ELEMENTS

FIELD FORTIFICATION.

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LONDON:

PRINTED FOR THE AUTHOR;

AND SOLD BY T. CADELL IN THE STRAND; AND T. EGERTON,
(SUCCESSOR TO MR. MILAN) CHARING-CROSS.

MDCCLXXXIII.

TO

LORD VISCOUNT FEILDING.

MY LORD,

THE Vanity of publickly declaring my Eſteem and Regard for your LORDSHIP, is the ſole Inducement for this Dedication; for as Mediocrity of Talent is, at preſent, the Aſylum from Envy and Contempt; I apprehend, though much againſt my Inclination, to have obtained that Protection for this and all my other Works.

THAT your LORDSHIP may emulate the moſt renowned for Knowledge, Valour and Virtue, is the ardent Wiſh of,

My LORD,

Your LORDSHIP's

Moſt humble

And moſt devoted Servant,

Little Chelſea,
January 13, 1783.

LEWIS LOCHÉE.

PREFACE.

FIELD Fortification is ſo univerſally acknowledged one of the principal branches of the Art of War, that it is preſumed every attempt to illuſtrate the ſubject will be thought laudable, and though not perfect entitled to indulgence.

It is, however, to be lamented that although the number of books on this branch of the Art of War exceeds that upon any one other, few have hitherto appeared that are not generally too ſuperficial to merit the character of a uſeful production.

Some have conſidered it abſtractedly, without any relative conſideration of circumſtances; while others have only entered the bewildered detail, into which this ſcience can be ſubdivided, without any attention to its firſt principles, which, like thoſe of moſt other ſciences, are extremely ſimple; ſo ſimple, indeed, that any one may acquire much information on this ſubject, if poſſeſſed only of ſuch a ſhare of mathematics as is requiſite for the Gentleman.

The

The design of this work is to give young students precise and adequate ideas on this important subject, by explaining and making a proper application of its principles; and so far as concerns the author himself, to give the military world an additional proof of his insuppressible zeal for the honour and improvement of the service.

THE

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ELEMENTS

OF

FIELD FORTIFICATION.

DEFINITION.

FIELD Fortification is the art of conſtructing ſuch temporary works, either in woods or open fields, or for the occaſional defence of houſes, churches, caſtles, villages, and ſmall towns, as will enable the men within to withſtand a greater number without. When the works are conſtructed in the open field, they conſiſt, generally, of a parapet and ditch.

The uſual methods of repreſenting field works upon paper, are Ichnography and Ortography.

Ichnography is the plan or repreſentation of the length and breadth of the works, cut thro' by a plane parallel to the horizon: by this we are acquainted with the value of the different lines and angles. Fig. 1. Plate I.

Ortography

Ortography is the profile or repreſentation of the works cut through by a plane perpendicular to the horizon, which ſhews not only their length or breadth, but alſo their height and depth: by this we are enabled to eſtimate the expence of the work done or to be done, and the quantity of materials neceſſary. Fig. 2. Plate I.

When to the plan of the works is added a draught of the environs, this repreſentation is called *topographical:* by topographical plans, the advantages and diſadvantages of a ſituation are quickly and clearly diſcerned.

REMARK.

Field works are alſo ſometimes repreſented by the rules of *military* or *cavalier* perſpective, and of *common* perſpective, both theſe methods are leſs uſeful than the former.

SECTION I.

Deſcription of the principal Lines.

CD, fig. 1, 2. Plate III and IV. is called *ſide of the polygon.*

AB, BC, *a*C, *e*D, Fig. 1, 2. *d g*, Fig. 1. C*g*, D*b*, Fig. 2. } Plate { II. III. IV. } Are called *faces*; becauſe they front the enemy.

AE, CD, *g f*, *e b*, Fig. 2. Plate { II. IV. } Are called *flanks*, becauſe the ſhot from them take the enemy in his approach to the works in flank, that is, ſideways.

Though the name *flank* is given only to ſuch parts as AE, CD, *g f*, *e b*; yet, as *to flank*, ſignifies to defend, whatever part ſerves to defend another part, may properly be called it's flank.

e b, Fig. 1, *e f*, Fig. 2, } Plate IV. is called *curtain.*

AC, ED, Fig. 1, 2. Plate II. are called *gorge.*

B*x*, Fig. 1, 2. Plate II. is called *capital.*

C*e*, D*f*, Fig. 2. Plate IV. is called *line of defence.* This line determines the direction of the ſhot.

[The lines repreſenting the gorge, capital, and line of defence, are imaginary lines.]

SECTION II.

Deſcription of the principal Angles.

FIG. 2. PLATE IV.

BCD, is called *flanked angle*, becauſe it is ſeen and defended by the flanks *eh*, *lk*.

C*gf*, is called *angle of the ſhoulder*, becauſe it covers the ſhoulders of the men placed along the flank *gf*.

gfe, is called *angle of the flank* *.

Angles are either *ſaliant*, or *re-entring*; ſaliant, when the ſummit turns without, as the angle ABC, fig. 1, 2, plate II. and the angle C*gf*, fig. 2, plate IV. and re-entring, when the ſummit turns within, as the angle C*a*D, fig. 1, 2, 3, plate III. and the angle *efg*, fig. 2, plate IV.

When the work is formed both of ſaliant and re-entring angles, the ſaliant angle is properly called *flanked angle*, to diſtinguiſh it from the re-entring angle, which is called *flanking angle*.

* It is alſo called *angle of the curtain*.

Of

Of Saliant and Re-entring Angles.

Of the Saliant Angle.

FIG. 9, 10, 11. PLATE II.

The ſaliant angle is deemed moſt advantageous when it is a right angle, becauſe it has the greateſt ſtrength; for, in the right angle, the line of reſiſtance, and the line whereby the body reſiſts, are both equal; whereas, in the oblique angle, the line of reſiſtance is ſhorter, in proportion as the angle is more oblique.

It is a general rule in field fortification, never to make the ſaliant angle leſs than 60 degrees, nor greater than 120 degrees: if leſs than 60 degrees, it will not have ſufficient ſtrength; and if more than 120 degrees, the ſides of the angle will be too much expoſed. The angle ABC, which meaſures only 50 degrees, cannot be deemed of ſufficient ſtrength; and in the angle CDE, which meaſures 130 degrees, the ſides CD DE are too much expoſed.

REMARK.

Conſtant experience proving that we cannot depend on the oblique firing of muſketry, eſpecially from behind a parapet, as ſoldiers are known to fire mechanically, that is, di-

rectly before them, and even without regarding whether they do execution or not; it follows, that oppoſite every ſaliant angle, there is neceſſarily a ſpace not defended, as O. This ſpace is a ſector of a circle, whoſe radii have for length the range of muſket ſhot, and, at the extremities towards the ſummit, are perpendicular upon the ſides of the angle; hence, the ſpace not defended will be greater, in proportion as this angle is more acute, and the leſs, in proportion as this angle is more obtuſe.

Of the Re-entring Angle.

FIG: 12, 13, 14. PLATE II.

The re-entring angle alſo is deemed moſt advantageous when it is a right angle, not only becauſe it has then the greateſt ſtrength, but becauſe (as the men generally fire directly before them) it is the angle of which the ſides afford to each other the greateſt mutual defence.

It is alſo a general rule, never to make the re-entring angle leſs than 90 degrees, nor greater than 120 degrees: by making this angle acute, the ſides, inſtead of affording mutual protection, will be expoſed to the fire of each other; and by making it more than 120 degrees, the fire from the ſides croſſing very obliquely, will not give

give much mutual defence. In the angle *a b c*, which meaſures only 70 degrees, the men behind the ſides *a b b c*, are evidently expoſed to their own fire; and in the angle *c d e*, which meaſures 130 degrees, the fire of the ſides *c d d e*, croſſes each other too obliquely to afford much mutual defence.

REMARK.

The ſcrupulous preference given to the right angle for the re-entring angle, as that capable of the greateſt mutual defence, ſeems to ariſe more from an expectation of what the men ought to do with the advantage of ſuch a conſtruction, than from what experience proves they are always capable of doing: it is, however, productive of ſome inconveniencies; for in time of action, ſome moments of confuſion may intervene, when the fire may be badly directed, and the men conſequently injured by each other. It has been known, even when this angle was obtuſe†, that the men have been ſo much annoyed

† Inattention to the poſition of the men of the firſt rank in the act of firing, and the conſequences of the neceſſary poſition of the ſecond rank, do not a little contribute to produce this calamity to the *left*. In ſpeaking of the right or left flanks or faces, we ſuppoſe ourſelves within the work, looking towards the enemy.

by their own fire, eſpecially when behind low and narrow parapets, as to be forced to abandon their works.

SECTION III.

Deſcription of the ſeveral Parts.

FIG. 1 and 2.† PLATE I.

Parapet.
Banquette.
Berme.
Ditch.
Glacis.
Second Ditch.
Palliſade.
Fraize.
Cheveaux-de-Frize.
Trous-de-loup.
Abbatis.
Fougaſſes.
Inundations.

Of the Parapet and Banquette.

The parapet is the bank of earth ſurrounding the poſt to be defended, and ſerves to cover the troops and artillery employed for it's defence. The dimenſions of the parapet vary according to the nature of the ground, and the purpoſes for which it is conſtructed: it's breadth at the top, is from 2 to 18 feet; and it's height within, is from 4 to 10 feet.

† Fig. 1 and 2, Plate I. are referred to throughout this ſection, unleſs expreſſed to the contrary.

Parapets

Parapets of great elevation, give great command, are leſs expoſed to ſurprizes, and afford greater ſhelter to the men within. Parapets of little elevation, are leſs expoſed to the enemy's cannon, and the fire from behind them is more *razant* *, that is, more *grazing:* Mr. Vauban conſidered 6 feet as the moſt advantageous elevation, and fixed the greater at $7\frac{1}{2}$ feet. The thickneſs of the parapet varies much more than the height: when 2 feet broad at the top, it is capable only of reſiſting muſket ſhot; but when 18 feet, it is capable of reſiſting the ſhot of the larger cannon. Experience proves, that when the parapet is 3 or 4 feet broad at the top, it can reſiſt a three-pounder; when 4 or 5 feet, a ſix-pounder; and when 7 feet, a twelve-pounder: conſequently, when works are much expoſed to cannon, the ſecurity will increaſe in proportion to the greater thickneſs of the parapet; but when they are only expoſed to the attack of *ſword in hand*, the ſecurity will increaſe in proportion to the greater elevation of the parapet.

REMARK.

Parapets of great thickneſs and much elevation, that is, ſuch as have large profiles, will generally be found moſt advantageous; not only becauſe they afford ſecurity againſt all kinds of attack, but becauſe it is known that ſoldiers meaſure, by their eye, the obſtacles which an enemy has to ſurmount to come at them; and that their confidence is the greater, in proportion as the dimenſions of the works they are to defend are larger.

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* There are two ſorts of fire, diſtinguiſhed by the names of *razant* or *grazing*, and of *fichant* or *plunging*: in the razant or grazing fire, the direction of the ſhot is parallel to the horizon, and conſequently deſtroys every thing within its range; and in the fichant or plunging fire, the ſhot being fired from a higher to a lower place, can only deſtroy what it meets near the point where it falls.

