposing on the loops is also a feature of the cable. In the multiple-twin type of cable the method of successive twinning admits of the bunching of pairs to a greater degree than the quadruple-pair cable; but in actual practice the quadruple-pair type of cable has satisfactorily fulfilled the requirements of bunching.

TESTING OF PAPER-INSULATED CABLES AT MANUFACTURERS' WORKS.

Paper-insulated cables are subject to the following tests at the manufacturers' works by officers of my department prior to being delivered:—

(*a*). For insulation, resistance, and contact.
(*b*). For electrostatic capacity between each wire and earth and between the wires of each pair.
(*c*). For conductor resistance.
(*d*). To check the relative positions of the wires in the cable.
(*e*). To ensure that the lead sheath is free from defects.
And finally, the insulating paper is tested for strength before and after drying.

(*a*) and (*b*). As it is necessary to ascertain the insulation of each wire from every other wire of the cable, all the wires which cannot possibly touch each other are grouped together and tested for insulation resistance and wire-to-earth capacity, the remaining wires of the cable being joined to the lead sheath and earthed. The wires forming the cable are divided into as small a number of such groups as is possible, and each group tested with all the other groups earthed. The capacity between the wires of a pair is tested by removing the earth connections from cable and battery.

The average insulation resistance and capacity per mile of wire is then calculated.

A battery of 600 volts is used for the insulation test and one of about 60 volts for the capacity test.

(*c*). The conductor resistance is measured by means of the Wheatstone Bridge. In making this test all conductors of the same gauge are connected in series, and the average resistance per mile of wire at 60° Fahr. is calculated. This test shows whether there are any broken conductors.

(*d*). This test is taken in order to ascertain whether the wires occupy the same relative positions at each end of the cable, and to ensure that they are in proper sequence. This is done by ringing a bell through each pair, and noting that the pairs are in the specified order. The test is necessary, as pairs sometimes cross one another during manufacture.

(*e*). The lead sheath is submitted to an internal air pressure of 75 lbs. per square inch, and immersed in water for 24 hours to ensure that it is free from defects.

Transport of Cable.

The transport to the site of the work of the whole of the pipes, cables, and other material employed in connection with these works has been carried out under local contracts. At the time the main underground works from London to Birmingham were started only horse transport was available, but when the new type of road motor vehicles began to be employed for trade purposes in this country some five years ago, it was decided to invite tenders for the haulage of cables and other materials from railway stations to the points at which they would be used by this means.

When the question was first considered in connection with a hilly section of the Northern Cable it was found that there was a considerable saving in favour of steam traction, and consequently this means was more extensively used afterwards, not only for cable drums, but for all classes of heavy line stores. Later it was calculated that the average cost of steam haulage in the districts where it was used was 73½ per cent. of the estimated cost of the same work if done by horse haulage, whilst the average time occupied was only 31 per cent. Steam traction proved especially advantageous and economical in those cases where the stores had to be conveyed over hilly roads.

The experience gained by our administration has resulted in considerable saving being effected as the works have proceeded. In many cases it has been found more economical to accept the maker's quotation for delivery of cables, etc., at their works, and to make separate provision for transport of the cable to the scene of the work.

The conditions in the districts near London differ largely from those in outlying districts. Cable drums cannot be delivered in bulk and left lying by the roadside until required, as is the case in country districts when large quantities of drums are delivered at one time by mechanical traction. For this reason, and as contractors have usually

to guarantee a delivery of only three drums per day, which is sufficient to keep a cabling gang employed, it has not always been found desirable to accept the quotation for mechanical traction in favour of horse traction on account of speed, and consequently the lowest quotation, whether for horse or mechanical traction, is usually accepted. When the question of the amount of cable which can be delivered in a given time becomes a matter of sufficient importance and when the route in question is hilly, mechanical transport undoubtedly possesses advantages. This was proved in connection with a certain section of the Northern Cable, when the cable required was delivered at the rate of from 8 to 12 drums per diem by mechanical transport, the empty drums being picked up on the return journey at the same time. Such a rate of delivery would have been more difficult to obtain, and certainly more costly, if horse haulage had been resorted to.

The following Tables give a general comparison between the cost of conveying cable—(I.), by means of horse and steam traction; (II.), by rail and sea :—

I.

Method of Traction.	Average Weight per Mile Kilomètre of Cable.	Weight of Drum.	Number of Drums per Mile Kilomètre of Cable.	Number of Drums per Journey.	Average Rate per Drum.
	Tonnes. Tons.	Tonnes. Cwts.			Francs. £ s. d.
Horse	24	10	8		1 6 2
	15·24	·5	5	1	32·7
Mechanical	24	10	8		16 9
	15·24	·5	5	5	20·9

Figures in block type show English equivalents.

II.

Comparative Statement of the Cost of Conveyance of Cable by Rail and Sea.

Destination.	Length of Cable.	Total Number of Drums.	Average Number of Drums per Trip.	Weight.	Rate by Sea. Owners' Risk.	Rate by Rail. Carriers' Risk.*	Amount Paid for Conveyance by Sea.	Cost had Cables been sent by Rail.*	Average Cost per Drum conveyed by Sea.	Average Cost per Drum for Conveyance by Rail.	Remarks.
	Kilomètres. **Miles.**			Tonnes. **Tons.**	Per Tonne. Francs. s. d.	Per Tonne. Francs. s. d.	Francs. **£**	Francs. **£**	Francs. **£** s. d.	Francs. **£** s. d.	
London to Glasgow (90 hours' voyage).	10m. 467y. 16·4	85	1·4	255½ 260	30 7 37·1	51 8 63·5	386 9650	660 16500	4 11 0 113·5	7 15 0 194·1	* There are no owners' risk rates for cable consigned from London to the places mentioned.
London to Glasgow† (90 hours' voyage).	23m. 264y. 37	187	10	551¼ 562	32 9 40·5	51 8 63·3	912 22800	1424 35600	4 17 0 121·9	7 12 0 190·4	† The cable in this instance was obtained from a different manufacturer than that in the first instance.
Liverpool to Chatham (72 hours' voyage).	16m. 832y. 26·4	215	15	483½ 493	27 0 33·4	44 0 54	659 16475	1066 26650	3 1 0 76·6	4 19 0 123·9	

Figures in block type show English equivalents.

In the early stages of these subterranean works it was considered that there would be some advantage in the telegraph administration possessing suitable vehicles for the transport of the cable drums from the railway depôts to the site of the works. In consequence, a vehicle was specially designed for horse haulage; later, a larger vehicle of the same type was designed suitable for use with steam and petrol engines.

The bodies of these vehicles are hung very low, with a view to facilitating the unloading of the drums on the roadside. They are provided with a specially strong screw brake in addition to a shoe skid. It has not been possible always to employ the special vehicles, and frequently wagons have had to be hired for the transport of cables from railway depôts; in such cases care has been taken to select vehicles having platforms hung low, not only to avoid the risk of accidents from overturning on rough and hilly roads, but also in order to reduce the labour of unloading cable drums at the site of the work. Extemporized gyns have been employed for unloading cables when the width of the road has not been sufficient to enable the drums to be rolled down skids.

(To be continued).

APPENDIX I.

Schedule showing (1) *Total Cost, and* (2) *Cost per Mile of Laying Main Underground Cables.*

Route of Cable.	Length of Cable.	No. of Wires in Cable.		Estimated Cost of Pipe Laying.	Average Cost per Mile of Pipe Laying (including Pipe).	Total Cost of Cable (including Pipe, Cable, Laying, Jointing, etc.).	Average Cost per Mile of Complete Cable.
		Max.	Min.				
	Miles.			£	£ s. d.	£	£
Northern Cable (London to Glasgow)	406¾	103	76	123,911	304 14 0	596,852	1,467
Western Cable (London-Tavistock section completed, Tavistock to Penzance section in hand).	342¼	162	24	84,642*	349 4 0	341,506†	1,579
Manchester to Leeds ...	43½	64	64	18,575	427 0 0	65,159	1,497
Newcastle to Durham ...	14½	109	109	4,400	303 0 0	23,713	1,635

* *Only 242¾ of pipe* laid to 31st March, 1908.
† Only 216¼ miles of cable drawn in to 31st March, 1908.

APPENDIX II.

Schedule showing Sizes of Pipes used in Connection with the Northern and Western Cables and Time Occupied in Pipe Laying.

Section of Cable.		Length of Section	Size of Pipe.	Depth Pipe Laid Underground.	Time Pipe Laying Occupied.	
From	To				From	To
Northern Cable.		Kilomètres.	Centimètres.	Decimètres.		
General Post Office, London.	Watford	29·60	7·50	6·00	Feb. 97	Aug. 97
Watford	Fenny Stratford ...	49·60	,,	,,	Aug. 97	Feb. 98
Fenny Stratford ...	Leamington ...	71·20	,,	,,	Feb. 98	Aug. 99
Leamington ...	Birmingham ...	38·00	,,	,,	Aug. 99	Mar. 00
Birmingham ...	Stafford	40·00	,,	,,	July 01	Feb. 02
Stafford	Nantwich	46·40	,,	,,	June 02	Jan. 03
Nantwich	Warrington ...	41·60	,,	,,	Aug. 02	Dec. 02
Warrington ...	Wigan	19·20	,,	,,	April 03	July 03
Wigan	Preston	28·80	,,	,,	June 03	Oct. 03
Preston	Carlisle	149·40	,,	7·00	Sept. 01	Mar. 03
Carlisle	Beattock	46·40	,,	6·00	June 04	Nov. 04
Beattock	Abington	30·80	,,	,,	June 03	Nov. 03*
Abington	Glasgow	59·00	,,	,,	July 04	Mar. 05
Western Cable.						
General Post Office, London.	Bayswater ...	5·60	—	—	Existing earthenware ducts	used.
Bayswater	Uxbridge	22·20	10·00	6·00	Nov. 04	April 05
Uxbridge	Slough	10·00	,,	,,	April 05	May 05
Slough	Reading	29·60	,,	,,	Oct. 05	Mar. 06
Reading	Hungerford ...	41·60	8·00	3·50 (8 in Reading)	May 06	Dec. 06
Hungerford ...	Bath	66·80	,,	6·00	Nov. 06	Mar. 07
Bath	Bristol	19·00	10·00	,,	Dec. 06	Mar. 07
Bristol	Churchill	21·60	8·00	,,	Aug. 07	Nov. 07
Churchill	Exeter	99·20	,,	,,	June 07	Jan. 08
Spur.						
Churchill	Weston-super-Mare	15·20	5·00	,,	May 07	Sept. 07

* This section is 300 mètres above sea level, and was much subject to storm interruptions. In consequence the work was placed in hand in advance of the other sections.

APPENDIX III.

MAIN UNDERGROUND SYSTEM.

Statement showing (I.) Costs of Laying and Jointing one 7·5-cm. or one 8-cm. Pipe (excluding Cost of Pipe), and (II.) Average Costs of Reinstatement under Various Classes of Paving.

