THE ROYAL ENGINEERS JOURNAL.

Vol. XXIII. No. 5.



MAY, 1916.

CONTENTS.

1,	. Tension Joints in Timber. By Lieut, I. W. LANDON Cambridge O. T. C. attached D. K.	PAGE.
2	Selence and War. By ANAGAPA	193
3.	. Passing Thoughts on Military Architecture in the Thames Defences. By Major	197
4.	RE. (With Photo)	203
5.	. Notice of Magazine: - Retue Militaire Suisse: The Italian Army-A Talk on Aeronautics-How can the German Front Le Pierced? By Major W. A. J. O'MEARA, C.M.G., P.S.C., Inte R.E. (Barrister-at-Law of the Inner	225
	iempie)	231



BULLIVANT & CO., Ltd.,

STEEL WIRE ROPES

FOR CRANES, LIFTS, HOISTS, WINDING and HAULING, Etc. DURABLE AND RELIABLE.

BULLIVANTS' Wire Rope Suspension Bridges. Specially adaptable for long spans over Rivers, combining great strength with minimum weight and cost.

BLOCKS, PULLEYS, AND ALL WIRE ROPE APPLIANCES.

Beg. 72, Mark Lane, E.C. Works: Millwall, London, E.

Telephone No.-East 3754 (2 Lines). Telegraphic Address :- "Constructive Iconworks, MILLEAST, LONDON" (3 words only chargeable).

MATTW. T. SHAW & CO., Ltd., MILLWALL, LONDON, E.

CONSTRUCTIONAL STEELWORK, FRAMED BUILDINGS, BRIDGES, ROOFS, Etc.

Large Stocks of Joists, Channels, Angles, Tees, Flats, Plates, Chequers, Rounds, Squares, Rivets, Bolts, Galvanized Sheets, etc., etc.

VERY PROMPT DELIVERIES GUARANTESD.

Abbreviated Notes on MILITARY ENGINEERING.

CONTENTS.

ROPES, SPARS, TACKLES, STRENGTH OF MATERIALS. BRIDGING. FIELD DEFENCES.

·CAMPING ARRANGEMENTS. DEMOLITIONS. ROADS.

Sixth Impression just published. Corrected to 1st January, 1916.

Price 6d. per Copy, Cash with Order.

SECRETARY, R.E. INSTITUTE, CHATHAM.



SOLE AGENTS for the

R.E. Institute Publications

(Institute Members excepted):

MACKAY & CO., LTD.,

CHATHAM.



BURBERRY WEATHERPROOF WAR KIT

"Invaluable for winter campaigning, as it ensures warmth, comfort and protection, and mitigates the risk to health of exposure to bad weather."

BURBERRY TRENCH-WARM — Supplies the services of three coats in one, each of which can be worn separately. A Weatherproof that will stand hours of rain; a light Camel Fleece Short-Warm; and a thick Overcoat for the severest weather.

UNIFORMS OF TENACE WHIPCORD A Burberry cloth of prodigious strength, made of pure botany wool. Will outwear three uniforms made of ordinary Whipcord.

THE BURBERRY -- With or without Detachable Fleece lining. Keeps its wearer dry on wet days; luxuriously warm on chilly; and is healthful and comfortable to wear in mild weather.

TIELOCKEN BELTED COATS. Great Coats, British Warms, Caps, Shirte, Puttees, and every detail of Equipment.

READY FOR IMMEDIATE USE Or made to measure in from 2 to 4 days.

MILITARY CATALOGUE POST FREE All Genuine Burberry Garments are labelled 'Burberry e

BURBERRYS Haymarket Bd. Malesherbes PARIS and Agents.



CONTENTS.

ı.	TENSION JOINTS IN TIMBEE, By Lieut. J. W. Landon, Cambridge O.T.C.,	Page,
	Allachty K.D	103
2.	SCIENCE AND WAR. By Anagapa	197
3.	PASSING THOUGHTS ON MILFIARY ARCHITECTURE IN THE THAMES DEFENCES, By Major A. A. Crookshenk, R.E	203
4.	MEMORE :	
	Colonel Augustus Le Messurier, C.I.E., R.E. By Col. H. M. Vibart, Jate R.E. (With Photo)	225
5.	NOTICE OF MAGAZINE :	
	Reque Militaire Suisse ;	
	The Italian Army—A Talk on Aeronautics—How can the German Front be Pierced? By Major W. A. J. O'Meara, C.M.G., p.s.G., late R.E. (Barrister-at-Law of the Inner Temple)	231

ERRATA.

R.E. JOURNAL, VOL. XXIII., No. 4, APRIL, 1916.

Line 3, page 155, for $(_{3}H_{3} (NO_{3})_{3})$ read $(C_{3}H_{5} (NO_{3})_{3})$.

ļ

Sixth line from bottom of page 156, for $(C_6H_2 \cdot OK \cdot (NO_2)_3)$ read $(C_6H_2 \cdot OK \cdot (NO_2)_2)$ Line 22, page 157, for $(C_6H_2 + CH \cdot (NO_2)_3)$ read $(C_6H_2 + CH_3 \cdot (NO_2)_3)$.

TENSION JOINTS IN TIMBER.

By LIEUT. J. W. LANDON, Cambridge O.T.C., attached R.E.

SEVERAL articles on "Timber Girders for Military Bridges" have recently appeared in the R.E. Journal. In these certain assumptions are made in designing the tension joints which do not appear justifiable.

Consider first two tension members joined by means of bolts and a simple cover-plate of timber. Such a joint in its simplest form is as shown in Fig. 1.



Assuming the bolt is kept far enough from the ends of the members, the most probable ways in which the joint will begin to fail are, either by the bending of the bolts, or by the compression of the timber by the bolt.

If the bolts are of sufficiently large diameter so that there is no appreciable deformation due to bending, the distri-

bution of bearing pressure on the bolt will be as shown in Fig. 2, where AGB represents the bolt and the bearing pressures along it are represented by the distance from AB to lines CD and EF. E This assumes the timber to be elastic and the bolt to remain straight.

FIG, 2

Neglecting friction between the members, a consideration of the equilibrium of the bolt leads to

$$\frac{rdx}{2} - \frac{r^{1}d(t-x)}{2} = \mathbf{P},$$

 $\frac{r}{x} = \frac{r^1}{1-x}$.

where d is the diameter of the bolt.

Also we have

From these two conditions-

$$\frac{rdt}{P} = \frac{2x}{2x-t}$$

$\frac{\text{Maximum bearing pressure}}{\text{Mean bearing pressure}} = \frac{2x}{2x-l}.$

To find x we have, from symmetry, the further condition that the bending moment at the middle of the bolt equals zero.

$$(t-x) r^{1} \{x + \frac{2}{3} (t-x)\} - \frac{rx^{2}}{3} = 0.$$

Substituting for r^1 in terms of r we get finally

$$x = \frac{3}{5}t$$

$\frac{\text{Maximum bearing pressure}}{\text{Mean bearing pressure}} = 4.$

Taking the value of x=3t, it is easy to show that the maximum bending moment on the bolt occurs at a distance from the middle equal to $\frac{t}{3}$.

The maximum bending moment

 $= \frac{1}{27} r dt^2$ or $\frac{4}{27} Pt$.

Tests of joints constructed as shown in Fig. 1 which have recently been made prove that it is not safe to assume a uniform bearing pressure in designing such joints, and also show that the ratio of maximum pressure to mean pressure is substantially 4.

In the joint considered the bolt has been assumed without a head or nut, and friction between the timber and bolt and also between the two timber members has been neglected. Friction plays a very small part in such joints, and failure occurs by the bolt crushing the timber and finally drawing out of one or other of the members. If the members are bound together friction will play an important part, and the final strength of the joint will be determined by the strength of the binding used. This is due to the fact that the more the joint yields the greater will be the pressure between the two members produced by the binding. This action, it may be noted, will come in whatever the shrinkage of the timber due to climatic changes. The same applies also to a single cover-plate joint in which ordinary bolts are used, so long as a large washer is placed both under the head and nut to prevent them pressing into the timber.

In the case of a joint with a cover-plate on either side, assuming the bolts are of a sufficiently large diameter to prevent any appreciable bending, the bearing pressure of the bolt against the timber may be assumed uniform, but friction will not automatically come into play. Any shrinkage of the timber due to climatic changes after the nuts have been tightened up will reduce the pressure, and this pressure will not be increased by the yielding of the joint.

Another point which requires consideration is the safe bearing pressure of round bolts on timber. It appears that this generally is

....

based upon the safe compressive stress of timber parallel to the grain. This is not justifiable, since the safe compressive stress is quite different along the grain from what it is across the grain, the former being some three or four times the latter. In the case of a round bolt fitting in a circular hole both these stresses are introduced, since the bolt wedges in its hole, no matter what is the direction of the pressure between the bolt and the timber. The problem is further complicated by the accuracy of fit of the bolt in the hole. The only satisfactory solution is by experiment.

Below are the results of some experiments made recently at the S.M.E., Chatham, and at Cambridge.

TESTS A.—Timber—Yellow deal. Bolts—3-in. diam.

Bearing pressure uniform along the bolt.

Bolt holes bored with an auger.

			Bearing pressure at which the strain ceased to be proportional to the stress.		
Parallel to grain	•••	•••	$\begin{cases} 2590 \text{ lbs. per sq. in.} \\ 2100 , , , , \end{cases}$		
Perpendicular to grain		•••	{ ¹ 440 ,, ,, 1190 ,, ,,		

In the tests parallel to the grain complete failure of the timber by crushing occurred at a stress only slightly in excess of that given above.

TEST B.-Made in a Testing Machine.-Timber-Yellow dealvery well seasoned-different from that used in Tests A.

Bolts-³-in. diam.

1916.]

Bolts carefully fitted in holes.

		Rearing pressure at which the strain ceased to be proportional to the stress.		
Parallel to grain	 •••	{3740] {3850	bs. pe	r sq. in.
Pernendicular to grain	 	1400	,,	,,
r orponaleum to State	 	{1000	.,	>>

These results show how variable the safe bearing pressure for bolts on timber is, and more tests are required.

TESTS C .- Single cover-plate joints as shown in Fig. 1.

The same timber as in Tests A,

Maximum bearing pressure taken four times the mean bearing pressure.

Diameter of bolt.	Maximum bearing pressure at which the strain ceased to be proportional to stress.				
$\frac{5}{8}$ in.	2630	lbs. pe	r sq. in.		
³ / ₄ in.	2160	,.	,,		
ζin.	2390	,,	,,		
ı in.	2840	"	,,		
11 in.	2510	,,	"		

In these tests the joints finally failed by the drawing of the bolt out of one member, at a load varying from one and a half to twice the load giving the above pressures.

TESTS D.—*Nailed Joints.*—The object of these tests was to determine the lateral resistance of wire nails when used to connect two tension members of timber, the direction of the pull being along the grain.

Most of the joints used were similar to that shown in *Fig.* 1, but with two cover-plates, each one-half the thickness of the members joined, and with wire nails in place of bolts.

The timber was well-seasoned yellow deal, similar to that used in Tests B. The nails were grooved iron wire. The results show that the relation between the lateral resistance at collapse of the joint and the length of the nail, for lengths varying from 3 in. to 6 in., may be fairly well represented by—

Lateral resistance per nail (double cover-plate)=260 L lbs., where L is the length of the nail in inches.

In experiments made with joints having only one cover-plate of thickness not greater than half the length of the nail, it was found the lateral resistance was about half that given above.

A few tests were made with round iron wire nails and these gave substantially the same results as with grooved iron wire nails.

In all cases final failure of the joint was produced by the drawing out of the point of the nail.

It is interesting to compare these results with those given in M.E., Part IIIA., pp. 83-85. Taking the tests in which two timber uprights were connected by a single crosspiece, and where the whole of the nail was in the timber, the results for nails varying from 3 in. to 6 in. in length will be found to be fairly well represented by—

Lateral resistance per nail=150 L lbs.

In these tests the point of the nail was in the upright members and the pull was parallel to the grain of these members.

Other tests of two members nailed together at right angles, but with the direction of pull perpendicular to the grain of the member containing the point of the nail, might be interesting. It is hoped to make these tests shortly.

Tests are being made at present on the lateral resistance of coach screws when used for connecting tension members.

SCIENCE AND WAR.

By ANAGAPA.

To deal fully with the part science plays in a modern war is a task. as will readily be realized, beyond the capacity of any single individual : justice can alone be done to the subject by the joint efforts of experts in the many branches of science laid under contribution, directly or indirectly, for the purposes of the prosecution of a war under modern conditions. An adequate treatment of the subject would require, not only a comprehensive examination into the many details of the naval and military services, but also into numerous questions connected with civil administration. A discussion of the part played by science in connection with the affairs of a navy, or an army, alone would occupy in itself the pages of a considerable volume; for there is scarcely a single branch of science, whether it be in the class labelled abstract, abstract concrete, or concrete, by Herbert Spencer, which does not in some way affect the well-being of sailors and soldiers, and the operations of war as conducted by modern navies and armies. At least as great would be the task of dealing comprehensively with the part played by science in matters connected with the civil administrations of a State, since under the conditions of modern civilization no branch of science is left entirely untouched by it. Although it may not be possible satisfactorily to cover, within a reasonable compass, the whole field in which science plays, or is capable of playing a part in modern war, yet a general survey of some of those aspects of the subject in which science plays, or may, at least, reasonably be expected to play a somewhat conspicuous part, does not naturally present the same formidable This being the case, an attempt will here be made to difficulties. review briefly the influence which science and the methods of science exercise, or may be expected so to do, on some of the more important matters connected with the conduct of a great war.