The

The height of the parapet within, to form a complete covering for the men, ſhould at leaſt be 6 feet, that is, equal to the height of men of the greater ſize; but when it is no more than $4\frac{1}{2}$ feet, it may enable men of the ordinary ſize to fire upon the enemy without the help of a banquette.

When the height of the parapet within, exceeds $4\frac{1}{2}$ feet, there is always conſtructed at the foot of it, a ſtep called *banquette*, about $4\frac{1}{2}$ feet broad, with a very gradual ſlope from the level line, to facilitate the aſcent and deſcent.

As the deſign of the banquette is to elevate the men, that they may ſee over the parapet to fire upon the enemy, it neceſſarily follows, that the banquette muſt be raiſed within $4\frac{1}{2}$ feet of the ſummit of the parapet; for the diſtance between the armpit and the foot, in the act of firing, in men of the ordinary ſize †, is about 4 feet 6 inches: thus, when the parapet is 5 feet, the banquette muſt be at leaſt $\frac{1}{2}$ a foot; when the

† This ſuppoſes the men 5 feet 8 inches high. Upon trial, however, $4\frac{1}{2}$ feet for the interior height of the parapet, will, in general, be found too great to fire over it, eſpecially when the parapet has much ſuperior talus, and as many men are only 5 feet 6 inches high, who can never fire over a parapet $4\frac{1}{2}$ feet high: this counts for the little effect of the fire from behind a parapet, half at leaſt of the ſhot being exhauſted in the air. The moſt advantageous height for the interior part of the parapet at this time, is from 4 feet 2 inches, to 4 feet 3 inches.

parapet

parapet is 6 feet, the banquette muſt be ſomewhat more than 1 foot and $\frac{1}{4}$; and when the parapet is 8 feet, the banquette muſt be nearly 4 feet.

The raiſing the banquette within a much leſs diſtance from the ſummit of the parapet than $4\frac{1}{2}$ feet, at the ſame time that it would greatly expoſe the men, and leſſen their confidence, would not facilitate their firing.

When the height of the parapet exceeds 6 feet, many recommend raiſing two banquettes: but one banquette with a very eaſy ſlope, is, if not more uſeful for the defence of a poſt, certainly more expeditiouſly conſtructed than two banquettes.

The ſpace of $4\frac{1}{2}$ feet allowed for the breadth of the banquette, is abſolutely neceſſary for forming upon it the men who are to defend the parapet. This ſpace allows the parapet to be *lined* two deep; that is, the men to be formed into two ranks *, the leaſt that can be admitted for a proper defence: when there is more than one banquette, the ſpace for the lower will be ſufficient, if $2\frac{1}{2}$ feet in breadth.

The parapet of field works is well lined for defence, when to every yard of interior perimeter †

* It is a general rule never to draw up the men who defend field works, more than two deep: a third rank cannot be of uſe, as it cannot fire without incommoding the other ranks.

† Mr. Clairac judges that one man for every yard perimeter, is ſufficient for the guard and defence of a field work.

a file

a file two deep is allowed: when cannon is uſed, 4 or 5 yards are allowed for every piece.

For the purpoſe of diſcovering the enemy in his approach, and of more effectually levelling at him, the top of the parapet is made ſloping towards the country. This ſlope is by ſome called *ſuperior talus*, and by others *plunge*; and it's direction is deemed the more advantageous, in proportion as it meets the horizon ſooner: in general it meets the counterſcarp.

Some engineers never allow this ſlope or plunge to have more than 2 inches for every foot in the height of the parapet, for fear of weakening too much the upper part of the parapet: thus, ſuppoſing the elevation of the parapet at AB, fig. 3, plate I. to be 6 feet, and that it has 6 feet alſo for thickneſs, the ſhot fired from behind ſuch a parapet with ſuch a ſuperior talus, will meet the ground at C, which is diſtant 12 yards from B, the ſpot the fire comes from. This proves, that at the exterior foot of every parapet, there is a ſpace, as CD, which cannot be defended by it; and this ſpace will evidently be the greater in proportion to the leſs ſlope of the ſuperior talus, and the greater height of the parapet.

From whence it follows, that in works which have no flanks, an enemy once paſſed the point where

where the direction of the ſuperior talus and the horizon meet, will be leſs expoſed as he approaches the parapet. This defect is an inſuperable objection to the uſe of works that have no flanks.

In proportion as the ſuperior talus has the greater or leſs ſlope, ſo the ſhelter againſt the direct fire will be the greater or leſs: the diſadvantages of the ſuperior talus having much ſlope, are, that it weakens the upper part of the parapet, and that the fire is more plunging. Mr. Vauban, by adding the glacis, not only diminiſhed the ſhelter againſt the direct fire, but obtained a more grazing fire.

The height of the parapet over the banquette not being ſufficient to cover the men in the act of firing, it is uſual for their ſecurity againſt the ſmall arms of the enemy *, to raiſe the interior part of the parapet with *ſacs a terre*, or ſacks made of ſtrong and coarſe cloth filled with earth. They are, in general, 2 feet in length, and 6 or 8 inches in diameter; and are placed in two rows one above another, with an interval between each in the lower row, ſufficient to receive the muzzle of the muſket: (ſee fig. 4, plate I.) this practice, though of conſiderable ſecurity againſt muſketry, will be of no ſervice againſt cannon, and in that caſe muſt be rather detrimental.

* This precaution might alſo ſerve to prevent the injuries to which flanked parts are liable, when the re-entring angle is not ſufficiently obtuſe.

Formerly,

Formerly, the interior part of the parapet was often raiſed with ſmall gabions filled with earth, ſomewhat more than 1 foot in height, and in diameter 12 or 14 inches at the top, and only 9 or 11 inches at the bottom, fig. 5, Plate I. There is another ſort of gabion made uſe of to conſtruct batteries, much larger and higher, and of a cylindrical form. A gabion is a baſket open at both ends.

That the cannon may fire upon the enemy, it is uſual to cut openings in the parapet, called *embrazures*. The dimenſions of the embrazure depend, not only upon the nature of the ſoil, and the height and thickneſs of the parapet, but alſo on the caliber of the piece, the height of the wheels, and the conſtruction of the carriage.

The embrazure is cut ſloping towards the country, and within 3 feet of the horizon. The breadth of the embrazure within, is no more than is abſolutely neceſſary to receive the cannon; but that without, is from 7 to 9 feet. The confined breadth within, is given to keep under cover, as much as poſſible, both the piece and the men who ſerve it; and the extended breadth without, is given to obtain a wider view of the enemy in his approach.

The diſtance between two embrazures is from 12 to 18 feet from center to center, that that part of the parapet which ſeparates them, and is called *merlon*, may be ſufficient to reſiſt the enemy's cannon.

[In

[In plans drawn upon a ſmall ſcale, embrazures are repreſented by iſoſceles triangles, ſet off the diſtance from center to center between the embrazures, whoſe baſes turn towards the country. See z, fig. 1, 2, plate II.]

Cannon is ſometimes uſed without the help of embrazures, that is, the cannon is made to fire *en barbette*:* this, however, cannot be done, unleſs the carriage be ſo raiſed, as that the muzzle of the cannon ſhall be upon the ſuperior talus.

Becauſe the difficulty of forcing a parapet is the greater, as the exterior ſlope of it is the leſs; and becauſe the beſt and moſt adheſive earth cannot long ſupport itſelf at a height of 3 or 4 feet, unleſs formed with a ſlope of very gradual aſcent; it is uſual to force it to ſtand with a ſmall ſlope, by lining it with *ſods*, *faſcines*, *hurdles*, &c. The exterior ſlope of the parapet is called *ſcarp*, and is in general about the $\frac{1}{3}$ part of the height.

The interior part of the parapet is alſo lined, and even with more precaution than the ſcarp, with a view to obtain little ſlope, which is abſolutely neceſſary to enable the men within to ſtand and fire with eaſe: this ſlope, which, to be ad-

* So named by the French, becauſe the ball in its flight ſhaves the ſuperior talus of the parapet.

vantageous,

vantageous, ſhould be only about 1 foot, cannot, however, be leſs than 1 foot and $\frac{1}{2}$, when lined either with ſods or faſcines.

Of the Berme.

To prevent the earth of the parapet rolling into the ditch, a ſpace is generally left between the parapet and ditch, called *berme*. The breadth of it depends upon the nature of the ground, the dimenſions of the parapet, and the length of time for which the work is intended to remain.

Many conſider the berme to be advantageous to the enemy, ſuppoſing it rather to facilitate than retard the operation of forcing the parapet. This it certainly does, when the parapet has but little height and thickneſs; for the enemy once placed upon the berme, is upon an equal if not a ſuperior footing to the men within †. It is obſervable, however, that if there was no berme, a greater ſlope would be requiſite, not only for the ſcarp of the parapet, but alſo for that of the ditch.

† To ſupply this defect, M. De Saxe recommends the parapet to be of ſuch a height as that its ſcarp may have about 6 feet.

Of

Of the Ditch.

The trench dug up at the exterior foot of the parapet, is called *foſſé* or *ditch*. At the ſame time that it ſerves to furniſh the earth neceſſary for raiſing the parapet and banquette, it contributes to increaſe the difficulty of approach, which is deemed the greater, in proportion to the greater breadth and depth of the ditch. The dimenſions of it depend, however, not on choice, but on the dimenſions of the parapet and banquette: it's depth ſhould, if poſſible, never be leſs than 6 feet.

The ſlope neareſt to the parapet, is called *ſcarp*; and that oppoſite to the parapet, is called *counterſcarp*. The difficulty of the paſſage of the ditch, is greater, in proportion to the leſs ſlope both of the ſcarp and counterſcarp; but more particularly that of the ſcarp, and eſpecially when the ditch is of ſuch a breadth, as to force the enemy to leap into it to paſs it.

It is obſervable, that the ditch is generally cut or rounded off at the ſaliant angle of the counterſcarp, to prevent its being in that part eaſier of deſcent.

To determine the ſlope of earth, is, if not impoſſible, at leaſt exceedingly difficult; for it depends not only on the nature of the ſoil, which

is very various, but alſo on the height of the ſlope: when common earth is uſed, the baſe of the ſlope is generally recommended to be equal to the height; and when clay or loom is uſed, the baſe is taken equal to $\frac{2}{3}$ of the height.

That the direction of the ſlope of earth depends, not only on the nature of the ſoil, but alſo on the height of the ſlope, though of much conſequence, is however not generally underſtood.

If we ſuppoſe the particles of earth to have no adherence to each other, then the ſlope of earth muſt, like that of grain or ſand, have the ſame direction in every elevation: but, on the contrary, it is known, that the particles of earth are adheſive; and, conſequently, the earth will never require ſo much ſlope as it would do if deſtitute of adherence. Experience, indeed, proves, that earth ſupports itſelf for a while even without a ſlope, to a certain height, which, though but ſmall, is greater or leſs, according to the greater or leſs adherence of the particles, that is, according to the nature of the ſoil.

Now, if we ſuppoſe the tendency of diſunion (when deſtitute of adherence) to be in the direction of *a b*, fig. 3, plate I. and that the adherence of the triangle *a b c*, is barely competent to ſupport the earth; if the ditch is made twice as deep, it is evident, that the adherence of the triangle *c d e* will be only double the adherence of the triangle *a b c*, and that the weight of the triangle *c d e* will be quadruple that of *a b c*. If the ditch is made three times as deep, it is evident, that whilſt the adherence of the triangle *c f g* is only treble that of *a b c*, the weight of it will be nine times that of *a b c*; for figures are to each other in a duplicate ratio.

