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CONTENTS.

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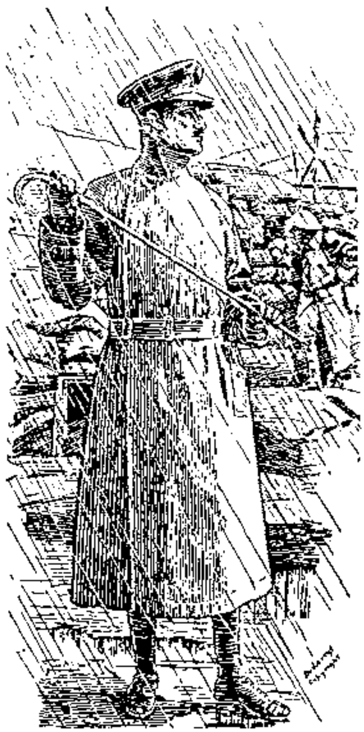

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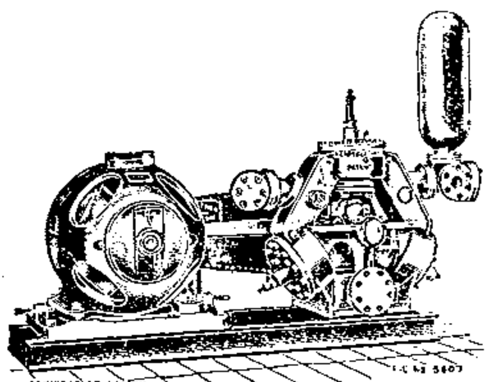

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CONTENTS.

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BATH HOUSES IN THE FIELD.

By Capt. L. B. O. Taylor, R.E.

The provision of some simple form of bath house in the field for troops is very desirable.

The following details, with drawings, of bath houses may be of interest and assistance to Royal Engineers who have to carry out this class of work. Details are given below for an installation suitable for from 4,000 to 5,000 men, and one suitable for a company, and a bathroom for officers.

Bath House for 5,000 *Men.—Plate* I. shows the design of the building which is practically a copy of W.O. plans and calls for no remarks. Forty shower baths are provided, and the capacity of the bath is about 800 men a day. From 3—5 gallons is allowed for each man. Hot and cold water tanks each hold 400 gallons and are on the same level; and, being at the highest point of the circuit, are open tanks. The hot-water tank and all hot-water piping were lagged with tarred roofing felt. The boiler consists of four parallel lengths of 2-in. pipe, joined together with the necessary tees and bends, and laid in a trench similar to that of a field kitchen. Brick baffle walls were built alternately above and below the pipes, and the upward slope given to the boiler was $\frac{1}{32}$. This was proved quite sufficient. Wood or coal can be used as fuel.

Plate II. gives details of the circulation system which is entirely on the primary circuit, and very simple. The hot-water return passes through a non-return valve, a full-sized drawing of which is given vide *Plate* II., *Fig.* 6; and then joins the cold-water feed from the tank to the boiler. By the introduction of this non-return valve it is claimed that whatever quantity of hot water is drawn off, it is impossible for the cold to gain any mastery over the hot, and this has been borne out in practice. The action of the non-return valve is briefly as follows:—The normal position of the valve is open, as shown in *Fig.* 6. As soon as hot water is drawn off, the rush of cold water to the boiler closes the valve, and keeps it closed until hot and cold tanks are both filled, and the system is balanced again. The circulation of water in the hot-water circuit due to water being heated in the boiler opens the valve again. In practice the valve has proved very sensitive and efficient. A syphon is fixed in the cold-water feed, between the cold tank and the point of junction with the hot return, its function being to prevent any chance of the hot water going up into the cold tank. Showers are provided, those illustrated being readily made by any tinsmith. Two systems for giving hot and cold water at the showers are illustrated in *Plate* II., *Figs.* 4 and 5. That in *Fig.* 5 is recommended, as although more wasteful of fillings, each man can mix hot and cold water to his own liking, whereas in *Fig.* 4 the cold water introduced serves five showers.

No complicated fittings of any sort are required in the bath house as illustrated here, and all stoves, etc., used are easily obtainable. The non-return valve is simple to make, and the one shown was made in the company in a very short time. It is found that from $1\frac{1}{2}$ to 2 cwt. of fuel are used daily. Hot water is obtained in about one hour after lighting up, and the fire can be allowed to die down about an hour before the final baths are taken.

The bath house costs £650 in all to build, the cost being divided as follows :—

Labour	£120
Materials and transport	£530

The cost of materials in this part of the world is nearly three times the cost at home, and it is estimated that a similar building could be built complete at home for £350.

The time taken to erect was a little over three weeks.

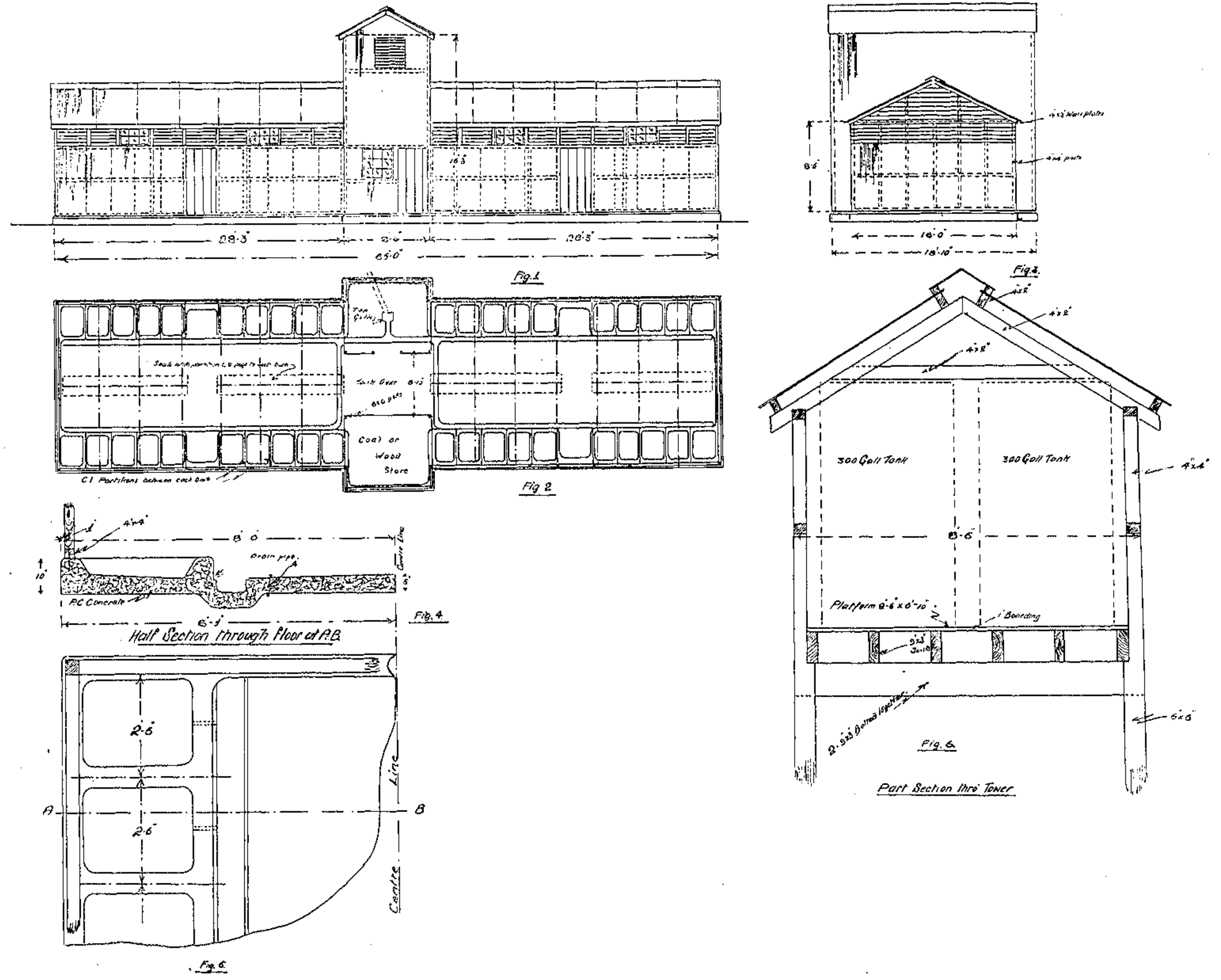
Plate III. gives details of a system suitable for a small bath house. A single length of $1\frac{1}{2}$-in. or 1-in. pipe or a combination of the two bent into coils in a field forge can be used; or as in the case illustrated the coils can be made up of 2-in. bends and sockets. The coils can be laid either horizontally or vertically, and appear to be equally efficient in either position.

Installations similar to this were put in for company baths and for officers' baths in a corps headquarters and have proved satisfactory, ample hot water being obtained within an hour of lighting the fires. No design for a bath house is given as any small shed can be readily adapted. In all cases illustrated a good head of water was obtained and no pumping was therefore necessary.

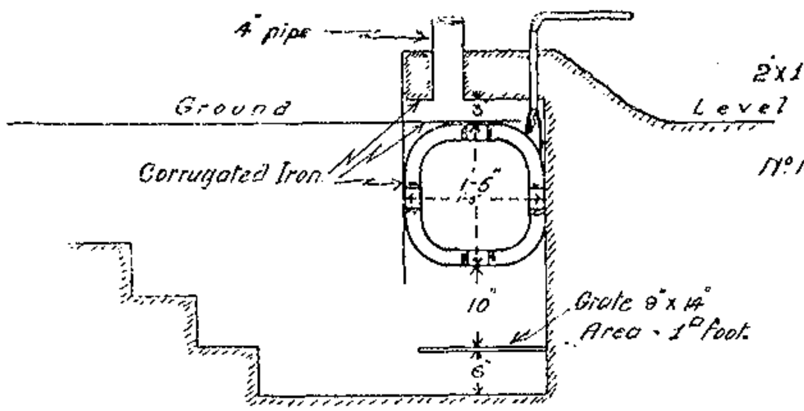
The arrangement of circuits in the large bath house is believed to be original, and was suggested by Sergt. T. Hagger of this company, who also invented the non-return valve. He has had great experience in hot-water engineering work in civil life prior to joining the Army, and worked out all the details given here.

PLATE I.

BATH HOUSES IN THE FIELD.



BATH HOUSES IN THE FIELD.



Section Thro' heater

Fig. 1.

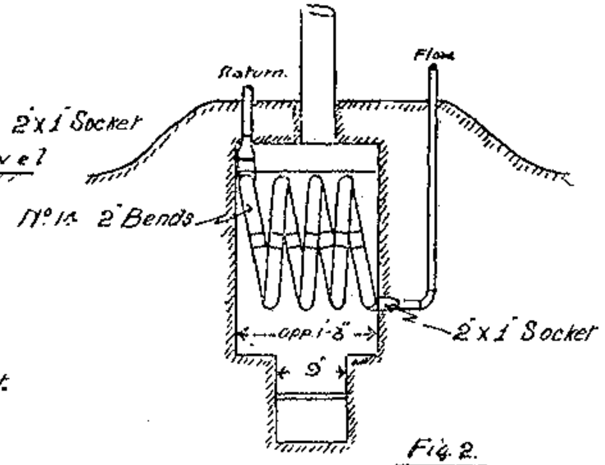


Fig. 2.

Front Elevation

Front Plate removed.