Laying and Jointing one 7·5-cm. or one 8-cm. Pipe.	Average Prices, including Filling in and Permanent Restoration of Pavement, per yard-run. [1]	Average Prices, including *Temporary* Restoration, *but excluding Permanent Restoration*, per *yard-run*. [2]	Average Prices per square yard super of Permanent Reinstatement. [3]
Footway.	s. d.	s. d.	s. d.
Cinders	1 0	9	5½
Gravel	1 2	10	7½
Cobbles	1 9	11	1 6
York stone on ashes	2 7	1 1	1 1
Flagstones	2 5	11	1 4
Cement slabs	2 6	1 0	1 11½
Tiles	1 8	10	1 5
Granite setts	2 4	1 4	1 9
Blue bricks on ashes	2 2	1 5	1 10
Ashes	1 3	10	9
Tar paving on ashes	2 1	11	2 1
Cement	2 10	8	3 8
Asphalte	2 8	9	3 10
Rock asphalte on concrete ..	3 5	1 0	—
Kerb	2 0	1 1	6
Roadway.			
Granite setts on concrete ...	6 1[4]	1 10[4]	4 6
Granite setts not on concrete ..	3 2	2 2	1 10
Gravel or flint	1 6	11	1 1
Macadam	1 6	10	1 5
Cobbles	2 5	1 5	2 0
Cinders	1 1	10	—
Grass Margin	10	8	6

[1] The contractors' charges include excavation of trench; removal of obstruction; carting excess rubbish to shoot; cartage of pipes; levelling and punning bed for pipes; laying and jointing pipes (providing lead and yarn); fill in, pun, and level; permanent reinstatement of pavings, including six months' maintenance to satisfaction of local authority.

[2] Contractors' charges include excavation of trenches; removal of obstructions; carting excess rubbish to shoot; cartage of pipes; laying and jointing pipes (providing lead and yarn); *fill in*, pun, and level; temporary reinstatement of pavings; lighting, watching, and guarding where necessary.

[3] 45 per cent. is the average percentage increase for work in London.

[4] Prices vary according to depth of concrete.

THE R.E. HEADQUARTER MESS.

(Continued).

By Lieut.-Colonel B. R. Ward, R.E.

In addition to the portraits, the Mess possesses busts of eight celebrated men. Seven of these busts are in the north annexe; the eighth—that of Vauban—is in the whist room, on the first floor.

Two of the busts—those of Sir John Jones and Sir John Burgoyne—have been already alluded to. The remaining busts in the north annexe represent Capt. Thomas Drummond, Sir Arthur Cotton, Sir Andrew Clarke, General Gordon, and Sir Richard Harrison.

The bust of Drummond, which is of colossal proportions, bears the following inscription :—

Captain Thomas Drummond, R.E.
2nd Lieut., March, 1816.
2nd Captain, August, 1837.
Private Secretary to Chancellor of Exchequer, 1833.
Under-Secretary for Ireland, 1835.
Commissioner, Irish Railways, 1836.
Died 15th April, 1840.

The foregoing inscription gives some indication of the wonderful political and administrative aptitude of this young Engineer officer, whose death at the age of 43 was regarded as a national calamity throughout the length and breadth of Ireland. The bust, copied from Hogan's statue erected in Dublin by public subscription in 1843, shows the features of a man not unlike the younger Pitt or Joseph Chamberlain, and evidently endowed with the highest intelligence and force of character.

Few men have crowded into the short space of 43 years so full a record of scientific work and political achievement. His inventions include first the "Drummond light," in which a block of lime was raised to the highest possible temperature by means of the oxy-hydrogen blast; and, secondly, the Colby-Drummond compensation bars for accurate survey measurements.

The "Drummond light" is still in every-day use in the form of the Welsbach incandescent mantle, and it was by far the most powerful

illuminant known until the advent of the electric arc. Sir John Herschel thus describes the impression produced when the light was first exhibited in the Tower :—"The common Argand burner and parabolic reflector of a British lighthouse were first exhibited, the room being darkened, and with considerable effect. Fresnel's superb lamp was next disclosed, at whose superior effect the others seemed to dwindle, and showed in a manner quite subordinate. But when the gas began to play, the lime being brought now to its full ignition and the screen suddenly removed, a glare shone forth, overpowering, and as it were annihilating, both its predecessors which appeared by its side, the one as a feeble gleam, which it required attention to see, the other like a mere plate of heated metal. A shout of triumph and of admiration burst from all present."*

The Colby-Drummond compensation bars were used in measuring the famous Loch Foyle base line—the most accurately measured base line in the world, according to Sir John Herschel. At this time Drummond was engaged on the Irish survey, under Lieut.-Colonel Colby. The survey was carried out by means of three companies of Sappers and Miners, specially trained in survey duties. It was commenced in 1825, and the first sheets, representing the County of Londonderry, were published in 1833. For scientific accuracy, combined with utilitarian and economic results, the work was one of the most striking ever accomplished by the Corps (see *Dictionary of National Biography*, Art., Colby-Thomas, Vol. XI., p. 258).

About 1831 Drummond glided into politics, and great as were his achievements in science, they are overshadowed by the greatness of his political work.

He was appointed Under-Secretary at Dublin Castle in 1835 at a time when Ireland was seething with political agitation, social disorder, and religious feuds. So terrible was the state of anarchy and disorganization in the country, that O'Connel loudly demanded the repeal of the Union as the only remedy for its ills. But Drummond was equal to the situation. "While engaged on the Ordnance Survey he had studied the Irish question on the spot. He was moved by the miseries of the people, touched by the injustice to which they were subjected, and pained by the evidence of misrule which everywhere met his eye. Ireland became to him a second fatherland, and he entered upon his labours full of zeal for the national welfare and determined to administer the law with even-handed justice." †

The most striking monument of his work in Ireland was the formation of the Royal Irish Constabulary, a problem to which his attention was turned soon after his arrival at Dublin, and we learn from the same source that "prior to his time the police were an inefficient, partizan, and corrupt body. Catholics were practically

* *Dictionary of National Biography*, Vol. XVI., p. 41.
† *Dictionary of National Biography*, Vol. XVI., p. 42.

excluded from the force, and public confidence in consequence withdrawn from it. 'Order' in Dublin was maintained by four hundred underpaid, worn-out, and drunken watchmen, while throughout the provinces the force formed rather a centre of disturbance than a security for peace."

Drummond completely altered this state of affairs. Acting on the principle that peace could be best kept in Ireland by trusting Irishmen —when fairly treated—to keep it, he replaced the watchmen by that great constabulary which was composed principally of Catholic peasants, and which in the course of time has completely justified its existence and has been so greatly increased. He also reorganized the equally untrustworthy local magistrates by placing over them stipendiaries—directly under his own authority—who won the confidence of the people by administering the law with great justice. At the same time, by the suppression of numerous small fairs and by other vigorous methods, he put an end to many of the notorious faction fights which were of such constant occurrence in the south.

One of the greatest difficulties which he had to encounter was the tithe war which had fiercely raged from 1830 to 1834. Although Parliament had declared that the tithe system needed reform, the executive insisted on the collection of tithe—even at the point of the bayonet and at the cost of many lives—until such time as it was actually abolished. Drummond refused to consent to such drastic measures. Police were no longer used to force the payment of the tithes, but the peasants were made to respect those engaged in exercising their legal rights.

The effect of this policy is best described in the following extract from the *National Biography*:—

"The executive no longer appeared as an instrument of a class, but it did not degenerate into a weapon of the popular party. This impartiality was new to the people and won their hearts. Legal rights harshly exercised were no longer enforced, and the people, finding an executive bent on justice, and powerful to protect as well as punish, showed a disposition, hitherto unknown, to obey the law. The peace was kept until the Tithe Commutation Act of 1838 reformed the system and relieved the peasantry from at least the direct payment of the obnoxious impost. The agrarian war also engaged Drummond's attention. In 1833 a strong 'coercion' act had been passed to put down agrarian disturbances, but it had so far failed that in 1834 the Lord-Lieutenant declared that 'it was more safe to violate the law than obey it.' Drummond understood the land question in all its bearings. He was far too sound an administrator not to be aware that, whatever might be the causes of disturbance, law and order should be upheld and outrages put down with a strong hand. Abandoning the old methods, he enforced the ordinary law with vigour. The abandonment of coercion made him popular with the masses of the people, and even those who sympathized with the agrarian organizations forgot the severity in the justice of the ruler. For the first and only time

in Irish history an organization of Irish peasants was formed to help the executive in bringing agrarian offenders to justice, and this society was formed in the very centre of agrarian disturbances itself—Tipperary. There was no difficulty in getting evidence against agrarian offenders, there was no difficulty in getting juries to convict when the evidence was clear."

Drummond was equally straightforward in his dealings with the landlords, and pointed out to them how "property has its duties as well as its rights," and also how "to the neglect of those duties in times past is mainly to be ascribed that diseased state of society in which such crimes take their rise"—two truths which have never since been entirely forgotten in the country.

For five years he was practically the Governor of Ireland, managing its affairs with wisdom, firmness, and justice, and making the executive strong, popular, and efficient. Unhappily no man could undertake so stupendous a task of administration and not feel the effects of the strain. His constitution was undermined, and he died in harness on the 15th of April, 1840, after having worked for nine hours in his office on the previous Saturday, the 11th of April.

The details of Drummond's career have been the more fully entered into in the present article, as his name is far less well known in our Corps to-day than it deserves to be. When we consider first his character, and in the second place his achievements both in science and politics, we may well question whether an officer of greater or even equal promise ever wore the uniform of the Royal Engineers.

(To be continued).

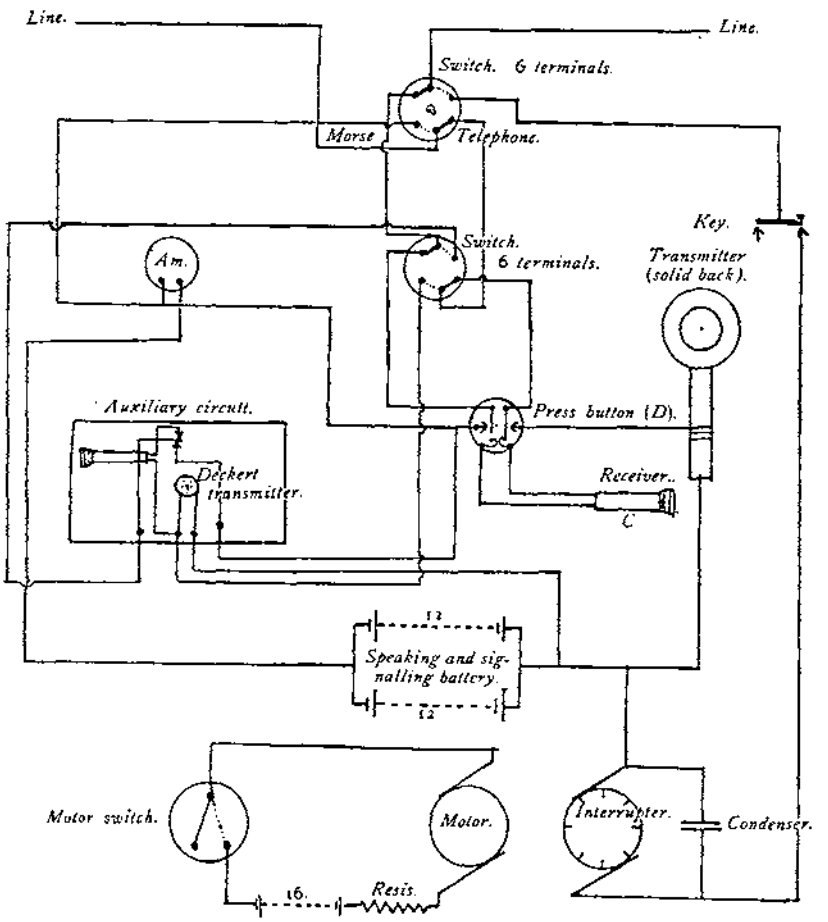
TRANSCRIPT.

THE SKERRIES WIRELESS TELEPHONE.

From the *P.O. Electrical Engineers Journal*, April, 1908.