From

From whence we muſt neceſſarily conclude, that if in the firſt inſtance the adherence is barely competent to ſupport the earth, it cannot be ſo in the ſecond, and much leſs ſo in the third; that is, as is ſaid above, the direction of the ſlope of earth depends not only on the nature of the ſoil, but alſo on the height of the ſlope; and, conſequently, the ſlopes of the ditch muſt be greater, both according to the nature of the ſoil, and in proportion to the greater depth of the ditch.

From this it follows alſo, that the ſcarp of the ditch, when the parapet is to be raiſed immediately on the border of the ditch, muſt have a greater ſlope than when there is a berme; and further, that this ſcarp muſt have a greater ſlope, in proportion to the greater height of the parapet, and the leſs breadth of the berme. This proves, that the omiſſion of the berme will likely be productive of greater inconveniencies than the uſe of it.

Of the Glacis.

Becauſe the difficulty of the paſſage of the ditch increaſes according to its greater breadth and depth; many recommend raiſing the exterior borders of the ditch, one, two, or more feet above the horizon, in the form ABC: the direction of AB, is the continuation of that part of the exterior ſlope of the ditch below the horizon; and the direction BC, is generally the ſame with that of the ſuperior talus of the parapet. It is becauſe the ſlope BC is ſo great, that this work is called *glacis*.

The glacis, which is ſeldom added for the defence of very ſmall works, beſides increaſing the breadth and depth of the ditch, and diminiſhing the ſhelter againſt the direct fire, is particularly advantageous to works much expoſed to cannon; for it ſingularly ſecures the parapet; and the enemy is alſo ſingularly expoſed to the fire from behind the parapet, during his whole aſcent upon the glacis, and more eſpecially ſo at the inſtant when he endeavours to leap over or into the ditch.

REMARK.

This work was in much eſteem with Mr. Vauban, who introduced it to obtain a more grazing fire, and to diminiſh the ſhelter againſt the direct fire which every parapet neceſſarily affords, and that in proportion as it has the more height and the leſs ſlope.

Of the advanced or ſecond Ditch.

To increaſe the difficulty of approach, ſome recommend a ſecond ditch, which is in general ſo conſtructed as that its bottom may be in the prolongation of the glacis; that is, its greateſt depth is at the exterior ſide: hence the profile of it is a triangle.

Of

Of Paliſades and Fraizes.

As a ſecurity againſt ſurprizes, and to increaſe the defence, field works are ſometimes either *paliſaded* or *fraized*, and ſometimes both.

Of Paliſades.

Paliſades are ſtakes of ſtrong ſplit wood, of about 7 or 8 inches broad, 3 or 4 inches thick, and 8 or 9 feet long, of which 3 or 4 feet are ſunk into the earth. They are pointed both at the top and bottom; and that they may be of greater ſtrength, they are faſtened to a horizontal rail * within two feet from the top, and are generally placed ſo cloſe to each other, as only to admit the muzzle of a piece between them. Their greateſt diſtance from each other is never ſo great as to afford room enough to creep through them.

Paliſades are planted either *vertically* or *obliquely*: the oblique poſition is generally deemed the moſt advantageous, becauſe the paliſade cannot

* When ſome of the paliſades are only of ſufficient length to allow 3 or 4 feet to be ſunk into the earth, to ſtrengthen the whole range, it will be neceſſary to faſten them to two horizontal rails, one at the top and one at the bottom. The rail or rails are always oppoſite to the ſide of the enemy.

ſo eaſily be cut at the bottom, nor torn up with ropes. The poſition, however, depends more upon circumſtances than choice.

Paliſades fixed at a certain diſtance from the parapet, as at Y, to obtain the additional ſecurity againſt *hand grenades* *, ſhould be planted obliquely, ſo as to form an angle of 45 degrees with the country towards the enemy: this poſition will greatly increaſe the difficulty of cutting them, or tearing them up with ropes, if not render it impoſſible; they will be the leaſt expoſed to the enemy's cannon; and the difficulty of paſſing over them will not be leſs than if they were upright, unleſs many faſcines were at hand to place under them. The diſtance at which hand-grenades can be thrown, is from 25 to 30 yards.

But this practice of fixing paliſades is not generally approved, not only becauſe the paliſades, notwithſtanding their oblique poſition, are ſtill much expoſed to the enemy's cannon; but becauſe, when once they are forced, the enemy is at full liberty to advance in ſtrength, deſcend into the ditch, and attack the parapet in

* The hand-grenade, which is a hollow ball or ſhell, generally of iron, but ſometimes of tin, and *papier maché* of about 2½ inches in diameter; was firſt uſed in 1594, at the ſiege of Wachtendoncht, a town near Guelders. It is filled with very fine powder, and ſet on fire by means of a ſmall fuze driven into the fuze hole.

whatever

whatever part he likes beſt, which is ſingularly advantageous to him, eſpecially in works that have no flanks.

Paliſades fixed in the ditch juſt at the lower extremity of the counterſcarp, as at Z, ſhould be planted upright; for the difficulty of cutting them will be as great in this inſtance, as when planted obliquely, and that of paſſing over them much greater.

Paliſades fixed in the ditch as at X, fig. 3, plate I. ſhould be planted upright alſo. In this inſtance, however, they can be more eaſily cut than thoſe planted at Y or Z.

Paliſades fixed at the lower extremity of the ſcarp, as at W, fig. 6, plate I. generally form an angle of 60 degrees with the ground towards the enemy.

Paliſades fixed upon the berme, are generally planted obliquely: in this ſituation, however great their obliquity may be, unleſs the berme be much lower or the glacis much raiſed, the paliſades muſt be much expoſed to the enemy's cannon.

[In plans, paliſades are repreſented by dots or points.]

REMARK.

The generality of engineers are for fixing the paliſades into the ditch, in preference to any

other place, not only becauſe they are not expoſed to the enemy's cannon, but becauſe it ſurpriſes and obliges the enemy to ſtop at the very inſtant that he is moſt expoſed to the fire from behind the parapet. The top of the paliſades, whether planted upright or obliquely, ſhould never riſe above the exterior border of the ditch.

Paliſades planted in the ditch, may, however, ſerve as props to receive hurdles, over which the paſſage of the ditch may be eaſily made.

Of Fraizes.

Paliſades fixed in the parapet, are called *fraizes*. When the ſtakes are 9 feet long, 4 feet lie within the body of the parapet, and the remainder leans over the berme, rather inclining a little towards the ditch: this inclination is given to prevent grenades, &c. lodging upon them.

To ſtrengthen the fraize, the ſtakes are faſtened to two ſleepers, one of which lies upon the level ground, in the direction of the exterior part of the parapet; and the other, which is generally a ſtronger rail, lies within the body of the parapet, and diſtant from the firſt rail 3 feet: the ſtakes are ſufficiently cloſe to each other, when they

they do not afford room enough to creep through them.

The fraize, eſpecially when not expoſed to the enemy's cannon, is a great ſecurity to the parapet, as there is no forcing them but by cutting them, which cannot be eaſily done, even when the works have no flanks *, conſidering the poſition of the ſtakes, and the deſtruction which hand-grenades thrown from behind the parapet muſt neceſſarily make among the men employed in ſuch an operation.

REMARK.

The uſe of paliſades planted vertically, obliquely, and horizontally, to fortify the avenues of open forts, the bottom of ditches, parapets, &c. was antient even in antient times. It muſt, however, be confeſſed, that their conſtruction requires much time and attention, and is very expenſive unleſs in countries abounding with wood.

Of Cheveaux de Frize.

Cheveaux de Frize are ſo called by the French, from being firſt made uſe of in 1658, at the ſiege

* The fraize in the faces of works which have flanks, are apt to cover the men againſt the fire of the flanks.

of

of Groningen, a town of Frieſland, to ſecure the avenues of the camp againſt the inroads of cavalry.

It conſiſts of a piece of timber 10 or 12 feet long, and is either round, ſquare, or cut into ſeveral more faces, through which a great many wooden pins are driven, of about 1 inch and $\frac{1}{2}$ in diameter, and 6 feet long, pointed at both ends, and often armed with iron †.

The moſt common uſe of the cheveaux de frize is to ſhut up and ſecure the entrance of the ſeveral works; but, like the paliſade, it is deemed of moſt ſervice when employed for the defence of the ditch, in which caſe cheveaux de frize are placed at the bottom of the ditch in a row, and faſtened together with chains or cramp irons. (See B, fig. 8, plate I.)

[In plans, chevaux de frize are repreſented by a line expreſſing their length, through which lines croſs each other, forming angles of 60 degrees each.]

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† The Ruſſians under Munich, and the Germans in their ſeveral wars againſt the Turks, were much indebted to the uſe of cheveaux de frize, for their ſecurity againſt the Turkiſh cavalry. The cheveaux de frize, during the latter campaigns of the Germans againſt the Turks, is ſaid to have conſiſted only of a wooden pole of about 1 inch and $\frac{1}{2}$ in diameter, and 9 feet long, pointed and armed with iron at both ends. When required, it was ſunk obliquely about 3 feet in the earth. At other times, it may ſerve for tent poles. What is become of this practice?

REMARK.

REMARK.

The practice of placing cheveaux de frize at the bottom of the ditch, was in much eſteem during the wars in Germany of 1745 and 1756: M. De Saxe is for placing them on the berme.

Cheveaux de frize placed at the bottom of the ditch may, however, ſerve as a prop to receive hurdles, over which the enemy may croſs the ditch.

Of Trous-de-loup.

Trous-de-loup are pitfalls in the form of an inverted cone, about 6 feet in diameter, and at leaſt as much in depth, with one or more pointed ſtakes fixed at the bottom *. They ſerve to increaſe the difficulty of approach, and are moſtly dug at ſome diſtance from the works, and ſometimes alſo at the bottom of the ditch. See fig. 1 and 7, plate I.

When trous-de-loup are dug without the ditch, they are generally in 3 rows, chequer wiſe, that is, two of the rows are quite oppoſite to each other, and the third in the middle covers the interval of the other two. The diſtance between the firſt row and the ditch is about 5 or 6 paces,

* *Crow-feet* may be uſed in the place of ſtakes: crow-feet are four pointed irons, ſo made that whatever way they fall, one point is always uppermoſt. They are from 4 to 8 inches long.

and

and the earth dug out is ſpread looſe about them, and is ſometimes employed to raiſe the glacis.

When dug in the ditch they generally form but a ſingle row. They are deemed advantageous only in proportion to their greater depth, and their cloſeneſs to each other.

REMARK.

Theſe pitfalls, in the form of their conſtruction, have ſome reſemblance to the wolf-trap, from which they take their name; and, like that alſo, are lightly covered with large twigs, brambles, briars, and looſe earth, to conceal the place of their ſituation, and produce in the enemy all the terror and diſmay that ſudden plunges into danger never fail to excite.

Of the Abbatis.

An *Abbatis* is a defence raiſed before a redout, or other field work, to impede the enemy's approach. It conſiſts of hewn trees with the points of their branches turned towards the enemy; and to increaſe the danger and difficulty of forcing it, the trees are not only placed cloſe to each other, but the branches are ſtript of their leaves and twigs, ſharpened at the extremities, and interwoven one in another.