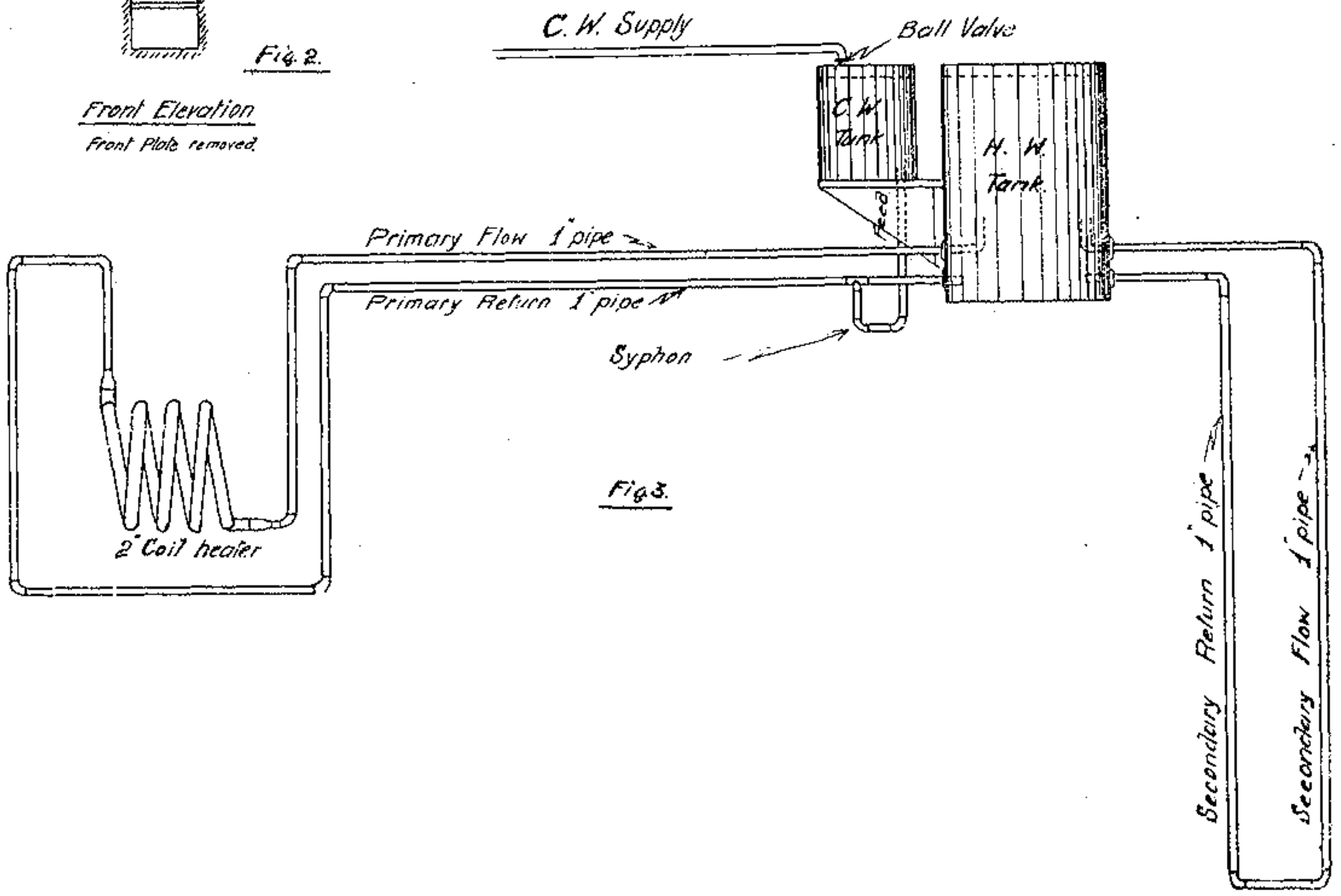
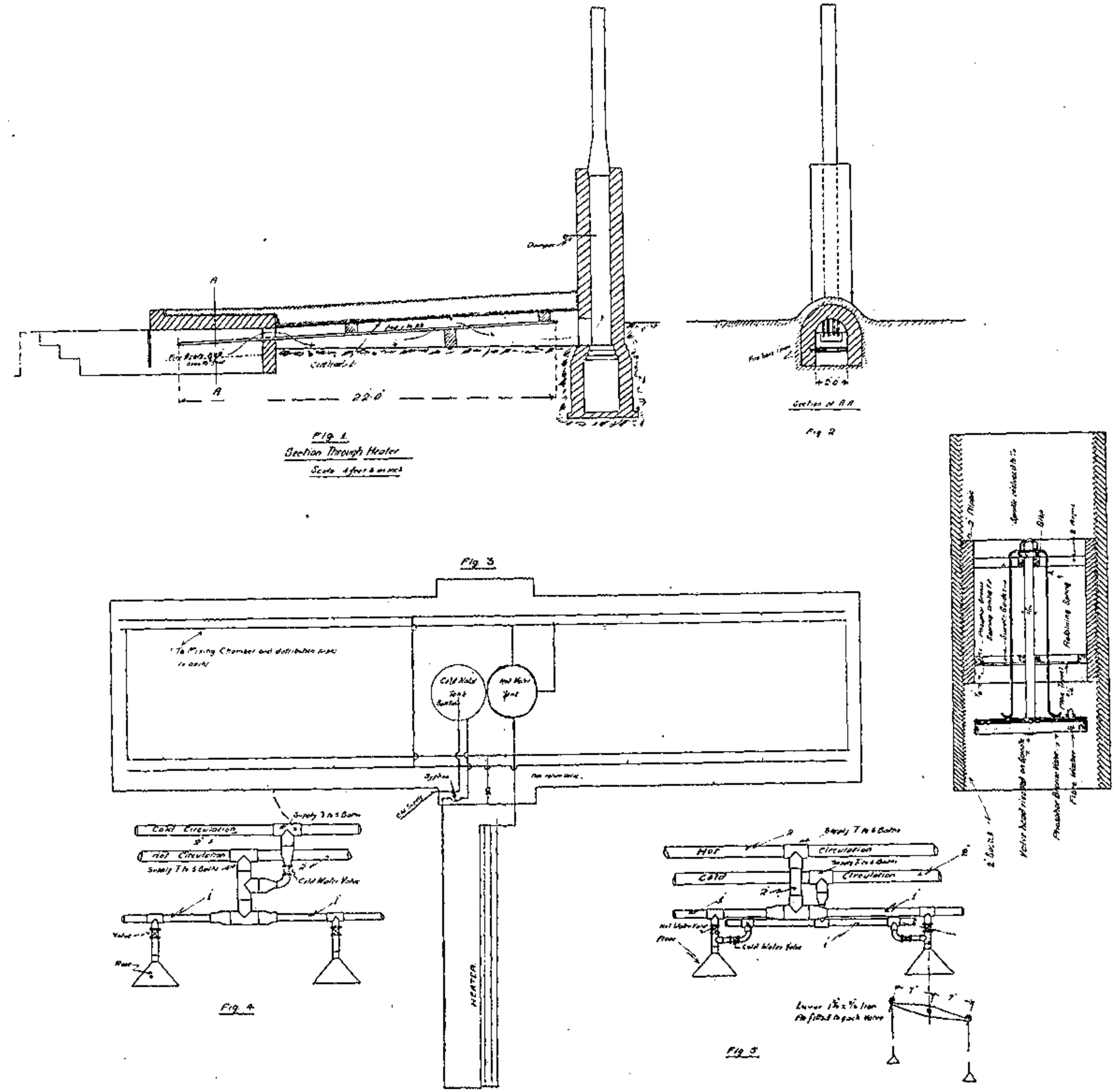


Fig. 3.

PLATE II.

BATH HOUSES IN THE FIELD.



GEOGRAPHICAL PROBLEMS IN BOUNDARY MAKING.

By Colonel Sir Thomas H. Holdich, K.C.M.G., K.C.I.E., R.E.

(*A Paper read at The Royal Geographical Society*).

The delimitation of an international frontier is the business of treaty makers who decide on trustworthy evidence the line of frontier limitation which will be acceptable to both the nations concerned, with all due regard to local conditions of topography and the will of the peoples who are thus to have a barrier placed between them. These are the two first and greatest considerations, and they involve a knowledge of local geography and of ethnographical distributions. Dependent thereon are other important matters which may largely influence a final decision—matters which may include military, political, or commercial interest, but all of which are subject to geographical and ethnographical conditions. It is only quite recently—within the last half century or so—that geographical knowledge has been considered an important factor (or considered a factor at all) in the education of the political administrator.

Fifty years ago the whole wide area of scientific knowledge embraced in the field of geography was narrowed to a ridiculous little educational streamlet which babbled of place names and country products. Scanty as was the educational value of geographical teaching fifty years ago, it was almost equalled in its feebleness by the practical knowledge of the subject which included the all-important matter of map-making. True we had our geodetic scientists, and much profound thought and practical energy had already been devoted to solving the riddle of the Earth's form and dimensions, such as laid the foundation for an after-extension of valuable bases for surface measurement which would sustain the building up of maps. But it was not the development of map-making alone which led to the better appreciation of the absolute necessity for scientific geographical education in the widest sense of the term. It was the discovery that we were being left very far behind in the field—not so much of pioneer research (there we have always held our own)—as of that practical knowledge which profoundly affected our position as a commercial nation, our prospects in the military field, or our political dealings with other countries when the question arose of partition or spheres of interest, that forced the conservative hand of our educational administration and led to the formation of geographical schools throughout the country. In short, it began to be quite clear that geography was a science that had to be reckoned with, and which it paid pre-eminently to study.

We have found now by the experience of the last twenty to thirty years that certain provisional methods, methods which involve the use of a smaller class of instruments and wireless telegraphy, and lead to rapid progress in advance of strict geodetic measurements, are quite sufficient to enable us to spread out our map system on comparatively small scales of work over the vast areas that are of primary interest to the commercial, military, or political geographer, without the accumulation of any error that would invalidate the map. This is the sort of work nowadays which is voluntarily undertaken by many travellers, and which gives us results that are far beyond those of earlier geographical pioneers in value. It is this sort of work which is wanting whenever a political discussion arises as to respective spheres of national interest in wide and only half-explored regions, and which usually remains wanting. It is often the fact of the possession of geographical data of the most absurdly elementary type that enables the commercial pioneer to succeed in striking effectively in the development of a fresh trade area. The details of such work concern the actual processes by which frontiers are secured, and belong to the demarcator, who completes the boundary demarcation when delimitation has taken shape in the form of an agreement or treaty between the high contracting parties. It is with the form of delimitation, and the primary necessity for trustworthy geographical information in the first place, and of sufficient geographical knowledge to prevent the misuse of technical terms that we are now concerned. This is an age of boundary making, of partitioning and dividing up territory, and it has by no means come to an end yet. It may well continue as long as the world endures. The territories to be partitioned, to which political boundaries have to be set, may be those of highly developed and well-mapped countries, or they may be dark and remote and guiltless of any map-illustration, which can be accepted as good enough to guide the work of demarcation. All sorts of countries, under all sorts of governments, from the black barbarism of Central Africa to the hothouse civilization of South America, have been subjected to the process, and of all of them may the same thing be said, *i.e.* that the process of frontier defining has resolved itself into a strictly geographical problem. It must always be so. A boundary is but an artificial impress on the surface of the land, as much as a road or a railway; and, like the road or the railway, it must adapt itself to the topographical conditions of the country it traverses. If it does not, it is likely to be no barrier at all. Boundaries have been twisted out of every conceivable natural feature with more or less success. The first preliminary to a boundary settlement should be, if possible, a reasonably accurate map of the country concerned;

but this is not always available, and it may happen that the mere agreement between two countries upon an abstract definition may be all that is necessary or possible for the time being. In that case, a store of future trouble is laid up if, in the terms of delimitation, it is not made clear that this arrangement is provisional only.

Here, then, we find the first rock upon which delimitation treaties split. It is the want of geographical knowledge. If, indeed, it is compulsory ignorance, if there is no possibility of waiting till maps can be made, the arbitrators are forced into the position of adopting the worst of all possible expedients—the straight line—then a provisional or inelastic agreement must take the place of a more elastic boundary.

Some very notable instances have occurred lately in connection with boundary settlements in Central and Southern Africa which illustrate the disadvantages of the straight line. In one case a meridian line was selected before even such preliminary investigations were concluded as might have determined a fairly accurate longitude and fixed a point on that meridian. The result was an awkward international complication as soon as it was discovered that a wide tract of valuable land had been erroneously assigned to England which subsequently had to be transferred to Belgium. In that case I think I am right in stating that quite enough of the geographical features of the country were known to decide whereabouts the dividing line ought to run, only unfortunately the meridian fixed upon did not happen to represent that line. There was little excuse for the mistake. In another instance a definite meridian was adopted which traversed a desert—the Kalahari desert—of South Africa. This is the eastern limit of what was German South-West Africa as it stood before the War. Now a desert may form an excellent frontier in itself, just as may the highest altitudes of a great range of mountains where the eternal snowfields and the remoteness of an uplifted wilderness are never trodden by the foot of man. It is true that even in deserts, African or Asiatic, wild nomadic tribes may exist who can band themselves together for mischief and who can raid across the frontier into each other's territory; and to them it may be desirable to point a landmark, either natural or artificial, and to say "You may not pass that mark." Outward and visible evidence of a barrier is the only thing they can understand. But how does a meridian help the matter? It is not only neither outward or visible without demarcation, but it may be very difficult and very expensive to determine. In this case a lengthy series of geodetic triangulation had to be carried from Cape Colony to the south of the boundary till it entered German territory, entailing years of scientific labour in a most unwholesome climate, and costing a sum equivalent to the value of many thousands of square miles of useful geographical mapping, in order to determine with some approximation to scientific exactitude where that meridian really lay. This was before the days of wireless receivers and the interchange of time signals.