It is well recognized that the principles which govern the prosecution of war in the actual theatre of operations involve considerations widely different from those which affect the more purely civil interests of belligerent nations in the regions more remote from the points of contact of the hostile naval and military forces; yet, in a great national war, no part of the community, and no part of the several interests of a belligerent nation can remain entirely outside the influence of the exceptional situation created by the outbreak of hostilities. This being so, the question has recently come much into prominence, in some countries, whether indeed the time has not arrived for Governments, in cases where the matter has not already received attention, to adopt an organization for war in which the boundaries of the responsibilities devolving on the supreme naval and military commanders, and the ministers concerned with the civil administrations of the State, shall be clearly and definitely delineated on the lines of the functions which, in strictness, appertain to each of these two main groups concerned with the conduct of war. Such a separation of responsibilities would, it is claimed, be logical and therefore scientific, and the advantage would be gained thereby that the responsible officers in each of these groups would then be able to confine their attention exclusively to the problems which, by past training and experience, they are best fitted to deal with. To put the matter precisely, the real question raised has been whether the ministers responsible in normal circumstances for the civil administration of a State should, under the special conditions of a great war, also occupy themselves with the formulation and supervision of the naval and military plans of campaign, or leave this aspect in the conduct of a war to be dealt with exclusively by the supreme naval and military commanders.

The conclusion arrived at is that a Central Government, having determined the political object of a war, should do no more than formulate the political and social considerations which must be borne in mind in the prosecution of the war. The objective having been once clearly pointed out, the naval and military methods to be adopted to attain the end in view should, it is urged, be left entirely and exclusively in the hands of the supreme naval and military commanders, so long as their plans conform to the general requirements laid down by the Central Government. This done, one obligation would still remain to be fulfilled by the civil authorities, that of providing the wherewithal in men and treasure necessary for the purpose of waging war. It is argued that, once the division of responsibilities between the civil and the naval and military authorities has been established on a scientific basis, and a complete understanding arrived at between them, the execution of naval and military plans would proceed automatically, and thus produce the highest measure of success attainable with the means and resources of a nation available for the prosecution of the war. Under these circumstances ministers, relieved of all responsibility for the purely naval and military aspects of the plan or plans of campaign affecting the whole theatre of war, would be in a position to devote themselves with greater assiduity to the problems of civil administration arising out of the war, and to the task of organizing the whole of the resources of the nation for the prosecution of the war, if need be. The problems of organization have now been reduced to a science governed by certain well-defined principles; therefore, it alone remains, when any exceptional situation involving the necessity of a change in the organization of a State arises, for a Government to apply these principles for the purpose of determining the nature of the modifications which shall be introduced into its normal organization. War creates such a situation, and often demands the introduction of radical changes in peace systems of State administration, and unless methods of science prevail in handling the situation, and particularly so in those regions where the supreme control resides, a nation cannot hope to wage war successfully.

In the face of the profound silence which reigns in relation to the present war, no exact information is available as to the war organizations adopted by the various belligerent nations. One at least of the belligerent nations, Germany, is known to have given considerable study to the science of war, and it is hardly possible that, her motto being "Thorough," the question of the adoption of a special war organization in place of her peace system of administration, can have been overlooked : indeed there are indications that considerable modifications have been made in the latter. The nature of some of the changes made may be gathered from an interesting description of the working of the "German Machine," during the days preceding the German retreat from the Marne, which appeared in the New York Nation of 24th September, 1914. In the article in question it is stated that, within the space of seven days, the German Great General Staff set in motion some four millions of men, and a nation at peace with the world became a nation at war; the components of the German military machine moved, it is said, with the smoothness of an accurately balanced engine and the regularity of a highly finished timepiece.

Simultaneously with the outbreak of war, hundreds of workshops ceased producing articles normally required for civilian consumption, and these hives of industry were at once placed under the orders of the Great General Staff, and, without loss of time, the energies of the workers, not absorbed into the ranks of the field armies, were diverted to the manufacture of uniforms, boots, and other munitions of war required by the troops sent to the front. Since the day that the Great General Staff set the German Army in motion in August, 1014, down to the present day, it has exercised sole and exclusive responsibility in relation to all military measures connected with the prosecution of the present war. At the same time, if reports published in the foreign Press can be relied upon, it would appear that those who have been made responsible for questions of civil administration in Germany, have been by no means backward in attending to the many old and new problems falling within the limits of their responsibilities; they have, from an early date in the war, fully realized that the real peril which threatens the Central Powers is that connected with the economic and financial pressure to which war subjects them. In consequence, a whole army of scientific men have, so it is said, been set to work to make an exhaustive examination into the economic and financial problems produced by the war with a view to the adoption of measures for warding off the dangers and crises, which have been menacing the chances of success for the Central Powers.

The more closely the situation is examined, the more evident it is that

the German arms have gained by the clear and sound conceptions entertained by the Imperial Government regarding the proper distribution of responsibilities between the civil and military authorities for the purposes of the prosecution of a great war, and by the adoption of a scientific organization to attain the end in view. Without in any way disparaging the organizations adopted, at the present time, in other belligerent States, an admission can safely be made that the application by the Imperial Government of methods of science in the organization of the German Empire for the conduct and prosecution of war affords useful lessons to all who may wish to learn from and profit by the experience gained by our enemies. The subject is an engrossing one, but the limitations of space forbid it to be further pursued herc.

It is now proposed to say a few words on those aspects of war which more intimately concern the fighting services themselves. Since the days of almost hoary antiquity, when, by its aid, warships were first navigated across open expanses of water out of sight of land, and the invention of gunpowder provided a new weapon for the prosecution of a war, science has been acquiring a greater and greater influence in most matters affecting the sailor and the soldier. Whether it is the Navy or the Army which owes the greater debt to the advances due to scientific research is a matter in regard to which it is practically impossible for anyone to express a definite opinion: in some directions science has done each of them an identical service; in other directions, it is sometimes the Navy, sometimes the Army which may be considered to have gained most by the more recent discoveries in one or other of the various fields of science.

In outline, the two main considerations affecting navies and armies have remained unaltered from time immemorial; navies and armies have, at all times, had to subsist in the theatre of operations, they have always been expected to fight at an advantage. But in both these respects, as time has progressed, enormous changes have come about in details; science and scientific methods have penetrated more and more deeply, as well in relation to matters connected with the provision of subsistence for navies and armies as in relation to those problems which concern their efficiency to undertake naval and military operations. The science of the chemist, that of the metallurgist, and that of the mechanical engineer have probably had a more marked influence in bringing about changes and modifications in the methods of war than have the discoveries of the workers in any other field of activity.

To the labours of the chemist, the metallurgist and the mechanical engineer, navies and armies owe many of the most important improvements in the armament and propellants, equipment and means of transport, tools and appliances with which they go forth to fight at the present day. Also, to the discoveries made in the field of science with which they are associated is it due that the newest arm, the Flying Corps, has so rapidly reached the high state of development and efficiency which has enabled it, in the present war, to play, both in the Navy and the Army, the conspicuous *rôle* so familiar to the public, and that, in spite of its infant years.

During the past half century, another feature which has wrought very great changes in war is the enormous growth in the world's armies and navies; in consequence, theatres of operations cover to-day infinitely greater spaces than of yore. To fight at an advantage, the concentration of superior forces at the decisive point at the appropriate moment is still required to-day as of old : it is the factor still constituting the element essential for the attainment of victory. Thanks to the physicist and the electric engineer, the difficulties connected with the provision of intercommunication between the several components of the vast navies and armies operating in widely separated areas have been satisfactorily overcome : each of these services has to-day at its disposal suitable means for rapid communication, which enable their leaders effectively to bring about those combinations which provide for the simultaneity of action of the several parts of a fighting force, which alone can bring success in modern war. The very considerable assistance the belligerent navies may have derived from wireless telegraphy, and the important rôle telegraphy and telephony have played in the land operations, now in progress, can only be fully learnt when the time arrives for making public the experiences of those who have had to provide and maintain these indispensable auxiliaries.

Even a cursory examination of the part science plays in war would be incomplete without reference to all that navies and armies owe to the science of the pathologist and of the surgeon. It is well known that in the wars of former ages disease claimed many more victims than rifle bullets and artillery projectiles; one of the most marked features of most modern wars has been the almost complete immunity which the present-day sailors and soldiers enjoy from the many scourges which ravaged the ranks of their predecessors in arms, an immunity which is alone attributable to the advances made in the science of preventive medicine. Similarly, "Listerism " and many other applications of science, such as Röntgen rays, magnetic extractors, etc., have come to the aid of the surgeon and assist him to alleviate the sufferings, and even to save the limbs, of those mutilated on the field of honour. Let it not be thought that because no express mention is made here of the part played in war by many another branch of science, therefore the aid derived from them by navies and armies is either insignificant or not properly appreciated ; neither view represents the truth; few there can be who, having read of aerial reconnaissances and gas attacks, can have allowed their imaginations to go so far astray as to overlook, for instance, the part which the sciences of the photographer and of the meteorologist must play in a modern war.

At the present day is seen the spectacle of a great conflict which is being carried out over a great expanse of the globe, and in which

{Мау

naval and military operations are being conducted, not only on the sea, and on and under the land, methods with which our ancestors of a couple of centuries ago were familiar, but to these long-known methods have been added others involving operations under the surface of the water, as well as those high in the heavens above land and water. As remarkable as are the changes in the methods of fighting which have taken place, and to which allusion has been made, is the complete transformation in the character of the weapons used, and in the composition of the forces which now take the field, as compared to those of even a century ago: the ships of modern fleets bristle with technical appliances; in the composition of the higher formations of armies, the relative numbers composing the technical arms show a prodigious increase, not only so, but even the services provided by these technical arms are more numerous and present features of greater complexity. The extent to which appliances of a technical nature find a place in the equipments of navies and armies is after all the best measure of the part science plays in war; these afford evidence on this point which can be almost as fully appreciated by a layman as by a scientific expert.

In taking advantage of the aid which science places at their disposal, navies and armies are but acting on the precepts of the ancients who, by the allegories contained in their mythology, have handed down to succeeding generations the wisdom of their own age. That the ancients appreciated the importance of preparing for war and of utilizing all the aids of science in its prosecution may, in some measure, be gathered from the descriptions of the preparations made by Perseus when he was sent forth to destroy Medusa-even the modern trench-fighter's periscope had a counterpart in the mirror of which Pallas made him gift. Bacon reminds us that : "The furnishing of Perseus with necessaries was that which only advanced his attempt and drew fortune to be of his side." To-day war has a science of its own, and however great may be the debt of gratitude which navies and armies owe to the workers in many other fields of science, to none is their debt greater than to those members of their own great professions who have had the foresight to recognize that it is the furnishing of navies and armies with the fruits of the latest discoveries in the fields of science which only advance their attempts and draw fortune to be of their side, and who have, in consequence, devoted their labours, long and persuasively, to ensure that nothing essential for the conduct of war should be lacking in the equipments of the respective services which have claimed their affections. By kindling one light at another these great men have made provision for the communication of science to the succeeding ages.

The above article appeared in the January number of the British Science Guild. 199, Piccadilly, London, W., and we are indebted to the courtesy of the Guild for permission to produce it in the R.E. Journal.—EDITOR.

PASSING THOUGHTS ON MILITARY ARCHITECTURE IN THE THAMES DEFENCES.

By MAJOR A. A. CROOKSHANK, R.E.

ANYONE taking a thought on the history of England and at the same time taking up a map of the country, would expect to find evidence of ancient fortifications on the line of approach by water to the capital. He would expect to find examples of military architecture in those places where the defences of the port of London against an attack by sea must obviously be placed, and, it may be added, he would not be disappointed. Architecture may be said to consist of two classes, the "Visible" and the "Invisible." The "Visible," like the poor, we have still with us; the "Invisible" exists chiefly in the pages of history, and in descriptions and drawings. The Thames defences are rich in examples of both classes, indeed, they are a regular museum of military or fortification architecture from 1402 onwards; and, if we include the Medway defences as well, the pedigree can be traced back to the Conquest.

The line of least resistance takes us to the "Visible" of the above two classes; the "Visible" makes a more direct appeal, as anyone can see the building for himself, and "seeing is believing." Seeing is a one-process system, whereas the appreciation of the "Invisible" building involves the use of several processes, such as reading, thinking, and imagining, and even then the result may be disappointing, as there may be a feeling of doubt left in the mind. Statements in history are sometimes founded on very slender evidence, and strike one as, what they call in journalism "unconvincing narratives."

The Thames Defences have visible examples of five different periods in military architecture. Firstly, the 1680, or Jacobean period (the Brick and Stone Age); and secondly, the 1715, or early Georgian period (the Brick Age), both in Tilbury Fort. Thirdly, the 1780 or late Georgian or Napoleonic period (the Earth Age), in New Tavern Fort. Fourthly, the 1870, or mid-Victorian or Crimean period in the "Thames" Forts, Coalhouse, Shornemead, and Cliffe (the Stone Age). Fifthly, and lastly, the more modern or late Victorian period in Hope Battery (the Iron Age).

The first thing one notices in reviewing these five periods, is the rapid decline in military architecture, from the aesthetic point of view. Facilis descensus Averni. It would not require a very long acquaintance with the iron box of Hope Battery to make one describe it as both a literal and an æsthetic Avernus. How the first period does put the others to shame, especially the last three ! How the glory has departed from Israel in the 200 years that elapsed between 1684 and 1884 ! In the days of the Restoration, England built military buildings that she was not ashamed of, and that she can point to with pride 240 years afterwards. The beautiful carved stone "water gate " of Tilbury Fort is justly celebrated far and wide.

" Gates of monarchs

Are arched so high that giants may get through."

Every year people, and the right class of people, too, namely, experts in architecture, building, and in art, travel long distances to see it.

> "The hasty multitude Admiring entered and the work some praise, And some the architect."