To prevent the enemy from forcing them aſunder to open himſelf a paſſage, the trunks of the

the trees are generally ſunk 3 or 4 feet into the earth *; and the principal branches that lie on the ground are faſtened down by ſtakes: trees of the middle ſize, and eſpecially fruit trees, are deemed moſt proper for forming an abbatis. When the trees in the neighbourhood happen to be very large, the larger branches will anſwer the purpoſe full as well as the trunks.

Fig. 1, plate I. repreſents the plan of an abbatis, *without expreſſing the earth dug out of the trench to receive the trunks.*

Fig. 8, plate I. repreſents its profile.

REMARK.

The abbatis is a defence univerſally known, and was probably one of the firſt in uſe, being mentioned by Herodotus, Thucydides, Xenophon, Polybius, and other ancient writers.

Mr. Folard conſiders the abbatis not only as the moſt formidable obſtacle to the approach of an enemy towards any work, but deems it of

* To receive the trunks, a trench is dug, in which the greater depth is towards the work; the profile of it is a triangle. The earth dug up is thrown towards the work; and when the trees are placed, it is generally made uſe of to fill the intervals between the trunks, and is alſo thrown over them in order to increaſe their ſolidity.

itſelf

itſelf a ſufficient fortification to ſecure a paſs or poſt. The earth taken out of the trench, if properly employed, may ſerve to cover the men.

Of Fougaſſes.

Mines that have for line of leaſt reſiſtance* leſs than 10 feet, are called *fougaſſes*. They are of the greateſt utility for the defence of the ſaliant angles and faces of works that have no flanks, and they require but little time for their conſtruction.

Mr. Santa Cruz conſiders fougaſſes to be as great an obſtacle as any that can be made uſe of to impede approach, on account of the dread with which their effects are known to impreſs the mind. Nothing diſconcerts and depreſſes men more, than to encounter danger againſt which they think neither their dexterity nor courage can afford them any ſecurity.

Of Inundations.

Among the ſeveral obſtacles to impede approach, that obtained by water is far from being deemed the leaſt advantageous: inundations, however, require much time and many precautions.

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* *The line of leaſt reſiſtance* is the line drawn from the center of the place where the powder is lodged, perpendicular to the neareſt ſurface of the ground.

REMARK.

REMARK.

The uſe of paliſades, trous-de-loup, fougaſſes, and other obſtacles invented to impede approach, depend much upon the nature of the attack to which a work is expoſed. The two methods of attacking field works are with cannon, and with *ſword in hand:* when expoſed to the attack of cannon, the ſecurity of the poſt will depend much on the greater thickneſs of the parapet; and when expoſed to the attack with *ſword in hand*, the ſecurity will depend on the greater breadth and depth of the ditch, and the application of one or more of the invented obſtacles above mentioned.

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SECTION IV.

Deſcription of the principal Field Works.

PLATE II.

Fleche or arrow, fig. 1.
Detached baſtion, fig. 2.
Redouts, fig. 3, 4, 5, 6, 7 and 8.

PLATE III.

Star Forts, fig. 1, 2, 3, 4, 5, 6 and 7.

PLATE IV.

Forts with { half baſtions, fig. 1. / whole baſtions, fig. 2.

PLATE V.

Têtes-de-pont, or Bridge Heads, fig. 1, 2, 3, 4, 5 and 6.

Of the Fleche or Arrow.

FIG. I. PLATE II.

The *fleche* or *arrow* is ſometimes alſo called *redan*, and conſiſts of two ſides, AB, BC, called *faces*, forming a ſaliant angle ABC, which meaſures from 60 to 120 degrees *: the opening AC, is called *gorge*.

* It is obſervable that the inward ſpace will be the leſs, in proportion as this angle differs from the right angle.

The

The fleche, which may be conſidered as the ſimpleſt of all field works, ſerves to ſecure the quarter guards of a camp, or advanced guard, and to cover a bridge, a ford, &c. The greater fleches have from 40 to 100 yards for the length of the faces; the thickneſs of the parapet at the top is about 12 feet, and the interior height of the parapet is at leaſt 6 feet. The breadth and depth of the ditch are determined by the quantity of earth neceſſary for raiſing the parapet and banquette. The ſmaller fleches have from 15 to 30 yards for the length of the faces; the thickneſs of their parapet at the top is about 3 feet, and the interior height of the parapet is about $4\frac{1}{2}$ feet.

[The parallel ſpace *o* repreſents the parapet, and the ſpace *p* repreſents the ditch.]

Of the Detached Baſtion.

FIG. 2. PLATE II.

The *detached baſtion* conſiſts of four ſides, of which the two greater AB, BC, are called *faces*, and the two leſſer AE, CD, which meaſure about the half of the greater ſides, are called *flanks*.

This work is raiſed for much the ſame purpoſes as the fleche, and, like it, is left open at the gorge: the detached baſtion is deemed of greater

defence than the fleche, as it cannot ſo eaſily be turned.

The breadth of the parapet at the top is ſeldom leſs than 8 or 9 feet, and the interior height of it is ſeldom leſs than 6 feet; that is, it is generally of ſufficient dimenſions to reſiſt at leaſt the cannon ſhot of the middling ſize, and to cover the men within the work.

[The ſpace *o* repreſents the parapet, and the ſpace *p* the ditch: when the faces of this work are to be flanked by ſome other works, the ditch then runs parallel to the faces only, and terminates at both ends in an inſenſible ſlope.]

REMARK.

Beſides the fleche and detached baſtion already deſcribed, there are many other works left open at the gorge, not only very different in ſize but in form, which is ſometimes regular and ſometimes irregular: their ſize and form, and alſo the dimenſions of their parapet, depend upon the importance of the poſt, the ſituation of the ground, and the particular views in raiſing the work. To prevent a ſurprize in the night, a row of cheveaux de frize well faſtened with chains or cramp irons, is generally placed in the gorge; and when theſe cannot be provided, trous-de-loup may be uſed for the ſame purpoſe.

Works

Works open at the gorge, unleſs for the purpoſe of covering a bridge or ford, or to ſecure the quarter guards of a camp, or to defend a poſt within ſo ſmall a diſtance from the camp, as to be eaſily ſuccoured and protected by the army, cannot be deemed of great defence, becauſe they can ſo eaſily be turned: when they are within ſuch a diſtance as to be ſeen and eaſily protected by the army behind, the men within them defend themſelves with greater confidence than if incloſed on all ſides; beſides, as they afford no cover, they are of little uſe to the enemy when taken: in all other circumſtances, however, works incloſed on all ſides are capable of greater defence.

Of the Redout.

FIG. 3, 4, 5, 6, 7, 8. PLATE II.

The Redout is a work generally incloſed on all ſides, except that where the entrance is made. It ſerves to ſecure a poſt, a grand guard, or communication; to defend a *defilé*, a bridge, a ford, &c. and is of various dimenſions, that is, of different plans and profiles. The extent of it is proportioned to the number of men who are to defend it, and the parapet is generally of ſufficient height to cover them: the entrance, which is made in the ſide or face leaſt expoſed, has no greater breadth than is abſolutely neceſſary for paſſing and repaſſing, and is commonly defended from within by a *traverſe*†, as D.

The redout has no preciſe or common form, but may be a ſquare, a rhombus, a trapezium, a trapezoid, a pentagon either regular or irregular,

† The *traverſe* conſiſts of earth raiſed in the form of a parapet, for which purpoſe it ſerves: when it is uſed to defend a paſſage, the French call it *tambour*.

a circle,

a circle, or any other form: the form, indeed, is determined by the ſpot of ground on which it is raiſed, and the purpoſes for which it is conſtructed*.

When there is no eſſential reaſon to the contrary, the form is commonly a ſquare, as Fig. 3; and becauſe, as it has already been obſerved, ſoldiers always fire directly before them, it neceſſarily follows that at the point of each angle of the ſquare redout, there will be a conſiderable ſpace, as ABC, that cannot be defended by any direct fire, except that of one man placed at the ſummit of the angle, which cannot be deemed of much conſequence. This ſpace ABC, is a ſector of a circle, whoſe radii AB, AC, are in the direction of the ſides of the angle, having for length the range of muſket ſhot: thus, if we ſuppoſe the range of muſket ſhot to be 300 yards, there will be four ſpaces not defended of about $70714\frac{2}{7}$ yards each, making together, $282857\frac{1}{7}$ yards.

If the redout is of a pentagonal form, as fig. 4, there will be 5 ſpaces not defended; and if of an

* The word *redout* is not uncommonly uſed to expreſs any field work, whether incloſed on all ſides or not; but, by *redout* here, is underſtood a work incloſed on all ſides, and formed wholly of ſaliant angles: when the work is incloſed on all ſides, and formed both of ſaliant and re-entring angles, it is more properly called *fort*.

hexagonal form, as fig. 5, there will be 6 ſpaces not defended, &c. that is, there will be as many ſpaces not defended, as there are ſaliant angles. It is obſervable, however, that the ſurface of the ſeveral ſpaces not defended of a redout of one form, will be equal to the ſurface of the ſeveral ſpaces not defended of a redout of any other form; that is, the 5 ſpaces *a b c* of the pentagonal redout, will be equal to the 4 ſpaces ABC of the ſquare redout; the 6 ſpaces *d f g* of the hexagonal redout, will be equal to the 5 ſpaces *a b c* of the pentagonal redout, and conſequently equal to the 4 ſpaces ABC of the ſquare redout; for, in each inſtance, the ſpaces not defended by any direct fire, are always equal to a circle of which the radius is of one and the ſame length, viz. the range of muſket ſhot.

And becauſe the circle may be conſidered as a polygon of an infinite number of ſides, it follows, that in the circular redout, fig. 6, there will be an infinite number of ſmall ſpaces not defended, which together will be equal alſo to a circle, having for radius the range of muſket ſhot.

This ſuppoſes that the firſt and laſt man's fire from behind the parapet of each face of a redout, is perpendicular at the extremities of each face; which, however, is not the caſe; for only the fire of the right hand man of each face is

is ſo; and that of the left hand man of each face is not perpendicular at the extremity of its face, but at about 18 inches, or the breadth of a man, from it: now, if this circumſtance is to be attended to, the ſpace not defended by any direct fire, will not be equal in every form the redout may have, but will be the greater in proportion as it has more ſides.

Hence, in a redout of any form whatever, the ſpace not defended by any direct fire, will be to the ſpace defended, as the ſurface of a circle having for radius the range of muſket ſhot, is to the product of the interior perimeter, multiplied by the range of muſket ſhot: thus, in the redout fig. 3, ſuppoſing the range of muſket ſhot to be 300 yards, of 80 yards interior perimeter, there will be $282857\frac{1}{7}$ yards not defended by any direct fire, and only 24000 yards defended; that is, in this inſtance, the ſpace defended will be to the ſpace not defended, nearly as 1 is to 12. This diſadvantage however, will be the leſs in proportion as the redout is the larger; that is, as the interior perimeter has the greater length.

Further, becauſe the whole ſpace not defended, is the ſame in every polygon, with this difference only, that it is more divided as it has more ſides; it follows, that the acceſs will be more equally difficult in proportion as the redout has more faces: and it is on account of this that

the circular form for the redout has the greater number of advocates. Beſides, all the points of the circumference of a circle being equally diſpoſed, the ſoldiers poſt themſelves throughout, which makes the ſpace defended vary every moment, and ſo the enemy is no where in ſafety. The direction of the ſhot, however, being divergent lines, if the redout is ſmall, the effect will be inconſiderable at ſome little diſtance.