THE Skerries are three rocky islets immediately north of Holyhead Bay, and $1\frac{3}{4}$ miles from the coast of North Anglesey. On the centre island stands the Skerries lighthouse. By reason of the extremely rough channel between the island and the mainland—which prohibits the laying of a submarine cable—communication between Skerries and the mainland was a matter of considerable difficulty, until in 1899 it was suggested by the Post Office Engineers that a wireless telephone should be installed.

SKERRIES INSTALLATION.



The system consists of two parallel conductors earthed at the ends, the adjacent ends being separated by the sea. The Skerries conductor, which is about 500 yards long and is supported on twenty-four 26′ well-stayed poles, is of 600 lbs. copper wire.

The mainland conductor is of 400 lbs. copper wire, supported on twenty-two 30′ poles, and is some 3 miles long. The ends of both conductors are earthed in the sea. From the accompanying diagram it will be seen that with the switch at "telephone," a receiver (C) is in series with the line, but no calling apparatus is provided.

Again, when Skerries "speak," the press button (D) is depressed, and the speaking battery completes the circuit through the transmitter lines and earths. The mainland circuit is a telephone receiver lines and earths, to which energy is probably transmitted by sea-conduction. No satisfactory calling arrangement has been as yet devised—that suggested by Sir Oliver Lodge in 1902 being found impracticable owing to earth currents, which vary from 30 milliamps at low water to 1 milliamp at high water. The difficulty is therefore overcome by speaking at fixed times.

The volume of speech varies considerably, the usual trouble being faint speech. At times however a considerable noise occurs through some unknown cause. In this case the wireless telegraph arrangement is used, and at other times the use of the auxiliary Deckett Transmitter facilitates matters.

The wireless arrangement consists of a motor driven by 16 dry cells. On its armature is placed an interrupter, which, with a key, serves to transmit the message in Morse code. The receiver remains the same as for telephonic purposes.

A. H. SCOTT.

REVIEWS.

RECOLLECTIONS OF A LIFE IN THE BRITISH ARMY.

By General Sir Richard Harrison.

Sir Richard Harrison's autobiography is one that cannot fail to interest the general reader, and should provide an instructive object lesson to the younger generation of Royal Engineer officers. It is written throughout in the cheery spirit of one who clearly made up his mind in early youth to make the most of life and its opportunities. An autobiography must of necessity be somewhat egotistical, but the egotism in the book under review is never aggressive, and is always combined with a generous appreciation of those with whom Sir Richard was associated.

The author entered the Service in 1855 (when only 18 years of age and practically straight from school at Harrow)—a critical period in the history of the country, towards the close of the Crimean War, and shortly before the Indian Mutiny and the China War of 1859-60. It was also a most fortunate period for a young officer, one of many opportunities of seeing active service and of sharing in the rapid promotion caused by casualties and augmentations. Of these fortunate opportunities Sir Richard had a good share and made a good use. One effect was that he gained his company in a little more than seven years, receiving a brevet majority some two years later. From that time he never looked back.

Although too late to take an active part in the Crimean War, he did duty at Scutari, where he doubtless acquired useful experience in maintenance of field hospitals, and more especially in surveying, on which work he was chiefly employed.

After a short tour of duty at Malta he was sent to India with a small detachment of R.E., where he arrived in time to take an active part in the Siege of Lucknow and the subsequent campaign in Oude.

He afterwards proceeded to China, where he saw much service in connection with the capture of the Taku Forts, Pekin, etc.—partly with his company (23rd) and partly on the Staff of the Q.M.G.—where he was fortunately employed under Lieut.-Colonel Wolseley, A.Q.M.G.

Sir Richard's descriptions of the incidents in India and China in which he took part are graphically related, throwing many side lights on the campaigns—such as do not appear in more formal and official records.

For the next 17 years or so Sir Richard held various Corps appointments, such as adjutant and brigade major at Chatham, and ordinary Corps duties in London, Devonport, and Aldershot, the monotony of which was broken by two official trips to Canada and United States, and by successfully qualifying for the Staff College.

His next active service was seen in the Zulu War of 1879-80 and the subsequent operations against Sekukuni. In those campaigns Sir Richard was chiefly employed on the Staff, and was at one time Com-

mandant of the Transvaal. Of the author's description of his share in these wars, the portion that will probably attract most attention is that which refers to the regrettable and much-debated incident of the death of the Prince Imperial. Colonel (as he then was) Harrison came in for a share of the flood of criticism that broke out in England, but his account of the affair strongly tends to prove that the young Prince's sad death was due to his own impetuosity and neglect of precautions in the matter of escort, rather than to any neglect on the part of the Staff.

On return from South Africa, Sir Richard was employed for two or three years at Aldershot, mostly on the Army Staff.

In 1882 he again saw service, in the Egyptian Campaign and subsequently in the Soudan. Space forbids any detailed notice of the good service performed by the author in these campaigns—mostly on the Army Staff in connection with lines of communication. His descriptions of his personal experiences are full of interest.

On the conclusion of the last-mentioned campaign Sir Richard reverted to the Army Staff as A.Q.M.G. at Aldershot, and was afterwards C.R.E. at the same station. In July, 1888, he was promoted Major-General and made a K.C.B. in 1889.

After a year of unemployment, he was given the post of Governor of the Royal Military Academy, whence he proceeded to the command of the Western District, a post he held for the full prescribed period, during which he attained the rank of General.

Sir Richard's next employment was as acting Qr.-Mr.-General at headquarters, a post he held for some six months, when he was transferred to the highest position in his Corps, viz., that of Inspector-General of Fortifications, and occupied it for five years—a period which covered the troublous and hard-working time of the Boer War. This was his last appointment, and thus, appropriately, General Harrison finished—as he began—his career of good service in a purely Corps occupation.

A perusal of this book shows that, with intervals of purely Corps duties, Sir Richard, after the earlier years of his service, held—on his merits—a series of Army Staff appointments. Assuredly some of his good fortune and rapid promotion was due to this fact, and his most successful career both emphasizes how valuable such Staff service is when well performed, and explains why so many of our more ambitious officers strive for appointments outside the Corps.

Another moral to be drawn from this interesting autobiography is the desirability of cultivating a *mens sana in corpore sano*. Few, like Sir Richard, when a Major-General, can play football at the age of 52, to say nothing of racquets at a still greater age.

Finally it may be stated that the book under review displays throughout a spirit of cheerfulness and bonhomie, and leads to the conclusion that the author, in his long service, must have made innumerable friends and few, if any, enemies.

All R.E. officers will unite in wishing General Sir Richard Harrison many years of health and happiness in his well-earned retirement, after such a varied and useful career, and in thanking him for a book which cannot fail to be read with profit and enjoyment.

TOPOGRAPHICAL SURVEYING AND SKETCHING.

By THOMAS H. REES, MAJOR, CORPS OF ENGINEERS, U.S. ARMY.—(U.S. Cavalry Association, Fort Leavenworth, Kansas. Price $2.50).

The above is the authorized textbook of the U.S. Army Service Schools, and has been prepared from the instructional lectures and pamphlets in use there.

The treatment of the various survey subjects dealt with, is guided by the desire to give the student such insight into them as is likely to be required for military purposes, and within a small compass. It is therefore more elementary than exhaustive.

The difference should be more clearly accentuated between the deliberate work required for map production in peace time, and the rapid field sketch which satisfies some particular military situation in war. Unless this distinction be kept in mind, there is always the danger that methods practised will be insufficiently accurate for a good topographical map, whilst unnecessarily complicated and too slow for war sketches.

For instance, sketchers should be taught to fix the heights of hills and valleys, interpolate the number of contours by calculation, and then space them by eye; not to calculate the H.E. (=M.D.) between each contour to two places of decimals of an inch and plot slopes in the piecemeal fashion of ancient practice. Such methods give a wrong idea of the broad treatment necessary in rapid military sketching. Moreover, the nice calculation of results, from readings of instruments which are *known* to be inaccurate, is a work of supererogation.

The habits engendered in the surveyor are partly antagonistic to those required in the sketcher, and a distinct caution as to the different ends in view is very necessary. Sketches are not maps.

Some useful hints are given on combined sketching, a subject more fully dealt with in a book by Capts. Cole and Stuart, and also published by the Cavalry Association. The general control is obtained by traverse Where a good small-scale map exists, as in most civilized countries, the control would better be furnished by an enlargement therefrom cut up for issue to various sketchers, or, better still, traced in sections on to celluloid sheets with margins.

The transit theodolite is explained in Chapter IV. The pattern with four instead of three levelling screws is referred to, albeit this is an unsound construction. However the instructions for levelling the instrument are good. The adjustments for the Wye Level are not given in the best order. Some notes are given on field astronomy, the use of a sextant, and measurements with a steel tape, sufficient for rough work.

Considerable labour has evidently been expended in the preparation of this volume, and the printing and plates are satisfactorily executed.

WAR SONGS.

SELECTED BY CHRISTOPHER STONE.—(Clarendon Press. 2s. 6d. net).

An interesting collection of "War Songs," selected by Christopher Stone, has lately been published by the Clarendon Press. The introduction is by Sir Ian Hamilton, and deals principally with the value of war songs and the partiality shown for them by the British soldier. The songs themselves are some 90 in number, and include not only most of the well-known favourites, but also many quaint old rhymes which have practically been long since forgotten. Although many an old Scotch or Border song is to be found, it seems curious that some of the most soul-stirring lines, which have ever been written on war, should be omitted from the selection. For instance, neither Byron's "Waterloo," Tennyson's "The Relief of Lucknow," nor Kipling's "Recessional" find a place, although "The Charge of the Light Brigade" and "Hohenlinden," amongst others, show that the selection is not intended to be marching songs only.

The book is well annotated and has an additional "Index of First Lines" which is likely to prove most useful.

NOTICES OF MAGAZINES.

KRIEGSTECHNISCHE ZEITSCHRIFT.

September, 1908.

Under the heading of "Russian Opinions as to the Rate of Building Fortifications," reviews are given of some articles which have recently appeared in Russian military journals, and which show the reaction that has taken place since the Russo-Japanese War.

The common opinion expressed by all these articles is that a fortress, whose permanent works are in process of construction, is worse off at the outbreak of war than a place which has no permanent works at all, for in the case of the former the necessary stores for building the work take up room—thus making communication difficult and reducing the field of fire. To avoid this state of unpreparedness the following course is proposed:—Defensive positions are chosen for a place according to its strategic importance and to local requirements. A garrison is then sent there and fieldworks are erected round the place. In a few weeks or months these will be converted into semi-permanent works by civilian labour, and finally after a year or two into permanent fortifications; the strength of the garrison can then be reduced by one-third without diminishing its power of resistance.

The cost of a fort for two companies, with a firing line 425 mètres long, is given as 2 million roubles (1 rouble = 3s. 2d.), and will take 1,000 workmen 800 working days (or 3 years) to build. The cost of placing semi-permanent works on a perimeter of 54 kilomètres is estimated at 40 million roubles, and the time required at 1½ to 2 months.

Prince Tomanoff expresses the opinion that a weakly fortified place—especially on the frontier—is worse than an unfortified one, as its capture gives the enemy a cheap moral victory. He considers that bombproofs for the garrison are of primary importance. These can be constructed for one company of infantry, for light Q.F. guns and machine guns and their detachments (324 men in all), in four weeks, and further in nine more days they can be converted to useful auxiliary points with glacis. The construction of bombproof magazines, and store rooms for explosives and other easily inflammable substances such as spirits or petroleum, should be begun at the same time and should be finished in the first year. In the second year the intervals between the forts should be filled in, trenches deepened, and accommodation for the garrison built; the third year sees the fortress finished in all such details as mining galleries and obstacles, whilst for the following two or three years the workmen are kept busy by the construction of the

road system and the erection of depôts inside the kernel of the fortification, as well as on a wall round the kernel itself.