The inscription over the entrance is interesting; it states that the gate was built in the 34th year of the reign of Charles II. On reading this the intelligent and cultured spectator promptly remarks that the statement is stupid, as there was "no sich thing," Charles II. having only done 25 years, from 1660 to 1685. The solution of the problem is that in those days, when patriotism was booming instead of being a sort of freemasonry as it is now, the years of Charles II.'s reign were reckoned from the last year of Charles I., *i.e.*, 1649.

There is much to admire in the buildings of the Jacobean period in Tilbury Fort. Besides the west gate, there is the stone gateway of the sally port on the north side, although it is only the back entrance, so to speak; the little stone arch on the west arm of the outer moat, although it is only the drain to and from the river; the beautiful claret-coloured brickwork with grey stone groins and string course in the parapet wall of the bastioned trace, the brickwork and steep pitched roofs with tiles in chessboard pattern and with white ridges in the main entrance; the mortuary over the Sally Port, with its pyramidal roof; and the two blocks of barracks on the east and west sides, the brickwork in the east block being almost black.

We leave the beautiful work of the 1680 period behind with regret, and pass on to the next period, the Early Georgian of about 1715, as represented by the Chapel and the magazines. Although the interval of time between the two is only a short one, yet a great change is noticeable. During these 30 odd years, domestic archi-

204

1916.] MILITARY ARCHITECTURE IN THE THAMES DEFENCES. 205

tecture in England had passed through the Queen Anne period, and this left its mark on the buildings in Tilbury Fort, which indicate a transition period. The Chapel is very Queen Anne-ish, whereas the magazines are more decorated, although only magazines with their buttresses, panel, and colour-scheme in the brickwork.

The Chapel is a fine example of its style, with its windows of varied design; its heavy cornice, and its roof, which is in the Jacobean manner, except that the tiles are in red and black stripes instead of squares. The Chapel is, in its own way, a beautiful building; it does not make that instantaneous appeal that its luxurious and expensive Jacobean neighbour does; it is a building that grows on one, and there is no better test than this of the classical, or that which is made to endure in anything, whether art, literature, or music. The good Queen Anne is always quoted as the great example of mortality; her building in Tilbury Fort might, on the other hand, be quoted as an example of immortality. Both these Georgian buildings, the Chapel and the magazines, have a two-colour scheme of red and buff in the brickwork, and beautiful hopper heads embossed with "1715, G.R.," and down-pipes of square section, all made of thick lead. The brickwork is in great contrast to that in the Jacobean buildings; in the latter the bricks are of a much deeper red colour, evidently of different composition, and they are laid with wider joints.

Of the other three periods previously mentioned, the 1780 (New Tavern Fort), 1870 (Thames Forts), modern (Hope Battery), the less said the better ; indeed, from the point of view of the æsthetic in military architecture there is nothing to be said at all. Presumably, these buildings were not intended to be ornamental; certainly no one could accuse them of being so now. Whether, as a provision of nature, they were useful by way of compensation, that is another story.

> " Our fathers next, in architecture skill'd Cities for use, and forts for safety build."

As will be observed in the foregoing, it is suggested that the architecture of the Thames Defences might be divided into two classes the "Visible" and the "Invisible." The "Visible" class having been discussed, it is now proposed to record some passing thoughts on the "Invisible" class. It was also stated that the Thames Defences were a museum of fortification architecture from 1402 onwards; it would, however, be more correct to fix the dividing line between the "Visible" and the "Invisible" class at 1680 and to state that the latter class contains buildings from 1680 backwards. The earliest recorded fortification, built over one thousand years ago, is so "invisible" that it can neither be seen nor even imagined.

THE KING ALFRED PERIOD, A.D. 893.

All we know is that in the year of grace 893 a fort is said to have been built by King Alfred at Milton. "In 893 a fleet of 80 sail of Danish ships," says Pocock, "under the command of Hastings, the Dane, sailed up the Thames, and crected a Fort at Milton by Gravesend." This is more than probable when we consider King Alfred's character and accomplishments. He was a great general, he was also "able and brave," says Oman, " and far above all men of his day in his desire for wisdom and learning, and from his earliest years was known as a lover of books and scholars. . . Seldom if ever, did any king combine so much practical ability in war and Governance with such a keen taste for literature and science."

Alfred may be reckoned the father of the English Navy, he built ships of larger size than any that had yet been seen in Western Europe (the "Super-Dreadnoughts" of the period), and provided that they should be well manned. He encouraged sailors, he was a friend of merchants. We have no space to tell of the many other spheres of Alfred's activity, such as his churchbuilding, his mechanical inventions, and his zeal in almsgiving and missionary work. "He saved England from the Dane, and brought her back to the foremost place among the peoples of Western Europe." Last, but by no means least, "he smote the Danes when they dared to invade his realm in his later years." Let us hope that the fort he is said to have built at Milton in A.D. 893 helped to repel these invasions by the Danes and to protect the river Thames, the town of Gravesend and the Port of London.

It is sad that a man of his many-sided genius and culture, and a king of his ability and efficiency should go down to posterity as the king who was scolded by an old squaw for scalding her scones. Yet he is far better known for this accomplishment than for any of his many others. What is fame?

THE HENRY IV. PERIOD, 1402.

The next Thames Fortifications were built more than 500 years later by Henry IV., in 1402. "On the 3rd July, 1402, he directed Commissioners," says Brabazon, "to see works erected properly by the men of East Tilbury . . . within one month from the date thereof . . . (the works to consist of) a curtain wall of earth with garretts." Evidently these could not have been very elaborate or permanent fortifications if they could be finished off by the men of a small village in one month.

There are no drawings of these defences, but we can imagine what they were like. It is recorded that the "town of East Tilbury was fortified by a wall of earth with garretts," presumably a sort of "Roman camp" work or high command earth parapet redoubt with small look-outs or watch towers at intervals round the perimeter. This "wall of earth" was no doubt traced round the high ground near East Tilbury Church and Village, then probably lapped by the salt waters of the Thames or North Sea. These defences were probably built to defend the Port of London against the descents of Norman privateers on our coasts. These raids were encouraged by Lewis of Orleans, the uncle of Queen Isabella, wife of Richard II.

Coalhouse Point was chosen as the site for the defences because it is a strategically strong position, commanding as it does both the Lower Hope and Gravesend Reaches of the river, and also the ferry which then existed across the river at the Point. Similarly King Alfred's fort at Milton guarded the ferry across the river at Gravesend as well as Gravesend town itself.

THE HENRY VIII. PERIOD, 1539.

Both these schemes of fortification consisted of one fort only. The next Thames Defences were built by Henry VIII., in 1539, or 137 years later. These were of a far more advanced design and covered a large area; they showed great progress in the art of fortification as they were built of masonry and carried cannon. "King Henry VIII. was the first," says Pocock, "who turned his thoughts towards protecting the Metropolis of this Kingdom by the erection of platforms on the sides of the Thames." The defence scheme consisted of five "platforms or bulwarks and blockhouses" (see *Sketch No.* 1). "One," says Brabazon, "was erected at Higham,



Sketch No. 1.

two at Tilbury, and two at Gravesend. They were called Higham, Hermitage (Tilbury or West Tilbury) and East Tilbury, Milton and Gravesend." "He mounted them," says Millar, "with cannon for the defence of the river."

There is no doubt about the sites of the Gravesend, Milton, Tilbury and East Tilbury blockhouses; two of them are shown in a map of the Elizabethan defences in 1588 (see *Sketch No.* 3). "The blockhouses at Gravesend," says Millar, "were both within the parish of Milton; one was built on the Chapel field near the ancient Chantry, the other in front of the Terrace."

The one at West Tilbury or Tilbury (called "Hermitage") was built on the site of an old chapel. The site of the fifth, the Higham blockhouse, is not known; neither the local nor the county archæologists have as yet succeeded in placing it. My own opinion is that it was on the river bank between the present Shornmead and Cliffe Forts, i.e., on that small and narrow strip of Higham parish which runs down to the river there. The blockhouse was called Higham Blockhouse and was therefore presumably in Higham parish. In this position it would guard the ferry across the river from Coalhouse Point, and also, with its sister blockhouse (East Tilbury) opposite, would block the west end of the Tilbury Hope Reach of the river or the east end of the Gravesend Reach. The approach to the ferry on the Kent side is supposed to have been along an old Roman road leading from Higham, past Higham " Mound " (the origin of which is wrapped in mystery and has never yet been satisfactorily explained) and then across Higham "Common" down to the river. The Romans also are said to have had a ferry at this point.

Henry VIII.'s scheme of Thames Defences against an attack by sea thus consisted in holding two lines across the river, one the East Tilbury to Higham blockhouse line at the inner or west end of Tilbury Hope Reach, or outer or east end of Gravesend Reach; and the other the Tilbury-Gravesend line in the middle of Gravesend Reach. Each of these lines had a blockhouse at each end of it, *i.e.*, the blockhouses were one on each bank of the river and opposite one another. The fifth blockhouse, called Milton, was evidently intended to protect the outlying parts of the town of Gravesend (in Milton parish) from bombardment by the enemy's warships.

As regards the design of the blockhouses themselves, they were of masonry, probably of stone, as better able to stand bombardment by the enemy's naval cannon. They had a semi-circular front (see *Sketch No.* 2); the back part of the blockhouse was at a higher level,



and from this the small arms were fired; the cannon firing from a semi-circular platform in front of and below the former. At the

1916.] MILITARY ARCHITECTURE IN THE THAMES DEFENCES. 209

back of the blockhouse was a small rectangular courtyard surrounded by a wall.

Henry VIII.'s fortifications were built to defend London and the shipping of the Port of London against the French Navy. During his reign he was frequently at war with France as his hereditary enemy. In 1513 he landed an Expeditionary Force of 25,000 men at Calais. In 1540 "he had to keep guard," says Oman, "against attacks on the South as well as the North." This would be the period of the Thames Defences. "King Francis had collected a great fleet in Normandy and threatened an invasion of England. Henry was forced to arm." In 1545 the French attacked the Isle of Wight. In 1544 Henry captured Boulogne and retained it against all attempts until 1546, when it was ceded to him. The struggles with France and Scotland had the most disastrous effects on the finances of the realm.

THE ELIZABETHAN PERIOD, 1588.

The next Thames Defences were built by Queen Elizabeth in 1588, or 49 years later. In the meantime Higham Blockhouse, one of the five built by Henry VIII. in 1539—1540, had been "discharged" in 1553, *i.e.*, the cannon had been removed and the blockhouse disarmed. This was the year of the death of young King Edward VI., and five years before Queen Elizabeth came to the throne. Evidently Queen Elizabeth was much concerned about her Thames Defences, for in the very first year of her reign, *i.e.*, in 1558, she visited Tilbury, and shortly afterwards arrangements for building fortifications were put in hand.

The Earl of Leicester (curious coincidence) was Governor of the old Henry VIII. Blockhouse at Tilbury in 1558, as he also was 30 years later, in the Armada year of 1588, when the Queen visited Tilbury. Was this first inspection in 1558 the beginning of their "affaire de cœur?" The Earl of Leicester, "with his comely face," was the only one of the Queen's many suitors who ever really touched her heart. She denied him her hand for purely patriotic reasons, because she thought that it would be better for the government of the country if she remained unmarried.

The Queen's journey in 1558 is thus described, says Pocock :— "From Blockhouse where she should be set on land unto the outward Quarter of the Campe." The Queen's anxiety about the Thames Defences in 1558 was due to the fact that England was in the midst of war with France, Queen Mary having lost Calais in that year, after it had been an English possession since 1347, *i.e.*, for more than 210 years. There was also the prospect of even greater danger from Philip of Spain, the late Queen's husband.

We read that in 1565 "Jasper May was one of the Governors of

Gravesend Bulwarke." In Queen Elizabeth's time "the Forts (*i.e.* Blockhouses) of Gravesend and Milton each had a Captain, two soldiers, one porter and five grooms." This shows that Gravesend and Milton Blockhouses had not been "discharged." The Elizabethan scheme of Thames Defences was much the same, in principle, as that of Henry VIII.; indeed it was the latter's scheme modified and enlarged. The blockhouses at Higham dropped out, as above explained; the blockhouses at East Tilbury and Milton remained as before (see *Sketch No.* 3). Large fortifications were erected round the blockhouses of Gravesend and Tilbury (Hermitage or West Tilbury), using the old blockhouses as "keeps," and a bridge or barrier of boats was built across the river between these two forts.



Sketch No. 3.

The general idea was, as in 1539, to defend the Gravesend Reach of the river at two points, at its cast or lower end and at its centre. The lower end was held by the Henry VIII. Blockhouse at the strategic position of Coalhouse Point (East Tilbury), the centre by the twin forts of Gravesend and Tilbury with bridge and barrier connecting them; and the outlying portions of the town of Gravesend to the east (in Milton Parish) were protected against bombardment from a hostile fleet by the Henry VIII. Blockhouse of Milton.

It seems curious that the Higham Blockhouse should have been dropped, leaving the lower end of Gravesend Reach to be held by one blockhouse only, on the Essex bank, and none on the Kent bank, although the deep water channel is on the Kent side of the river, and ships could in those days, by hugging the Kent bank, have passed up the river out of range of the cannon in East Tilbury Blockhouse.

The Elizabethan scheme of defence probably relied more on the very strong Gravesend to Tilbury line, and more or less abandoned

[MAY

the advanced or first line (East Tilbury to Higham) of Henry VIII. On second thoughts I am doubtful whether the East Tilbury or Coalhouse Point Blockhouse was "alive" in the 1588 scheme. I notice that in the map (see *Sketch No.* 3) it is called "Old Blockhouse" and differentiated from the Milton one, which is called "Blockhouse," and whereas the establishment of Gravesend-Milton Blockhouses in Elizabethan times is on record, no establishment is given for East Tilbury Blockhouse. On the other hand there is no mention of the latter being "discharged," as is clearly recorded in the case of Higham Blockhouse; also East Tilbury Blockhouse is shown in the map of Thames Defences in 1588; also no establishment is given for Tilbury Fort, which we know was "alive," neither have the drawings of Gravesend Fort been found yet, though we know that it was designed at the same time and by the same hand as Tilbury.