Another advantage of the circular form is, that of all the iſoperimetrical figures it has the greater ſurface; and becauſe among regular polygons when iſoperimetrical, that which has the greater number of ſides, has alſo the greater ſurface; it follows, that the pentagonal redout* will on that account alſo be preferable to the ſquare redout when iſoperimetrical; and that the hexagonal redout will be preferable to the pentagonal redout when iſoperimetrical; &c. And further, becauſe of two iſoperimetrical figures of the ſame number of ſides, that whoſe ſides are moſt equilateral and equiangular, has the greater ſurface; it follows, that the regular form claims the preference over the irregular form; that is,

* The pentagonal and hexagonal, &c. form is, however, much more difficult to be traced than the ſquare form: hence ariſes that preference which is given to the ſquare form.

the

the ſquare is preferabe to the trapezoid, when iſoperimetrical.

The circular form cannot, however, be always adopted: when a road, a bridge, a ford, or any other place of ſmall extent, is to be defended, a front is generally oppoſed, which to be advantageous, ſhould be as oppoſite and parallel to the part to be fired at as poſſible. Some circumſtances require the rectilinear form, ſome the curvilinear, and ſome even the mixt form; therefore, an attachment, for this or that reaſon, to any particular form in preference to every other, let the circumſtances of the ſpot on which the work is raiſed, the purpoſes for which it is conſtructed, and the ſituation of the adjacent ground, be what they may, is rather a proof of pedantry, than of that judgment which knows how to take advantage of every different ſituation that occurs: thus in the inſtance, fig. 7, where the ſides follow the edge of the height, and ſome of the angles are oppoſite that part of the hill which is moſt difficult of acceſs; the form, though very irregular, will be of greater defence* than any regular form whatever.

* In ſuch a ſituation it will be advantageous for the parapet not to be high, and its ſuperior talus to be as great as poſſible; nor will there be a neceſſity for a ditch on the outſide. The earth to form the parapet, may be taken from within; by which means the men will ſooner be under cover.

[The

[The ſlope of the hill is repreſented by a ſhade, which is the longer and fainter, in proportion as the aſcent is the more gentle, and the ſhorter and ſtronger as it is the more difficult.]

In every circumſtance it will be prudent to attend to the defect of the ſaliant angle: ſome recommend to cut off the ſaliant angle, as at *b*, fig. 4; and others to round it off, as *l*, fig. 5; both theſe methods, however, while they imperfectly ſupply the defect of the ſaliant angle, at the ſame time diminiſh the inward ſpace.*

Mr. Clairac, and many other engineers, recommend the interior ſide of the parapet, to be cut *en crémailliere*,† that is, with an indentation, as fig. 8, but after ſuch a manner, that, in the ſquare redout, the ſides *a b* may be perpendicular, and the ſides *b c* parallel to the diagonal BE. The ſides *ab*, *bc*, meaſure commonly about 3 feet each, ſufficient to receive one man; but they are more advantageous when each meaſures 5 or 6 feet. By this method the ſoldier can give 3 different directions to his fire, and the

* The defect of the ſaliant angle may in ſome meaſure be ſupplied alſo, by poſting the greater number of the beſt ſoldiers towards theſe angles: ſome recommend the parapet towards the ſaliant angle to be raiſed ſomewhat higher.

† So called by the French, from its reſemblance to a pot-hook, and to the teeth of a ſaw.

defect

defect of the ſaliant angle does not only diſappear, but a greater fire is brought to bear upon the object to be fired at, than if only at a ſingle face; and conſequently the paſſage of a bridge, ford, defile, &c. may be rendered more difficult: the ſum of the ſides *a b* of one face are equal to the diagonal B E.

Mr. Clairac aſcribes this invention firſt to M. *de la Fon*, in 1740, and then to M. *de Verville*, in the year 1741; though it is well known that this ingenious improvement was introduced long before that time by *Tanſini*, in the defence of a covert-way.

The redout *en crémailliere*, however, diminiſhes the ſtrength of the parapet, and is of difficult if not impoſſible conſtruction: it requires a better revetment to execute it even than ſods, which is conſidered as the beſt revetment that is commonly at hand for field works †; it enlarges the inward ſpace; and the banquette runs parallel, not to the cremailliere, but to the line AB.

[The ſpace *o* repreſents the parapet of the redout, and the ſpace *p* the ditch.]

† It will require a brick wall to ſupport the earth within, which is ſeldom practicable in field works: Mr. Muller, indeed, aſſerts, that ſods may anſwer the purpoſe full as well as bricks, which, if it was true, would invalidate the objection. Late experiments, however, tend to contradict Mr. Muller's aſſertion. Innovations ſhould not be too haſtily adopted, nor too raſhly rejected.

Of

Of the Number of Men neceſſary for the Defence of the Redout.

The parapet of field works is well lined for defence, with a file two deep for every yard of the interior perimeter; and when cannon is to be employed, 4 or 5 yards are allowed for each piece: thus, a ſquare redout of 40 yards interior perimeter, will require 40 files or 80 men for its defence; a ſquare redout of 80 yards interior perimeter, 80 files or 160 men; and a ſquare redout of 120 yards interior perimeter, will require 120 files or 240 men. But on account of the banquette and traverſe which ſecures the entrance, there will not be room ſufficient in the *terreplein* * of the redout of 40 yards interior perimeter, to receive the 80 men allowed for its defence; in that of 80 yards, there will be only room ſufficient; and in that of 120 yards, there will be ſome to ſpare. This ariſes in conſequence of ſimilar figures not being to each other as their perimeters †, but as the ſquares of their perimeters; ſo that tho' the redout of 80 yards interior perimeter is only double that of 40 yards, yet its ſurface is quadruple; and tho' that of

* The level ground within.

† That is, if one perimeter is double the other perimeter, the ſurface will be double alſo.

120 yards interior perimeter is only treble that of 40 yards, yet its ſurface is nine times greater: hence, in determining the number of men neceſſary for the defence of a redout, ſome attention ſhould be paid not only to its interior perimeter, but alſo to its ſurface.

Conſequently, deducing from the general rule above-mentioned, 200 men will require a redout of 100 yards interior perimeter; for 200 men formed two deep, make 100 files, which, at one yard each file, are equal to 100 yards:

Conſequently, 150 men and 2 pieces of cannon will require a redout of 85 yards interior perimeter; for 150 men formed 2 deep, make 75 files, which, at 1 yard per file, are equal to 75 yards; and 2 pieces of cannon at 5 yards each, make 10 yards, amounting together to 85 yards.

Mr. Clairac ſuppoſes the parapet of a field work to be ſufficiently lined for defence, with two men for every fathom interior perimeter: and remarks further, that 36 men will be ſufficient for the defence of a redout of 24 fathoms perimeter*; but that 256 men will be wanted for the defence of a redout of 64 fathoms perimeter†. And becauſe 36, the number of men ſufficient for the defence of the redout of

* This is only at the rate of 3 men for every two fathoms perimeter. Mr. Clairac conſiders 24 fathoms as the leaſt meaſure for the interior perimeter of a redout.

† This is at the rate of 2 files 2 deep for every fathom. Mr. Clairac conſiders 64 fathoms for the meaſure of the interior perimeter of a redout, to be the moſt that ſhould be admitted.

24 fathoms

24 fathoms perimeter, and 256, the number of men required for the defence of that of 64 fathoms perimeter, are the ſquares of 6 and 16, which happen to be the $\frac{1}{4}$ of the perimeter of theſe redouts; Mr. Clairac has deduced the two following rules: 1ſt. to find the number of men, ſquare the $\frac{1}{4}$ of fathoms that the interior perimeter meaſures, and the product will be the number of men required for defence; and 2d. to find the interior perimeter, quadruple the ſquare root of the number of men given, and the product will give in fathoms the interior perimeter. Large redouts by theſe rules contain more men in proportion than ſmall redouts, which is certainly advantageous. There are many occaſions where theſe rules may anſwer; but there are many which will not only require a file two deep for every yard interior perimeter, but in which it will be prudent even to have beſides a reſerve, to replace thoſe that are killed or wounded.

REMARK.

The interior perimeter of a redout ſhould never be leſs than 50 yards, and it is ſeldom made greater than 150 yards: if leſs than 50 yards, eſpecially if of an irregular form, the men within will much incommode each other; and ſhould hand-grenades be uſed by the enemy, the men cannot find ſecurity againſt them: when the number of men is greater than what would require a perimeter greater than 150 yards, it is generally deemed more advantageous to conſtruct works with flanks, that is, works formed of ſaliant and re-entring angles, to ſupply the defects of the ſaliant angles.

To

To trace, upon Paper, a Square Redout for 200 Men.

FIG. 1. PLATE VI.

Suppoſing that a file two deep is requiſite for the defence of every yard interior perimeter, it follows, that the number of men given will require the interior perimeter of the ſquare redout to be 100 yards.

Upon AB, which anſwers to 25 yards, conſtruct a ſquare, and ABCD will meaſure the required perimeter; then at the diſtance of 6 feet from the ſeveral ſides, and without, draw a parallel line, and the ſpace *a* repreſents the breadth of the parapet at the top.

At 2 feet from this line, draw a faint line, which will terminate the ſcarp of the parapet.

At 3 feet from this line, draw another parallel line; and the ſpace *b* will repreſent the berme.

At 4 feet from this line, draw a faint line; and this line will terminate the ſcarp of the ditch.

At 2 feet from this line, draw another faint line; and the ſpace *c* will repreſent the bottom of the ditch.

At 4 feet from this line, draw a line; and the ſpace *d* will repreſent the counterſcarp. To prevent the ditch being of eaſier deſcent, it is generally rounded off at the ſaliant angle of the counterſcarp;

terſcarp; ſo that the ſeveral lines terminating the upper and lower part of the counterſcarp are not like the other lines, produced till they meet; but are joined together by an arc of 90 degrees.

At 2 feet from the ſeveral ſides of the ſquare ABCD, and within, draw a faint line; and this line will terminate the interior ſlope of the parapet.

At $4\frac{1}{2}$ feet from this line, draw a parallel line; and the ſpace *f* will repreſent the terreplein of the banquette.

Laſtly, at 3 feet from this laſt line, draw a faint line; and this line will terminate the ſlope of the banquette. The correſponding angles of the ſlopes are joined together by right lines.

REMARK.

When the plan is drawn upon a ſmall ſcale, the two laſt lines are omitted; but they are nevertheleſs imagined, ſo are likewiſe the lines terminating the interior and exterior ſlopes of the parapet, the ſcarp and the counterſcarp. See fig. 1, 2, &c. Plate II. III. IV.

That theſe ſeveral lines may be properly and diſtinctly marked, it will be found neceſſary to make uſe of the ſcale of an inch to repreſent 8 or 10 yards: the ſame ſcale to repreſent 12 or 16 yards, is not uncommonly uſed.

To

To trace the Entrance and Traverſe.