Next to absolute blank ignorance of the geographical conditions which prevail in the theatre of boundary operations perhaps the sharpest and most dangerous rock in the delimitator's course is an inaccurate or assumed geography on which to base his treaty. Perhaps the most remarkable instance in recent history of this form of delimitation error is afforded by the dangerous antagonism which arose between the two great South American Republics of the Argentine and Chile with reference to the partitioning of Patagonia. Patagonia had only recently emerged from primæval conditions of barbarism under Indian occupation. Opportunity for exploration had been small, and the usual result of geographical enterprise along the Pampas bounded by the Andine foothills had been disastrous to the geographer. Such knowledge as was at the disposal of the high contracting authorities who met in July, 1881, to frame a treaty which should dispose of Patagonia between the two claimants had been furnished chiefly by old-world records of missionary enterprise which were seldom illuminating as map illustrations of the Andine territory. Later and more scientific inquiries carried out by competent explorers revealed the fact that the text of the treaty was based on inexact geographical knowledge. Throughout the northern territories of these two Republics the international boundary for thousands of miles had been determined by a line which was eminently satisfactory to both parties. It was the great divide of the Andes which parted the waters of the Pacific from those of the Atlantic. Nothing could have been better. As a natural barrier it is magnificent; as a definite line of partition facing the trespasser either way it may perhaps be difficult to recognize here and there, but as such intervals are just those which no trespasser from either side can possibly approach this is a matter of no consequence whatever. The extension of such a line to the extreme South of Patagonia, where the Andes end, so far as South America is concerned, was the simple and effective solution of an international difficulty that presented itself to the political arbitrators. The treaty laid down the principle that Nature's excellent management for a central water parting should continue to furnish the boundary, and decreed that it should be maintained by the main range of the Cordillera of the Andes which parted the waters of the Pacific from those of the Atlantic to a point near the Straits of Magellan. When, however, geographical explorers took the field it was not long before they discovered that the conditions of the treaty were irreconcilable.

The Southern Andes break up into a mountain system which still contains all the grandeur of snow-capped ranges, seamed by magnificent glaciers, and presents to the Pacific a snow-crowned rampart of majestic forest-clad hills, with, here and there at intervals, the white pinnacle of a volcano dominating its walls. But on the Argentine side it softens down towards the pampas and plains into a comparatively irregular formation of lower ridge and valley, flanked by broad terraces, scarlet and purple in autumn with all the glory of the Patagonian beech scrub, and infinitely varied both in form and feature. This lesser Cordillera encloses valleys of great beauty, and is frequently traversed by lakes of surpassing loveliness, the waters of which draw this way and that, taking their sources sometimes from the flats and "Masetas" of the Argentine plains, and passing right through the mountain system to an exit in the Pacific. This, to the treaty makers, was unexpected and vexatious, and experts on either side were deputed to prove that the boundary could follow but one course, which course (according to the side from which the argument proceeded) was either the main range of the Cordillera (*i.e.* that which was highest and most dominating) or else it was the main water parting—the great divide—of the continent, which sometimes followed a prominent range and sometimes was lost in marshy flats. War seemed the only possible termination of the dispute. Millions, many millions, were spent in ships and armaments, and the foundation was laid for an effective army trained on the latest military principles (German chiefly) on either side of the Andes. It really appeared as if a most natural assumption of geographical conformations which did not exist were destined to set back the tide of splendid progress of which both Republics could boast, and to wreck them on the shores of a long, bloody, and probably indecisive war. Fortunately stern good sense prevailed in the end, and British arbitration, crowned with the King's award, was accepted with deep gratitude by some and, I am inclined to think, relief by all.

Another instance of assumed geographical data for the basis of treaty making which led to results which were certainly awkward and expensive and which might have been dangerous, occurred in connection with the Russo-Afghan frontier. There was once, not so very long ago, a Liberal Government led by Mr. Gladstone, which was anxious to bring the tension of doubt and suspicion which surrounded Russia's proceedings in Asia to an end, and at the same time to deal very gently with Russia's political sensitiveness. This was to be achieved by setting a boundary between Russia and Afghanistan, and thus to draw across Central Asia a hedge beyond which Russia's progression southwards could not extend. There followed a meeting between high diplomatic dignitaries on either side (in which British interests were represented by that worst of all possible treaty makers, Lord Granville) and the delimitation of the boundary was duly effected. There may have been worse delimitations perpetuated since that day—I am inclined to think that there have been—but there has never been one in which less precautions have been taken to ensure that the map geography of the regions in question was accurate. There is this much excuse for the light-hearted acceptance of the ancient maps then in existence, that for the greater part of the delimitation, the Oxus River was itself to represent the dividing line; and the Oxus River, no matter how much displaced on the map, was a great natural feature which could not be missed. The trouble came with the definition of a particular point—the post of Khwaja Salar—as a boundary objective on the banks of that river. Great rivers which wander untrammelled and free through wide alluvial plains of their own making are not to be trusted as permanently bound by any banks which possess no artificial means of defence against corrosive action, and the Oxus (a splendid boundary in its higher reaches) is no exception to the rule in the plains of Afghan Turkestan. Two commissions, the unwieldy British and the compact Russian, spent weeks of diligent searching, with the interchange of much political controversy, over that wretched post, which was not of the least importance, and which had been washed in by the river and swallowed whole many years before the commissions met. The worst result, however, was delay in the field of Afghanistan whilst an uncertain-tempered and gout-ridden Amir (who was exceedingly anxious to be rid of the commission) dominated the political situation. It was, indeed, exceedingly dangerous, and we were well out of it.

Assumed geography hardly works more havoc with frontier treaties than does the misapplication of geographical terms. The main points of the land configuration may be sufficiently well known; maps may be fairly up to date, and the setting out of an agreement may be based on points and features that are fixed and unalterable. And yet the terms of an agreement may lead to most unpleasant discussion as to their meaning between rival commissions in the field, and may even be the means of breaking up proceedings altogether until the high contracting parties have explained themselves. Several such instances have occurred within my experience. One of the simplest occurred during the demarcation of the boundary between Afghanistan and those tribal territories which were to be reckoned independent and beyond interference by the Kabul Government. The boundary concerned passed through an open country—a country of hill and plain where the hills were sharply defined in long and generally continuous lines, sometimes knife-edged as to their summits, with steep rocky spurs deeply rifted by water channels. From the foot of the spurs there sloped away in smooth but often steep gradients the fans formed by detritus washed down from the mountain sides forming what is locally known in Baluchistan as "dasht." The "dasht" sometimes shaped itself into a broad and apparently smooth ramp 7 or 8 miles in width, a prairie land of low scrub and flowers in spring, a wide expanse of stone-dusted slope in winter, which stretched between the foot of the mountain spurs and the meandering course of the nullah bed which formed the main drainage line of the valley. A very considerable length of the boundary which was to be based on the mountain range or ridge was defined as following " the foot of the hills." Here at once was the opening for serious disagreement—and the disagreement promptly arose. What was the " foot of the hills " ? Was it where the steep rocky spurs ended and the sloping grades of the dasht began ? Or was it where the nullah ran in the midst of the plain and the slope from the hills could descend no farther ? In the latter case one would have expected the boundary to have been defined in the treaty by the actual nullah bed rather than " the foot of the hills." That, at any rate, was the interpretation maintained, and the interpretation nearly led to a frontier war.

Another instance of similar slipshod definition occurred in the Asiatic highlands where the Pamirs spread out their gently sloping flats and valleys under the shadow of well-defined mountain ranges. So vast and so rugged are these ranges that it is only by grace of a glacial ramp that they can be ascended, as a rule. The connection between the triangulation which should determine the points on which to base the boundary between Afghanistan and Russia in these uplifted regions and that which supplied us with a series of fixed peaks in the Himalayas to the south was exceedingly difficult. However, it was accomplished, more or less successfully, and Indian triangulation was carried into the Pamirs and connected with the Russian surveys. This was important scientifically for reasons which concerned the demarcation of a boundary based on astronomical determinations of latitude. All went well enough after the junction was completed and accepted for the purpose of supplying initial data. The trouble arose when approaching the end of the demarcation ; the boundary was defined in the treaty as running to the Chinese frontier. The definition was as follows :—" From this point the boundary shall run in an easterly direction to a junction with the Chinese frontier." What is an easterly direction ? A little north of east ? A little south of east ? Due east ? The expression was indefinite, and the interpretation involved the question of certain passes (whether they were of value or not we need not stay to inquire) which were considered as important at the time. The short summer and autumn were drawing rapidly to a close. Snow was settling deep in the passes Indiawards, and it seemed possible that ere an answer could be received to the simple question, " What is an easterly direction ? " the camp of the commission would be snow-bound in those vast altitudes and condemned to an Arctic existence for the next six months. Naturally there was no agreement between English and Russian camps ; and they arranged to separate for the winter. Much expense was incurred in collecting fuel and selecting the best shelter available for the next six months. It fortunately happened, however, that the weakness in geographical expression had been recognized in time. It appeared to be so certain to lead to complications as to justify an early reference to the chief contracting authorities in anticipation of such complications; and the reply, which determined the conclusion of the line on the basis of ascertained topography, was received just in time (and only just in time) to enable us to escape over the passes, already deep in snow and thickly shrouded with menacing snow mists, back to sunny India.

It is true that geographical nomenclature is by no means fixed. The question has been discussed with great diligence and careful research both by the Royal Geographical Society and the Geographical Society of America, but it is not with reference to the actual facts of land conformation in nature that trouble usually arises. It matters not much whether the technical classification of land forms is geodetic, based on the geological history of the formation, or whether it is simply physiological description expressing the character of the form in terms of its relation to other geographical features; whether the names of such features have a foreign derivation, or whether they are pure Anglo-Saxon, so long as the geographical definitions contained in a boundary treaty are technically accurate and precise in their meaning. Probably the actual loss to England due to the promulgation of boundary treaties drawn up with little or no regard to simple precision in statement could be reckoned in millions of pounds sterling. If a man were making a will full of complicated provisions, he would employ a lawyer armed with the full technical vocabulary of that rhetorical profession to make it for him. If he wishes to put a hedge between his own and his neighbour's estate he would take care that the agreement was correctly worded. But in defining a boundary between one nation and another not even the most elementary knowledge of geographical nomenclature has seemed to be considered necessary. To take the case already quoted of the boundary disagreement between the Republics of Argentine and Chile: nearly all the trouble arose from the interpretation of the words "main range." What is a main range? I could give you many other examples of equally indefinite description, but there is not space.

There is yet another shoal in the intricate sea of delimitation (even when the delimitation is based on sound topography) and that is the selection of some impossible geographical feature to carry the boundary. This is indeed not very usual, but it is very fatal to rapid and satisfactory progress in demarcation. An instance of this occurred in demarcating that part of the Indian boundary which separates Chitral (and Kashmir interests) from Afghanistan. Here the agreement defined the boundary as running parallel to the Chitral River at an even distance of 4 miles from the river bank. Thus it fell on the spurs of a flanking range, about halfway between the summit and the foot, festooning itself from spur to spur, cutting across mountain torrents and dividing water rights in accessible valleys, a continuous line of ascent and descent over some of the wildest, ruggedest and most inaccessible mountainside country that the Indian frontier presents, albeit it overlooks one of the loveliest of frontier valleys. Demarcation was an utter impossibility, nor could, or would, any tribesman of that wild Pathan frontier pretend to recognize such a line without an infinity of artificial boundary marks. Fortunately, it was possible to suggest an alternative without any great loss of time, and as that alternative was the well-marked crest, or divide of the range, instead of being halfway down its ragged side, and as the alternative would include a certain concession of (utterly unimportant) territory to the Afghans there was no great difficulty in effecting an alteration in the text of the agreement. Here again the hazard of the business was delay.