Prince Tomanoff, as well as Timtshenko-Ruban, is opposed to the idea of converting simple fieldworks into permanent works, on account of the large amount of labour involved in the transport and handling of concrete. The latter authority recommends the commencement of the external line of permanent defences as the first operation, as this allows time, in case of an attack, to construct the second line. He also states that skilled labour will not be difficult to obtain, as most fortresses exist as the defences of railway junctions, or of towns important mainly for their trade and manufactures. He recommends as the programme to be followed in the construction of each individual work :—

1st Year.—The trenches in the work and its armouring from the roof to the ultimate ground level.

2nd Year.—The casemates under the parapet.

3rd Year.—The emplacements for close-range artillery.

4th Year.—The ammunition magazines.

The advantage claimed by this system is that a work is made bomb-proof as soon as possible, and inner details are seen to later in the fifth year, whilst in the sixth year the hitherto provisional means of communication between forts and batteries, in the intervals and their magazines, are made permanent, and the field of fire improved by deforestation and clearances. Finally, less important communications are improved or made. The article closes by a few remarks on coast defence. A prolonged battle between coast defences and warships is unlikely, but if made when the attacker is strong enough, will take place when the ships are 5 to 6 kilomètres from the shore. The coast defences will consist of the following :—(1), the long-range guns, which also serve to defend distant minefields; (2), guns for the protection of closer minefields; (3), batteries to resist a landing; and (4) guns for fighting at close quarters. The situation of the defences on the land side depends on local tactical requirements. The suggested order of construction of the various defences is—firstly, the planning and masking of gun emplacements; secondly, the installation of rangefinders and electric projectors; thirdly, the erection of observation and firing cells for the minefields; fourthly, the cement parapets should be made as well as expense magazines; and finally, the reserve magazines should be built. The defences on the land side should be carried out on the principles already laid down for land works.

NEUE MILITÄRISCHE BLÄTTER.

4th and 12th October, 1908.

THE IMPERIAL MANŒUVRES IN ALSACE-LORRAINE.—The theatre of operations chosen being heavily wooded, cut up with streams, rivers, and artificial waterways, and with but few townships, made great demands

on the mobility of all arms. After the least rain the difficulty of marching was greatly increased by the clayey nature of the soil. The badly graded main roads with their continual rise and fall wearied the infantry. The dung-heap at the door of every house and the typical Lorraine village increased the difficulty of billets, and the prevalence of typhoid in the district was an added danger to be guarded against by the responsible authorities. Under service conditions however such difficulties must be faced, and the experience was valuable. The manœuvres were the largest since 1893, conducted under the Kaiser's supervision. "Blue" consisted of the XV. Army Corps, the Bavarian Cavalry Division, and the 3rd Bavarian Infantry Division. The "Red" side was formed by the XVI. Army Corps and the Cavalry Division "A." The 8th Bavarian Infantry Brigade of six battalions and a composite battalion of field artillery were added during the manœuvres. The writer of the article describes the course of the fighting, and then observes that the troops were severely tested, although the weather was on the whole good. On September 7th the 33rd Infantry Division in warm weather marched 52 kilomètres without showing distress, and on the same day the Cavalry Division "A" did 70 kilomètres. No cases of heat stroke were reported. "According to the new regulations"—modelled perhaps on Japanese experiences—skirmishers were used, who made every use of cover in their advance, and only opened fire when they had gained the fire position; covering fire, from a position in rear, was utilized to assist their advance. The noiseless work in line of skirmishers is commended; indicating that a high grade of fire discipline was observed, fire increased or diminished without words of command being heard as the enemy offered a target or withdrew under cover. The writer of the article observes that two years ago everyone, from the colonel of infantry to the private, got into a state of excitement which was wont to express itself in shouted orders and abuse. The field artillery of both sides however seemed to have clung to old traditions in this respect. The work of the cavalry appears to have been up to date according to our ideas. Positions, of which they gained possession, were immediately defended by dismounted troopers supported by the machine-gun detachments. The field artillery sought to avoid the old favourite artillery duel, and when possible directed their fire much more against the infantry. The infantry attack was supported up to the shortest range by batteries pushed right forward, but, with a few exceptions, the gunners omitted to dig themselves in.

Three pioneer companies were used by "Blue" as infantry. In the strengthening of Red's position on the night of the 9th—10th and on the morning of the 10th the pioneers found extensive employment, and were keenly assisted by the infantry. Little experience was gained this year in bridging. Mechanical transport was used for the baggage and supply of the XVI. Army Corps. Thus the 33rd Infantry Division (380 officers, 10,200 men, 1,800 horses) had 9 lorries with 7 trailers, the 34th Infantry Division (500 officers, 15,400 men, 2,130 horses) had 10 lorries and 17 trailers, and the Cavalry Division (200 officers, 3,580 men, 3,580 horses) 10 lorries and 8 trailers. The supply columns filled up in Metz

and Remilly, and brought the supplies to the intermediate depôts, which changed according to the movements of the troops. From these the troops fetched, in their regimental transport, their requirements for the next day—the automobile columns then went back to Metz and Remilly, loaded in the evening, and drove laden the next morning to the new intermediate depôt. They had to do an average of 80 kilomètres a day, which in view of the nature of the country was pretty heavy. The new travelling field kitchen, nicknamed "The Peashooter," gave satisfaction.

Referring to the increasingly complicated methods of communication, the writer thinks that in war the old method of despatch riders on picked horses will again be resorted to.

The volunteers of the German Motor Bicycle Union turned out 180 strong.

The captive balloons were able to make ascents each day, but no comment is made on their utility.

THE GERMAN MILITARY AIRSHIP.—The issue of 31st October, 1908, contains an article entitled "The Official Report of the Great Flight of the Military Airship." The flight lasted 13 hours, and is considered a record. It was not a speed trial, but was undertaken both to test the airship's endurance and the possibility of proceeding between fixed points. The goal was Magdeburg. For one-half of the trip, only one motor was in use; during the remainder two motors. The airship started from Tegel and reached Magdeburg in 9 hours 40 minutes, returning in 3 hours 21 minutes. The airship only made 68 miles in eight hours against the wind, whilst with the wind it accomplished 80·7 miles in three hours. The gas used was five weeks old, but the vessel remained for nearly five hours on end at a height of over 3,000'. It is claimed that the practical utility of the military airship was evinced in a special way by unforeseen events. For instance, about 4 o'clock at night the wind increased to such an extent that both motors had to be employed at high speed. As a result one motor broke down and was put out of action for an hour, but the repairs were effected in the air. Later one of the steering lines got out of order, so that the reserve line had to be taken in use. The repairs lasted three-quarters of an hour, but did not affect the flight. It is claimed that the airship has thus proved that the putting out of action of one motor does not affect the flight or steering. The rigid airship has done a 12-hour flight and the non-rigid 11½ hours, so that this flight may be taken as a world record. According to the writer of the article, the French airships have not done more than seven or eight hours, and he also remarks that the Russian airship can only be regarded as a large model, and no importance need be attached to its trials. It has a very heavy substructure, of which the practical value has not yet been proved.

During this flight 33 lbs. of ballast were spent, while the store of petrol and lubricating oil would have permitted a further flight of four hours' duration. It is claimed that this flight has proved that the airship in favourable weather can keep in the air for 17 to 18 hours. The limit of its radius of action will be tested by further trials.

The conditions of contract stipulated that the non-rigid airship should keep a height of 1,500 mètres (about 4,900') for at least one hour, and the rigid airship reached on its trip on the 4th August a maximum of 1,000 mètres, which it could only maintain for quite a short time on account of the considerable loss of gas that ensued. The writer goes on to say that the advantage of having ballonets in high flights is unquestionable. The size of the ballonets will generally be calculated so as to prevent loss of gas at a height of 1,500 mètres.

In making comparisons between the rigid pattern and non-rigid pattern of airship, it must be remembered that the latter is small, and its performances cannot be expected to compare with those of great ships of the rigid type.

The German War Automobile.—An article on the results of trials with motor transport in the 1908 Kaiser Manœuvres appears in the November issue. After sketching the opportunities which the future holds for this type of transport, the article proceeds to give some details of the wagons employed. The 33rd Infantry Division had the greatest variety in its "automobile column," which consisted of one Siemens-Schockert train (motor wagon with five trailers, capacity 15 tons), one 30-h.p. Stoltz wagon (one trailer, 6 tons), one 20-h.p. Stoltz wagon, one Büssing lorry '06, one Gaggenau lorry '07, one Ducommun lorry '07, one D.A.G. lorry '05 (one trailer, travelling workshop), one light Argus supply wagon (spare parts and tools), and two passenger cars (Kolonnenbegleitwagen). The Cavalry Division was equipped with eight lorries of the type of a light military wagon, which has been constructed in various motor-car factories for the German War Department, and is the result of prolonged trials. These wagons proved the best, although all the others came up to requirements. The daily run averaged 90 to 100 kilomètres, half of which was accomplished with loads. The Siemens train, constructed somewhat after the Renard principle, proved very practical, viz., each separate wagon having its own driving road wheel, in order to get sufficient adhesion with the heavy load. The difficulty of turning the train is avoided by the tractor being capable of being coupled at will at either end. It is also possible, by cable leads, to connect single trailers to the electrical power of the tractor, and—while the train halts—to run these separate trailers to any desired place, such as a bivouac situated to one side of the main road.

E. G. Wace.

Rivista di Artiglieria e Genio.

November, 1908.

The Map of Italy, Scale 1 to 250,000, of the Italian Touring Club.—The Italian map, on a scale of 1 to 250,000, edited by the Italian Touring Club, is an important publication which does honour to the country, and which constitutes a remarkable means of national culture.

The complete map will contain 58 sheets. The sheets measure 335 mms. by 450 mms., and cover an average area of about 9,240 square kms.

As a work of technical lithography this map—printed at Rome at the Geographical Institution of Dr. De Agostini—can compete with the most artistic maps both as regards detail and general quality. The maps are printed in nine colours. There are itineraries and measurements of declivities, and on the great roads of communication the distances are marked in kilomètres.

The districts are accurately represented with the addition of the latest works; Naples, for instance, contains an index showing the new industrial buildings which cover a very large area; also the plans of Rome show clearly the great arteries, with the principal palaces and other great buildings in the capital. Lastly, the coast beacons, the stations for wireless telegraphy, the central isolated electrical stations, both the main and smaller lines of railway, the tramways, etc., are all shown, as are also the woods, which have not hitherto been shown on maps.

MOUNTED PIONEERS IN RUSSIA.—An article taken from the *Militär Wochenblatt* contains a favourable account of the mounted pioneers in the Russian Army. For many years two divisions (four squadrons) of mounted pioneers existed in the Russian Army. They were formed in 1819 and disbanded somewhere about 1862.

The two last wars—viz., the Russo-Turkish and the Russo-Japanese—have clearly shown the need of resuscitating these troops, as in both of them the mounted pioneers have been employed with advantage.

In the war of 1877–78, four days after the passage of the Danube, a detachment of mounted pioneers was formed of Cossacks. A sotnia of sappers was formed from sappers taken from the Cossacks of the Don, and from other Cossacks a sotnia of pontoniers was organized with the Cossacks of the Ural. An officer of Cossacks—as commandant—and three officers of sappers were appointed to the first, whilst the sotnia of pontoniers had all its organization taken from the Cossack cavalry and was commanded by an officer of pontoniers. The two sotnia were reunited in an independent "division," commanded by Colonel Count Reniker, who was recalled from leave for this purpose.