At 2 or 3 feet from *g b*, which is perpendicular upon the middle of the ſide of the ſquare ſuppoſed to be leaſt expoſed, draw on both ſides of this line, a parallel line; and the ſpace between theſe two parallel lines, which meaſures 4 or 6 feet, will repreſent the entrance: when it meaſures 6 feet, it will be wide enough to admit cannon.

At 3 or 4 feet from the line terminating the banquette, draw a parallel line; and this line will terminate the exterior ſlope of the traverſe.

At 2 feet from this line, draw another parallel line; and this line will terminate the exterior ſide of the traverſe at the top.

At 3 or 4 feet from this line, draw another parallel line; and the ſpace *n* will repreſent the breadth of the traverſe at the top.

At 2 feet from this laſt line, draw a faint line; and this line will terminate the interior ſlope of the traverſe.

The length of the traverſe is generally ſuch, as to ſecure the men placed behind AD and BC, from being ſeen through the entrance.

REMARK.

The traverſe has generally a banquette and ditch, which in this conſtruction are both omitted, deeming them rather detrimental, as they take up much of the inward ſpace without contributing to the defence. This omiſſion, however, obliges the traverſe to be formed with the earth taken out of the ditch; and the interior height of it to be only about $4\frac{1}{2}$ feet.

The traverſe alſo has not the ſame thickneſs as the parapet, that the inward ſpace may ſtill be increaſed: 3 or 4 feet for thickneſs at the top will in general be found ſufficient for the traverſe, conſidering its ſituation. When cannon are uſed, the traverſe is not conſtructed till the cannon are within the work, this allows the traverſe to be raiſed nearer to the parapet, which ſecures the entrance more effectually, and increaſes the inward ſpace.

When the redout is large, inſtead of defending the entrance from within by a traverſe, many recommend the covering it with a fleche; but this conſtruction, without giving more ſecurity, greatly increaſes the labour. When a fleche is raiſed, great care muſt be taken, that the ditch of the fleche is defended by the redout.

To

To deſcribe the Profile of the Redout.

FIG. 2. PLATE VI.

The *profile* being a repreſentation of the different breadths, heights, and depths, of the ſeveral parts of a work; and the *plan* a repreſentation of the length and breadth of its ſeveral parts; it follows, that to deſcribe the profile required, the plan muſt be ſuppoſed to be cut perpendicularly from the top to the bottom, in the direction of a line, as *y z*. See fig. 1, plate VI.

The firſt ſtep to deſcribe this profile is, to prepare a ſcale greater than that of the plan, that the ſeveral breadths, heights, and depths, may be diſtinctly repreſented*; and the ſecond is, to draw an horizontal line as AB. All the parts above this line, repreſent what is raiſed above the ſurface of the ground; and thoſe below it, what is ſunk beneath the ſurface.

From the point A to C, upon the horizontal line AB, meaſure 3 feet, allowed for the baſe of the ſlope of the banquette; at the point C, raiſe the perpendicular CD of one foot and a half, for the height of the banquette; and draw, parallel to AB, the line DE, to which give $4\frac{1}{2}$ feet for

* That the ſeveral parts may be properly and diſtinctly expreſſed, it will be neceſſary to make uſe of the ſcale of an inch to repreſent 4 or 6 yards: the ſame ſcale to repreſent 8 or 12 yards, is not uncommonly uſed.

the terreplein of the banquette*: the line AD repreſents the ſlope of the banquette.

From E raiſe the perpendicular EH $4\frac{1}{2}$ feet, for the height of the parapet above the banquette †; from H, draw HI parallel to AB; upon HI meaſure for HL 2 feet, and join EL to repreſent the interior ſlope of the parapet.

Make LI 6 feet for the thickneſs of the parapet at the top ‡; and from I let fall the perpendicular IK upon the horizontal line AB; then give to KM $4\frac{1}{2}$ feet, and draw the line LM for the ſuperior talus, or plunge of the parapet: by this conſtruction, the fire may reach nearly the border of the counterſcarp.

---

* This breadth allows the men to be drawn up two deep; but a third rank can be of no uſe, as it cannot poſſibly fire over the parapet. Many deem the addition of the fire from the ſecond rank rather detrimental, as it is not only uncertain, but is likely to incommode the firſt rank: this practice, however, upon trial, has been found preferable to that of lining the parapet only with a ſingle rank for firing, whether the fire is kept up either by countermarching, or by the exchange of fire arms.

† Upon trial, however, $4\frac{1}{2}$ feet will, in general, be found too great to fire over the parapet, as many men at preſent are enliſted who ſcarcely meaſure 5 feet 6 inches, and who, as experience proves, cannot fire over a parapet above 4 feet 3 inches high. The height of the parapet over the banquette not being ſufficient to cover the men in the act of firing, it is not uncommon for their ſecurity againſt the ſmall arms of the enemy, to raiſe the interior part of the parapet with *ſacs a terre*: but this practice prevents the fire of a ſecond rank.

‡ This thickneſs will be ſufficient to reſiſt cannon of the middling ſize.

From

From K to N, upon the horizontal line AB, meaſure 2 feet; and join MN to repreſent the exterior ſlope of the parapet ‡.

From N to O meaſure 3 feet allowed for the breadth of the berme §; then let fall the perpendicular OP of 6 feet, and draw the line PR.

From P to Q meaſure 4 feet || allowed for the baſe of the ſcarp, and join OQ to repreſent the ſcarp.

From Q to R meaſure 2 feet, allowed for the bottom of the ditch, and raiſe RS perpendicular to meet the horizontal line AB; from S to T meaſure 4 feet, allowed for the baſe of the counterſcarp; and join RT to repreſent the counterſcarp.

REMARK.

By this conſtruction, the ſolidity of the parapet, banquette, and traverſe, amounts to about 590 yards, and that of the excavation of the ditch only to about 557 yards; that is, there is a difference of about 33 ſolid yards, which are

‡ This ſlope is about the $\frac{1}{2}$ of the height.

§ Three feet for the breadth of the berme, will, in general, be deemed greater than is neceſſary, eſpecially as the parapet has not much thickneſs nor great height: when the ſoil is clay or loom, a breadth of about 2 feet may be ſufficient; but in all other caſes, eſpecially if the work is to laſt ſome time, the berme will require about 3 feet for breadth.

|| This ſuppoſes the ſoil to be clay or loom, in which caſe the baſe is taken equal to the $\frac{2}{3}$ of the height.

allowed for lining the parapet either with faſcines or with ſods, that are not taken out of the ditch.

Direction for Drawing the Lines.

The lines of the plan are diſtinguiſhed into *ſtrong* and *faint* lines, the degree of ſtrength and faintneſs varying in proportion as the plan is drawn upon a greater or leſſer ſcale; but the lines of profiles are in general of one and the ſame degree of ſtrength.

The lines of the plan which terminate the parapet at the top, are drawn ſtrong *; but, by way of diſtinction, that repreſenting the interior ſide, is drawn ſtronger than that repreſenting the exterior ſide.

The lines that terminate the terreplein of the banquette and its ſlope, the lines terminating the interior and exterior ſlopes of the parapet, the lines terminating the berme and the ditch, and the lines terminating the ſcarp and counter-ſcarp, are drawn faint; and, by way of diſtinction, the lines terminating the ſeveral ſlopes, are drawn ſome degrees fainter than the reſt.

The lines that join the correſponding angles of the ſeveral ſlopes, and which repreſent the ridges and gutters, are drawn ſomewhat ſtronger towards the head, than towards the foot.

* The lines that terminate the *traverſe*, and the line that terminates the *crête*, or interior ſide of the glacis, are alſo drawn ſtrong.

Of

Of Star Forts.

FIG. 1, 2, 3, 4, 5, 6 and 7. PLATE III.

Star forts, like the redout, are incloſed on all ſides, but have greater extent; and being formed of ſaliant and re-entring angles, are deemed of much greater defence. Star forts have from 4 to 8 *points*, that is, from 4 to 8 ſaliant angles: they are ſo called from a ſuppoſed reſemblance to a ſtar, of which the rays form the angles. The entrance is made in the part leaſt expoſed, and in the re-entring angle; and it is commonly defended from within by a traverſe.

The ſize of the ſtar fort, like that of moſt other field works, depends generally upon the number of men who are to defend it; and the dimenſions of the parapet depend upon the peculiar ſervice for which the work is raiſed. The height of the parapet is at leaſt 6 feet, and its breadth at the top is from 9 to 18 feet; and that the ditch, which ſhould not be leſs than 6 feet deep, may be the broader and deeper, a glacis is generally raiſed immediately upon its exterior border, as A, fig. 1. which is of peculiar ſervice in covering the parapet: when the parapet is of great height, ſome raiſe the glacis at 5 or more feet

from the exterior border, to obtain a *covert-way* *, as A fig. 5.

The ſtar fort is generally deemed conformable to that grand maxim of permanent fortification, that every part about the circumference of a work muſt be ſeen from ſome other part; that is, every part of the ditch and berme, is ſuppoſed to be ſeen from within. This, however, is not the caſe; for, oppoſite every re-entring angle, there is neceſſarily a ſpace in the ditch, which, on account of the height of the parapet, and depth of the ditch, cannot be ſeen from any part within; and this ſpace will be the greater, as the parapet has the leſs ſuperior talus, and the greater height, and the ditch the greater depth.

The regular ſtar fort with 4 points, fig. 1, is conſtructed by giving to the perpendicular *a b*, the $\frac{1}{8}$ of CD: by this conſtruction, the re-entring or flanking angle being about 152 degrees, the fire from the faces *a* C *a* D cannot croſs, and therefore cannot afford any defence to the ſaliant angles. This fort cannot, therefore, be deemed of greater defence than the ſquare redout, nor claim a pre-

* It is called *covert-way*, from a ſuppoſition that the men within it are covered, that is, in no danger from the enemy's fire. The covert-way, though generally level with the horizon, is ſometimes ſunk one or two feet lower, which is done when the glacis cannot be raiſed ſufficiently to cover the men. This is diſadvantageous, as it decreaſes the depth of the ditch.

ference

ference to it, eſpecially as its conſtruction is more difficult, and there is leſs inward ſpace in proportion to the perimeter.

Some, may think, that there is no diſadvantage in giving to the perpendicular more than the $\frac{1}{8}$ of the exterior ſide; but that would much leſſen the inward ſpace, and make the ſaliant angles too acute; for, by the preſent conſtruction, the ſaliant angle is not quite 63 degrees, which is as acute as it can well be.

The regular ſtar fort with 5 points, fig. 2, is conſtructed by giving to the perpendicular *a b*, the $\frac{1}{6}$ of CD: by this conſtruction, the re-entring or flanking angle is about 143 degrees, which is ſtill too obtuſe to afford protection to the ſaliant angles.

The regular ſtar fort with 6 points, fig. 3, is conſtructed by giving to the perpendicular *a b*, the $\frac{1}{5}$ of CD: by this conſtruction, the flanking angle is about 136 degrees, which is ſtill too obtuſe to protect the ſaliant angles.

The perpendicular is not only fixed at the $\frac{1}{5}$ of the exterior ſide in the ſtar fort with 6 points, but it is fixed alſo to the $\frac{1}{5}$ of the exterior ſide in every other ſtar fort of a greater number of points: hence it follows, that the perpendicular in the ſtar fort with 4 points, is the $\frac{1}{8}$ of the exterior ſide; in that of 5 points, is the $\frac{1}{6}$; and in

in that with 6, 7*, or 8 points, is the $\frac{1}{3}$ of the exterior ſide.