In the year 1588, the year of the Spanish Armada, "Gravesend was then fortified," says Pocock, "and western barges thither brought to make a bridge like that of Antwerp, to stop the entrance of the daring foe, and give free passage both to horse and foot, between Kent and Essex as occasion served." " In the year of the Spanish Armada," says Clifford, "the Earl of Leicester, then Governor of Tilbury Fort, blocked up the channel." Some authoritics describe the chain of boats as being a "barrier" only, i.e., simply a boom, to obstruct the enemy's ships; others say it was also a bridge of boats to facilitate the passage of troops across the river in case the Spaniard: effected a landing in the country. The design of this barrier (see Sketch No. 3) shows that it was of chevron shape in plan, the point projecting eastwards, i.e., towards the enemy, the "cut" or gap being left in the centre. Presumably it was left open either to allow traffic through when there was no danger, or else to allow the enemy's ships through one at a time only, when they could be disposed of in detail, if necessary, from the ends of the bridge. From this design it would appear that this barrier was intended more as an obstacle than as a bridge. This salient angle would enable the forts on both banks of the river to enfilade the obstacle without firing into one another, but the shape would be a disadvantage for a floating bridge in a tidal river. The idea may possibly have been to "go into bridge " or close up the bridge with the help of the flood tide swinging in the long arms or the ebb tide the short returns at the end of the long arms (see Skeiches 4 and 5),



Sketch No. 4.



Sketch No. 5.

the latter arrangement being the better for enfilade fire. This scheme, however, makes no allowance for dead water at the turn, and its successful working would depend on "my friend the enemy" being obliging enough to attack when we wanted him to and not at a time of his own choosing or at the time which suited him best.

The design for Tilbury Fort shows a great advance in fortification on the Henry VIII. period of 49 years before; this is only to be expected in the wonderful Elizabethan period, England's "Golden Age." It is disappointing, however, to find that no Englishman was apparently qualified to design the fort; it was done by an Italian, Frederico Genebelli. Italy in that period, after its great Renaissance, must have been far more advanced and far more civilized than England. Shakespeare selected Italian foundations for most of his plays; in fact Italy was "the fashion." Genebelli also "prescribed" the bridge or barrier of boats and the fort at Gravesend, the design of which is not available. In this interval of 49 years fortifications underwent a mighty metamorphosis, from a small masonry blockhouse to a star-trace fort covering a large area. Genebelli's design for Tilbury Fort consisted of a star of six points and thirteen faces, including the river front (see *Sketch No.* 6). It



Sketch No. 6.

had two lines of defence, each with a wet moat filled from the river; the inner ring was built close round the Henry VIII. Blockhouse, using the latter as a "keep" or last stronghold; in this ring was al o a gun platform for about eight guns. The outer line of defence was much longer than the inner. The entrance to it on the north, or land front, was protected by a guardhouse and by a drawbridge; the inner moat was also protected by a drawbridge, so was the road which ran north and south, from the north or land entrance across the middle of the fort down to the causeway and to the approach from the river. The design of the parapet (see *Sketch No.* 7) shows



Sketch No. 7.

just as great an advance in the art of fortification as the plan. It is a high parapet type with the banquette raised well above the ground, both interior and exterior slopes are revetted with masonry walls, there are two wet ditches, the outer one strengthened by a palisade. In fact the whole design shows the "spacious days of good Queen Bess" and is a great credit to her. As regards the work of actual construction it is interesting to note that the labourers were paid 8d. a day, *i.e.*, a little more than is now, in 1915, paid for a single hour, and carpenters received 14d. a day, now they get on an average about 9s. a day 1

"When the nation," says Millar, " was in dread of an invasion from Spain in the year 1588, fortifications were erected at Gravesend and Tilbury, and a fleet of battleships, to contest the passage of the river, moored here, whilst a large army encamped near the fort at Tilbury. On the 8th of August, 1588, Queen Elizabeth came in a State barge to Tilbury, to review her troops, and landed under a royal salute from Gravesend and the opposite fort." "In 1588," says Brabazon, "on both sides of the river fortifications were erected according to the prescription of Frederick Genebelli, an Italian . . . a barrier of boats was also built by the Governor of Tilbury Fort, the Earl of Leicester . . . on the 8th August, 1588, Elizabeth arrived in her barge at Tilbury Fort." "Leicester, whom the Queen loved till his death day, perished of a fever the same year (1588)."

On arrival at Tilbury the Queen rode to the house of the Squire of West Tilbury (just west of the village), where she stayed the night. Next morning she rode out to the famous Tilbury Camp, which was on the high ground, and dry sandy and gravelly soil, near West Tilbury Church. This army was one of the three armies of Volunteers raised in great haste when the threat of the Spanish Armada became known. One army was to guard against a landing on the south coast and an advance on London from the south. This army was concentrated near Portsmouth. Another army remained in London to protect the capital and the person of the Sovereign. The third was to guard against an advance on London from the east coast or from the banks of the Thames; this was concentrated at West Tilbury. The men in the latter army were all Volunteers from the counties of Essex and Kent, which, as usual, displayed great patriotism and public spirit in rapidly raising a large number of men.

The Queen rode out, inspected the troops, and then made them her well-known Tilbury speech, which was as follows :—

" My LOVING PEOPLE,-We have been persuaded by some, that are careful of our safety, to take heed how we commit ourself to armed multitudes, for fear of treachery; but I assure you I do not live to distrust my faithful and loving people. Let tyrants fear! I have always so behaved myself, that, under God, I have placed my chiefest strength and safeguard in the loyal hearts and goodwill of my subjects. And, therefore, I have come amongst you, as you see at this time, not for my recreation and disport, but being resolved in the midst and heat of the battle to live or die amongst you all; to lay down for my God, and for my kingdom, and for my people, my honour and my blood ever in dust. I know I have the body of a weak and feeble woman; but L have the heart and stomach of a King-and of a King of England, too ! -and think foul scorn that Parma or Spain or any Prince of Europe should dare to invade the borders of my realm, to which, rather than any dishonour shall grow by me, I myself will take up arms. I myself will be vour General, Judge and Rewarder of every one of your virtues in the field. I know already for your forwardness, you have deserved crowns; and we do assure, in the word of a Prince, they shall be duly paid you. In the meantime my Lieutenant-General shall be in my stead, than whom never Prince commanded a more noble or worthy subject ; not doubting but by your obedience to my General-by your concord in the camp-and your valour in the field, we shall shortly have a famous victory over those enemies of my God, of my kingdoms and of my people,"

These wonderful words, a masterpiece of brief and appropriate oratory, help to explain that great power which this Queen exercised over men, and the genius she had for attracting around her the best talent in the country, and for then getting their very best efforts out of them. It is to be remembered that in those days the soldiery were very undisciplined and monarchs visited them at some risk; indeed, on this particular occasion, the Queen was strongly advised and begged not to go near this newly-raised army. Yet, in the course of a speech of a few sentences only, she must, with her fine sentiments and magnetic words, have roused their noblest feelings of patriotism and duty, have quickly won over any waverers, and by the time she had finished she must have had all the men shouting themselves hoarse and cheering for their Queen and country. "Towards the end of her reign," says Oman, "the people came to look upon her as a sort of second Providence, and credited her with an almost superhuman sagacity and omniscience."

In connection with Queen Elizabeth's inspection of Tilbury Camp, on the 9th August, 1588, it should be remembered that the final engagement between the British Fleet, under Lord Howard, of Effingham, and the Spanish Armada was fought on August 8th and 9th off Calais. The Armada had been bombarded, hustled and worried all the way up the Channel from Plymouth for a whole week ; by the time the Spaniards reached the Straits of Dover they were demoralized. In this engagement on August 8th and 9th the Armada was shattered, and it fled into the North Sea before a strong southerly gale, and there dispersed. The British Fleet then sailed victorious up the Thames and reported the rout of the enemy after 10 days' continuous fighting. "They were welcomed," says Oman, " by the Oueen, who had gathered a great force of Militia at Tilbury, to fight the Duke of Parma if he should succeed in crossing with Spanish troops from Flanders and invading the country." "Elizabeth behaved splendidly during the crisis, she had organized a strong army and put herself at its head, inspiring every man by the cheerful and resolute spirit which she displayed . . . it is unlikely that the Duke of Parma would have been successful against the numerous and enthusiastic levies which were ready to fight him."

There is a good deal of truth in the remark that "when a Queen is on the Throne the country is governed by men, when a King is on the Throne, by women." "Would that there were more of the Elizabethan spirit," says Lord Rosebery, "in England in these days." Queen Elizabeth returned to London the same day, 9th August, 1588, by barge from Tilbury.

THE CHARLES II. PERIOD OF 1680.

The next period dealt with in the history of the Thames Defences is the 1680 or Charles II. period, *i.e.*, nearly 100 years later. The Henry VIII. Blockhouses no longer appear as part of the defence scheme. This is not to be wondered at considering that they were built 141 years previously. Tilbury Fort, as built by Queen Elizabeth, disappeared when Charles II. built his fort on the same site, but it is not known when the Henry VIII. Blockhouses of East Tilbury and Milton, and the Elizabethan fort of Gravesend were broken up either by man or by nature; the fortifications of Gravesend and Milton were in existence in 1650, and the one inside Tilbury Fort in 1725.

It is in a way, satisfactory to note that the Henry VIII. Blockhouse of Gravesend survived till 1834, *i.e.*, it nearly celebrated its 300th birthday. After prolonged negotiations it was eventually sold by the Crown to the Corporation of Gravesend, or rather to a committee of the inhabitants, for £7,000, and the present Terrace Pier was built on its site. On the other hand it is sad that this old blockhouse did not survive the sale of 1834. One of the advertisements used to announce this sale is now (1915) in the Royal Engineers Office at Gravesend. There are also in this office two large scale maps, one dated 1736 and the other 1780, both of which show this blockhouse clearly. It was used by Charles II. as a banqueting house, and perhaps this is why it survived and was kept in repair when the other blockhouses were allowed to go to ruins. If it had weathered that storm it would probably still be with us, and what a great addition a fort, dated 1539, would have been to the rich store of antiquities that Gravesend already possesses, what an attraction to visitors, and what an object of veneration to archæologists, historians, architects, and military engineers. Evidently in those days, i.e., between 1588 and 1680, a soldier's life was not altogether a happy one. In 1631 the pay of the garrison (gunners) of Gravesend Fort was six years in arrears, and of Tilbury Fort seven years.

In 1650 Gravesend is described by a visitor as follows, says Pocock: "We walked about the town, where we saw its strong Castle, defended by ramparts and bastions of earth, furnished with a good number of cannons, and a great garrison within it as being a place of consequence." The Charles II. scheme for Thames Defences appears to have consisted of one fort only—at Tilbury. It was a one-fort design like the King Alfred and the Henry IV. schemes, except that the former placed his solitary fortification at Milton (next Gravesend), and the latter placed his solitary fort at East Tilbury village.

The fortifications in the Elizabethan scheme, viz., the large forts at Tilbury and Gravesend and the blockhouses at Milton and possibly at East Tilbury (or Coalhouse Point), also now disappear from the scene as live defences, though the Henry VIII. Blockhouse of Milton, as previously stated, lasted till 1834, or another 150 years.

Charles II.'s fort of 1680 at Tilbury seems to have been built on the same site as the Elizabethan fort of 1588. The latter must have been demolished (or rather what was left of it after nearly a hundred years, a period which included the great Civil War and the Commonwealth), as no traces of it remain. There was, of course, very little masonry in the 1588 fort; it was mostly earthwork, except the Henry VIII. Blockhouse, the guard-house at the north entrance, the foundations of the two drawbridges and the south entrance gate, and the retaining walls or revetment of the parapet.

For the design of the fort, Charles II. consulted, as Elizabeth had done before him, the greatest authorities on permanent fortification in Europe at the time. It was the golden age of the art of fortification, and the leading exponents were Coehorn (a Dutchman, who

lived 1621 to 1704, and who was known as "The Vauban of the Netherlands "), and Vauban, who lived 1633 to 1707. Vauban was the great French military engineer, who then had a world-wide reputation. He is the outstanding figure in fortification design, Antwerp being his most famous creation. He invented the famous "bastion trace," with its ravelins, sally ports, curtains, bastions, caponiers, escarps, counterscarps, galleries, etc. The principles which he laid down were being taught in this country over 250 years after his birth-surely a unique record in such an ever-varying and continually progressing art as fortification.



B West Bastion. C North-West Bastion. D North-East Bastion. E East Bastion. F Berme, G Moat. H Shice. and Part. * Main Bridge. 3 Bridge of the Ravelin. 4 Gunners' Guard.

5 Barriers.

- Ravelin,
 K Covered Way,
 Parapet of the Glacis,
 M Place of Arms,
 N Two Lines of Guns. O Avant Fosse, P A Redan and P A Redan and a Redoubt in it. Q Diques. 6 Barbette Platforms. 7 Stove House. 8 Master Gunner's Store Room.
 - 9 The Chapel with Guard Room
 - under it.
- R Floodgate. S T U Redoubt. Wharf and Crane. U Landing Bridge, W Powder Bridge.
- X Cisterns. Y Offices. Z Water Gate.
- 10 Barracks. 11 New Sluice. 12 Old Powder Magazine. 13 New Powder Magazine.