References to a few of the difficulties which have occurred in the interpretation of comparatively recent boundary treaties ow.ng to lapses in scientific geographical description only prove that until lately the great principle of recognizing the geographical function of boundary demarcation, before proceeding to political definition in detail, was misunderstood. Quite recently, however, many boundaries have been settled in many quarters of the globe (especially in Africa and in South America) which have led to no disastrous disputes whatever, and have called for no arbitration. This is a satisfactory proof of the gradual development of geographical teaching for which the Royal Geographical Society may fairly claim a share of credit. To illustrate the advance made in geographical definitions we may refer to the position of geographical knowledge in the eighteenth century. Geographical terms in treaty definitions in those days was so vague as to be almost grotesque. There is one treaty with its attendant interpretations and the disputes arising therefrom which makes a good story, and is worth a reference, if only to set a point to our satisfaction at the gradual development of this branch of practical knowledge. The negotiations for the Canadian boundary from the Bay of Fundy to Juan de Fuca have really lasted into this century—but they commenced late in the eighteenth century. In November, 1782, representatives of Great Britain and the United States signed at Paris a provisional treaty of peace. It acknowledged the Independence of the United States. Article II. provided that between the United States and Canada " it is hereby agreed and declared that the following are and shall be their boundaries, viz., from the north-west angle of Nova Scotia, viz., that angle which is formed by a line drawn due north from the source of the St. Croix River, to the Highlands; along the said Highlands which divide those rivers which fall into the St. Lawrence from those which fall into the Atlantic Ocean, to the north westernmost head of the Connecticut River; thence down along the middle of that river to the 45th degree of north latitude; from thence by a line due west on said latitude until it strikes the River Iroquois or Cataraquy; thence along the middle of the said river into Lake Ontario," etc. The definition then deals with the series of great lakes and their connecting streams till the boundary reached the lake of the woods. "Thence through the said river" (lake of the woods) "to the north-western point thereof and from thence on a due west course to the River Mississippi" . . . "East by a line to be drawn along the middle of the River St. Croix from its mouth in the Bay of Fundy to its source, and from its source directly north to the aforesaid Highlands which divide the rivers which fall into the Atlantic Ocean from those which fall into the River St. Lawrence; comprehending all islands within 20 leagues of any part of the shores of the United States and lying between lines to be drawn due *east* from the points where the aforesaid boundaries between Nova Scotia on one part and East Florida on the other shall respectively touch the Bay of Fundy and the Atlantic Ocean; excepting such islands as now are, or heretofore have been, within the limits of the said province of Nova Scotia."

On 3rd September, 1873, a definitive Treaty of Peace was signed at Paris in which Article II. was repeated as above.

For geographical information the negotiators were dependent on a map issued in 1755 called Mitchell's map. It appears to have been a better map of North America than any previously published, but it was a fact which must have been well known to the negotiators that much of the country was absolutely unexplored. The childlike faith with which that map was registered as the basis of an important treaty sufficiently indicates the value set on scientific geography in England in those days. The following difficulties immediately presented themselves to the demarcators:—

1. Where was the River St. Croix? There were two rivers 50 miles apart, either of which might be the St. Croix of the map. The name was unknown locally.

2. What was the source of the river which was finally decided to be the St. Croix (in reality the Schowdic) supposing it had two branches (which it had).

3. What was meant by the *north-west angle* of Nova Scotia? Where was it?

4. What were the Highlands? Did they merely represent a divide, or were they actually hills?

The discussion of these questions lasted for many years. There was a long period of acrimonious dispute lasting about 50 years over the question of the Highlands alone, during which we were more than once on the edge of a war with the United States, and geographical theories were put forward which would lead to the conviction that a sense of humour has only recently been acquired by Americans. An ancient grant of all Nova Scotia made in 1621 to Sir William Alexander and defining the borders of that province was produced in evidence of former boundaries, from which it was clear that the expression " due north " from the source of the St. Croix had been substituted in the treaty for " northward "—and the western branch of the St. Croix (or Schowdic) had been adopted for the eastern. The first piece of pedantry cost England all the northern half of the state of Maine; the latter was not of great consequence. The " Highland " question was finally referred to the King of the Netherlands for arbitration, and that wise monarch, with the geographical acumen of a Dutchman, at once put his finger on the weak spot, and after pointing out that boundary disputes based on apocryphal geography must ultimately end in compromise, he decided that a divide was not necessarily hilly or mountainous, and awarded a line from the head of the St. Croix northwards as a " line of convenience " to the " north-west angle of Nova Scotia," and from thence by the St. Lawrence-Atlantic divide to the head of the Connecticut (which river also had two heads). The award did credit to his position as king of a nation of practical geographers; needless to say this did not satisfy the disputants, and the boundary finally accepted departs from the divide (to the advantage of Britain) for a space sufficient to destroy its value as a true geographical barrier. This arbitration treaty was signed in 1842. The area in dispute amounted to about 12,000 square miles, of which about 5,000 fell to Britain, who made concessions about the head of the Connecticut, where the 45th parallel had been wrongly determined.

Long before this fierce antagonism had been roused by the question of the fishing rights, and the ownership of islands in the Bay of Parquamoddy into which the St. Croix debouches. The geographical definition of a bay was called in question as soon as it was admitted on both sides that the " due east " of the treaty meant " due south." Was the Parquamoddy Bay a part of Fundy Bay? Was Fundy Bay the Atlantic, etc.? Difficulties here were not finally disposed of till the year 1910. From the head of the Connecticut to Wood's Lake there was no fundamental ground of dispute. It was found that the great chain of lakes really did link up one with another, and the only question that arose was in connection with islands in those lakes. In Wood's Lake, however, it was speedily discovered that no line running west from the north-west corner of the lake would ever reach the Mississippi; inasmuch as that river rose south of the lakes. Consequently the effort to reach the Mississippi was abandoned, and the 49th parallel of latitude was adopted as the international boundary under the mistaken impression that it was the *northern* boundary of Louisiana. The nature of this extraordinary boundary from the Lake of the Woods to the sea need not be referred to, but the final difficulty of San Juan's Island renders this story of an historical geographical muddle complete. The treaty maintained that the boundary was to follow the 49th parallel to the middle of the channel between Vancouver and the mainland, and thence pass southwards following the middle of the channel round the mainland. But between Vancouver and the mainland south of 49° north latitude there is an archipelago of islands, and at least three channels that might be called main channels leading through them southwards. Chief among these islands was San Juan. In 1859 a pig was shot by an American on San Juan and the American was haled before a British magistrate and threatened with imprisonment. This put a climax to the dispute, American honour was touched, and troops were landed from both sides. It looked as if the pig incident would lead to war; but the position was saved by arbitration, the Emperor of Germany being appointed arbitrator. The award gave away the whole archipelago to the United States.

It may be added that in 1870 the Canadian boundary at Pembina was found to be 4,700 ft. south of its true position in parallel 49 degrees. This was rectified and the work completed in 1874. Demarcation was effected in 1908. It has only just been completed (if indeed it is complete), but the cost of maintaining it will last through all time.

Absurd as are many of the incidents connected with the Canadian boundary, it may be doubted whether the Alaskan muddle was not almost equally remarkable. It was primarily caused by the purchase of Russian territory in Alaska by the United States, which included a strip of coast land extending roughly from Mount St. Elias, in South Alaska, to Cape Muzon and the Portland Canal to the west of British Columbia and bordering the Pacific. After much negotiation a convention was concluded at Washington in January, 1903, which was to decide the position of the boundary by reference to a tribunal. The difficulty of decision arose chiefly from the original terms of delimitation in the treaty of 1825. The boundary was to run northward from the 56th degree of north latitude (*i.e.* the head of the Portland Channel—or canal) "following the crest of the mountains situated parallel to the coast until its intersection with the 141st degree of west longitude, subject to the condition that if such line should anywhere exceed the distance of 10 marine leagues from the ocean then the boundary . . . should be formed by a line parallel to the sinuosities of the coast and distant therefrom not more than 10 leagues. If any continuous range such as the treaty demanded had existed with a crest uniformly parallel to the coast it might have been an ideal boundary, but the geographical impossibility of such a disposition of nature seems hardly to have been recognized, and the question resolved itself into the determination of an irregular line in a mountain region which should never be more than 10 leagues from the ocean, and which should accord as far as possible with the condition of parallelism to the coast. This involved the secondary question of what is the coast line in such an archipelago of islands and islets as that with which the tribunal had to deal. The condition of strictly following its sinuosities was an impossible one. The tribunal finally decided on a line which was a mountain boundary practically in accordance with the contention of the United States. The line joined certain peaks marked on a map attached to the award forming a sinuous boundary about 30 miles from the general trend of the shore, and is, presumably, a line which it would be impossible to demarcate. The question of the course that the line should take from the point of commencement to the entrance to the Portland Channel formed an important branch of the award. This involved the right of occupation to certain islands. By the decision of the tribunal (with the strong dissent of two of the British members) the channel of the treaty was decided to be that which passes to the north of Pearce and Wales Islands, and which transfers two other important islands, Silklan and Kanna-ghunut, commanding the channel, to the United States, from Canada. The indignation which was aroused in Canada by this decision is a matter of comparatively recent history. It did, in fact, ignore one of the most important principles of boundary making when a compromise is in question. In the scheme for a fair and useful division between rival claims generally, it is most important to preserve the entity of any one concession in particular. For instance to divide a valley so that water sources are on one side and the irrigable lands on the other, is merely to invite the trouble which it is the whole object of a boundary to prevent. In this case the right of navigation through the channel to Canada, and the command of the channel to America by the cession of these islands, certainly seems to be a mistake.

REINFORCED CONCRETE.

By H. M. WILSON.

THE following paper is reproduced by the kind permission of the Secretary of the Society of Engineers, Mr. A. S. E. Akerman, B.SC., A.M.I.C.E. :—

This is a form of construction that is engaging the attention of the best engineers. There is no doubt that many large structures in the future will be made of reinforced concrete, especially in the case of reconstruction work after the war.

Reinforced concrete has existed in practice and theory for more years than one would perhaps imagine. It is generally recognized that Mons. Monier was responsible for the first combination of steel and concrete, in order to produce a stronger material, as long ago as 1860. Metal had been used in conjunction with concrete previous to this, such as in the dome of St. Paul's Cathedral, and in some Roman work, but it is believed that these were instances of conjecture rather than calculation.

Portland cement is the finest material for the preventing the corrosion of iron and steel, but only if applied in the proper manner. People realized this, but were under the impression that the unequal expansion of the two materials would cause a combination to be a failure through their not adhering to each other. This theory was exploded by the experiments of Hyatt, Bonniceau, and others which conclusively proved that for all practical purposes the expansion of steel and concrete are the same. The coefficients of expansion for these materials being concrete, 0·000,006, and steel, 0·000,0065. After this the use of reinforced concrete became more extensive, and it has been increasing ever since, gaining greater popularity for constructional work each year, on account of its excellent and peculiar properties. Reinforced concrete is fire proof, incorrodible, vermin proof, increases in strength with age, and is unaffected (owing to its monolithic form) by vibration, and sometimes even by earthquakes.

America is at present the leading nation in reinforced concrete work, whereas England ranks only fourth amongst the nations in the work. It is sincerely hoped that this may not be the case for long, for England with her splendid engineers should be able to make great strides in this comparatively new branch of constructional work.

The Moduli of Elasticity of Concrete and Steel.—The modulus of elasticity of concrete has not as yet been accurately determined, the results of experiments varying from 6,000,000 lbs. per square inch to 500,000 lbs. per square inch. The modulus of elasticity of steel is far more constant, viz.: 30,000,000 lbs. per square inch. The ratio of the modulus of elasticity of steel to that of concrete is generally taken as 10, though some recommend the value 15.

Adhesion of Concrete to Steel.—This depends on two things, namely the area of the surface of contact and the nature of the concrete. For the best concrete the minimum adhesion is about 275 lbs. per square inch. This is only theoretical however, and in order to prevent the steel slipping through the concrete, owing to the diminution of the cross sectional area of the steel when loaded, the adhesion is taken as 100 lbs. per square inch. This uncertainty leads to the different forms of patent bars designed to avoid the necessity of having to rely on the surface friction by providing a mechanical bond between the steel and the concrete.

General Theory of Reinforced Beam Action.—It is generally assumed that the normal stress on a vertical section of a beam varies with the distance from the neutral axis, consequently the curve of the stress is a straight line.

The bending moment, and the resulting tensile and compressive forces have a maximum value (in the case of a beam freely supported at its ends and loaded with a uniformly distributed load) at the centre, and decreased to zero at the ends of the beam.

A beam reinforced horizontally alone fails through diagonal tension, for although the shearing stress may not in itself be sufficient to cause the failure of the beam, however small the amount of shearing force, it is accompanied by a considerable amount of diagonal tension.

In experimental work it will nearly always be found that a beam reinforced without provision being made for diagonal tension will break with 100 lbs. per square inch of shearing stress on the section, owing to the diagonal tension that results from it.

In theory the stirrups should be perpendicular to the lines of stress, but this is impracticable owing to the fact that the inclination of these lines is different at different points in the beam. The angle of 45 degrees occurs only at the neutral axis, and so there is really no reason why the stirrups should not be vertical, which is practically always the case, as stirrups set vertically are far less liable to get out of position when the concrete is put in place than they are if set an angle. The greatest diagonal tensile stress occurs at the extremities of the beam and it is, therefore, customary to bend up some of the tension bars towards the end so as to resist this force.