The regular ſtar fort with 6 points, fig. 5, is more commonly traced upon an equilateral triangle, in this manner: divide each face *a b*, into 3 equal parts; and upon the center diviſion *c d*, trace the equilateral triangle *c d e*; and *a c*, *c e*, *e d*, *d b*, will terminate one front: by this conſtruction, the ſaliant angles are 60 degrees each, and the re-entring angles only 120 degrees; therefore, as the ſpace which is not defended by any direct fire, is leſs than in the foregoing conſtruction, it claims the preference. The ſpace oppoſite the ſaliant angles is reduced to a rectangle, the leſſer baſe of which is equal to the gorge *c d*, and the greater is equal to the range of muſket ſhot.

The ſtar fort with 8 points, fig. 6, is conſtructed alſo upon a ſquare, by giving to the perpendicular *a b*, the $\frac{1}{8}$ of CD, and then tracing upon the center diviſion *e f* an equilateral triangle; and C *e g f* D will terminate one front: the gorge *e f* is taken equal to C *e* or *f* D. This conſtruction is the moſt perfect; for the ſaliant angles are not only conformable to the general rule, but the re-entring angles meaſure about 106 degrees each, which enables the faces to afford

* The ſtar fort with 7 points on account of the great difficulty in tracing the ground, is ſeldom uſed.

each

each other mutual defence. The ſpace oppoſite the ſaliant angles, which is not defended by any direct fire, is now reduced to a triangle, whoſe baſe is the gorge *ef*.

The regular ſtar fort with 8 points, may alſo be conſtructed upon an octagon, by giving to the perpendicular the $\frac{1}{3}$ of the exterior ſide: by this conſtruction, the re-entring angles meaſuring about 113 degrees each, may enable the faces to protect each other.

The ſtar fort with 8 points, fig. 7, is conſtructed alſo upon a ſquare, as follows: divide each ſide of the ſquare into three equal parts, and upon the center diviſion, *cd*, trace an equilateral triangle; and *acedb* will terminate one front: this conſtruction, indeed, gives an irregular form, which however has the advantage over the preceding method, though not in defence, yet in containing more inward ſpace, and being of eaſier conſtruction. The ſpace not defended oppoſite the ſaliant angles *o*, is reduced to a triangle, whoſe baſe is equal to *fg*; and the ſpace not defended oppoſite the ſaliant angles *p*, is a rectangle, the ſmaller baſe of which is the gorge *fh*, and the greater is the range of muſket ſhot.

[The ſpace *r* repreſents the parapet, the ſpace *s* the ditch, and the ſpace *z* the glacis.]

REMARK.

REMARK.

Beſides the ſtar forts already deſcribed, there are others, which though ſomewhat different in form, have nevertheleſs much the ſame or greater defects; and moſt of them may ſafely be deemed the offspring of minds whoſe object was not defence, but the mere diverſification of forms.

The advantage aſcribed to the ſtar fort over the redout, is from a ſuppoſition that all its parts reciprocally flank each other. This advantage, however, is imaginary *, except in fig. 6, and partly in fig. 7; for in every other caſe, there is, as in the redout, a ſpace oppoſite every ſaliant angle, which is not defended by any direct fire: this ſpace, though leſs than in the redout, is the greater, as the ſtar fort has the leſs points.

The diſadvantages of the ſtar fort, are, however, real; eſpecially in thoſe with 4 or 5 points,

* Any dependence upon oblique firing, eſpecially from behind a parapet, muſt be imaginary: but admitting the reality of it even to the higheſt ideas of its advocates, the defence in the ſtar fort, fig. 1, of the 8 faces, when employed to flank the ſaliant angles, that is, to fire obliquely, will not allow the $\frac{1}{5}$ part of the men to fire, while the perimeter would naturally allow it, were the men to fire directly before them: thus, inſtead of 300 men which were allowed for the defence of this fort, only the fire of about 60 men can be employed.

which

which formerly were the moſt admired, and indeed the only forms in uſe: and it is rather wonderful, that ſuch works ſhould obtain commendation, and a preference to the redout, if it is conſidered, that they are not of much greater defence, are more difficult in the conſtruction, and give leſs inward ſpace in proportion to their perimeter.

In the infancy of the conteſt in America, the rebels generally adopted the ſtar fort, which, as it could not be an object of preference founded on the knowledge of its advantages and defects, we muſt aſcribe to the influence of the French, who are generally ſuppoſed to be the inventors of that work, and with whom it ſtill remains a favourite.

Of Forts with Baſtions.

FIG. 1, 2. PLATE IV.

Theſe forts are of two conſtructions, one with *half baſtions*, and the other with *whole baſtions*: and both are either regular or irregular; regular, when applied to fortify a ſpace forming a regular polygon; and irregular, when applied to fortify a ſpace forming an irregular polygon. The regular form is moſt common: that with half baſtions is ſometimes conſtructed upon an equilateral triangle, but more generally upon a ſquare; that with whole baſtions, is ſeldom conſtructed upon an equilateral triangle †, but generally either upon a ſquare or an hexagon.

Beſides a parapet and ditch, they have ſometimes alſo a rampart, covert-way and glacis. The rampart is a maſſy bank of earth ſurrounding the poſt, upon and at the extremity of which is raiſed the parapet: it ſerves to range the troops and artillery, to overlook and command the environs, and to increaſe the difficulty of forcing the poſt. The dimenſions of the rampart are determined by the ſituation of the poſt, and the nature of the ground: its breadth at the

† When applied to fortify an equilateral triangle, the baſtions are not as uſual placed at the angles, but upon the ſides.

top,

top, excluſive of what is neceſſary for raiſing the parapet, ſhould be from 5 to 6 yards at leaſt, that is, of a ſpace ſufficient to receive the cannon. This ſpace is called *terreplein*.

Of Forts with Half Baſtions.

FIG. 1.

The length of the ſide of the polygon is from 60 to 120 yards: the fort, fig. 1, is traced by producing the ſide CD, which meaſures 100 yards, ſo as to make C *d* equal to the $\frac{1}{3}$ of CD; dividing the ſide C *a*, which is equal to CD, into 3 equal parts, in *e* and *f*; and drawing the line of defence *df*, and the line *eg*, perpendicular upon *a*C: the line *dg* repreſents the face, the line *eg* the flanks, and the line *eh* the curtain.

[The parallel ſpace *o*, which meaſures 6 yards, repreſents the parapet, and the ſpace *p* the ditch.]

By this conſtruction, the face *gd*, obtains no more defence than itſelf can ſupply, except what it may receive from behind the part *fh*, commonly called *ſecond flank*; but as this defence is very oblique, no dependence can be placed upon it; conſequently, as in the ſquare redout, there will be 4 ſpaces, as A, which may be conſidered as not defended.

Many

Many imagine, that the number of men placed behind the ſecond flank *fh*, to defend *dg*, that is, to fire obliquely, can be as great as if they were left at liberty to fire directly before them: this, however, is far from being the caſe; for no greater number of men can be placed behind *fh* for the purpoſe of flanking *dg*, than upon a perpendicular let fall from the extremity *h*, upon the line of defence *df* produced, which, in this inſtance, will not be even half the number of men, becauſe the length of this perpendicular is not quite the half of the line *fh*. Beſides, the moſt ſtrenuous advocates for the certainty of oblique firing, admit it to be practicable only for a ſingle rank, whereas in direct firing, two ranks can certainly fire at a time; ſo that the defence of the ſecond flank *fh*, admitting its practicability, cannot be equal to the $\frac{1}{5}$ of what the line *fh* could afford, if employed in direct defence.

Beſides, on account of the height of the parapet, and the depth of the ditch, oppoſite every re-entring angle, there is neceſſarily a ſpace in the ditch, which, as it cannot be ſeen from any part within, will not be defended: this ſpace, though the greater in proportion as the parapet has the leſs ſuperior talus and the greater height, and the ditch the greater depth, will never afford ſo much ſhelter, as to produce any diſadvantage while the works have only a parapet, berme, and ditch *: when, however, they have alſo a rampart, this ſhelter may be ſufficient to render

* For by making the ditch there only about $4\frac{1}{2}$ feet deep, this ſpace will not even allow ſhelter to a ſingle man when upright.

an

an attempt on that angle leſs difficult than is commonly apprehended.

The poſition of the flank *eg* would be more advantageous, when forming an angle with the curtain *eh*, of about 100 degrees: this will increaſe the length of the flank, check the enemy ſomewhat ſooner, and prevent the men behind *eh* being annoyed by the fire of the flank *eg*, which is not unlikely to happen in the common poſition.

This laſt conſtruction for the flank, not only checks the enemy ſomewhat ſooner, but alſo more effectually; for there being no vacant ſpaces in the direction of the ſhot, it muſt neceſſarily wound and deſtroy more men. To be convinced that there are no vacant ſpaces when the direction of the ſhot is oblique to the enemy, and that there are ſome when the ſhot is perpendicular to the enemy, we need only place ourſelves facing the center of the battalion, and throw our eye directly upon it; and we ſhall ſee a number of vacant ſpaces, and conſequently openings for the paſſage of many ſhot: but if afterwards we direct our eye from the ſame point to the wings, we ſhall not be able to perceive the leaſt opening through the files, and, conſequently, every ſhot in that direction muſt neceſſarily take effect. This fire, which is juſtly deemed the moſt deſtructive, and by the French com-

monly called *feu en echarpe*, that is, *oblique fire*, differs widely, however, from that oblique fire in which the direction of the ſhot is oblique to the rank that produces it, and may either be perpendicular or oblique to the enemy. In the *feu en echarpe*, the men fire directly before them, and the direction of the ſhot is oblique to the enemy: the one is nature directed by art; the other, ignorance controuling nature.

Of

Of Forts with Whole Baſtions.

FIG. 2.

The length of the exterior ſide of the polygon, is from 100 to 240 yards: a leſs length for the exterior ſide than 100 yards, would not make this work ſufficiently ſpacious, nor its fronts of great defence; and a greater length for the exterior ſide than 240 yards, increaſes the labour, and places the flanked parts beyond the common reach of muſket ſhot. To trace the fort fig. 2, give to the perpendicular *a b*, the $\frac{1}{6}$ † of CD; from C and D, draw, through *b*, the lines C*e* and D*f* indefinitely; upon C*e* and D*f*, that is, from C to *g*, and from D to *h*, take the $\frac{2}{7}$ of CD; then from C, as center, deſcribe an arc through *h* meeting C*e* in *e*, and from D, as center, deſcribe an arc through *g*, meeting D*f* in *f*; then join the points C, *g*, *f*, *e*, *h*, and D, by right lines; and C*g*, D*h*, will repreſent the faces, *g f e h* will repreſent the flanks, and *e f* the curtain. The ſame operations being repeated on the five remaining ſides of the polygon, will form the ſeveral faces, flanks, and curtains.

[The parallel ſpace *o*, which meaſures 18 feet, repreſents the parapet; and the ſpace *p*, which meaſures 7 yards, the terreplein of the rampart.

† In the ſquare, the perpendicular is fixed at the $\frac{1}{5}$ of the exterior ſide.