" In Charles II.'s reign," says Brabazon, "Government resolved upon the erection of a regular fort at Tilbury in March, 1667. Sir Martin Beckman is said to have prepared the plan, having recently superintended one at Sheerness. Sir Bernard de Gomme, engineergeneral, was also employed in both places, probably under the

direction of Sir Martin, engineer-in-chief. For the principle of their design they were indebted to Cochorn and Vauban, who were then giving instruction in Europe. From Coehorn came the happy suggestion of crecting the foundation upon piles, driven so deep that, being pointed with iron, they entered the solid rock adjoining the chalk hills on the other side. Next the river is a strong curtain with a fine gate, called 'The Water Gate.' The Governor of Tilbury Fort claims the ferry which passes between his premises and Gravesend.''

This ancient privilege explains why it is that nowadays the Army is allowed free passage on the Gravesend-Tilbury ferry steamers. In the good old days this ferry, which ran between Tilbury Fort and the Henry VIII. Blockhouse at Gravesend, was the perquisite of the governor of the fort, and as pay in the Army then was, so to speak, "few and far between," and often many years in arrears, these ferry tolls probably formed a large proportion, if not the whole, of his emoluments.

The Governor built the inn, appropriately called the "World's End," for the accommodation of people waiting to get across the ferry. "The Governor," says Pocock, "claims the ferry from his premises to Gravesend, on the same terms as the Corporation of Gravesend and Milton do theirs, and he has built for the greater convenience of passengers a public house for his ferrymen to dwell on the spot (emphatically termed the 'World's End')."

Tilbury Fort has had a long line of Governors—the Governor in the Elizabethan period was the Earl of Leicester. Other Governors were: In 1650, Colonel George Compton; in Charles II.'s time, the Duke of York. This Duke of York was the King's brother, and New York was called after him. His daughter married the Prince of Orange in 1677, and afterwards became Queen of England (William and Mary, 1688—1702). The Duke of York's title was "Governor of Gravesend and Tilbury," which shows what an important place Tilbury Fort was considered to be in the reign of Charles II., as well as in that of Queen Elizabeth. The Governor in 1818 was Sir George Lowry; in 1824 Lieut.-Colonel Hawker.

In Charles II.'s time the staff of Tilbury Fort consisted of one governor, one lieut.-governor, one storekeeper, one clerk, one master gunner. The salary of the governor was $\pounds 300$ a year and that of the master gunner $\pounds 41$ IOS. "Tilbury Fort, opposite to the Blockhouse at Gravesend," says Pocock, "may be looked upon as the Key to the City of London. . . The Esplanade of the Fort is very large, and the Bastions are the largest of any in England . . . a Platform . . . in which are planted IO6 Cannon, generally

carrying from 24 to 47 pound ball; a Battery as terrible as important to the place . . . so that they must be daring men who will venture in the largest ships to pass such a Battery."

Tilbury Fort, as designed in the Coehorn and Vauban manner by Sir Martin Beckman and Sir Bernard de Gomme, "Engineer-General," consisted of a bastion trace forming a regular pentagon with five bastions (see Sketch No. 8), two on the land front, the north-east and the north-west, and three on the river front, the east and the west, with the "water bastion" between them. The latter bastion was never completed and eventually a "powder bridge" was built on the site. The main entrance was by the beautiful carved stone "water gate" between the west and the water bastions. The fort was surrounded by two wet moats, of which the inner was 150 ft. wide. Between this and the outer moat or "avant fosse" there was a low command parapet or "covered way." From the sally port between the north-east and north-west bastions, i.e., to the north or land front, the "main bridge" over the moat led to the ravelin. Similarly there was in the outer moat a "redan with a redoubt in it." Near the water gate was the "land bridge" (the present stone causeway). The fort had an underground water tank and an underground powder magazine in the east bastion, and two blocks of barracks. The old Henry VIII. Blockhouse of 1539, i.e., some 140 years before, is shown as being in the centre of the water bastion. At the salient of each bastion there was a gun platform "en barbette." The chapel, "with a guard room under it," was added in 1715, and two more above-ground powder magazines in 1716 to 1724. A gun platform for 31 guns, extending along the river bank on either side of the water bastion, was added at about the same period.

The fort itself has a high command parapet, with a high masonry wall of red brickwork, with white stone quoins, string course and weep holes, on its outer side. The architectural beauties of these buildings of the Charles II. and early Georgian periods have already been mentioned. The fort was begun in 1667 as regards the preliminary work, and was built between 1682 and 1687. The ornamental water gate is dated the 34th year of Charles II., *i.e.*, 1683, counting from the last year of Charles I., or 1649.

It is sad that Charles II. had, like Queen Elizabeth before him, to seek inspiration from foreign authorities in his design for Tilbury Fort, but then he had, except for a few months, never been in the British Isles. "He was," says Oman, "Continental in his manners, thoughts and life."

The new fort at Tilbury was apparently built as a protection against the Dutch. In 1666 "the English Fleet had not recovered from the disaster in the Downs, for Charles II. had squandered on his palace and harem the liberal grants which Parliament made him to repair his Navy. While the seas were unguarded a Dutch squadron slipped up the Thames . . . and held the Port of London blockaded for some days." In the following year the project for a new fort at Tilbury was put in hand. In 1671 Charles II., in alliance with Louis XIV., of France, declared war on the Dutch.

THE LATE GEORGIAN PERIOD, 1796.

The next period dealt with in the history of the Thames Defences is the late Georgian period, 1779-1798, *i.e.*, 115 years later. During this period a fort was built at Lower Hope Point, another at Shornemead in 1795-1796; a third at Coalhouse Point in 1798; and a fourth at New Tavern, Gravesend, in 1779-1780. The first three forts were dismantled in 1820, after Waterloo and the long peace which followed. These forts had a life of about 22 years only.



Sketch No. 9.

They were thus easily the shortest lived fortifications in the history of the Thames Defences. Tilbury Fort of 1680 was, of course, still "alive" in this defence scheme, and, indeed, was "alive" 200 years after its birth. The designs for Lower Hope Point, Shornemead and Coalhouse Point Forts may have been similar, as New Tavern was built 16–18 years before the other three. Lower Hope Point and Shornemead mounted four guns (24-pounders) each.

The 1796 scheme of Thames Defences had the fortifications spread over a large area, as in the schemes of Henry VIII. (1539) and of Queen Elizabeth (1588), except that the area defended was extended further down stream, *i.e.*, to Lower Hope Point. The defences thus protected the west end of Sea Reach, both ends and the centre of Tilbury Hope Reach, and the east end and centre of Gravesend Reach. The two previous schemes above mentioned had not touched Sea Reach at all. The forts were symmetrically placed, two on the Kent bank of the river and two on the Essex bank, and arranged so as to "break joint" in plan, and one (New Tavern) was placed so as to protect the town of Gravesend (just as had been done by King Alfred 900 years previously, and by Henry VIII. 260 years previously), and with its twin fort opposite (at Tilbury) the ferry over the Thames and the centre of Gravesend Reach.

The design of the forts of this period at Lower Hope Point, Coalhouse Point and Shornemead is not available, but was probably similar to that of New Tavern. The latter was, however, built 16 years earlier. The design of the fort at New Tavern, Gravesend, can be seen in a valuable old map, dated about 1780, in the Royal Engineers Office at Gravesend. The fort ran along the river bank in one line from the old Henry VIII. Blockhouse (*i.e.*, the present Terrace Pier), castwards, and then joined on to a closed fort of irregular star trace (similar to that of Tilbury Fort built by Queen Elizabeth in 1588), the present New Tavern Fort. The parapet was of earth, at a gentle slope on the outer side ; the gorge defence was in the west face of the closed fort and consisted of a loopholed brick wall barracks. Magazines, etc., were built inside the closed fort, some under the parapet.

"At the lower end of Milton Place," says Millar, " is the fort, erected in 1778, which so completely commands the river at this



Sketch No. 10.

point, with a sweep of open country besides that an enemy would at much hazard attempt to pass the mouths of its cannon. The state of public affairs at this period (1779) produced the construction of additional military works at Gravesend, as well as other arrangements in connection with the general system of defence."

It is interesting to note that at the time of the mutiny at the Nore (April, 1797), of the Channel and North Sea Fleets, Shornemead Fort fired on a large ship full of mutineers and made her strike her flag. New Tavern Fort was built as a defence (with Tilbury Fort opposite) against the Fleets of France, Spain and Holland. France declared war on England in 1778 after the disastrous American War. Spain followed suit in 1779 and Holland in 1780. A period of 10 years' profound peace then followed from 1783 to 1792.

The other three forts of this period were the outcome of the French Revolution which began in 1789. The French Convention declared war on George III. in 1793 and this great war lasted with but two short intervals till 1815. In 1796 Spain joined France, and England had now, as in 1778 to 1780, to face the united Fleets of France, Holland, and Spain. This accounts for the three additional Thames forts being built in 1796—1798, *i.e.*, for precisely the same reasons as New Tavern Fort had been built 18 years before. "The Fleets of France, Spain and Holland if united," says Oman, " would outnumber our own; and for the next three years (1797—1800) the safety of England hung on the power of our admirals to keep the junction from taking place . . . if once beaten the English Fleet could not prevent an invasion of England . . . and the victorious armies that had overrun Germany, Holland, and Italy from coming ashore in Kent or Sussex."

THE MID-VICTORIAN PERIOD OF 1870.

The next period we come to in the history of the Thames Defences is the mid-Victorian period of about 1870, *i.e.*, about 100 years after the last period. In this period New Tavern Fort and Tilbury Fort were reconstructed and modernized in 1868—1871. New gun platforms to take up-to-date artillery were built, also new magazines. This defence work was probably the outcome of the Crimean War.

In 1874 new forts were built at Coalhouse, Cliffe and Shornemead. These defences were also probably the result of the Crimean War as the preliminary work was begun in 1861 to 1863. The general scheme of Thames Defences of this period was a modification of the late Georgian scheme of 100 years earlier. The defences were concentrated on the west end of Tilbury Hope Reach and on the east end and centre of Gravesend Reach, *i.e.*, Cliffe Fort was substituted for Lower Hope Point Fort and the protection of the west end of Sea Reach abandoned.

Cliffe Fort was placed as a twin fort to Coalhouse Fort, and just opposite it. Shornemead and Cliffe Forts were placed close together on the Kent bank, probably because the deep water channel runs close along that bank of the river. The design of the three forts at Cliffe, Shornemead and Coalhouse was quite different from anything previously attempted. They are all three in the Crimean War or Todleben style and consist of a roughly rectangular trace, built of masonry, the high outer walls faced with granite similar to those at Sebastopol, which were bombardment-proof and which resisted our heaviest naval guns in the Crimean War. This period might be called the "stone age."

[MAY

The barracks, magazines, etc., are placed on the perimeter, leaving a small open courtyard in the middle. The entrance is by a heavy bullet-proof doorway. The emplacements for heavy guns are, of course, on the river faces of these closed-in fortifications. Each fort is provided with underground water tanks.

One point of great interest in these three forts is that they were built by Gordon of Khartoum, who was stationed at Gravesend, as Commanding Royal Engineer, when he was a "Captain and Brevet Lieut.-Colonel," from 1866—1871. Gordon did not approve of the scheme of defences given him to build, in fact he considered the scheme a bad one and, in his usual fearless way, stated so officially. For this he was badly reported on by his superior officer, who described Gordon as not fit to be an Army officer and implied that he should be removed.

It would be interesting to know if this superior officer lived to see the world-wide sorrow which Gordon's death caused, not only throughout the British Empire, but in every great nation, friendly or hostile, and whether he lived to change his opinion.

THE LATE VICTORIAN PERIOD OF 1900.

The last chapter of the history of the Thames Defences is that of the late Victorian period of 1900. In this period one fort only was built, namely, Hope Battery.

The late Georgian scheme of 1796 had a fort at Lower Hope Point. This fort was abandoned shortly afterwards, and in the mid-Victorian scheme of 1870 there was no fort at Hope Point, but one higher up the river at Cliffe instead.

In the late Victorian scheme of 1900 there was a reversion to the late Georgian type, and a fort was again built at Hope Point. This fort had a very short existence of a few years only, a shorter life even than its ancestor or predecessor, which, at any rate, lived for 22 years.

Nevertheless, this fort is of great interest, as it marks a new era in the progress of the art of fortification design, the era of metallic forts. The gun platforms and gunners' shelters, etc., are all made of steel plates, the men's barracks are an entirely separate building, as also are the officers' quarters, the office, engine room, etc., *i.e.*, the fort consists of a number of detached buildings not enclosed in any way or protected by a parapet, earth-mount, masonry wall, moat or fence. This " iron-age " fort marks another new era in the employment of electric searchlights, with coast defence artillery, thus enabling the guns to be used with effect by night.

It will be seen from these Notes that the Thames Defences cover a period of over 1,000 years, from A.D. 893 to 1900. The following examples of fortification design can still be seen "in the flesh," so to speak :— The Tilbury Fort of the 1680 period, with additions of the 1720 period; New Tavern Fort of the 1780 period; Coalhouse, Shornemead and Cliffe, also additions to Tilbury and New Tavern of the 1870 period; and Hope Point of the 1900 period. Altogether a fine museum of architecture, probably as fine a museum as can be found anywhere in the British Isles in as small a compass, with its examples of Charles II., Queen Anne to early Georgian, late Georgian, mid-Victorian and late Victorian styles.

If these Notes help to arouse interest in the history and development of the Thames Defences in particular, and of fortification design and fortification architecture in general, they will have served their purpose, especially so if they result in further research work being undertaken, and the history carried back earlier than 893, or more information being obtained about the 893-1900 period.



COLONEL AUGUSTUS L E MESSURIER

MEMOIR.

.

COLONEL AUGUSTUS LE MESSURIER, C.I.E., R.E.