It is quite easy to put vertical stirrups in place, and they form a connection between the tension and the compression areas.

The adhesion of the bars to the concrete transmits the stress from the bars to the concrete, consequently this must always be checked as much as the tension in the steel.

Horizontal bars placed near the bottom of the beam provide sufficient reinforcement for the central part of the beam, but additional reinforcement must be used at the extremities to meet the diagonal tension, as has already been mentioned.

Action of a Reinforced Concrete Beam under Loading.—(1). The beam acts as a true combination of steel and concrete until a stress of about 3,000 lbs. per square inch occurs in the steel.

(2). The neutral axis then rises and the concrete loses some of its tensile value, and the tensile stresses formerly taken by the concrete are taken by the steel.

(3). The position of the neutral axis remains fixed as the concrete has lost its remaining resistance to tension. Thus it is seen that the resistance of the concrete affects the deformation and deflection of the beam when the loads are small, but with greater loads the steel alone does take the tension, the resistance of concrete to tension usually not being taken into account.

Centering.—It is absolutely essential that the concrete should not be disturbed after it has been put in place, and on that account the centering must be of such a nature and design as to prevent this taking place and so that it can be easily eased and removed without producing a jarring effect on the recently completed work.

As in cast-iron construction it is desirable that there should not be any sharp corners, so in concrete work all sharp corners must, wherever possible, be avoided and round corners be constructed.

The timbering forms or shuttering used in concrete work can be lime washed or greased so as to give a rendering to the work and at the same time make their removal less difficult. A camber of at least ¼ in. in a foot should be given to all beams and slabs of reinforced concrete. The joints should be such that little leakage can occur. The forms should be arranged in such a way that the sides of columns can be moved first, then the sides of the beams and the centering, and lastly the supports below the beams themselves.

The sides of the columns can generally be removed about a week after the laying of the concrete. Fourteen days from the time of placement is usually allowed for the removal of centerings. The beam supports are allowed to remain in position longer so that the concrete may have a better opportunity of setting hard before the beam has to support the full dead load. The beam supports may usually be removed after three weeks from the time the concrete was put in place, but in cases of large spans this time should be increased.

The removal of all kinds of centering and forms requires a considerable amount of experience, and must only be done under the directions and supervision of the engineer in charge, as it involves great responsibility.

Water.—The amount of water required for mixing concrete depends upon the weather at the time of mixing as well as upon the nature of the aggregate and the sand. The concrete when mixed should be sufficiently plastic to remain at an angle of about 30 degrees in a barrow and not wet enough to drip when placed upon the centering. After the concrete has been rammed the water should just ooze to the surface.

Steelwork.—The steel should stand a stress of 34,000 lbs. per square inch before any appreciable set is apparent. It should stand bending, when cold, to an angle of 180 degrees round a bar of the same diameter without any fracture. No concrete work should ever be carried out when the temperature is that of freezing, or indeed if it falls below 39 degrees F., as at that temperature water is at its maximum density. If concrete has taken its initial set before frost comes on then it is quite all right, but the forms and centering must be left up for an extra period of time corresponding with the time the frost lasted.

Should a frost occur when the work is newly laid, it should be covered with sacking.

Placing of Reinforcements.—The steel must be in such positions that it acts in the best possible manner and as shown on the working drawings, and it is the duty of the engineer in charge to see that this is done. It is also of the greatest importance that they are not moved from their positions by the laying of the concrete. Concrete should be kept slightly wet for at least seven days after it has been laid. Careful examination must be made before the concrete is laid to ascertain whether there is any dirt in the centerings, and if there is it must be all removed before any concrete is introduced. All the centerings and forms should be wet at the time of laying concrete, so that the timber may not absorb any of the moisture from the concrete. Whenever possible the concrete should be placed in position from as small a height as possible, owing to the tendency of the cement to separate from the other ingredients when dropped from a height. All the concrete must be well rammed, especially round the steel bars.

The ends of bars projecting from any recently completed work must not be knocked or jarred, as such an action would damage the final set of the concrete and thus reduce its strength.

Columns.—In square columns three of the four sides are shuttered before the work is commenced. The steel bars are then put in place and the concrete is introduced from the open side, the fourth shutter being built up as the work proceeds.

Beams.—Sometimes it is found difficult to make the concrete pass between the bars of a beam, and in such cases the concrete may be made more liquid than usual.

Slabs.—When the centering has been erected, the bars should be placed in the positions allotted to them on the working drawings, being kept apart for the time being by the use of templates. The crossbars are wired to the main bars at frequent intervals and serve to keep the latter in position.

Corrosion of Steel in Reinforced Concrete.—Much is said nowadays on the question of the corrosion of the steel bars in reinforced concrete; a considerable amount of practical evidence, however, enables all engineers experienced in reinforced concrete to state most emphatically that under no conditions is the steel adversely affected by the concrete. Chemical action takes place between the cement and the steel, calcium ferride is formed, and this prevents corrosion taking place.

In order to demonstrate, in a purely non-technical manner, the great difference there is between the strength of ordinary and reinforced concrete, the author made two beams, one of reinforced concrete and the other of plain concrete. They were both of the same dimensions, each being 2 ft. long, 1 in. deep and 1½ in. wide. The concrete in each consisted of:—Three parts of sharp river sand to one of slow-setting Portland cement. The reinforced beam had bars of an alloy, which consisted mostly of zinc, no steel bars small enough being obtainable. The reinforcing was placed ⅛ in. from the bottom of the beam. The stirrups were made of copper bell wire, six being placed at each end of the beam.

The beams stood the following loads:—Plain concrete beam—120 lbs. at the centre. The reinforced beam—470 lbs. at the centre.

In conclusion the author would like to urge upon his fellow students the advisability of reading up this subject, which is not only interesting to all engineers but which will undoubtedly be the great structural material of the near future.

COLONEL AUTHUR MOFFATT LANG CB

he became Chief Engineer and Secretary. When making the road from Simla into Thibet, to open up traffic with China, the path had to be carried in places along the face of vertical cliffs in gorges thousands of feet deep. The only way of tackling this was to sling native workmen over from the tops of the almost inaccessible rocky scarps, who would jump holes in the face of the cliff, and fix steel jumpers or crowbars at the proper levels and distances, using them to support wooden platforms from which blasting operations could be undertaken. Gradually in this way a narrow roadway was worked out in the cliff. It required a good head to superintend all this overhanging work, and no better man than Arthur Lang could have been found for the job.

In 1871 Capt. Lang was appointed to officiate as Principal of the Thomason Civil Engineering College, Roorkee. Promoted to Major in 1872, he was made permanent Principal of the College in 1873 and held the appointment till May, 1877. On his return from furlough in 1879 Lieut.-Colonel Lang was posted to the Military Works branch and was placed in charge of the Fortification Branch at Headquarters, Simla. One who worked under him there says, "As a young subaltern I was much struck by his strict control combined with encouraging urbanity and consideration for juniors. His knowledge of the art of fortification and details connected therewith was vast, and under his superintendence a number of valuable projects were prepared. Out of office his kindliness and friendliness were marked, and the hospitality of his house was unbounded."

Lieut.-Colonel Lang was next appointed Superintending Engineer and Secretary to the Agent to the Governor-General, Beluchistan, and took up his duties in February, 1881, at Sibi. In October of the same year he was promoted Brevet Colonel, and in January, 1883, was appointed to officiate as Chief Engineer and Secretary to the Chief Commissioner, British Burma, at Rangoon, where, as the province was somewhat disturbed at the time, a really good man was wanted. On his advancement to Chief Engineer, Class II., he was appointed to the Local Government North-West Provinces in April, 1885; but as he had been nominated C.R.E. of 1st Army Corps he was directed to remain pending further orders in Burma. He arrived at Naini Tal, N.W.P., in July and was promoted Chief Engineer, Class I.

He was permitted to retire on the maximum pension on 1st December, 1888. Thus ended a long and distinguished career in his country's service.

This notice of the public career of Colonel Arthur M. Lang would be far from complete without an appreciation of his personal character. Strong and full of fiery bravery, as we have seen, he was at the same time gentle and modest—his was a nature to avoid and dislike publicity. He was always active and athletic, and when Principal of the Roorkee College he interested himself

At Cawnpore he joined the army under Sir Colin Campbell, marched to Lucknow and served throughout the "relief." Here he was among the first at the storming of the Sikandarbagh, where he was knocked down by a bullet and bruised, though not wounded, and was also with the 93rd Highlanders at the capture of the Shah Najaf. At the capture of the Mess House he was ordered, with Lieut. Forbes, to blow in the gate, and was promised the Victoria Cross personally by Sir Colin Campbell. He crossed the moat with explosives, but, as he afterwards said, unfortunately (!) there was no opposition.

After his return from Lucknow, on 6th December, he was present at the Battle of Cawnpore, and then served with Walpole's Brigade in minor actions in the Doab. In January, 1858, he was employed on the defences of Futtegurh Fort.

In February and March, 1858, Lieut. Lang served throughout all the operations of the Siege and Capture of Lucknow under Sir Colin Campbell, taking part in the assault and capture of many important positions including the Imambara and Kaisarbagh.

Among his plucky acts here was a daring reconnaissance (in company with Lieuts. Medley, R.E., and Carnegie, R.E.) of Kadam Rasul and the Shah Najaf. These places were found to be abandoned, enabling a considerable advance to be made without opposition and loss. Application was again made for a V.C. with the same answer as on the first occasion. Lieut. Lang was for the fourth time mentioned in dispatches.

After the Capture of Lucknow he served with Sir Hope Grant's Column in Oudh, including the action at Baree, etc., till he was recalled to Lucknow for employment in housing the large army quartered there in 1858.

So ended Arthur Lang's work on active service, which has been narrated in as much detail as is permissible in this short memoir, in order to show the energy and fearlessness of his nature. A young man of fine stature and splendid physique, he had been captain of the cricket and football teams at Addiscombe, and in the stress of war was always foremost in deeds of daring, courage and endurance.

For his services in the Mutiny he received the medal with three clasps; and there can be no doubt that the C.B. which was only awarded to him in 1908, when he was in his 76th year, was thoroughly well earned.

After these events he was appointed Assistant to the Chief Engineer of Oudh, and Executive Engineer, 3rd grade, in July, 1859. After transfer to the Punjab (Umballa) in January, 1861, he was promoted Captain in March, 1862, and to the 2nd grade in the following June. In 1863 he was appointed to the Hill Roads Division, Simla, and transferred to Oudh in 1865 as Assistant Secretary to the Chief Commissioner of Oudh. Promoted to the 1st grade later in that year would be necessary in the assault. Unobserved the officers descended the 16-ft. counterscarp and Lang mounted to the berm and ascended the breach. The enemy had heard them, and a hasty retreat was made to the crest of the glacis. The party then ran back, followed by a volley from the rampart which fortunately hit no one.

For his gallant conduct on that day (related at length in the *Life of General Sir Alex. Taylor*, and also in Lord Roberts' *Forty-One Years in India*) Arthur Lang was recommended for the V.C. by Capt. Taylor and Capt. Maunsell, R.E. (afterwards General Sir Frederick Maunsell). This was not granted on the ground that the work was "within the line of duty." He was, however, "mentioned in dispatches."

On the following day Lieut. Lang guided the storming party of the 1st Bengal Fusiliers, H.M. 75th Foot, and 2nd Punjab Infantry 1,000 strong in all, led by the heroic Nicholson, to the Kashmir Bastion breach. The impetuous Lang was first up the breach, and feeling the muzzle of a Sepoy's musket against his chest, pushed it aside and thrust at the man with his sword, which to his dismay failed to pierce his opponent's kamarband and doubled back till it almost described a loop. Fortunately the kukri of a little Gurkha flashed over his shoulders, and the Sepoy fell, his head and shoulders almost severed from the trunk.

As General Nicholson, with Capt. Taylor, diverged with the 3rd column to Skinner's House in the city, Lieut. Lang, with Lieut. Pemberton, guided the 1st and 2nd columns along the ramparts past Moree Bastion, Cabul Gate, and on to Burn Bastion, which, however, was not taken, though many officers (including Lieut. Lang) reached it. He was mentioned in dispatches for the second time.

From the 14th to 19th September, Lang, who was one of the very few unwounded R.E. officers, was employed continuously in sapping through houses, courts, and lanes, seizing and fortifying the main buildings in continuous hand-to-hand fighting. On the 19th he aided in the capture of Burn Bastion, and in company with Lieut. F. Roberts, R.A. (afterwards F.M. Lord Roberts), made a reconnaissance up to the Lahore Gate, which led to its capture the next day.