To the sotnia of sappers were allotted three pack carriages—one for entrenching tools, one for electric material, and one for explosives. Each mounted sapper was also provided with suitable tools. The material for the pontoon sotnia was taken from the equipment of the regular bridging battalions.

On the 3rd July, 1877, the division of mounted pioneers attached to the advance guard of General Gourko set out from Simnitza by Sistova, where it arrived somewhat late owing to damage done to the heavy carriages which were behind on the march. In the march which followed to Tirnova (75 kms.) the detachment—owing to the same causes—was four days in reaching the station.

At Tirnova the commandant of the pioneer division obtained permission from General Gourko to lighten the heavier carriages, and only

retained four pack wagons containing the tools indispensable for pioneer services. Notwithstanding this they still had to contend with great difficulties on the march from Tirnova to Hajnkiöj owing to the pack wagons, and it was found necessary to leave another wagon behind.

However these improvised pioneers rendered satisfactory service, keeping all the roads of the Balkans in good repair, so that all the troops of General Gourko's advance guard were able to push on without stop. The pioneers worked incessantly for four days. During the march itself, and later on when no technical work was required, the mounted pioneers were utilized for reconnoitring purposes.

After the capture of the Schipka Pass, General Gourko ordered the formation of a special mining detachment, composed from the sotnia of the Don, with a cavalry officer, two sapper officers, and 60 selected men, with the best horses available. The detachment was told off to destroy the Adrianople-Jeni Zagra Railway. The material, together with the explosives, was carried in forage sacks. The mining detachment was divided between the two dragoon regiments of Astiakan and Koran. Special sapper officers were employed to carry out the destruction of the railway. Several bridges were mined, many lines of telegraph were cut, and finally the railway station of Jeni Zagra was destroyed.

The division of mounted pioneers was employed both in mining and in fortifying the Schipka Passes.

Afterwards the sotnia of the Don was disbanded and the sappers returned to their own battalions; the sotnia of the Ural was retained, but was only used for cavalry services. On the advance on Adrianople another detachment of mounted pioneers was formed, but this time it was taken from the regiments of regular cavalry.

The mounted pioneers, during the Russo-Turkish War, proved to be of great use, although they were only raised in a time of need, had no knowledge of the special technical work entrusted to them, and were provided with heavy wagons not adapted to the work.

After the war the superior military authorities were induced to recognize the necessity of instructing cavalry in pioneers' duties. The officers and troops of cavalry were from time to time attached to the sapper battalions. The result of this however was not satisfactory, as the individuals who went through courses of instruction with the sappers failed to show any practical knowledge, and soon forgot what they had learnt theoretically. This was shown during the last war. The cavalrymen, who had been attached to sapper battalions, were not versed in the use of explosives for destructive purposes, and were useless in other technical matters which should form part of the duties of officers and men of the pioneers.

The author of the article in the *Invalido Russo* concludes by expressing the hope that in time of peace regular detachments of mounted pioneers will be organized, seeing that the instruction of the cavalry for so short a time with the sapper battalions is not sufficient to form pioneers, and that it is impossible for individuals of the sapper battalions to undertake service on horseback in war time only.

To each cavalry division, according to the author, a squadron of

pioneers should be assigned, and this again could be subdivided into four detachments, which could be employed independently.

AUSTRIA-HUNGARY.—*The New Regulations for Field Fortification.*—The orders proscribed in the Austria-Hungarian Army for field fortification, and which until now have been dispersed in various official publications, will now be all collected under the title "Regulations for Field Fortification." This book will, according to notices in the *Fremdemblatt*, be the principal modern work on this subject, and will be a valuable guide for the officers.

The regulations are divided into three parts, treating respectively of the principal tactics in relation to field fortification, of their technical application, and the distribution of the works.

In the technical execution of works it is necessary, when occupying the ground, to take all possible advantage of its natural undulations.

The regulations lay stress on the importance of the observation of artillery fire, and of the communication which should exist between the observatories and the commanders of batteries.

EDWARD T. THACKERAY.

RECENT PUBLICATIONS OF MILITARY INTEREST.

JANUARY, 1909.

(*Published Quarterly*).

THE following extracts from the list compiled by the General Staff, War Office, are published in the *R.E. Journal* by permission of the Army Council.

HISTORICAL.

FROM ISLAND TO EMPIRE. By J. S. C. Bridge, with an introduction by Sir Cyprian Bridge. 343 pp., with index and maps. 8vo. London, 1908. Chatto & Windus. 6s.

This volume contains a most excellent outline of the growth and consolidation of the British Empire from the commencement of Queen Elizabeth's reign up to the conclusion of the late South African War.

It is divided into twelve chapters, dealing separately with the operations which took place (often concurrently) in different parts of the world. Commencing with the early struggles with Spain and Holland and the wars of Marlborough, the author passes on to the situation in America, the Seven Years' War, and the Conquest of Canada. He then devotes one chapter to the rise of the Empire in India, and three more to subsequent events in India up to the end of the Indian Mutiny. The War of American Independence occupies two chapters, and Nelson and Napoleon, Egypt and South Africa, are allotted one chapter each.

In a book of this size it is impossible to deal fully with each phase of history in a period extending over three and a-half centuries, but the salient points have been described in sufficient detail to give a very good general idea of the whole, and it forms a succinct history in which the interest is maintained throughout, and the necessity for co-operation between the Navy and Army is fully brought out.

The author hopes that readers of the book may be induced to proceed with the study of those authoritative works to which he frequently makes reference in the text, and this is by no means unlikely, as interest is sure to be aroused in all who read it.

The index is good and sufficiently full to be of considerable use for reference purposes, and a chronological table of events at the commencement of the book is a useful adjunct.

THE CAMPAIGN OF 1805 IN GERMANY (La Campagne de 1805 en Allemagne). Historical section of the French General Staff. 770 pp., with 15 maps. 8vo. Paris, 1908. Chapelot. 17s. 6d.

This volume deals at considerable length with Napoleon's strategy after the capitulation of Mack at Ulm; it describes the operations against Kutusow, which culminated in the defeat of Mortier by superior numbers at Dürrenstein, and shows how the Russian leader succeeded in frustrating Napoleon's attempt to crush his army. Immense care has been taken to obtain the necessary documentary evidence, with the result that the work is complete and of great historical value.

WATERLOO (Waterloo). A French translation by General Goiran of the Italian book by General Albert Pollio, General Officer Commanding 25th Infantry Division, Italian Army. 640 pp, illustrated by photographs. 8vo. Paris, 1908. Lavauzelle. 9s. 6d.

This is a careful study of the Waterloo Campaign, which the author has evidently done his best to keep unbiased. The volume shows clearly that most of the information has been derived from French sources, and leads one to suppose that the author is of opinion that British, Dutch, Belgian, and Prussian sources are untrustworthy, as they all seek to magnify the part played by the troops of their own nation in the great victory; possibly also General Pollio knows French better than the other languages, and has found it easier to devote his attention to the French literature on the subject.

The author evidently has a very high admiration for Napoleon, and has come to the conclusion that the success of the allies in the Waterloo Campaign was due more to good fortune than to skill, either in strategy or in tactics. He looks upon the Duke of Wellington as a stubborn fighter and cool leader, but apparently has a poor opinion of his powers as a strategist. In his criticisms on the Battle of Waterloo, General Pollio hardly gives sufficient credit to the British infantry, whilst his admiration for the French troops, fully justified as it is, rather tends to warp his judgment with reference to their opponents. In speaking of the numbers at the disposal of Napoleon and Wellington respectively he does not give sufficient weight to the fact that the Anglo-Dutch Army was a heterogeneous mixture of four nations, of whom a fairly large proportion had little interest in the struggle; whilst the French troops consisted of seasoned veterans, under famous generals, fighting under the eye of their beloved Emperor, who was staking everything on the success of this last battle in his career.

The translation is good and accurate, and the French is easy to read.

THE CAMPAIGN OF 1815 IN THE NETHERLANDS, Vol. I., Quatre Bras (La Campagne de 1815 aux Pays-Bas). By Colonel de Bas, Director of the Historical Section of the Dutch General Staff, and Colonel Count T'serclaes de Wommersom, of the Belgian General Staff. 548 pp. 8vo. Paris, 1908. 18s.

This book is a plea for a fuller recognition of the part played by the Dutch-Belgian troops in the Waterloo Campaign. The authors, who have had access to many little known documents, remark that it has become traditional to depreciate the valour of their countrymen in this campaign, and that recent historians have repeated the calumnies of earlier writers. The book commences with an account of the sufferings endured by Holland and Belgium under the rule of the Republic, and later of Napoleon, thereby showing how little cause the inhabitants of these countries had to be in sympathy with France.

The history of the various corps of the Dutch-Belgian Army is given in detail, and the difficulties of organizing the new army in 1813-14, with the limited financial resources at the disposal of the Government, are described. Coming to the events of the 100 days, much space is devoted to the consideration of the situation of the allied armies on the 14th and 15th June, 1815. The authors, without reflecting upon the sagacity of Wellington, for whose skill and ability they express the greatest respect, evidently consider that the Duke adhered too long to the view that Napoleon's main movement would be towards the British right. They hold that the initiative of General Perponcher in marching to Quatre Bras on the night of the 15th—16th, in opposition to the orders directing him to concentrate on Nivelles, was mainly instrumental in repairing the mistake and preventing the interruption of Wellington's concentration. The book concludes with a detailed account of the Battle of Quatre Bras and of the part played by the Dutch-Belgian troops in that engagement.

GRANT AND LEE IN VIRGINIA. By Lieut.-Colonel H. M. E. Brunker. 63 pp. 8vo. London, 1908. Foster Groom. 3s.

A summary of the operations in May and June, 1864, and, if read in conjunction with fuller accounts of this campaign, should assist officers in preparing for the Military History Examination for Promotion, which is the object of the book. The sketch maps are clear.

FOUR YEARS UNDER MARSE ROBERT. By Robert Stiles, Major of Artillery in the Army of Northern Virginia. 3rd edition. 368 pp. 8vo. New York, 1905. The Neale Publishing Co. 8s.

Major Stiles' reminiscences of the Civil War have already achieved a well-deserved popularity. His picture of War, from the personal point of view, is drawn with the sure hand of one who has witnessed what he relates, and with the balanced judgment of a mind which has long pondered its subject.

After the first Battle of Manasses the author enlisted in the Richmond Howitzers, and from that day till 6th April, 1865, when he was taken prisoner at Sailor's Creek, he served with the Army of Northern Virginia. He was present at the Battles of Williamsburg and Seven Pines, and throughout the Peninsular Campaign, but was not at the Second Manasses or Sharpsburg. His artillery section, which had been sent to Richmond after Malvern Hill to be re-equipped, joined the main army in time to take part in the Battle of Fredericksburg, and bore its share in all Lee's subsequent battles till the end of June, 1864, when the whole battalion was transferred from Petersburg to the lines between the Appomatox and the James, and remained there virtually without firing a shot till 2nd April, 1865. Promoted to the rank of major in December, 1864, the author was posted to the battalion of heavy artillery at Cheffin's Bluff, and commanded it during the retreat from Richmond. His military career closed amid a blaze of glory, for after the surrender of the Confederate forces at Sailor's Creek, General Ewell called him up and publicly congratulated him upon the record which his battalion had made in that engagement.