COLONEL AUGUSTUS LE MESSURIER, C.I.E., Royal (Bombay) Engineers, died at his residence, 57, Mount Avenue, Ealing, on 19th February last in his 79th year, having been born at Eden Hall, Bombay, on 23rd June, 1837. He was the eldest son of Augustus Smith Le Messurier, Esq. (of an ancient Guernsey family dating back to 1259, William Le Mazerier, who was Sheriff of London), and Sarah Anne Taylor Morley, widow of James Morley, Esq., Barrister, and daughter of Capt. Starr Wood, H.M.S. *Chesterfield*, by his second wife, Elizabeth Travers.

Augustus Smith Le Messurier, Esq., was a barrister-at-law and practised his profession in Bombay. In 1831 he was appointed a Puisne Judge, one of three, but as immediately after, it was ruled there were only to be two in future, the appointment was disallowed; but on 10th September, 1833, he was promoted to be Advocate General of Bombay, and retained this post till 15th December, 1856.

Augustus, his eldest son, was sent home in 1841, and never saw his father again until he arrived in England in October, 1854. In 1847 Augustus was sent to Kensington Proprietary School, which vied with Cheltenham and Wimbledon Schools in sending up their boys direct to Addiscombe and thence to India, under the *régime* of the Honourable East India Company.

At school he showed great aptitude for sketching and survey, as well as athletic sports, especially cricket and rowing, as many of his brother officers would remember at Chatham in 1867, when he coached and successfully stroked a four-oared crew called the "Mulligatawnies" in the R.E. and other regattas on the Medway.

At school in the early "fifties " he was the prime mover in initiating sports, when he took many prizes, high pole jumping being his great forte. He was frequently on the river Thames, and greatly interested in boat building and the great oarsmen of the day. He seldom missed the Oxford and Cambridge Universities Boat Race; likewise at Lords he was always present at the great matches of the season.

Notwithstanding his pleasurable pursuits he devoted a great deal of his time to work for others, notably as a Governor and Member of the Committee of Almoners of Christ's Hospital, especially when the move to Horsham was in contemplation, and subsequently he paid visits to Horsham and to Hertford. On 1st February, 1855, he joined Addiscombe as a Cadet, passing through the ordinary routine with an extraordinary number of extra drills for trifling offences. He obtained his Commission on 12th December, 1856, with 12 others (John Herschell heading the list, a son and grandson of two celebrated astronomers), in the Honourable East India Company's Engineers.

Early in 1857 he joined the R.E. Establishment at Chatham, then under Colonel H. Sandham, R.E., with the local and temporary rank of Ensign.

He was keen on reconnaissance and survey work, was also employed in the operations of blowing up the old Rochester Bridge, and on one occasion was nearly drowned in the diving dress off the Dockyard wall. Yachting, boating, and boxing were his chief amusements, with many a night spent on the marshes after curlew, wild duck, etc.

He left London for India on 8th January, 1859, landed at Bombay on 12th February, and at that place was a guest of Mr. W. Frere, Bombay Civil Service (elder brother of Sir Bartle Frere), for some 10 or 12 days before proceeding to Poona, when he was posted to the Bombay Sappers. He lived at Kirkee with his great school and college friend, William Merriman, until ordered on field service to Okamundel in September. He was present at the Storming of Beyt and Siege of Dwarka, etc., and was present with Charles A. Goodfellow (Bombay Engineers) when that distinguished officer gained the Victoria Cross.

On return from active service he held appointments in the Public Works and Railway Departments, and in 1862–63 was employed on the Bombay Harbour Defences under Colonels Walter Scott and de Lisle (both of the Bombay Engineers), having as his companions his old schoolfellows, William Merriman and George Oldham, the trio being inseparable, and were known in society as the "Triumviri," or "The Three Graces." The Oyster Rock Battery stands as a monument to his memory, and on revisiting it in 1890 with his lifelong friend was pleased and astonished with the excellent work he had superintended so many years before.

Between 1863 and 1866 he held appointments as Executive Engineer at Nassick, Nuggur, and Kirkee, and in 1864 became Deputy Consulting Engineer for Railways. In 1865 he paid a brief visit to England, Ireland and Holland, and in 1866 was posted to Chatham for a "Refresher" course of military duties, under Colonels Fitzroy Somerset, and Lennox, v.c., meeting his old friend (William Merriman) there, similarly engaged. The duties he found light, but with those of Mess and cricket secretaries, yachting, rowing, hunting, shooting, etc., he passed an enjoyable time. Bicycling had then been instituted, which he took up in earnest, this standing him in good stead in after years as President of the Ealing Cyclist Club. Although a heavy weight, he rode well to hounds, was a fair shot and in India was known as a good "whip," driving four in hand and tandem; also a "big game" shot.

Towards the close of 1867 (4th November) he left Chatham and embarked at Gravesend with Oliver St. John (after Sir Oliver B. St. John, K.C.S.I.) for active service in the Abyssinian Expedition, under Sir Robert Napier (after Lord Napier of Magdala). He was placed in charge of the water supply, earning the sobriquet of "Pumps."

Lord Napier in his despatch of 1st June, 1868, says :--" The water supply at all the stations (where the most perfect order was required to water quickly many thousands of animals) all formed part of a great military work on which the campaign had been supported. The well sinkers under Lieut. Le Messurier have rendered excellent service throughout the campaign, and the Royal Engineers have rendered invaluable services during this expedition, which has given such an ample field for their employment."

Lieut. Le Messurier was present at the action of Arogi, and at the Storm of Magdala and death of King Theodore. At Magdala he was one of the very first inside the fortress. He returned to Bombay on 24th June, 1868, was reposted Deputy Consulting Engineer for Railways next month, and in July, 1870, acted as Consulting Engineer for Lieut.-Colonel John Salisbury Trevor.

On 3rd January, 1871, he married, at Seetabuldee, close to Nagpore, Kathleen Elizabeth, daughter of Major-General Geo. Gill Moxon, B.S.C., in October following was posted to Sind as Deputy Consulting Engineer for Railways for charge of the Guaranteed Railways, and in April, 1875, acted for three months as Consulting Engineer at Lahore.

Frem October, 1875, to April, 1876, he was deputed as Secretary, Railway Transport Committee (experiments in embarking and disembarking troops from railway trains), at Delhi, and so was present at that place during the visit of H.R.H. the Prince of Wales (after King Edward VII.), when he was presented to His Royal Highness.

In May, 1876, he went to England and was sent on special duty to Brussels Exhibition to collect information regarding military railways. At this time he was promoted to the rank of Major.

In January, 1877, he was present at Delhi at the Proclamation of the Queen Empress, and shortly after was made Under Secretary (Superintending Engineer, 2nd Class), Railway Branch, on Special Duty.

In November, 1878, he proceeded on field service to Afghanistan with the Kandahar Column, under General Sir Donald Stewart, K.C.B., when he held the post of Brigade Major to Colonel R. H. Sankey, R.E. (after Sir Richard Sankey, K.C.B.). He was present at the action of Saif-u-din, was mentioned in despatches, *London* Gazette, 7th November, 1879. He did a great deal of excellent work as Brigade Major of Engineers, and Colonel Sankey, Commanding Engineer, wrote : "To Major Le Messurier, Lieuts. Call and Childers I owe more than I can well express." For these services he obtained his Brevet of Lieut.-Colonel and returned on 22nd October, 1879, to Simla, being posted shortly after (28th November, 1879) Chief Engineer of Mysore State Railway, Bangalore.

In February, 1880, he went to England, and in April he was appointed by the Secretary of State to visit forests in the east of France and report on timber-cutting operations, when he visited Nancy, Epinal and Gerardmer, in the Vosges. He returned to Bangalore the end of May, 1880, and continued to hold his appointment till November, 1885, but during this interval he paid a visit of three months to England in 1883, and was on duty at the Calcutta Exhibition for a month in December, 1883.

In November, 1885, he left on furlough to England for two years and travelled *viâ* Egypt, Palestine, Asia Minor and Turkey, etc., arriving at Ealing 31st March, 1886. A month or so after he attained the rank of Colonel. He was present at the opening of the Indian and Colonial Exhibition as the Mysore Delegate on 4th May, 1886, and was presented to H.M. the Queen by H.R.H. the Prince of Wales; and en 2nd August was presented at Osborne with the C.I.E. by H.M. the Queen. Shortly after he paid his first visit to the Channel Isles.

On 14th September, 1887, he started alone for India *via* the Caucasus, Trans-Caspia, Bekhara and Persia, arriving at Bombay 9th December, 1887, the journey thus occupying about three months, and was then on special duty to the Government of India till February, 1888.

By the end of the year 1887 his notes were printed and placed at the disposal of the Viceroy, Lord Dufferin. The Viceroy granted him permission to publish his narrative a few days before he left India, and so it happened that much of the story relates to events which were then a year old.

The authorities had by no means approved of his having undertaken this journey, but they allowed the publication, although by no means as he had originally wished. His notes, etc., were in three books and three of illustrations splendidly got up with photos, etc. These books bore the titles of --

1. 'From England to the Caspian' (1A) and, 'Caucasus. Illustrations.'

2. 'Trans-Caspia,' (2A) and 'Trans-Caspia. Illustrations.'

3. 'Persia' (3A) and 'Persia. Illustrations.'

The books are unique, but were published as private and confidential, and copies were only sent to the Viceroy, the Commander-in-Chief, Duke of Connaught, Major-General Pemberton,

1916.] COLONEL AUGUSTUS LE MESSURIER, C.I.E., R.E. 229

the Q.M.G., Mrs. Le Messurier, and his lifelong friend, Colonel William Merriman.

He was allowed to publish London to Bokhara and a Ride through Persia, containing 320 pages, with 18 illustrations, which was the outcome of the three mentioned above, but of course a great deal of interesting information had to be omitted at the instance of the Government.

In February, 1888, he was appointed Consulting Engineer for Railways at Calcutta, and in September and October of the same year he paid a visit of some weeks to Assam; while early in 1889, he visited Burmah on special duty to inspect the railways. This duty lasted two months; and on both these occasions he was accompanied by his wife.

Soon after his return from Burmah he was appointed Chief Engineer and Secretary, Public Works Department, Punjab, and this important post he retained for rather more than three years, but on 23rd June, 1892, he had to vacate the appointment, having attained the age of 55.

In the year 1890 he paid a flying visit to England, travelling via Spain and returning via Darmstadt and Florence, and in the following year he served in the Black Mountain Campaign (Medal).

On 23rd June, 1892, his services were placed at the disposal of the Military Department, and during the latter part of that year he travelled up the Sutlej Valley and through Kulu, Lahoul and Ladak to Kashmir for nearly six months, till Christmas Eve, 1892, and retired from the Service 27th May, 1893, nearly 37 years since the date of his first commission.

He was a man of fine physique and commanding presence, a noble character with the courage of his opinions, kind and gentle, a thorough officer, gentleman and sportsman, with shrewd common sense and vast knowledge, a man of travel and no mean author. He was a member of the Royal Geographical and Royal Zoological Societies and a Governor of Christ's Hospital, and in all these institutions he took a very keen and lively interest. In addition to his book on Kandahar in 1879 and that on Persia and Bokhara he published a work on the "Game, Shore, and Water Birds of India" in 1874, which by 1887 had attained its third edition.

He had a very varied career, was four times on active military service and had four medals. He served in many parts of India in the Public Works and Railway Departments such as Bombay, Sind, Mysore, Punjab, Assam, Burmah, and Central Provinces, and he always served with distinction. He visited Cashmere, Persia, and the Caucasus while he was still in the Service, and after retirement he still cherished his love for travel, for in the year 1897 he travelled round the world for six months. In 1899 he cruised round the British Isles accompanied by his eldest daughter; visited Norway the same year, and in 1900 cruised in Trinity Yacht Irene to the Scilly Isles. In 1907 he visited Newfoundland, Labrador, Nova Scotia, Canada and Boston.

His robust health gave way about two years before his death, and he died at Ealing on 19th February and was buried on 24th at City of Westminster Hanwell Cemetery, some miles from Ealing.

The cheery and genial presence of Gus Le Messurier will be sadly missed by his many friends.

A great deal of information has been furnished for this brief memoir by his lifelong friend, Colonel William Merriman, C.I.E., who first knew him at school in 1847, and was closely in touch with him during a great part of his life.

The writer of this short memoir knew Colonel Le Messurier well, having been with him at Addiscombe and Chatham in early days; met him again at Bombay and Bangalore, and saw him occasionally in after years, and thoroughly appreciated his fine manly and cheery character.

This brief record of a busy life cannot more fitly be closed than by adding an appreciation of him by his eldest daughter.

"It is indeed I feel a privilege to write these few lines about one who was 'lovely and pleasant in his life,' and who seemed to have peculiarly the gift of sympathetic relationship with his fellow men. His open generous nature appeared to love instinctively and gladden everyone with whom he came in contact; friends, acquaintances, even a beggar in the street, all responded to that intuitive keen sense of fun, humour and human sympathy which radiated from his gracious, joyous personality like sunshine."

"To those of his immediate family circle his life was a never-ending source of joy and inspiration impossible to express in words, so full it was of deep affection and kindly ways. He had a great love of travel, not only for its own sake, but for the valuable knowledge it enabled him to get, and this is evidenced in the criticisms of his book, *London to Bokhara*, a journey he was the first to make over a hitherto impassable route. His love of books and study and unusual powers of observation are evidenced in his book on the Birds of India, also in papers on various subjects compiled during his busy life, and the course of a long and varied career."

"During his last illness he remained bright and cheerful and uncomplaining to the last, and his lively interest in men and matters unabated to the end."

He leaves a widow, one son and three daughters to mourn his loss. His son, Darel, is a captain in S3rd Wallajabad Light Infantry, and is married. Of the three daughters the two eldest are married, Maud to Major-General W. Dalrymple, c.B., Colonel Commandant, Connaught Rangers; Sylvia to Mr. Arthur Preston, while the third, Dorothea Violet Claire, is unmarried.

HENRY M. VIBART, Colonel, R.E. (Retired).

REVUE MILITAIRE SUISSE.

No. 2.—February, 1916.