On the 20th he was with the 60th Rifles at the capture of the Palace when Lieut. Home, R.E., blew in the gates. On the 24th September Lieut. Lang marched from Delhi with a column sent to clear the Doabs and reach Cawnpore, and was present at the actions at Bulandshahr and Aligarh, and at the demolition of Malagarh Fort, where he was blown down by the explosion which killed Lieut. Duncan Home, who had been promised the V.C. for his exploit in blowing in the Kashmir Gate at Delhi.

On 10th October he was also present at the Battle of Agra, where he had several hand-to-hand combats, and was for the third time mentioned in dispatches.

MEMOIR.

COLONEL ARTHUR MOFFATT LANG, C.B., R.E.

ARTHUR MOFFATT LANG, born in Bengal, India, November, 1832, was the eldest son of Arthur Lang, Esq., I.C.S., and Sarah, only daughter of General R. Tickell, C.B.

Educated at Rugby and Cheltenham College, he entered Addiscombe Military College, from which he passed out at the head of his batch and winner of the Pollock Medal. He obtained a commission in the Royal (Bengal) Engineers in June, 1852, and on completion of the course of instruction at Chatham was posted as Assistant Executive Engineer to the M.W.D., joining the Rawal Pindi Division, Punjab, in November, 1855. He was appointed Executive Engineer and Superintendent of Civil Buildings, Lahore, in August, 1856, and in March, 1857, went to the Mian Mir Division. This was the year of the Mutiny, and Lieut. Lang was soon to pass through the most eventful period of his life.

We first hear of him at the Siege of Delhi, at which he was present throughout the operations. During the final stage he served under Capt. Taylor, R.E. (afterwards General Sir Alexander Taylor, G.C.B.), in tracing, building, and maintaining No. 2 Right Battery in daily tours of duty from 7th to 13th September. On the latter date he was ordered by Brigadier-General John Nicholson and Capt. Taylor to go down at 10 p.m. to inspect the breach which had been made in the Kashmir Bastion, as it was of the utmost importance that the assault should be delivered as soon as possible owing to the losses sustained by the troops, and the exhaustion of the gunners through constant and continuous service of the guns under the hot fire of the enemy's batteries. On the plea of imperfect sight at night, Lieut. Lang asked to be allowed to go while it was yet daylight. Taylor agreed, and with an escort of four men of the 60th Rifles, Lang crept to the edge of the cover in the Kudsiabagh, and then leaving his escort behind he ran up the 60 yards of glacis under fire, and from its crest made his notes about the breach. This done he leapt to his feet and, in his own words, "legged it for all he was worth" through a driving hail of bullets, getting back to cover unhurt.

The same night at 10 p.m. he conducted another Engineer officer, Lieut. George Medley, to the same place, taking an escort of six men of the 60th Rifles and a short ladder in order to ascertain whether ladders in the games of the students, often playing football with them, and encouraged that side of their education almost as much as their study of the various sciences connected with engineering. His intellect was keen and unclouded to the last, and his all-round general knowledge most remarkable. There were few subjects of which he was not a master, and yet he never obtruded his knowledge. He was well-known as an authority in the entomological world, and made a collection of Himalayan and other Indian butterflies and moths, among which were specimens previously unknown. The collection is now in the keeping of the Calcutta Museum. In his later years he took great delight in the cultivation of flowers, and it was an education to talk to him on the subject. A man of charming and frank manners, he possessed the ease, tact and consideration for others which mark the true gentleman. When it is added that he was an earnest and sincere Christian, it will be readily understood that to know him was to admire and love his noble character.

He was married three times and leaves a widow and nine children—three sons (all in the Army) and six daughters. He died at Guildford, where he had lived for many years after his retirement, worshipped by his family and beloved by a wide circle of friends.

J.W.S.

REVIEW.

THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1916.

A SHORT notice of this volume has already appeared in the *R.E. Journal* for July, 1916, in which a brief summary is given of the contents of this, the fourth number, of the *Year-Book*. The contents of the volume are of considerable importance and deserve fuller mention than it was possible to include in the short notice referred to above; in consequence, a further review has been prepared of those portions of the *Year-Book* which are of special interest to the general reader. The volume begins with a very useful historical summary under the heading of "Record of the Development of Wireless Telegraphy." From it we learn that although 47 years elapsed (1840 to 1887) between the date when Joseph Henry first produced high-frequency electric oscillations and the date when the brilliant experimenter Heinrich Hertz discovered the progressive propagation of electro-magnetic action through space, yet in less than 10 years from the date of Hertz's discovery Marconi was already in the field with his application for the first British patent for wireless telegraphy (2nd June, 1896), and only six years later he was able to receive readable messages at a distance of 1,551½ miles (on board s.s. *Philadelphia*, in February, 1902). The latest success in the wireless field recorded in the *Year-Book* is the fact that on 28th September, 1915, the American Telephone and Telegraph Company, working in conjunction with the Western Electric Company, succeeded in telephoning by wireless across the American Continent from Arlington to Hawaii, a distance of nearly 5,000 miles. The rapid progress wireless telegraphy has made since 1896 can to some extent be gauged by scanning the lists of Land and Ship Stations given in the *Year-Book*: the former occupy 57 pages, whilst the latter occupy 137 pages of the volume. Of the Land Stations, three are stated to have a normal day range exceeding 2,000 nautical miles, *i.e.*, Glace Bay (3,125 nautical miles), S. Francisco (2,500 nautical miles), and Hawaii (2,500 nautical miles), whilst a couple of dozen of the Ship Stations in the list are stated to have a normal day range of at least 500 nautical miles. The night range of three dozen of the Ship Stations exceeds 1,000 nautical miles, three of them being stated to have a range as high as 1,500 nautical miles.

An article on "Intelligence in Naval Warfare" is contributed by Mr. Archibald Hurd. In it he traces the development of the Signal Service in the British Navy and compares the conditions which existed with regard to this service in Nelson's times with those which prevail to-day. "Probably few of those who are watching the progress of events in the greatest naval war in the history of the world," says Mr. Hurd, "realize fully the changed conditions, particularly in respect of intelligence, under which hostilities are being conducted. At the time of the last great war the system of signals employed at sea, and only recently introduced, was crude, and was regarded with suspicion and mistrust by many senior officers, while the Board of Admiralty can hardly be said to have possessed what we should regard as an intelligence department." It was not till 1805 that Lord Barham, on becoming First Lord of the Admiralty, constituted himself practically Director of Intelligence, yet during the ten years preceding this date an almost uninterrupted war at sea had been in progress. The only swift means of communication between the Admiralty and the ports at this time was the post-horse, supplemented by the recently developed semaphore system, and the orders of the Admiralty had to be conveyed from British shores to vessels at sea by small, swift sailing ships. Mr. Hurd remarks: "Fortunately, though means of communication were slow, the movements of ships were far slower. . . . The success with which communications were maintained between the Admiralty Board in London and the fleets engaged in hostilities in far distant theatres of war constitutes no mean tribute to the organizing ability and mental powers of the officers of those days." At the period of the Great War, the wonder of the age was the semaphore, the invention of an Englishman named Edgeworth. This method of communication was in 1794 already in use in France as a means of communication between that capital and the French armies on the frontier—its use spread to other parts of the Continent of Europe shortly after. "In the late years of the eighteenth century," Mr. Hurd tells us, "a series of semaphore stations was established, connecting the Admiralty in London with the officers commanding at Portsmouth, Plymouth and Deal. High points at short intervals were selected for the construction of semaphore towers." The sites of many of these towers, marked "Telegraph," are shown on Ordnance maps of a century ago. The signalling apparatus at first consisted of six shutters arranged in two frames; later Sir Home Popham brought into use the familiar mast with two arms. Under favourable circumstances the Greenwich Time signal could, it is stated, be passed to Portsmouth and an acknowledgment received in less than one minute. But the semaphore could obviously only be used for short and simple messages, and the Lords of the Admiralty had to rely upon post-horses to a large extent in order to obtain despatches from the officers at sea.

"The signalling arrangements between the naval authorities ashore and the officers at sea were," Mr. Hurd tells us, "not less rudimentary than the means of communication between ship and ship, as signals were passed under great difficulties." We learn from the synopsis of flag signalling given by Commander Robinson in his "British Fleet" that flag signals were employed in the English service in the thirteenth century. The early system was complicated and unwieldy; however, it remained in use till the close of the American War. It was replaced in 1792–3 by the two codes, known as Lord Howe's signals, which were themselves superseded by Popham's code at the urgent request of Nelson himself, just prior to the eve of Trafalgar. The credit for the development of naval signalling, as it is known to-day, must, however, be given to Kempenfelt, the great pioneer, who persevered in his task of providing the Navy with a system of flag signalling, in spite of the bitter opposition of his brother officers, until success was attained.

Mr. Hurd refers to the momentous change in methods of communication which has been brought about by the invention of wireless telegraphy. He recalls that Barham, in his day, was hesitating as to the wisdom of employing flag signals at sea and contrasts the position in which this great sailor was with regard to communication services when First Lord of the Admiralty with that of the occupant of this office at the outbreak of the present War. Writing of Barham, Mr. Hurd says: "He would be dumb with amazement at the statement that in the opening days of the War the Germans, by a wireless message from a home station, had been able to send a message into the farthest recesses even of the Pacific Ocean, warning merchant vessels to proceed at once to the nearest neutral port, in order to avoid capture." The warning referred to enabled German owners to save 80 per cent. of the shipping belonging to them from capture or destruction. Attention is also drawn by Mr. Hurd to the facilities which wireless telegraphy places at the disposal for maintaining communication between the Board of Admiralty and the Admirals commanding at sea, and between the various components of the Grand Fleet itself.

The second article in the *Year-Book* deals with the very interesting subject of "Photo-Electric Phenomena" and is contributed by Professor J. A. Fleming, F.R.S. Light and electricity, as is now well known, are very closely connected together, and since Hertz first noticed, in the course of his celebrated researches in the production of electric waves, that the discharge in the form of an electric spark between two balls is facilitated when light from another spark falls upon them, many physicists have turned their attention to the investigation of photo-electric phenomena. The use of the term photo-electricity, it should be noted, is restricted to the description of the particular effects which are connected with the power of light of certain kinds to cause an electric discharge or leakage of electricity from certain substances, and also, under some conditions, to produce an electric charge, or electromotive force or ionization.

It has been established by experiment that ultra-violet light facilitates the discharge of negatively electrified metal balls and zinc plates; it has also been found that if the zinc plates are oxidized or tarnished, or have been long exposed to the air since polishing, then the discharge of negative electricity from them proceeds much more slowly. If the plates are positively electrified the discharge does not take place or does so very slightly.

In his article, Professor Fleming gives a description of special forms of apparatus—some of them devised by himself—used to obtain the effects described above.

The consideration of the effects observed during experiments show that there is a leakage of negative electricity from negatively electrified bodies when they are exposed to light, chiefly ultra-violet light. That is to say—in modern terminology—light falling on certain substances causes an escape of electrons from them.

The times taken by various substances, solid, liquid or in powder to get rid of their negative charges can be ascertained by suitable experiments—these are described by Professor Fleming—and data can thus be obtained for comparing them with each other with regard to their photo-electric activity in air. Caution, however, must be exercised in interpreting the results of the observations in air; the radiation most effective in the case of one metal or substance is not so in another, and, moreover, the nature of the surrounding atmosphere affects the result. Account has also to be taken of a very noticeable effect, commonly referred to as *photo-electric fatigue*, which consists in a rapid decrease of the photo-electric sensitiveness of a freshly-cleaned surface of metal if left exposed to the air. As the photo-electric sensitiveness is not recovered on resting, Professor Fleming suggests that *photo-electric deterioration* would be a more appropriate term for describing the falling off in sensitiveness.

Photo-electric deterioration seems to be due to a peculiar condition of the gaseous layer adhering to the surface of bodies; however, further research is necessary to clear up the matter.

Experiments indicate that pure, clean metal surfaces in a very high vacuum suffer no photo-electric deterioration. Professor Fleming describes experiments carried out, in exhausted tubes, with liquid potassium sodium alloy, which is very highly photo-electric, and, moreover, sensitive to ordinary visible light. Under suitable conditions the following facts can be observed, namely:—

(*a*). That the alloy surface rapidly discharges negative electricity when light from an arc lamp falls on it.

(*b*). That when illuminated the alloy discharges positive electricity.