His whole service was passed with the artillery, though he received his first commission in the engineers, and "was actually advanced one grade in engineer troops for meritorious service in artillery." He claims for the artillery of Lee's Army that "in proportion to its numbers it furnished perhaps more officers below the rank of general who were conspicuous for gallantry and high soldiership than either of the other two arms," and he adduces some very good reasons to show why this was so. Incidentally he remarks that during the latter part of the war an infantry company in the Army of Northern Virginia did not average over fifteen or twenty men. During the campaign of 1864 he acted as adjutant to Cabell's battalion, and consequently his knowledge of that campaign is more comprehensive and detailed than of any other. Of special interest is his account of the Bloody Angle at Spotsylvania. On the 12th May his battalion was put in at the left base of the salient, but he differs from the majority of writers in maintaining that, though the fire was at times heavy, yet at no time in front of his position did it approximate the intensity of the fire during the great attack at Cold Harbour. It appears from this narrative that, had not Grant, after Cold Harbour, crossed the James, Lee would have attacked him, and Early had been appointed to lead the attack, when the operations of Hunter in the Shenandoah Valley necessitated the abandonment of the plan.

Naturally Lee is the hero of the book, and from its pages can be realized something of the intense devotion with which the Army of Northern Virginia regarded their great leader. Next to Lee, Jackson seems to have commanded the author's greatest admiration, though he never served under him. He describes an interview, of which he was, perhaps, the only witness, between Lee and Jackson during the Peninsular Campaign, which closely resembles the well-known interview between the same generals preceding Jackson's flank march during the Second Manasses Campaign. Vivid pictures are also given of D. H. Hill, with his monomania on the subject of personal courage, and of Jubal Early, Lee's trusted lieutenant in spite of his eccentricities.

One of the last chapters of the book is entitled "Fatal Mistake of the Confederate Military Authorities." This mistake was their failure to realize that promotion is "the informing spirit of an army." Not even Lee himself had power to confer promotion on the field. It had to come *through* the War Department, and the process was slow. Where gallantry was officially recognized the promotion lagged and followed so far behind that the heroic deed had by that time been forgotten, and the moral effect was almost, if not entirely, lost. The author's own case is typical. He was recommended for promotion for gallant conduct on 12th May, 1864, but the promotion did not come till more than six months after, and the commission *ranked* not from the date of the engagement (of which not the slightest mention was made), but from the date of its issue. The attempt of the Government to establish badges of distinction and a roll of honour was rendered futile by the absurd provision that the recipients of such honours were to be selected by the men themselves. The author also condemns the system, which was first adopted, of allowing the soldiers to elect their own officers. The monstrosity of such a mode of selection is sufficiently proved, in his opinion, by the fact that one Virginia regiment successfully protested against the assignment of Jackson to command it. In spite of official discouragement Lee's Army attained a high standard of discipline, as is admitted by General Hooker, who attributed to it his defeat at Chancellorsville. Not the least of the influences promoting discipline and order was probably the religious revival which took place in the winter of 1864 at Fredericksburg.

GRANT'S CAVALRY IN THE GETTYSBURG CAMPAIGN. By J. S. Mosby. 222 pp., with portraits and map. 8vo. New York, 1908. Moffat, Yard. 8s. 4d.

This work is of a controversial nature, in which the author undertakes to clear General Stuart of the charge of having been the cause of the failure of the Gettysburg Campaign.

The first chapter deals with the cavalry battle of Brandy Station or Fleetwood, with regard to which the author makes the following important points:—

1. Stuart was not meditating a raid, as stated by Hooker and Pleasonton. He had massed his cavalry in Culpepper County partly to screen Ewell's movement to the Shenandoah Valley, partly to guard against a repetition of the Stoneman raid, and partly to get the benefit of the rich pasture grounds in that neighbourhood.
2. Pleasonton crossed the Rappahannock to fight Stuart, did fight him, and was fairly beaten. The author maintains that to cover up his defeat Pleasonton invented the theory that he was sent to make a reconnaissance in force and voluntarily withdrew when he had effected his purpose. In support of this view several facts are quoted.
3. Pleasonton gained no information worth having by his expedition. The author justifies this statement by a reference to significant movements of the enemy on days immediately succeeding the cavalry battle, all of which remained undiscovered by Pleasonton.

The rest of the book is devoted to the Gettysburg Campaign. The author bases his case upon alleged discrepancies between Lee's two reports and the inaccuracy of them both, when compared with the correspondence and orders since published. The discrepancies however do not seem to amount to very much. Both regard the absence of cavalry as the cause of the premature collision of the 1st July. The author attributes the failure of the campaign, on the other hand, not to Stuart's absence but to Heth's presence at Gettysburg. He attacks both that General and his corps commander, A. P. Hill, and even goes so far as to impugn the veracity of Lee's second report. The arguments with which Colonel Mosby supports his case are undeniably strong and entitled to the closest attention, but are unmistakably those of a strong partizan and not of an unbiased critic; they cannot therefore be accepted without reserve; nevertheless the book assists materially to elucidate the campaign.

OFFICIAL HISTORY OF THE RUSSO-JAPANESE WAR. Part II. Prepared by the Historical Section of the Committee of Imperial Defence. 164 pp., with 12 maps. 8vo. London, 1908. 5s.

This is a continuation of the Official History, Part I. of which was published by the General Staff. It forms an advanced portion of the combined naval and military history which is in course of preparation, and deals with the operations from the Battle of the Ya-lu to Liao-Yang, exclusive. It contains no comments, and naval operations have been touched on only in so far as they affect the movements of troops on land.

ACCOUNT TO THE CZAR OF THE RUSSO-JAPANESE WAR (Rechenschaftsbericht an den Zaren über den Russisch-Japanischen Krieg). By General A. Kuropatkin. German authorized translation by Navi. 371 pp., including 32 appendices and a preface. 8vo. Berlin, 1908. Risel's Deutsche Centrale für Militärwissenschaft.

This work, which is published by authority, contains four chapters. The first deals with the operations up to and including the Battle of Liao-yang; the second treats of fighting on the Sha-ho; the third describes the "operation" of Mukden. The fourth chapter, which bears the title "Conclusion," is also devoted in part to a discussion of the fighting around Mukden, and ends with a review of the conditions under which the war was fought and of the results achieved.

In a preface the translator draws attention to the alleged causes of the Russian defeats, viz.:—Differences of opinion and the lack of uniform military thought. He quotes the author, who says that in every rank there was a lack of men endowed with true soldierly qualities and with the iron nerves which would have enabled them to endure, without any weakening of purpose, fights which continued for days.

In Chapter I. we are told that Alexieff originally considered 16 battalions of infantry as sufficient for the defence of the Kwantung Peninsula. This number was afterwards increased to 36, and after Makaroff's death the Viceroy called for early assistance from the Russian field army, since "strictly speaking Port Arthur cannot be considered as a fortress—it ought to be able to resist a sudden attack, but could hardly sustain a siege of two or three months." Stoessel concurred in these views. The Russian Commissary General at Port Arthur, unaware of the abundance of supplies in Manchuria, ordered them from Europe. General Sassulitsch excused his disobedience in fighting the Japanese on the Yalu on the grounds that he reckoned on success. The way in which Russian reinforcements were sent backwards and forwards between Hai-cheng and Liao-yang led to a hopeless mixing up of tactical units at an early period of the campaign. They were the outcome of plans, hastily formed and as hastily abandoned, for offensive movements southward, towards Port Arthur, and eastward. Kuropatkin discusses these plans, and points out incidentally that paucity of transport and mountain artillery rendered the Yalu project impracticable. The Xth Corps, which was the first to arrive from Europe, is severely criticized by the Commander-in-Chief. Many of the reservists were small and awkward, and the older men amongst them were aggrieved at being called out before younger categories. Many of the higher commanders were fresh to their posts and unfit for them. On an average, 800 men (out of 4,000) in each regiment were away from their unit. Of the courses open to him on the 18th August, viz., (1) to move against Oku and Nozu whilst observing Kuroki, and (2) to retreat on to the main Liao-yang position whilst opposing Kuroki with as large a force as possible, Kuropatkin chose the latter, as (1) would have led to disaster in the event of Kuroki being successful against the covering detachment. In discussing the alternatives open to him on August 21st* he refers to the spontaneous retreat of several of his subordinate generals, with the consequent probability of the Japanese right wing penetrating as far as the railway.

* These dates are O.S., and 13 days must be added in comparing them with non-Russian accounts.

Chapter II. opens with a consideration of the position taken up by the Russians after Liao-yang. Amongst its disadvantages he cites :—

(1). The undue échelonning to the rear of his left wing due to a re-entering bend in the Hunho, east of Mukden. As a result of this a success of the enemy on this flank would have brought him on to the Russian communications.

(2). The proximity of the *Hunho in rear of the position.*

(3). The fact that the enemy held the Fushun coal mines.

It was (3) especially that prompted him to undertake an offensive movement.

According to Kuropatkin, the failure of the Shaho operations was due to—

(1). Stakelberg's want of skill ; the latter is alleged to have possessed a threefold superiority over the Japanese.

(2). The irresolute leading of generals commanding portions of the Western Detachment.

He recounts the views expressed by various Army Commanders at councils of war which took place between the Sha-ho fighting and Hei-keu tai.

The report on the latter battle reveals serious defects in reconnaissance and in intercommunication between commanders.

Many pages are devoted to a discussion of General Kaulbars' action at Mukden ; this officer is declared to be mainly responsible for the disastrous termination of the battle. Kuropatkin accepts a due share of the responsibility for failure, since he did not insist on the formation of a sufficiently strong strategic reserve, and did not attempt to prevent the mixing up of units. A perusal of the narrative clearly shows that the breaking up of tactical units was often resorted to without any necessity.

In the final pages he alludes to the advantage which the Japanese possessed in being able to replace losses so quickly. Their efficient system of espionage is ascribed partly to the sympathy (?) of the Chinese. The national enthusiasm for the war which prevailed in Japan is contrasted with the lukewarmness exhibited in Russia. The frequent suicides amongst Japanese prisoners of war are alluded to, and three instances are quoted of parties of Japanese suffering annihilation in preference to capture during the fighting at Mukden. On the other hand, many strictures are passed upon the conduct of Russian troops in action. During the latter portion of the Liao-yang fighting the hesitation of the men to advance through the high kaoliang near the right bank of the Tai-tsu-ho was one of the factors which induced the Russian commander to desist from offensive operations in this quarter.'

In the report on the Sha-ho fighting *unfavourable comment* is passed on the unsteadiness of portions of one army corps and on the tendency of men to quit the ranks in order to succour wounded comrades. The unsatisfactory conduct of two army corps at Hei-keu-tai is likewise mentioned.

The orders and details regarding the disposition of the forces which are given in the appendices are based on carefully compiled official data. The text, too, contains much statistical information. At the beginning of the fighting around Liao-yang the Russian Army was 350 officers and 14,800 men short of its paper strength ; some companies had only 100 out of 220 bayonets. On September 16th 670 officers were lacking. After the Sha-ho fighting 252 battalions mustered only 140,000 bayonets ; 2,700 officers were wanting, the average number per battalion being 11. At the beginning of 1905 the shortage of officers had risen to 5,600.

The Russian losses at Mukden are given as 2,118 officers and 89,352 others. On the morrow of the fighting 114 battalions of the II. and III. Army Corps averaged 144 bayonets each, but three days later the numerous stragglers who had rejoined raised this figure to 300 bayonets. The report clearly demonstrates the demoralization which pervaded the Russian forces at that time. In several portions of the book discussions occur as to the impossibility of offensive movements, despite the numerical superiority which is admitted in some of these instances. The passive tendencies of the directing authority are betrayed throughout the report.

The book contains no map, and as the transliteration of Chinese names differs considerably from ours, British readers of the book will often experience difficulty in identifying places.