THE ITALIAN ARMY.

Impressions from the Front.

The *Revue* article is accompanied by photographic reproductions containing views of the country in which the Italian Army is, at the present time, operating.

The subject is divided into sections as follows :-----

I. The Pacifist Policy of Italy.—It is pointed out that the Tripoli Campaign in no way modified Italian foreign policy; this had up to July, 1914, continued to be governed by the provisions of the Treaty creating the Triplice. The Italian Government considered the provisions of this Treaty as a sufficient safeguard against any aggression from external sources against their country. In consequence, Italy had not, prior to the outbreak of the present hostilities, made any elaborate military preparations to meet the contingency of a European war, but had diverted her resources into channels which would rehabilitate her financial position and improve the social welfare of her people,

There was by no means any general feeling of optimism in Italy regarding the military situation during the pre-War days; many farseeing men had in their public speeches and by their writings warned their countrymen of the necessity of taking measures to defend the Austrian frontier of Italy. Schemes for fortifying a number of strategic centres on the Italo-Austrian frontier had been studied, but financial reasons had prevented the matter from being pursued to a practical conclusion; a few forts were constructed on the Trentino and in Cadora, but a project for establishing a fortified line on the Livenza and all other similar proposals were completely abandoned. Further, the Italian Government also held its hand in the matter of improving the strategic railway communications on the Austrian frontier.

On the other hand, Austria had, in recent years, taken active steps to put her Italian frontier in a state of defence as is evident from the number of forts constructed in the last decade or so in the Trentino, in the Dolomites, in the valley of the Fella, the basin of the Plezzo, at Tolmino, Gorizia, and places south of those mentioned. The railway network on the Italian frontier was also extended by the Austrian Government at the cost of some hundreds of thousands of pounds; lines being constructed, in some cases, in mountainous regions where they could have no value except for military purposes. Everything seemed to point to the preparation by the Austrian General Staff of an offensive plan of campaign against Italy. Some of the higher officers of the Italian General Staff had urged the construction of strategic railways, but as soon as the Austrian Government heard that the subject had been mooted it at once made a remonstrance. The pacifist tendency in Italy was so strong that the Italian Government yielded to the wishes of their north-western neighbour.

The reliance placed by the Italian Government on the provisions of the Triple Alliance as providing a guarantee for the independence of Italy was clearly demonstrated in the spring of 1914; on the transfer of political power from Signor Giolitti to Signor Salandra, alternative programmes were put forward in regard to expenditure on the Italian military establishments-one proposed by General Porro would have involved an "extraordinary" expenditure of 16 millions sterling and the other by General Grandi involving an expenditure of $7\frac{1}{4}$ millions sterling. The latter proposal was accepted; and this at a time when Germany had raised 50 millions sterling, by a special war tax, for increasing her already bloated armaments, and Austria was also busy with military preparations. The average of the annual expenditure on military establishments in the important Continental states for the five years preceding the War represents the following outlay per head of population :- Austria, 75. 9d. ; France, 13s. 32d. ; Germany, 12s. 82d. ; Italy, 5s. 21d.; Russia, 5s. 91d.

At the outbreak of present hostilities Italy was not in a position to take part in a European War; however, the real reason why Italy did not join the two Central Empires in August, 1914, did not arise from this fact, but arose from her statesmen taking the view that no casus factoris existed which imposed an obligation on their country to take part in a war under the provisions of the Treaty binding the Triple Alliance.

II. The Preparation.—The Italian General Staff and the Departmental Services spent the period from August, 1914, to May, 1915, in completing arrangements for bringing the armament, etc., of the Italian Army up to the requirements of a modern war.

At the beginning of the present war Italy mobilized 12 Army Corps (consisting of 94 Regiments of Infantry); 2 Grenadier Regiments; 12 Regiments of Bersaglieri (each having I battalion of cyclists); 8 Regiments of Alpini; 36 Regiments of Field Artillery; 2 Regiments of Mountain Artillery; 10 Regiments of Siege Artillery; 29 Cavalry Regiments; 6 Regiments of Engineers; one Battalion of Technical Troops; one Battalion of Aviators. In the period which elapsed subsequent to the date of its first mobilization, the Italian Army has been largely increased, so that the figures given above no longer hold good.

III. The First Task of the Army.—Although it was Italy that declared war against Austria and 'not vice versâ, yet in the first instance the Italian Army played a defensive rôle. This was due to the fact that the first objective of the Italian higher command was the securing of a line more easy to defend against the Central Powers than that afforded by the actual frontier of Italy.

At the beginning of the War the Trentino was, on the Austrian side, defended only by fortress troops and territorial battalions, whose military value was a doubtful quantity. The Austrian General Staff had

anticipated that Italy would require nearly four weeks in which to complete her mobilization; but it soon became evident to them that the Italian Army would be ready to take the field within a fortnight. The Austrian General Staff had made their arrangements on the assumption that a clear fortnight would be available in which to transfer troops from Galicia to the Trentino. This will explain why it was that at the beginning of hostilities the Austrians confined themselves to the defence of certain very important strategic positions only, such as that of Pasubbio, and employed inadequate numbers of territorial troops for the purpose, allowing Italy to put her field army into movement and thus to occupy at a very early date important defiles and commanding positions along the Austrian frontier. The Italians could have easily penetrated further into Austrian territory than they did, but in doing so they would have run a serious risk of being cut off had Germany immediately pushed forward sufficiently large forces to effect this purpose.

The first objective of the Italian Army was the occupation of the dominating positions at the outlets of the Guidicarie and the Adige Valleys, and on the Trentino front, so that defence works might be constructed at these points for the purpose of holding the enemy in check with a relatively small force. Under these circumstances the main body of the Italian Army could be held in hand in order to repel any large body of troops which the Germans might send against Italy. The results aimed at by the Italian General Staff were attained.

IV. The Italian Offensive.—Towards the end of June, 1915, the Italians were already in occupation of the positions, in proximity to their frontier, which they were expected to hold on to against Austro-German armies attempting to invade Italy. At the period last mentioned the Italian Engineers commenced the construction of strategic railways, semi-permanent works, concreted entrenchments, dug-outs, etc. From the date of their success at Castel Nuovo, on the Carso, in mid-July, 1915, the Italians carried on a vigorous offensive warfare which resulted in putting into their hands the high-lying plateau in this region. Towards mid-June, 1915, the Italians had also conquered Plava, and its heights on the Isonzo, and were able thus to establish themselves in Austrian territory on the line Gorizia-Tolmino.

The Italians having assumed the offensive along their whole front pursued it with great vigour. A period of calm then ensued which was utilized for the purpose of constructing defence works on the line gained so as to form a new line from which the offensive could be further pursued. The new offensive movement was begun by the Italians towards the middle of October last, and resulted in a considerable advance forward.

On the Carso the Italians gained ground in the valley of the Doberdo and occupied the spurs on the northern slopes of Saint Michel towards Gorizia, and, in consequence, commanded the routes leading to the fortified position of Sabotino. The Italians also gained the ground, near Monte Santo and Kruck, which may be said to constitute the natural ramparts for the defence of Gorizia. Immediately to the south of the place last mentioned, Italian troops crossed the Isonzo and pushed forward to the vicinity of Saint Andrea and compelled the Austrians to withdraw their artillery to the east of Gorizia. Much progress was made by Italian troops on the Tolmino and Plezzo sectors, several Austrian forts being silenced in the latter sector.

In the Dolomites the Italian offensive resulted in the conquest of the Cortina D'Ampezzo Basin and of certain parts of the frontier region in the Dolomites. In the Trentino, the Italian offensive gave the Italians possession of the Bezzecca, the valleys of the Concei, Ledro and Lagarina, which form a semicircle about Riva; the railway communications to the place last mentioned were also completely cut off by the Italians.

V. The Difficulties to be Overcome.—In Austrian official circles there has always existed a latent hope that the territories lost to Italy in 1859 and 1866 would some day be reconquered. The Grand Duke Ferdinand, the heir presumptive to the throne of the Hapsburgs, has very deeply cherished the idea that this would come about some day and he has devoted much care to the pursuit of a policy intended to accomplish this purpose. Evidence of this is to be found in the first line of forts constructed in Austria along the Italian frontier; and in the frequently repeated refrain, which occurs in the Grand Duke's speeches, that Lombardy and the Venetian provinces must be reconquered.

The Austrian Government has caused a fortified position to be constructed, as a first line, at an enormous expenditure, around the region in which are situated the Stelvio and Tonale Passes, Lardaro, Riva and Valarsa; there is also a very important second line of works round Trente. These works are armed with very powerful guns and are provided with ample barrack accommodation for their garrisons. In some cases, a single fort has involved the expenditure of a million sterling. The entrenched camp of Gorizia, which covers the region enclosed in the "great triangle" at the angles of which stand Monte Santo, Sabotino and Saint Michel, is a marvellous example of the art of the Austrian military engineer. The defences of this area are so designed that should an enemy obtain a foothold in one of the angles of the "great triangle " he can at once be brought under an intense artillery fire from the guns at the other two angles of this triangle. In spite of this, however, the Italians, having early in their campaign against Austria forced their way into one of these angles, have continued to hold on to the positions thus gained.

Italian soldiers have exhibited a tenacity of purpose and a courage in attack in every way equal to similar qualities exhibited by Russian and Serbian soldiers in Galicia and in Serbia; they have frequently broken through strongly entrenched lines held by the Austrian troops.

VI. The Co-operation of the Various Arms.—Those who have had the good fortune to visit the Italian troops at the Front have put on record the opinion that the co-ordination between the different branches of the Italian Army is perfect; the only branch which has broken down is the Army Postal Service. In spite of the extremely difficult nature of the country in which parts of the Italian Army are operating—in the mountain regions supply and ordnance parks have at times had to be organized in localities at an altitude of 8,000 to 9,000 ft. above sea level—nevertheless, the troops have been supplied with the utmost regularity with rations, animunition and stores, except in those rare cases in which the roads to the parks are commanded by Austrian artillery and the roads can therefore only be traversed during hours of darkness.

VII. The Supreme Command.—The supreme command of the Italian troops at the Front is vested in the King of Italy; his Chief of Staff is General Cadorna who has been responsible for the measures taken in recent times in connection with the reorganization of the Italian Army.

VIII. The Infantry .- A description of this arm of the service is given in the Revue article, under three subdivisions, namely (a) the Flite, (b) the Territorial:, (c) Bersaglieri and Alpini. Italy has adopted military service on the basis of two years with the colours. The physique of the recruits enrolled annually is good and they are said to become rapidly acclimatized to the varying condition; of heat, cold and humidity, which prevail in the localities in which the Italian Army was quartered in peace times. In recent years a grey-green uniform has been adopted for the Italian Army, and when it mobilized for the present war all the troops were clothed in garments of this colour. At 32 years of age the Italian soldier passes from the Active Army into the Territorial Force -corresponding to the Swiss Landwehr-and remains therein until he completes the 39th year of his age. Men belonging to the Territorial Force are largely drawn on to fill up the supply and transport units, and to carry out the other administrative services in the second line. Men of this class are recognizable by the numbers and distinctive badges on their headdress. Territorials are also allotted to the combatant arms, and they have taken part in much of the fighting on the Isonzo and on the Carso during the present war. The Bersaglieri were first formed in 1836, the intention of the military authorities being to have a special Corps d'Élite in the Piedmontese Army for the recruits with physique above that of the average soldier. This corps from its earliest days has had to undergo a training which put the men to a severer physical test than that to which the remainder of the Army had to submit. The Bersaglieri are more lightly equipped than the ordinary infantry, the trained man in the corps being really a highly skilled marksman possessing a very high degree of mobility. Service in the Bersaglieri is very popular in Italy. The Alpini were first raised in 1873; the men for this corps are drawn from the mountain regions; each of the battalions of this corps receives recruits from the Alpine zone in which its headquarters have been established. The whole of the service of the Alpini battalions is spent among the Alps.-(To be continued).

A TALK ON AERONAUTICS.

The article on the above subject which appeared in the January number of the *Revue* for the current year (vide R.E. Journal for April, 1916) is concluded in the number of the *Revue* under review.

Dirigibles.—From the earliest days of the present war aircraft have been allotted to the belligerent armies on both sides. Since dirigibles must be based on hangars, they were unable to move forward with the armies to which they belong. The German Army had much bad luck with their dirigibles at the beginning of the War; if reports are to be believed, by the 3rd September, 1914, they had lost 7 out of 12 Zeppelins in its possession. In the first days of the War, the factory at Friedericshafen was busy, day and night, turning out airships at the rate of one per three weeks. The air raids made by the Allied aviators on the German Zeppelin stations and harbours, as also the aerial attacks made by German aircraft on the British Navy and on the coastal area of England, are dealt with in some detail in the *Revue* article.

Since the occupation of Belgium by German troops hangars for Zeppelins have been constructed in many parts of the occupied territory. Reference is made in the *Revue* article to the use made by the British Navy of utilizing airships as aerial patrols in connection with the transport of troops and material across the English Channel.

It is stated that up to the time of writing of the *Revue* article the Italians had lost one dirigible and the British none, against which must be put a loss of 23 Zeppelins by the Germans.

Acroplanes.—In the early days of the War, the acroplanes on both sides were, at times, flown at so low an altitude that they were hit by the rifle bullets fired against them.

The French had from the beginning taken the precaution to provide protection for the fusclage of military machines by suspending steel shields, having a V section, below it. The Germans, however, only provided protection in their military machines for the engines and the seats of the pilot and observer. At the beginning of the War, aeroplanes were alone employed for scouting purposes and acted individually or in pairs; the Germans were first notified of the march of Allied troops on von Kluck's flank, which led to the hurried retirement of the German Army from the Marne, by aeroplanes so employed. During the progress of the battle on the river last named, it was a French aviator who discovered and reported the gap between two of the German armies, which gave the Western Allies an opportunity to score a success.