(*c*). That the alloy when illuminated actually generates an electric current, proving that light causes an emission of negative electrons from the alloy surface.

In the latter case the photo-electric current varies with the colour of the light thrown upon it, *i.e.* with the wave length. It is pointed out that: "If it were possible to obtain the rare metal rubidium in large quantities, it would be possible to construct a rubidium photo-electric battery of a large number of cells, which would create a considerable electric current merely by illuminating the rubidium surface." In this case the energy represented by this current would, it is needless to say, be drawn from the light energy.

Mention is next made of the photo-electric properties of various classes of substances, solid and liquid, and it is pointed out that there is a certain connection between fluorescence, phosphorescence and photo-electric leak or discharge. Broadly speaking, the fact that a substance is fluorescent is generally an indication that it is photo-electric and will lose negative electricity when illuminated by ultra-violet light.

Professor Fleming gives in outline the explanations which have been offered to account for photo-electric effects. These explanations are based on the modern view that electricity possesses an atomic structure, the atoms of negative electricity, called electrons, being regarded as constituents of chemical atoms.

To put it very briefly, it appears clear from investigations which have been made that photo-electric sensitiveness is not an atomic property, but a molecular one, and depends also on molecular grouping. Accordingly it has been assumed that there are in connection with certain molecules or groupings of atoms certain electrons which can be set free by light of short wave length. A certain energy is required to get the electron away from its atom or to detach it from home. The ordinary undulatory theory cannot, taken by itself, adequately explain photo-electric effects, and, consequently, it has been necessary to introduce modifications. For instance, Sir Joseph Thomson has suggested that luminous energy is concentrated at certain points on the wave front, whilst according to the more recent hypothesis developed by Planck, Einstein and others, it would appear that the radiation is not emitted continuously, but in gushes or bundles—called *quanta*. This view of the case gives to the radiant energy an atomic character, and the *quanta* can be spoken of as atoms of energy. Although this quantum theory helps to explain photo-electric effects, and also many other matters, very easily and has attracted much attention, yet leading physicists have felt that it does not provide a final theory and that photo-electric phenomena are still not yet fully explained.

Photo-electric effects in the cases of gases are next considered, and particularly the circumstances under which light of short wave length can ionize gases or produce in them positively and negatively electrified particles. Experiments show that ultra-violet light of very short wave length can ionize gases, and it has also been proved that there is a connection between the length of the longest wave of light which can effect this ionization and the ionizing voltage. The product of this longest wave length and the voltage is always a number near to 11,000 or 12,000—the wave length being measured in Angstrom Units. Experiments carried out, with suitable precautions, prove that light of wave length less than about 1,400 Angstrom Units can ionize, *i.e.* can produce positive and negative ions in a gas. Since the sun has a very high temperature, it must certainly radiate light of very short wave length, but it has been established that the light which reaches the surface of the earth from the sun and stars contains no wave length shorter than about

2,950 Angstrom Units. It would therefore seem that there is an absorption of ultra-violet light of very short wave length in the upper levels of the atmosphere. There are well-known phenomena in connection with wireless telegraphy which seem to indicate the existence of somewhat strong ionization in the upper levels of our atmosphere which, in part at least, must be due to ionization by solar light, since the condition of the atmosphere in this respect varies by day and night. Professor Fleming points out that, roughly speaking, there are three layers in the earth's atmosphere, not, however, sharply delimited from each other, in which ionization occurs. In the upper or highest layers of the atmosphere there is a strong permanent ionization with a predominance of negative ions; in the middle layers there is ionization, both positive and negative; and in the lower layers near the earth there is weak ionization. The refractive index of ionized air for long electric waves has been proved experimentally to vary with the degree of ionization, and this may explain some of the curious variations in the strength of radio-telegraph signals observed at or about sunrise or sunset and the extension of range of freak signals observed at other times by the refraction or bending downwards of the electric rays. There are good grounds therefore for believing that atmospheric photo-electric effects play a very important part in long-distance wireless telegraphy. Further research, however, is necessary before all these phenomena can be disentangled and explained.

The third article, entitled "The Allies' Strategy in 1915," is contributed to the *Year-Book* by Colonel F. N. Maude, and he deals at length with the plans of the Allies' Campaigns in the Western and Eastern Theatres and in Poland.

Colonel Maude concludes with a brief reference to the great part wireless telegraphy has been playing in the War. He points out that "Within the territories of the Central Powers the existing telegraphic facilities were already so complete that the General Staff could probably have handled their armies nearly as well without its aid. The Allies, on the other hand, during the last six months could hardly have co-ordinated their movements lacking its aid. . . ." "Similarly at sea. Whereas the Germans have had little opportunity of availing themselves of wireless communication between headquarters in the Kiel Canal and their ocean outposts, the maintenance of our blockade services, under the new conditions imported into naval warfare by the submarine, would have been very nearly impossible without wireless telegraphy."

The fourth article of the series is entitled "Capacitance, Inductance, and Wave Length of Antenna," and is contributed by Dr. W. H. Eccles, D.SC.

Dr. Eccles tells us that "The main purpose of this article is to call attention to the fact that a knowledge of the wave length of an antenna is, from the practical as well as the experimental aspects of wireless telegraphy, of greater importance than a knowledge of the electrostatic capacitance or the steady current inductance."

It is pointed out that in the matter of the so-called electrostatic capacitance of an antenna indefiniteness is introduced by the want of precision concerning the position of the bottom end of the antenna relative to the earth. Again, so many variable factors affect the electrostatic capacitance of an antenna, such as the existence of conductors or partial conductors in its neighbourhood, that the measured or calculated electrostatic capacitance is of little value when dealing with problems connected with oscillations in an antenna.

Similarly with regard to the inductance of an antenna, although its approximate value may be obtained by calculation, it must be borne in mind that the steady current inductance is never equal to the effective inductance and therefore ought not to be used in radio work.

Dr. Eccles remarks that "The whole position can be summed up in the statement that in the case of the antenna of radio-telegraphy the capacitance and the inductance are distributed; and not only is this true of the antenna wires, but also of neighbouring conductors such as the earth, the masts and the stays, with the result that the effective inductance and capacitance depend greatly on the frequency and cannot be confidently calculated from steady state values." In consequence, it is urged that the natural wave length of the unloaded antenna should always be used for the following reasons :—

(i.). There is no indefiniteness about the term itself or about the circumstances in which the antenna must be put for measurement—the antenna must be connected to its normal earth.

(ii.). The phenomenon of variation of the antenna characteristic does not enter, since the natural wave length of a particular aerial is necessarily associated with a fixed frequency.

(iii.). The neighbourhood of other conductors, permanent or temporary, good conductors or partial conductors, has, in general, insignificant effect.

Further, the natural wave length of an antenna is generally more easily and more accurately calculated than is the steady capacity or inductance. Experiments carried out by Dr. Eccles tend to show that the value of the natural wave length of an unloaded antenna is equal to the length of the antenna multiplied by 4·20. The natural wave length of an antenna can be readily measured with the aid of a wave metre and buzzer.

Dr. Eccles draws attention to the fact that in the early days of wireless telegraphy, when plain aerial sending was the rule, the natural wave length was the customary electrical datum. But, when inductance was inserted in aerials to increase the wave length of the radiation, the notion of measuring the electrostatic capacitance was introduced in order to facilitate the calculation of the new wave length. However, difficulties in connection with these calculations can, it is pointed out, be overcome by the use of simple graphical charts. Five charts of the kind referred to are given in the article and a few examples are worked out to illustrate their use.

A general survey of war happenings affecting radio-telegraphy is provided in an article by Mr. H. J. B. Ward entitled "Wireless Waves in the World's War."

The first step of importance taken in connection with the present War was undoubtedly that connected with the recall in the early hours of 30th July, 1914, of the first fleet which had just left Portland and was about to disperse for manœuvre leave; in this matter wireless telegraphy played an indispensable part. Three days later, *i.e.*, two days before the outbreak of hostilities, the British Government took steps to assume complete control of all means of wireless communication throughout the British Isles and its territorial waters, thus rendering it possible to establish a strict censorship on all communications between the British Isles and all foreign countries.

The matter of dealing with wireless outside the British Empire has presented many difficult problems. In the case of the enemy installations either destruction, or capture and retention, have been the only effective courses open to us. In neutral countries, however, the situation has been complicated owing to (*a*) the various interpretations put upon neutrality by the governments of the different countries; (*b*) the amount of influence obtained in peace time by the German Government through their state-aided pseudo-private erection of stations; and (*c*) the amount of control exercised by the responsible neutral governments over outlying portions of their territories.

The attitude of all the *Governments*, it is stated, has been most correct throughout; the difficulties which have been experienced have been due to the surreptitious influence exerted by Germany rather than to the official attitude of neutral governments. An incident of this kind is referred to in the *Year-Book* in connection with the erection of a base of supplies and a radio-telegraphic signalling station at Easter Island, which is under the jurisdiction of Chili.

Attention is called to the report of a member of one of the naval expeditions engaged in "rounding up" the German Pacific Colonies, in which special emphasis is laid on the fact that wireless installations were constantly being found in isolated and out-of-the-way places—in some cases 50 miles from the coast—artfully concealed amongst trees. This is but one example out of many of the cunning exercised by Germany in pursuing her policy of secret world-wide wireless.

Brief references are made in the article under review, *inter alia*, to Enemy Wireless in the Field, British Field Radio Activities, Wireless on Aircraft, Wireless in the "Senior Service," the Naval "Nerve Centre," Enemy Naval Wireless, and Wireless in the Mercantile Marine.

Perhaps one of the most striking points in connection with wireless which has been developed by this war lies in the fact that much of the official information—particularly enemy information—has been brought to the notice of newspaper readers through this medium.

In an article dealing with "The Progress of Radio-Telephony in the U.S.A. during 1915" mention is made of the fact that on 21st October, 1915, "radio-telephonic messages, emanating from Arlington, were heard in radio receivers at San Francisco, California, Pearl Harbour, Hawaii, and Eiffel Tower, Paris, France." The results achieved outdistance anything heretofore accomplished. Without Professor Fleming's vacuum valve it would be impossible to telephone any such distances as indicated; it is the keystone of the arch on which these successes in wireless telephony have been built.

Among other articles of interest included in this number of the *Year-Book* are the Report of the Committee appointed by the British Association for carrying out radio-telegraphic investigations, articles on the "Measurement of Signal Intensity," "The Problems of Interference," and "Long Distance Services": the last of these gives a brief outline of progress up to date in the wireless field.

W. A. J. O'MEARA.

NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

No. 7.—July, 1916.

The Belgian Army in the Field.

Composition of the Belgian Army at the Beginning of the War.

The article on the above subject begun in the June number of the *Revue* (*vide R.E. Journal* for September) is concluded in the number of this publication now under review.

At the time Germany violated the neutrality of Belgium, the Belgian Army was undergoing reorganization in accordance with the provisions of the recent law on the subject which came into force eight months before the declaration of war. Nevertheless, the mobilization of the Belgian Army was carried out with surprising rapidity—it was ordered at 8 p.m. on 31st July, 1914, and was completed before midnight of the 4th August following. On the evening of the date last mentioned the Belgian Army was already on the move, so that when the German Army entered Belgium, on this date, simultaneously with the declaration of war, it ran up against King Albert's Army and found itself too late to prevent the mobilization of the Belgians, to the great disappointment, no doubt, of the German Great General Staff.

The Belgian Army at this time consisted of 120,000 trained and embodied men (these were practically all between 20 and 36 years of age). During the short space of time which elapsed between the declaration of war and the actual invasion of Belgium 45,000 Belgians offered to join the Army as volunteers, but only about one half of them could be accepted.

A detail of the organization of the Belgian Army is given in the article under review. This information has already appeared in a review of the part played by the Belgian Army in the operations of 1914, which appeared in the *R.E. Journal* for November, 1915, and is therefore not repeated here. Since the outbreak of the War, many modifications have been made in the original organization of the Belgian Army; some of these have been necessitated by the heavy casualties suffered, others in order to meet the needs of the tactical situation. As is well known, the outstanding feature of the present war is the great demand made on the technical branches of the armies, and King Albert's Army, as well as those of the other belligerents, have brought special units into existence to meet the needs of the situation. Large numbers of Belgians have also been employed in the workshops and arsenals of France in connection with the manufacture of munitions of war, and some of the novel appliances in use in France and Flanders to-day are the inventions of Belgians.

When the War began the Belgian Army had but one 75 mm. gun in its possession, and this had a comparatively short range. To-day the Belgian Artillery is plentifully supplied with excellent long-range guns of large as well as of small calibre. Great developments have also taken place in the matter of the provision of machine guns.