GERMAN OFFICIAL ACCOUNT OF THE RUSSO-JAPANESE WAR (THE YALU). Authorized translation by K. von Donat. 258 pp., 9 appendices, including 5 photographs, 6 maps in pocket. 8vo. London, 1908. Hugh Rees. 10s. 6d.

This is a translation of the second of the series of monographs concerning the Russo-Japanese War prepared by the German General Staff. The first (of which no translation has hitherto appeared) dealt with the Siege of Port Arthur.

HISTORY OF THE ROYAL REGIMENT OF ARTILLERY. By Lieut.-Colonel H. W. L. Hime. 148 pp. 8vo. London, 1908. Longmans. 6s.

This book carries on the history of the Royal Regiment of Artillery from 1815, where the book by Colonel Francis Duncan left it, to 1853. It is therefore chiefly concerned with the wholesale reductions after the Napoleonic wars, and the subsequent increase of establishment due to the representations of the Duke of Wellington in 1847.

THE MILITARY MEMOIRS OF LIEUT.-GENERAL SIR JOSEPH THACKWELL, G.C.B., K.H. By Colonel H. C. Wylly, C.B. 424 pp., including appendices and index. 8vo. London, 1908. Murray. 15s.

This historical biograph is compiled from the diaries and correspondence of Sir Joseph Thackwell during the sixty years he spent in the Service, supplemented by carefully selected extracts from acknowledged authorities on the military events in which he was concerned. He served in the Peninsular War and was present at Waterloo. In that battle his superior officers were killed, and in the evening it devolved upon him to lead his regiment, the 15th Hussars, in a final charge upon a square of the Imperial Guard. Two horses had already been killed under him, and during this charge he was shot through the bridle hand; nevertheless he continued to lead the charge with the reins in his teeth until another bullet shattered his left arm and brought him to the ground. He was left all night where he fell, and the following day had his arm amputated. Within ten days he was however riding over the battlefield, and within a comparatively short space of time was hunting in France. The next service he saw was in Afghanistan in 1839, where he commanded the cavalry, and was fortunate enough to escape the horrors of the retreat from Kabul by being sent back to India after the rout of the Afghans at Ghuznee. He served in a similar capacity in the short campaign against the Mahrattas of Gwalior and in the war against the Sikhs in 1846.

During the latter, the victory of Sabraon was due in a large measure to his leading and the gallant conduct of the troops under his command, who, after the British infantry had been checked, resolutely attacked the entrenched enemy. In the Battle of Gujerat the cavalry again were mainly instrumental in obtaining the decisive victory which terminated the campaign.

At the age of seventy-three this gallant veteran tried hard, but without success, for a command in the Crimea.

As a record of a long and varied career this book is well worth reading, and not the least interesting feature is the picture it presents to us of a man of independent means with such high ideas of the obligations of a gentleman and a soldier that the whole of his life is devoted to military service, in which he carries out his duties in a punctilious and unselfish manner.

POLITICAL.

FRANCE AND GERMANY. By Victor Meyn'er. 139 pp. 8vo. London, 1908. Sonnenschein. 2s.

This historical *précis* of the political relations between France and Germany covers the period from the Treaty of Frankfort in 1871 to the Algeciras Conference in 1906, but the greater portion of it deals with the events of the last four years.

It is a useful and concise account of the events leading up to the Algeciras Conference, but the reader must bear in mind that the author is evidently playing the part of prosecuting counsel against Germany; it will also be noted that no authority is as a rule given for the many emphatic statements that are made.

EUROPE AND THE OTTOMAN EMPIRE (L'Europe et L'Empire Ottoman). By R. Pinon. 603 pp., with 2 maps. 8vo. Paris, 1908. Perrin. 4s.

This valuable work by Monsieur René Pinon is of especial interest in view of the present crisis in the Near East.

The book is divided into twelve chapters. Commencing with a review of the evolution in modern times of the Near Eastern question, the author goes on to discuss the Black Sea and the question of the Straits. Four chapters are devoted to a consideration of the Macedonian question and are followed by chapters dealing with the rivalry of the Great Powers in the Ottoman Empire; the Tabah incident and the Arab question; the Austro-Serb conflict; the rise of Bulgaria and its present importance. The two succeeding and final chapters deal with French interests in the Near East.

STRATEGICAL AND TACTICAL.

PREPARATION FOR WAR ON THE COAST (Kriegsbereitschaft an der Meeresküste). By Vice-Admiral Galster (retired). 19 pp. 8vo. Berlin, 1908. Verlag der *Neuen Revue*. 10d.

This article, a reprint from the *Neue Revue*, has been written with a view to bringing to notice the necessity for improving the North Sea coast defences for the better protection of the important commercial towns of Hamburg, Bremen, and Emden. The writer argues that the defence of the coast cannot depend on the action of the mobile fleet, but must be ensured by coast defences.

The works at Cuxhaven, he states, are insufficient for the protection of Hamburg. A subsidiary position further up the Elbe should be selected for the establishment of other works and minefields.

He points out that Great Britain has, according to him, most effectively protected her principal ports by strong defences all round the coasts of Great Britain and Ireland. In his enumeration of the British coast defences he takes into account the coast forts at Hythe and Eastbourne. It would seem probable that he lays undue importance on the value of the Martello towers.

The author further maintains that coast defences must be so strong as to make a hostile fleet chary of engaging them.

TACTICAL PRINCIPLES. By J. Bürde. 96 pp. 8vo. London, 1908. Rees. 3s. 6d.

The author traces briefly the changes in tactics from the time of Frederick the Great up to the present day, and describes the main causes which have rendered these changes necessary. He then goes on to consider the motives which actuate men on the field of battle, and enunciates eight chief tactical principles based on the most powerful of such motives, in the author's opinion, namely, the passion of revenge.

These eight principles are then discussed in detail, and many examples from campaigns are alluded to in support of them. To the majority of these principles no exception can be taken, but some require rather stronger arguments in support of them than Mr. Bürde has expressed in this short volume, before they can be accepted as they stand.

Perhaps the most valuable part of the book is the last half of it, and this is devoted to a discussion of the conditions which favour an extension of front. Frontages, he states, are dependent on two factors—the size of the force and the number of the communications—and the wide frontages employed in late wars were due to these causes and not to modern firearms.

Mr. Bürde has illustrated the discussions principally by means of imaginary examples and rough sketches, with the result that they are both lucid and brief.

His object is not to give an exhaustive treatise on tactics, but merely to throw light on tactical subjects. In this he has ably succeeded.

TRAINING AND EDUCATION.

NOTES ON OPTICS. By H. J. Davidge, B.SC., M.I.E.E. 92 pp., with 72 figures. London, 1908. H.M. Stationery Office. 6d.

This is an altogether excellent little text book, and may be cordially recommended to any one desirous of acquainting himself with the elementary theory of ordinary optical instruments.

The various applications of the properties of light to simple optical instruments, with special reference to those used in the Service, form Part II. of the book. The optics of search lights, the sextant, the microscope, field-glasses and telescopes, optical gun sights, stereoscopes and range-finders, are described in the clearest manner. The book is well printed and adequately illustrated. It covers ground which is not, as far as we are aware, exactly covered by any previous publication, and meets a distinct want. It is one that should be in the hands of every officer whose duties involve the use of any optical instrument, and who desires to understand the nature of the tool he is employing.

NOTES ON TACTICS, FOR THE USE OF CANDIDATES AT THE STAFF COLLEGE (Causeries sur la tactique, à l'usage des candidats à l'Ecole supérieure de guerre). 2nd edition. By Capt. Serret. 270 pp., with map. 8vo. Paris, 1908. Chapelot. 3s. 6d.

This book is intended for Candidates for the École supérieure de guerre; it comprises sixteen tactical problems, a short treatise on field fortification, and twenty-one exercises for the use of an instructor or examiner.

In each problem the General and Special Ideas are given on which the problem is based; then there is an elaborate study of the dispositions, beginning with the orders which would be given by the General of Division and General of Brigade. The various incidents which might occur in the carrying out of the orders are discussed, and the points which the officer who has to give orders should bear in mind, as well as the duties of the covering screen of cavalry, the artillery, etc. A map shows the scene of the imaginary operations described in the exercises, comprising the country to the north-west of Verdun.

NOTES ON STAFF RIDES AND REGIMENTAL TACTICAL TOURS FOR BEGINNERS. By Major T. E. Fowle. 26 pp. 12mo. London, 1908. Gale & Polden. 2s.

The second edition of this book, the first edition of which was published seven years ago. It deals briefly with the general object of Staff, Regimental, and Tactical Tours, and gives general instructions as regards the method of carrying them out. It concludes with notes on writing an appreciation of the situation and Notes on Reconnaissance. In both of these the author gives numerous headings, which may be useful to beginners, for whom the book is written, but which, if rigidly adhered to, are apt to lead to the inclusion of much unnecessary detail.

On the whole the book should prove useful to those for whom it is intended.

THE RUSSIAN MANUAL OF FIELD FORTIFICATIONS FOR THE INFANTRY. Official. 73 pp., many illustrations. 12mo. St. Petersburg, 1908. General Staff.

This is a portion of the first part of the new *Manual of Field Fortification for the Infantry*, and deals with the "Strengthening of Positions." The second and third parts will deal with "Communications" and "Troop Telephones." The completed manual will replace the text-book issued in 1891.

The volume is divided into two sections:—

(1). Instruction laid down for the private and lance-corporal.
(2). Instruction laid down for non-commissioned officers.

A third section, not yet published, will give instruction for the officer.

The first section contains forms of trenches, traverses, and shelters, and is written in such simple language that, with the help of the pictures, which are drawn in perspective, any soldier should be able to understand it without instruction.

The second part gives some instruction as to the siting of trenches, revetments, screening, shell-proofs, head-cover and loopholes, latrines, abatis, wire entanglements, deep military pits, utilization of walls, ditches and other existing cover, kitchens, and perspective views of two redoubts.

There is nothing new or remarkable in the volume. No pattern of fire trench with a low parapet is given, 20" being the lowest shown. Special attention is directed to digging lying down, the necessity for providing cover for the head and shoulders, and for conveniences—latrines, water-casks, ammunition recesses—in trenches. The deep military pits, to which the Japanese engineers say they owed many decorations, are retained.

The book is very short and the patterns simple as might be expected of an army with recent war experiences.

INSTRUCTIONAL LETTERS ON TACTICS (Taktische Unterrichtsbriefe). By Major-General Griepenkerl. 286 pp., with 4 maps. 8vo. Berlin, 1909. Mittler. 7s. 6d.

This is the 7th edition of the valuable work originally published by General Griepenker (then a captain) eighteen years ago. A new edition has been rendered necessary by the recent changes in German regulations, and notably by the issue of new Field Service Regulations and Training Manuals for Infantry and Field Artillery. The contents of the work are otherwise unchanged.

The 6th edition was translated and adapted to English organization by Capt Maxwell under the title of "Letters on Applied Tactics." (Rees, 8s 6d.).

FORTIFICATION APPLIED TO SCHEMES. By Lieut.-Colonel L. J. Shadwell and Major W. Ewbank. 252 pp. 8vo. London, 1908. Rees. 10s. 6d.

The second edition of this book, written to aid candidates in their study of this subject for promotion. The first portion of the book consists of an amplification of the Manual of Military Engineering and of explanations how the calculations as to working parties, tools, material, etc., are arrived at and can be practically applied.

The rest of the volume, and by far the greater portion, is devoted to showing how the principles contained in the manuals should be applied to the solution of problems, and a selection of papers, both for the practical and theoretical examination, is given with solutions.

This book serves a useful purpose, as it enables candidates to direct their studies on the right lines, and goes thoroughly into the necessary details.