It is stated that the empty train which was sent by the Belgians full steam ahead out of Antwerp in order to interfere with the German railway service was discovered in sufficient time by a German aviator who was able to avert the impending collision between it and a German troop train.

Aeroplanes were also employed both by the Belgian, as well as the German Army, to disorganize the march of supply columns by dropping bombs on the wagons moving along the roads.

The Germans succeeded, in the early days of the War, in capturing a large number of French aeroplanes and other material at Rheims, which was then an important military flying centre. The Germans were, however, able to remove all their own aeroplanes, and stores connected therewith, when obliged to evacuate Habsheim, near Mulhausen.

Since the date at which the opposing armies came to a halt and became engaged in trench warfare, which still continues, aerial photography has assumed a very important $r\delta le$. For instance, a map of the Morto in the Gulf of Saros was mapped from 35 photographs taken from acroplanes; the existence of an important Russian camp, in a wooded region of Poland, which was completely hidden from view, was only discovered after photographs taken by a German aviator were developed. A smudgy appearance was noticed in a photograph taken in this region in two zones among the trees; these were correctly diagnosed to be smoke from camp fires; many other cases of the valuable

part played by aerial photography are on record. The well-known use made of aeroplanes for locating hostile batteries and signalling their sites by circling round the emplacements, by wireless telegraph messages and in other ways is referred to in the *Revue* article.

Early in 1915, the Western Allies started the campaign of air raids on a large scale; aeroplanes were at that time employed by squadrons instead of singly or in pairs. The first of these raids was carried out on the 12th February, 1915, with 34 aeroplanes and scaplanes; the objective being the German coast batteries at Ostend and Zeebrugge. A list is given of some of the more important of the raids carried out, between the 16th February and 24th September, 1915, inclusive, as reprisals in respect of German aerial attacks on Paris and other French towns; in one of these raids, that of 26th August, 60 aeroplanes visited the Forest of Houltust and, at the same time, 62 aeroplanes attacked Dilligen. From the beginning of the War to the end of June, 1915, French aviators had made 37 attacks on German towns against 80 similar attacks made on French, English and Russian towns by German aviators.

Aerophanes have also been employed during the present war to maintain communication between besieged fortresses and field armies, for instance, as in the case when the Russians were besieging Przemysl.

The French have constructed a triplane machine capable of carrying a crew of six men. It is stated that engines of 100 and 120 h.p. are being substituted in some cases for the lower-powered engines previously carried by aeroplanes.

The practice has also been adopted of providing aeroplanes with two engines in order that higher speeds may be attained.

In all the belligerent countries very large numbers of pilots are being trained. The instruction is, as a rule, progressive; after spending a short time at one of the depôt schools, the partially trained recruits are sent to centres in rear of the armies; here they are employed on guard duty, and finally they go forward to the fighting line. The supply of recruits is said to exceed the wastage caused by the War.

Already a distinct type of aerial tactics has been developed during the progress of the War; new features in aerial warfare are expected to make their appearance in the year of grace 1916.

A RETROSPECT.

The Return of a Contingent ; Freiburg, 1499.

The article under the above heading commenced in the *Revue* for January, 1916 (vide R.E. Journal for April, 1916), is concluded in the number of the *Revue* under review.

The supposititious conversation referred to in the previous review is continued; this part of it deals mainly with the subject of the arms and appliances in use in the Swiss Army of the 15th century.

Those who have devoted themselves to the study of the development of military weapons from early times will find much of interest in this article.

How can the German Front de Pierced?

The Revue article is based largely on the views of Capt. Laffargue, of the 153rd (French) Regiment of the Line, an officer whose experiences in the present war well qualify him to express opinions on the subject dealt with by him. Capt. Laffargue, having taken part in the Battles of Nancy and Ypres and having, in consequence, been an eye-witness of the colossal effort made by the Germans on these two occasions, was much impressed by the utter failure of the German troops to carry their attacks to a successful issue. He was one of the many officers who had come to the conclusion that the German front could not be pierced; but having been wounded in May, 1915, he was able to spend some time meditating over his experiences. Capt. Laffargue has altered his original opinions and having recorded his present views the Commander-in-Chief of the French Armies has caused the same to be printed at the public expense and to be distributed to the troops in the field. Capt. Laffargue has made a valuable contribution to the military literature on the tactics of the present-day warfare and there is a strong consensus of opinion in France that his conclusions are on the whole sound.

The author of the *Revuc* article opens by asking the question: "Is it possible to pierce the German front?" In reply to this question he points out that "experience has shown this to be possible" and cites the fact that in May and September the French actually did pierce the German front both in Artois and in the Champagne, although it is true that no advantage was taken on these occasions of the French successes for reasons which have yet to be disclosed.

As might be expected Capt. Laffargue's views have not been accepted in their entirety; criticisms have been levelled against some of his doctrines. A brief *résumé* of these criticisms appears in the article under review.

Capt. Laffargue is of opinion that an intense artillery bombardment must precede every attack by infantry in order that a way may be prepared for the advance of the latter arm. The criticism directed against this proposition is that a cannonade will but increase the vigilance of the troops on the defence who will rightly assume that increased activity on the part of the enemy's artillery must be a prelude to an attack. Being forewarned, the defenders will without doubt make dispositions by manning trenches, etc., to defeat the plans of the attackers ; in such a case failure on the part of the attackers is almost certain. The critics argue that if, on the contrary, the infantry, taking advantage of darkness, were to launch an attack without any previous artillery bombardment, the chances of success would be greater and the artillery could in such a case be employed to create a "barrage" in rear of the trenches attacked in order to prevent supports from being pushed forward. Briefly, the counter-proposal amounts to this: launch the infantry attack without noise and previous artillery preparation; do not open artillery fire until the infantry have reached the enemy's trenches, in the case where the attack succeeds, or until the infantry are thrown back, in the case where the attack fails. Practical experience does not, it is said, encourage formation commanders to adopt the method advocated by Capt, Laffargue's critics. The writer of the Revue article expresses the opinion that "artillery preparation is rendered absolutely necessary owing to the proved inefficiency of all other means which have been proposed for the destruction of the obstacles along an enemy's front. It will be so much the worse for the defenders if the artillery bombardment succeeds in drawing them into their front line trenches."

As is well known, the ruse has frequently been adopted in the present war of bringing about a sudden interruption in the artillery bombardment of the attack and then as suddenly reopening it against the same section of the enemy's trenches after the elapse of 10 minutes. In such cases the real attack has only been launched after a succession of false alarms. In the early days of the War the Germans were often deceived by such tactics and suffered heavy loss owing to a premature manning of their fire trenches; they know better now.

It was the practice according to the tactics of former times to make the "centres of resistance" the objective of an attack; this had an effect similar to seizing the horns of a bull. To-day, no advantage is gained by the adoption of the tactics referred to and, in consequence, it is against the "curtains" and not against the "bastions" that attacks are now launched; although, of course, every effort is at the same time made to effect as great a destruction of the "centres of resistance" by artillery fire as is possible.

Machine guns being the weapons which inflict the heaviest losses on the attacking infantry, every effort must be made to locate their emplacements in order that as many of the machine guns as possible may be put out of action before the infantry attack is launched. Artillery officers appear to be shy about expending ammunition on machine-gun emplacements; Capt. Laffargue is strongly of opinion that not only should the artillery concentrate fire on what are known to be machinegun emplacements, but even on all points suspected of being used for harbouring machine guns. He points out that the artillery should not expend their efforts on the destruction of machine guns days before an attack, but as late as possible during the period of the artillery preparation, and that the same rule should be applied in regard to the silencing of the enemy's artillery.

Although infantry can be pushed forward during the artillery preparation, it is not possible for them to attempt the occupation of the enemy's first line trenches during this period. It is advocated that the infantry attack should be preceded by a grenade attack and the use of lachrymatory bombs against the sections of the enemy's trenches which it is intended to seize. Capt. Laffargue points out that the French have the munitions for this purpose, but he urges that more powerful types should be supplied to the army than those now in use.

A short description is given in the *Revue* article of the general lines on which the French attacks on the German front have been planned and carried out; briefly, an intense artillery fire is brought to bear on the enemy's fire trenches and the obstacles along the sectors to be attacked, the ground in rear of these sectors are also searched with artillery fire so as to cause as much disturbance to the enemy's troops in billets as possible, a point is made of shelling the roads leading from the fire trenches towards the rear, and particular attention is paid by the artillery to the defenders' artillery and machine guns. After the bombardment has been kept up, with intervals of silence, for a sufficient time to unnerve the enemy and to disorganize his defence arrangements generally and conditions favourable for an attack have been created, the infantry are launched forward. The attackers' artillery then directs its attention to the second line trenches of the defenders ; it also creates a " barrage " so as to prevent troops being rushed forward for a counterattack and at the same time endeavours to knock out any of the defenders' machine guns, the positions of which may have remained masked until the final stages of the attack. The importance of dealing with these machine guns promptly cannot be exaggerated ; the artillery ought on no account to overlook their duty utterly to crush machine guns at every stage of the attack as soon as their existence becomes manifest and more particularly those coming into action during the final stages of the attack. It is suggested that aeroplanes can also co-operate at this stage of the attack by dropping bombs on reinforcements, on bridges, viaducts, exits of villages, etc.

NOTES AND NEWS.

Switzerland.—Colonel Feyler contributes an article to the Revue on "The Affair of the Swiss General Staff." Colonel Feyler states that his article is written with the object of making known the views of the French Swiss. In this article is investigated the causes which have led up to the scandal arising from the indiscreet conduct of Colonels Egli and Wattenwyl. A mistake appears to have been made by the Federal Council in appointing Colonel Wille to the Chief Command.

It is said that this officer was best known in Switzerland by reason of his display of insubordination rather than for his military capacity. General Wille appears to possess strong German sympathies which he has not been at any pains to conceal. The violation of the neutrality of Luxemburg and Belgium profoundly moved the French Swiss; however, not only did the violent acts of the Kaiser's troops leave the German Swiss unmoved, but in Swiss military circles admiration was openly expressed for the conduct of the German Army. The military measures adopted by the Swiss General Staff at the outbreak of war also created disquietude in the minds of the French Swiss; these measures indicated clearly enough that whereas France was looked upon as a possible enemy to Switzerland, Germany, on the other hand, was considered in the light of a possible ally. The mistrust of the French Swiss by the Swiss General Staff is held to be the fundamental cause of all the unrest which has prevailed in Switzerland since August, 1914.

This number concludes with promotions, etc., in the Swiss Army and a bibliography of publications of military interest.

W. A. J. O'MEARA.

ADVERTISEMENTS.



Works: STRANTON WORKS, WEST HARTLEPOOL.

G. E. CARRINGTON,

For many years Master Tailor, Royal Engineers,

TAILOR & MILITARY OUTFITTER,

53, HIGH STREET, OLD BROMPTON, KENT,

And at CARLTON HOUSE, REGENT STREET, near Waterloo Place, S.W.

HOURS OF BUSINESS :-

Old Brompton, 8.30 to 7.30; Saturdays, 8.30 to 1. Carlton House, 11 to 6; Saturdays, 11 to 1.

NOW READY.

R.E. Field-Service Pocket-Book.

THIRD EDITION, 1915.

Price to Members of the R.E. Institute, 2s. 6d. per Copy.

The book will also be supplied to W. and N.C.O.'s and men of the Corps at the same price on receipt of Cash with order.

Price to Non-Members of the R.E. Institute, 3s. 9d. per Copy, including postage and on receipt of Cash with order.

SECRETARY, R.E. INSTITUTE, CHATHAM.

THE SILICATE PAINT COMPANY,

J. B. ORR & Co., Limited.

CHARLTON, LONDON, S.E.,

- Manufacturers of --

DURESCO. Washable Water Paint ; damp-resisting ; cheaper than Oil Paint or Wall Paper.

SILICATE OIL PAINT. Ground stiff in Oil, or ready mixed for use; non-poisonous; finely ground; greater body than White Lead.

ENAMEL PAINTS. High-class Varnish Paints.

History of Submarine Mining in the British Army.

By LT.-COL. W. B. BROWN, R.E.

Post Free to Members of the R.E. Institute, 6s. To Non-Members, 8s. 6d.

From SECRETARY, R.E. INSTITUTE, or the Agents, Messis, W. & J. Mackay & Co., Lid., Chatham, or any Bookseller.

NOW READY.

VOL. III.

History of the Corps of Royal Engineers,

ΒY

COL. SIR CHAS. M. WATSON, K.C.M.G., C.B. Late R.E.

This Volume continues the History of the Corps from Vols. I. and II. by the late Major-General Whitworth Porter, to 1912, and is bound uniform with the other volumes. It contains 418 pages, with Photogravure of the late Field Marshal Sir Lintorn Simmons

Price ; Members of the R.E. Institute, 7/-; Non-Members, 10/6. Post Free.

MERRYWEATHER'S "VALIANT" Steam Pump & Boiler

AND ITS MANY USES.



A-Watering Ships.E-Village Fire Engine.B-Carried by 4 Men.F-Cutting Timber.G-Watering Troops at Tugela River.G-Driving Stamp Battery.D-Fruit Spraying.H-Extinguishing Fire.

Merryweathers' also make Petrol and Oil-Driven Pumps. But for "Up-Country" Use they strongly recommend their famous "Valiant" Portable Steam Pump.

This Pump is :-

Reliable, Simple and its fuel is obtainable everywhere at very low cost.

Weighs only $6\frac{1}{2}$ cwt.

WILL PUMP THROUGH 3 MILES OF PIPING.

CAN BE ARRANGED FOR BURNING WOOD FUEL

Write for PAMPHILET 616 S.R.E. MERRYWEATHER & SONS, 63, Long Acre, W.C. Works : Greenwich, S.E., London.