Considerable attention has also been given to aviation, and Belgian aviators are constantly engaged on long and short distance raids into the territory occupied by the German invaders.

The uniform of the Belgian Army also has undergone a complete transformation. The old uniform has been completely discarded and one of a serviceable design, brown-grey in colour, has taken its place. The colour of this uniform harmonizes with that of the earth and vegetation in Flanders. Belgian soldiers have been provided with steel helmets, with cloth covers of the same colour as their uniform, for use in the trenches.

The Belgian has proved himself a brave soldier. He is not credited with possessing an aggressive spirit or any great enthusiasm for offensive tactics. However, during the present war, Belgian troops have, on several occasions, rushed to the attack with such remarkable courage as to carry positions from which it was thought the enemy could not be driven back. The surprises of the War, such as the 16½-in. howitzer fire and the use of poisonous gases, have not disturbed the *morale* of the Belgian soldier. Speaking generally, the great fault of the Belgian soldier is his lack of discipline; this is no doubt due to the spirit of independence which is a characteristic of the Belgian people as a whole.

The author of the *Revue* article is of opinion that during the progress of the War, Belgium has got over the difficulties of her military crisis in a most skilful way. From this intense trial her army comes out reformed, strengthened, regenerated. In fulfilling its mission with heroism and success, the Belgian Army has been transformed into a perfect modern fighting machine.

If an explanation is required of the causes which have moved Belgium to accomplish so much, it must be sought, according to the author of the *Revue* article, in the deep-rooted affection the Belgian has for his fatherland, in his desire for vengeance, fired by the spirit of independence with which he is imbued, in a hatred of those who attempt to deprive him of his liberty. A most serious mistake was, it is said, made by the Powers when they endeavoured to impose an obligatory neutrality on Belgium and undertook to guarantee this neutrality.

MUSKETRY TRAINING OF THE SWISS INFANTRY.

New instructions for the musketry training of Swiss Infantry were approved on the 13th April, 1916: the musketry training scheme, of January, 1908, has in consequence been superseded. The 1908 scheme introduced radical changes in the training programme which had been in force up to that date in the Swiss Army; the principles laid down in the 1908 scheme are in no way altered by the new Musketry Instructions, details of the training programme are alone affected.

No change has been made in the recruits' course. Minor changes have been made in the preparatory target practice course—the so-called *exercices préparatoires*—at short ranges (from 50 to 200 metres) and in connection with the test practice—the so-called *exercice d'essai*—at 300 metres: in the former case the change affects the class of targets and in the latter the standard of skill required. An important change has been introduced in the recruits' final target practice course—the so-called *exercices principaux*. The part of the old course in which the recruit had to fire in the standing position at the target, known as D, at a range of 300 metres has been abolished, and instead the recruit is required to fire with his elbows resting on a parapet either at the target, known as H, or at a target representing head and shoulders, at a range of 100 metres. He fires six rounds at these targets, and is not allowed the use of any auxiliary sighting appliance; it is not until the whole of these rounds have been fired that the result is signalled. The conditions laid down are intended to represent those of trench warfare.

The former allowance of ammunition of 200 rounds per N.C.O. and recruit and of 100 rounds per officer remains unchanged.

An entirely new course of range practice for young officers has been introduced; it consists in firing 30 rounds at various classes of targets at ranges of 100, 200, 300 and 400 metres, in the prone and standing positions and on the knee.

An increase in the allowance of revolver ammunition has been made. Formerly officers and N.C.O.'s were allowed 48 rounds and the recruit 60 rounds; in both cases these numbers have been increased to 80 rounds of ball and 20 rounds of blank ammunition.

Changes have been introduced in the efficiency badges and in the classification of officers and men in musketry. The writer of the *Revue* article does not approve of the new regulations on the last points referred to; he considers this part of the new scheme to be illogical; otherwise he is satisfied that the new instructions mark progress in the matter of musketry training.

Improvisation of Stretchers out of Shelter Tents.

The manual for the use of the *personnel* of the Sanitary Corps of the Swiss Army provides for the instruction of the men of that corps in the improvisation of stretchers. At Schools of Instruction for men of the Sanitary Corps a part of the training of the *personnel* consists in the construction of emergency stretchers made from articles of military equipment, such as greatcoats, rifles, belts, haversacks, etc.

In the *Revue* article descriptions are given (with illustrations) of the methods in which a shelter tent, consisting of a square of canvas (length of side, 5 ft. 3 in.), can be utilized, with the aid of one or more supporting poles, for improvising a stretcher.

The Three Phases of the Advance in a War of Positions.

The *Revue* article consists of five plates with descriptive matter relating to the diagrams, etc., thereon.

On Plate I. are given (*a*) a section of a fire trench at a loophole and (*b*) a section of a "dug-out" with a protected entrance.

It is pointed out on this plate that the French first line is not one continuous trench. In many sections of defence there is an interval between the trenches—a *zone de combat*—500 yards and more wide, which provides a space for manœuvre during the *first phase* of trench warfare.

As the works of the belligerents approach nearer to one another the *centres of resistance* increase in number and are connected to one another by a *defensive curtain.* It is from this line of works that saps, which form the approaches and advanced parallels, are pushed out during the *second phase* of trench warfare. In the *third phase,* the advanced parallels of the opposing forces become linked up during the progress of mine warfare.

Plate II. depicts in outline a part of the first line positions prepared by the French and German troops on the Lorraine front at a time when the main body of the opposing forces were separated by a distance varying from 900 to 1,100 yards.

Plate III. depicts the same part of the front as in Plate II. when the French trenches had been pushed to within from 200 to 400 yards of the German main position.

Plate IV. depicts the same part of the front as before when the stage of mine warfare had been reached.

On Plate V. a section is given of the ground between one of the French *centres of resistance* and an enemy advanced parallel to illustrate the progress of trench warfare. On it are shown the positions of the trenches forming the *centre of resistance,* the parallels, and the lines of obstacles between the *centre of resistance* and the enemy's advanced parallel.

NOTES AND NEWS.

Switzerland.—A special contributor calls attention to a pamphlet entitled *Le peuple et l'Armée* by O. Bosshardt which has been recently published in Geneva. The author of the pamphlet has been attached to the Swiss General Staff since the mobilization of the Swiss Army in the autumn of 1914. He has thus been in the position to hear and see many things and particularly, it is said, to notice the differences which, at the present time, are dividing the Swiss people and their army. It is thought that Monsieur Bosshardt has taken too serious a view of the situation; there is no real antagonism between the Swiss people and the Swiss Army. There are unfortunately officers in Switzerland, as elsewhere, who hold extreme views and express them openly, but there are no grounds, it is said, for the view that all Swiss officers hold the opinion that the maintenance of discipline and the spirit of a democracy represent two irreconcilable elements in a State and therefore cannot co-exist. There are, it is true, certain officers who take a pleasure in quarrelling with the civil authorities, but they are not in the majority. Washington required that all his officers should be *gentlemen.* To-day, one cannot, it is said, be so exacting on this point as in the past. Soldiers and civil authorities are often inclined, it is said, to be too touchy; Monsieur Bosshardt recommends both these classes to put their duty to the Army and to the people before all things else.

Switzerland should continue to maintain her traditional policy of neutrality; there should be no parties in the Republic labelled "Interventionist," "Ententophil," or "Germanophil." Every Swiss should do his best to help his Government to maintain peace in the Republic. Switzerland should be in the nature of a beacon to lead ships in a storm to a refuge of safety; in order that this object may be attained her people must be united and her army strong.

That discussion may not take place on military matters in the National Assembly is something which at first sight causes a shock, but it is well to bear in mind the old adage: "Speech is silvern; silence is golden." There are times when it is one's duty to speak, others when to maintain silence.

United States of America.—A special correspondent refers to the brush of the 13th U.S. Cav. Regiment with a band of Mexican bandits, and also to the preparations which were on foot at the time of writing to send an expedition into Mexico to punish Villa. This correspondent is naturally unable to deal with the details of the Expeditionary Force. It is stated however that difficulties were being experienced, owing to the weakness of the American Army, in getting together a sufficiently large force for the purpose. However, on the 16th March last, Congress passed a resolution for 30,000 additional recruits to be enrolled, in order to bring up the Establishment of the Army to 120,000 men. In consequence, 147 new recruiting offices were opened and kept busy day and night; and striking posters were posted up everywhere *à la mode anglaise*.

Villa's raid has had the result of causing large numbers of men to join the forces, even the National Guard.

The Lines of Communication from the American-Mexican frontier, in the case of an offensive campaign, are likely to have a length of 270 to 280 miles. Preparations are therefore on foot to organize motor-transport supply columns, which will enable communication to be effectively maintained between the supply bases and the troops in the fighting line.

It is said that the 7th New York Regiment (which is part of the State Militia) has shown considerable enterprise and has by private effort provided itself with motor transport. In this respect this regiment is better off than regiments in the Regular Army.

As regards the United States Artillery, the Ordnance Department has since 1903 been carrying out experiments with motor vehicles designed for the use of this arm. In 1915 experiments were carried out at Rock Island and at the artillery ranges at Fort Gill with tractors for drawing guns and ammunition wagons. Tractors were not found suitable for drawing field guns and their ammunition wagons, but in the case of heavy artillery they were found very useful.

The question of army reorganization is again to the front in the United States. The scheme of the War Minister (Mr. Lindsay Garrison) contemplates the provision of (i.) a Reserve which would comprise not only the present reservists of the Regular Army, but also all "old soldiers" under 45 years of age and specialists (doctors, engineers, etc.) willing to serve voluntarily, and (ii.) a "Continental Army," which would be a kind of voluntary militia raised by the Federal Government and not by the several Federal States. It is expected thus to raise 400,000 men, in contingents of 133,000 men per annum. The men in the "Continental Army" would serve three years with the colours, and three years in a "Continental Reserve." It is expected that considerable difficulty will be experienced in recruiting such an army.

A proposal was, at the time of writing, before the Senate for increasing the Peace Establishment of the American Army to 178,000 men and the War Establishment to 250,000 men. The question of federalizing the

National Guard or Militia comes before the House of Representatives periodically, it has been again raised.

Among the innovations referred to is the organization of machine-gun sections in cavalry regiments and an increase of two batteries in the 4th Regiment of Mountain Artillery.

Attention is also drawn to alleged defects in the Aviation Service.

Portugal.—A special correspondent refers to the difficulties which are being experienced owing to the censorship; he has been obliged owing to the regulations to suspend his periodical contributions to the *Revue.*

A Portuguese Expeditionary Force has occupied the Bay of Kionga. The Portuguese acquired the territory of Kionga, which is situated in the extreme north of the Mozambique littoral in December, 1886, by treaty at the time that Portugal and Germany came to an agreement with regard to their respective spheres of influence in East Africa. In June, 1894, the Governor of German East Africa caused the German flag to be hoisted at a point south of Rovuma, during one of his visits of inspection, in territory belonging to Portugal, and even had the audacity to invite the Portuguese Governor to be present at the ceremony. The Portuguese officials raised a protest at this unwarrantable act and appealed to Great Britain to act as an intermediary to bring about a friendly settlement of the question. The matter was referred to arbitration and on the decision going against Germany, the German Government accused Portugal of encouraging a contraband traffic in firearms with the natives and of having failed to suppress the slave trade. The Portuguese Government had no difficulty in refuting these preposterous allegations; however, in view of the serious risk of military aggression, Portugal sold the territory in dispute to Germany. Under the circumstances, the fact that Portuguese troops have been able to conquer the Kionga territory by force of arms has given considerable satisfaction in Portugal.

INTERNATIONAL NEWS.

The German Note to Switzerland has once more brought into prominence the question of the relations between belligerent States and neutral States. What with the demands of Germany, on the one hand, and the attitude of the Allied Powers in relation to the action which the Republic should take in regard to these demands, on the other, Switzerland finds her position as a neutral somewhat embarrassing.

To the Swiss the conduct of both parties appears somewhat arbitrary, and also contrary to the spirit of treaty obligations. However, there is this difference between the treatment Switzerland is receiving from those who are attempting to pull her in opposite directions; whereas the Allies in no way propose to deprive the Swiss of things essential to their existence, the Germans do not hesitate to threaten that they will deprive them of necessaries of life. The attitude of the Powers can be summed up as follows:—Attitude of Allies: "We do not ask you to take our part against Germany, we only ask you not to make use of our substance for her benefit." Attitude of Germany: "We ask you to take our part against the Allies by procuring their substance for us."

Switzerland has every wish to maintain her traditional neutrality, but in the present circumstances she finds it most difficult to do so.

W. A. J. O'MEARA.