APPLIED TACTICS FOR EXAMINATION PURPOSES. By Capt. Demangel. 192 pp. 8vo. Yorktown, 1908. Bradford. 5s.

The second edition of this book, as its title denotes, deals with Applied Tactics solely from an examination point of view. It is a supplement to "Questions and Answers on Tactics" by the same author, and is intended to be read in conjunction with it.

Its value lies chiefly in calling attention to principles set forth in Combined Training and other text books, and showing how these affect the solution of problems on a map.

Diagrams illustrating the various examples quoted are not given, and without them it is somewhat difficult to follow the author's meaning.

THE MILITARY LAW EXAMINER. By Lieut.-Colonel G. C. Pratt. 317 pp. 8vo. London, 1908. Gale & Polden. 4s. 6d.

The seventh edition of this well-known publication.

ADMINISTRATION, ORGANIZATION, AND EQUIPMENT MADE EASY. By Lieut.-Colonel S. T. Banning. 265 pp. 8vo. London, 1908. Gale & Polden. 4s. 6d.

This is the eighth edition of this publication, revised and brought up to date by Capt. R. F. Legge.

MILITARY LAW MADE EASY. By Lieut.-Colonel S. T. Banning. 332 pp. 8vo. London, 1908. Gale & Polden. 4s. 6d.

A fourth edition of this book, brought up to date in accordance with recent text-books and Army Orders.

FORTIFICATION AND MILITARY ENGINEERING.

ENGINEER FIELD MANUAL. Prepared under the direction of the Chief of Engineers, U.S. Army. 456 pp. and index. Numerous plates. 8vo. Washington, D.C., 1907. U.S. Government Printing Office.

The book is divided into six parts, viz. :—(I.) Reconnaissance; (II.) Bridges; (III.) Roads; (IV.) Railroads; (V.) Field Fortifications; and (VI.) Animal Transportation.

Though entitled a "Field Manual," the book gives considerably more detailed information than is customary in the "Field Manuals" issued to our army.

Part I., dealing with "Reconnaissance," gives very detailed information, not only about military sketching, as understood in our army, but also about survey work in general, including a description of the construction, adjustment, and use of various instruments, such as a Field Level and Theodolite.

Part II., entitled "Bridges," while giving various examples of temporary military bridges, at the same time gives much valuable information regarding stores and formulæ for the calculation of stresses in bridges of a more permanent nature.

Part III. deals with "Roads," and is devoted more especially to the repair of existing ones, as it is pointed out that, as far as roads are concerned, this will generally be the work which the Military Engineer will have to perform. Tables are included in this part for assisting in the calculation of the amount of earthwork necessary in repairing or constructing a road.

Part IV. is devoted to "Railways," about which much information is given regarding rolling stock, traffic management, and the laying out of a line of railway. Very little information is, however, given regarding rapid repairs to a railway.

Part V. gives various dimensions of field entrenchments, obstacles, etc., and the definition of terms used in connection with them.

A considerable portion of this part is given up to a description of military mining.

Part VI. includes a considerable amount of veterinary information, while at the same time giving some interesting notes on transport, and pack-transport more especially.

AERIAL NAVIGATION.

GERMANY AND ENGLAND, PLAIN SPEAKING TO THE EMPEROR (Deutschland und England, ein offenes Wort an den Kaiser). By Regierungsrat R. Martin. 94 pp. 8vo. Hanover, 1908. Adolf Sponholtz Verlag. 1s. 6d.

This enthusiast on aerial navigation for military purposes, to be devoted to offensive uses against Great Britain, has already published two or three books dealing with the same subject, which have been noticed in this publication.

The author commences, in his introduction, with an appeal to the Kaiser to place the foreign policy of Germany on a sound basis, and to abandon ship building for air-ship construction, which is, in his opinion, the only means by which Great Britain can be brought to subjection.

He devotes a chapter to the question of the daily increasing danger of a general world war, and another to pointing out how England's geographical position as an island will cease to exist once Germany has command of the air, and that consequen ly the difficulties which Cæsar, William the Conqueror, and Napoleon had to contend with in the invasions by the two former and the contemplated invasion by the latter of Great Britain by sea will be eliminated from the problem.

After dealing fantastically with the manner in which an invading army of 200,000 could be landed in England by means of air-ships, he concludes his book semi-apologetically by arguing at some length that the very fact of Germany possessing the means to put this operation into practice will force Great Britain into an Anglo-Teutonic alliance, which would be entirely acceptable to Germany; for Mr. Martin maintains that the political and commercial interests of Great Britain in no way clash with those of the German Empire, and that the last thing desired in Germany is to see the dismemberment of the British Empire.

BOOKS OF REFERENCE.

THE ARMY ANNUAL YEAR BOOK AND ALMANACK, 1908. Edited by Major F. S. Baden-Powell. 467 pp. 4to. London, 1908. The Army Press. 7s. 6d.

The first edition of this publication. It contains full information on the various methods of obtaining commissions in the Regular and Indian Army, Special Reserve, and Territorial Force, together with a full account of the new Territorial scheme from its origin.

Articles giving a brief account of Manœuvres and Campaigns of the year, and the lessons to be learnt from them; the policy on the North-West Frontier; recent progress in Aerial Navigation; and Machine-guns, are included.

In addition it contains details regarding an Army in the Field, the Indian Army, the year's Recruiting, and the Army Estimates, and concludes with a brief account of the Military career of the late Sir Redvers Buller, and of the Union Jack Club.

More than a quarter of the book consists of extracts from Regulations on Pay and Pensions, and Lists of Officers holding Staff Appointments at home and abroad.

The Establishments given are not quite up to date, but otherwise as a book of reference on the Military Service it should prove of value.

TRAVEL AND TOPOGRAPHICAL.

TWENTY YEARS ON THE NORTH-WEST FRONTIER. By G. B. Scott (Survey of India). 272 pp., with 2 maps. Crown 8vo. Allahabad, 1906. Pioneer Press. 2s. 4d.

An interesting record of a surveyor's experiences among the Pathan tribes of the north-west frontier of India, beginning in the early sixties and ending with the Afghan War of 1878-80. The writer tells the story of the Ambela Campaign of 1863, and relates personal experiences in the Black Mountain Expedition of 1868 and the Afghan War. The account of the two Bazar Valley Expedi ions in 1879 and the chapter "Among the Mohmands" are of special interest in the light of recent events.

The book concludes with a chapter entitled "Can Russia invade India," in which the writer criticizes our past dealings with Afghanistan and gives his views as to the steps to be taken to secure India against the Russian menace.

MISCELLANEOUS.

MARSHAL ALEXANDER BERTHIER AND HIS END (Marschall Alexander Berthier und sein Ende). By Dr. phil. Michael Strich. 127 pp. 8vo. Munich, 1908. Reusch. 3s.

Michael Strich has written this book partly with a view to supplementing Derrécagaix's recently published biography of Marshal Berthier, which he feels to be incomplete in one respect. The strategical services and military virtues of the great Chief of the Staff have been dealt with by Derrécagaix, Michael Strich maintains, with very commendable thoroughness, but the man Berthier has been passed over too briefly. This is particularly regrettable, he continues, as a psychological study of the Marshal affords an indispensable clue to the solution of the problem of his death.

Michael Strich gives a short narrative of the life of Alexander Berthier, combined with an exceedingly interesting character study of this remarkable man, who was Napoleon's constant and most trusted companion.

The final catastrophe, which was enacted at Bamberg on 1st June, 1815, is examined with minute care, the author having had access to the archives of Bamberg, Munich, Vienna, and Berlin. One is led irresistibly to the conclusion that Berthier caused his own death, and that it was not the result of an accident or the work of assassins, as has been averred. If further confirmation of this conclusion were needed, the psychological history of the great Chief of Staff, as narrated in this volume, would provide it abundantly

IS GERMANY SUPERIOR TO US? IMPRESSIONS FROM BEYOND THE VOSGES (Ist Deutschland uns überlegen? Eindrücke jenseits der Vogesen). By Major Driant (translated into German by Lieut. Hedler). 32 pp. 8vo. Berlin, 1908. Walther. 6d.

This work is a translation from the French. The author, Major Driant, a son-in-law of General Boulanger, has already given vent to a cry of alarm, when he published in 1906 a pamphlet entitled "vers un nouveau Sedan," which caused a considerable sensation at the time. He now again calls the attention of his countrymen to what he considers the superiority of the German Army, German character, and German institutions.

His opinions of the German Army were apparently chiefly derived from attendance at some Imperial manœuvres in Silesia. He quotes from conversations with German officers, who appear to think that they will some day go to war with France, but would much prefer to fight the English. The latter however, they say have unfortunately no army. But they (the English) must have troops on the Continent, and the French have been selected for this purpose. The German officers warned the Frenchman that his

country would get no help from England. England, they said, is the only country in Europe that does not fear war, as she has in the past always got other nations to do her fighting for her.

Major Driant's admiration of Germany and all things German is almost fanatical. Particularly does he contrast the slackness of discipline, the "Hervéism," and anti-militarism, which he asserts are rife in the French Army, with the order and strict discipline that obtain in the armed forces of the German Empire.

A NEW WÖRTH (Ein neues Wörth). By Major von Hoppenstedt. 238 pp., with 2 maps and 9 plans in the text. 8vo. Berlin, 1909. Mittler. 5s.

The author of this book has already penned another on the same lines, entitled "The Battle of the Future," which has attracted some attention in Germany, and was noticed in No. 1 of this publication.

"A New Wörth" is a graphic and spirited description of an imaginary battle fought under modern conditions on the original battlefield.

The element of reconnaissance by means of air-ships and the use of explosives from these aerostats are new factors which are introduced.

An interesting book.

THE BOOK OF WAR, THE MILITARY CLASSIC OF THE FAR EAST. Translated from the Chinese by Capt. E. F. Calthrop, R.F.A. 120 pp. 12mo. London, 1908. Murray. 2s. 6d.

As stated in a preface by the translator, this work still remains the most celebrated treatise on war in the literature of China. It is a collection of the sayings of Sun and Wu, two commanders who flourished about the 5th century B.C., and it is interesting to note how amongst these sayings are to be recognized many of the principles which at the present time are regarded as essential to success in war. *Moral* was even in those days recognized as of supreme importance; a commander is advised, as regards the passage of a river: "After crossing waters, pass on immediately to a distance." The health of the troops must be considered. As regards reconnaissance: "The rising of birds shows an ambush. Startled beasts show that the enemy is stealthily approaching from several sides. High, straight spurts of dust betoken that chariots are coming. Long, low waves of dust show the coming of infantry." A great deal of stress is laid upon the necessity, before giving battle, of an accurate knowledge of the enemy's condition, and for this purpose the use of spies is strongly advocated.

The book is one which will well repay perusal, although much of it is in the usual inconsequent Chinese style, of which the following is an example:- "Righteousness is overcome by propriety; might by humanity; revenge by words; tyranny by deception; unrighteousness by strategy."

LONG-DISTANCE RIDES (Dauerritte). By Veterinary Surgeon Dr. Heuss. 52 pp. 8vo. Berlin, 1908. Mittler. 1s. 6d.

The author enters very fully into the question of these exercises. He treats the subject under two main headings: preparation for the ride, and the method of carrying out the ride itself.

Under the first of these headings the selection of the class of horse to employ, the conditioning and training of the animal, and shoeing are carefully gone into. Opinion, in Germany at any rate, seems to favour half-bred horses for the purpose. The execution of the ride includes division of the distance and the nature of pace, feeding and watering, etc.

The natures of disease resultant on long-distance riding, and the measures to be taken with reference to treatment of the horse on completion of such an exercise, are also dealt with.

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