The ſpace *q* repreſents the ditch, and is traced as follows: take with the compaſſes the breadth intended for the ditch, which in this caſe meaſures 24 yards, and with that interval from the flanked angles deſcribe arcs; then from the interior meeting of the parapet of the faces and of the flanks, draw lines tangent to theſe arcs; and the interſection of theſe lines at *i*, will form the re-entring angles of the counterſcarp.

The ſpace *r*, which meaſures 6 yards, repreſents the covert-way; and the ſpace *s*, which meaſures 24 yards, repreſents the glacis: the ſpace *t*, which is taken out of the glacis, is called *place of arms*, and ſerves to flank the ſaliant angles of the covert-way, and alſo as a *rendezvous* for the troops employed in the defence of the covert-way.]

To increaſe the defence, ſome even add *half moons* or *ravelins** before the curtains, as A: they ſerve to cover the curtains and flanks, and to defend the faces, which without them cannot be ſaid to be defended but by one flank: where no half moons are raiſed, it will be more advantageous to take for the length of the faces, the $\frac{1}{4}$ inſtead of the $\frac{3}{7}$ of CD, which this will increaſe the length of the flank.

This conſtruction for field forts, which is the ſame as that uſed by Mr. Vauban in fortifying towns and other places of great extent, has obtained the general preference on account of this

* Sometimes alſo called *redan*, when it has no rampart.

ſingular

ſingular advantage, that there is not the leaſt part in the circumference of the work but what is ſeen by ſome other part: ſtill, however, it has a great defect *, occaſioned by the little obliquity of the flanks, and the little elevation common to field works; for, if duly conſidered, the baſtions will be found more likely to deſtroy than to protect each other. The men behind the curtain, if the work has no rampart, may even be annoyed by the fire of the flanks †; and there is much reaſon to ſuppoſe that the fire of the flanks will more likely force the men to abandon the defence of the baſtions, than prevent the enemy from approaching them.

This defect may notwithſtanding be remedied, by making the flanks to form an obtuſe angle, not only with the curtains, but alſo with the lines of defence. This change will create no defect, as flanks in field works are not, like thoſe in permanent fortifications, the worſe for being ſomewhat expoſed. Beſides, it is not neceſſary to fire obliquely upon the faces, nor even to graze them; for there is no danger of being expoſed to the defence of a breach, or a lodgment of the miner. The worſt to be apprehended is a ſudden attack by a ſuperior force,

* This conſtruction gives alſo very little inward ſpace in proportion to its perimeter.

† To avoid this, ſand bags or ſmall gabions placed upon the parapet of the curtain may ſupply this defect.

which it will always be found advantageous to check as ſoon as poſſible.

REMARK.

The principle, that "there is not the leaſt part "in the circumference of a work but what ought "to be ſeen by ſome other part," though abſolutely neceſſary in permanent fortification, may without much reluctance be diſpenſed with in field fortification. Field works, to be more equally difficult of attack, and of greater defence, ſhould certainly be terminated by ſaliant and re-entring angles; and the diſtance between the ſummit of the ſaliant or flanked angles, and that of their adjoining re-entring or flanking angles, ſhould be within muſket ſhot*. The ſaliant angles to be advantageous, ſhould meaſure about 90 degrees, and the re-entring angles about 100 degrees †; and if to obtain theſe ends, a very irregular form ſhould be the conſequence, it will ſtill be preferable to any other more regular form that is defective in theſe points.

The form of a field fort, however, ſeldom depends upon choice, but generally upon the

* Though the point blank of our firelocks, when attention is paid to the loading, is known to be about 300 yards, yet it will be prudent to rate it at much leſs, conſidering that men ſtationed behind works, pay ſo much attention to the fire of the enemy, as to give very little to the effect of their own fire.

† That is, the flanked parts ſhould form an angle with their flanking parts of about 100 degrees.

ſpot

ſpot where it is to be raiſed, the purpoſes for which it is conſtructed, and the ſituation of the adjacent ground; and theſe often make a nice arrangement of lines unneceſſary. Thus, when a work is to be conſtructed upon an eminence as fig. 3, the moſt important point will be to prevent the enemy advancing under cover: but to obtain this end, the ſides that terminate the work, muſt neceſſarily follow the edge of the height, as in the preſent conſtruction; in which it plainly appears, that though every other conſideration is laid aſide, yet this work will in this inſtance be more advantageous than any other form, in which the ſides ſhould not follow the edge of the height, however perfect it may be in every other reſpect.

REMARKS.

I.

When the work is intended to remain for ſome time, to ſhelter the men againſt the inclemencies of the weather, it is uſual to erect a guard-houſe, built with large beams and planks. That it may be more ſecure, it is commonly ſunk 3 or 4 feet below the ſurface; and to prevent its being pierced by the enemy's grenades, joiſts are laid along the top, and covered with about 2 feet of earth---when deſtitute of time, materials, or ſituation, huts or tents are uſed inſtead of them.

II.

To preſerve the powder and cartridges from contracting damp, as well as from being ſet on fire, holes, ſerving as magazines, are dug within the work, the ſides of which are lined with planks to keep the earth from tumbling in, and it is alſo covered over with planks.

Of Têtes-de-pont, or Bridge Heads.

FIG. 1, 2, 3, 4, 5, 6. PLATE V.

Works conſtructed to cover or ſecure a bridge, or to contain troops to ſecond the manœuvres of a body of men, either in forcing the paſſage of a river, or in repaſſing it in their retreat, are called *têtes-de-pont*, or *bridge heads*: they are generally left open at the gorge, and beſides have an entrance made in the part leaſt expoſed, which is defended from within by a traverſe.

The ſize of bridge heads is not, like that of moſt other field works, determined ſolely by the number of men neceſſary for their guard, but is generally much larger, to enable the troops to file off without confuſion, and to favour their retreat in repaſſing a river.

Their form depends chiefly upon the breadth of the river to be paſſed, its courſe either in a ſtrait or a curve line, and the height of the oppoſite banks.

REMARK.

REMARK.

The curve may either be concave, or convex; that is, the bend of the river may either be inwards or outwards: the inward bend, fig. 4, is generally preferred for the paſſage, becauſe the bridge, or work, cannot be ſeen but in front; and becauſe the troops, after their paſſage, may file off and form before the work, under the protection of batteries raiſed on this ſide, without the enemy having it in his power to diſturb them but at a great diſtance: when the bridge is conſtructed at the outward bend, fig. 6, it may be enfiladed from all ſides; the *head* of it can only be defended obliquely, and from a great diſtance; and the troops cannot file off and form before the work, without danger of being immediately charged by the enemy.

To cover a Bridge when the River is narrow, and its Courſe forms a ſtrait Line.

FIG. 1.

If the oppoſite banks are of an equal height, and the breadth of the river, and the ground about it, will admit the uſe of ſmall arms from the oppoſite ſhore, the detached baſtion, fig. 1, may be deemed ſufficient; eſpecially, if the detached flanks B, are raiſed on this ſide of the river.

The ſaliant angle C meaſures 60 degrees, that is, it is as acute as it can well be, that the faces *a* C, which meaſure 40 yards each, may be protected

tected by a nearer and more direct fire; the flanks *ab* measure 20 yards each, and form a right angle with the edge of the bank, that the defence of it may be as direct as possible; and the detached flanks B are raised so as to form, upon the faces C *a* produced, an angle of about 100 degrees.

By this construction, every part may be said to be flanked by some other part, except the small space *abf*, a defect, however, that may easily be supplied by raising the flanks D. The flanks B may also be enfiladed from the opposite shore; to prevent which, it will be necessary to raise the parapet E, which, in such a circumstance, is commonly called *epaulement.*

[The space *o* represents the parapet, and the space *p* the ditch, which runs parallel to the faces only, and terminates at both ends in an insensible slope: this slope is given, to enable the parts B which are to flank this work, to see the ditch in its whole extent.]

REMARK.

When the bank on the side opposite to that upon which the work is raised, is the highest, it may appear more advantageous for the flank B to form a right angle with the faces C *a* produced: this, however, should not be done, unless the bank is considerably higher, and the parapet of the detached bastion has much thickness.

When

When the bank is much higher on the ſide of the river upon which the bridge head is to be raiſed, the detached baſtion cannot well be deemed ſufficient, becauſe it cannot then receive much protection from the oppoſite ſhore; and, in ſuch a circumſtance, the work ſhould neceſſarily be formed of ſaliant and re-entring angles, that the ſeveral parts may reciprocally flank each other.

The detached baſtion, however, is by many ſtill deemed ſufficient, provided the flanks B are raiſed upon a rampart of ſuch a height, as to bring theſe at leaſt on a level with the oppoſite ſhore: this can only ariſe from a ſuppoſition that the men in theſe detached flanks, have much more confidence, than thoſe in the work itſelf, and conſequently direct their fire much better.

To cover a Bridge when the River is broad, and its Courſe forms alſo a ſtrait Line.

FIG. 2.

If the breadth of the river, or the ground about it, will not admit the uſe of ſmall arms from the oppoſite ſhore, it will then require a work formed of ſaliant and re-entring angles, that the ſeveral parts may flank each other: in ſuch an inſtance, the work fig. 2, may be conſtructed, in which the ſaliant angle A meaſures 60 degrees;

60 degrees; the flanks *b c* measure 30 yards, and form with the faces A *c*, which measure 50 yards each, an angle of about 100 degrees; and the remaining part *b d* forms with the edge of the river a right angle; the part *c k* measures 30 yards.

By this construction, every part of the work may be said to be flanked by some other part, except *g b*, which, however, may easily be done from the opposite shore, by the detached battery B, or by a floating battery.

REMARK.

In the instance abovementioned, some require more spacious works, and recommend fig. 3, which is commonly called *horn work:* the perpendicular *a b* is the $\frac{1}{8}$ of CD, which measures 120 yards; the faces C *c* D *d*, measure the $\frac{1}{4}$ of CD; the flanks *c f*, *d g*, form an angle of about 100 degrees, with the lines of defence C *g* D *f*; that part of the *wing* C *i* D *i*, measures 80 yards, and is perpendicular upon CD; the flanks *h i* measure 20 yards, and with the wings C *i* D *i*, form an angle of about 100 degrees; and the remainder of the wing *b k*, is parallel to C *i* D *i:* the length of C *m* is 120 yards.

By this construction, every part may be said to be flanked by some other part, except the part *b k*, which, however, cannot be a great defect,

defect, as it may eaſily be flanked either by a floating battery, or by a battery B, from the oppoſite ſhore: ſome expect to ſupply this defect not only by making C*i*, D*i* parallel, but to bring the extremities *ii* ſomewhat nearer to each other than CD; but this remedies the evil only in part; it increaſes the perimeter, and decreaſes the inward ſpace.

Others recommend the ſtar fort with 8 points, fig. 7, plate III. in which one of the ſides of the ſquare is to be left out, that the work may be open towards the river. This, though of much eaſier conſtruction than the two preceding methods, has greater defects than either of them.

The ſtar fort, fig. 6. plate III. in which one of the ſides of the ſquare is left out, that the works may be open towards the river, may be uſed alſo, and is preferable to the foregoing, as being capable of greater defence.

To cover a Bridge when the River is narrow, and its Courſe forms an inward Bend.

FIG. 4.

If the oppoſite banks are of an equal height, and the breadth of the river, and the ground about it, will admit the uſe of ſmall arms from the oppoſite ſhore, a fleche may be deemed ſufficient, when ſupported by detached flanks.

The

The fleche with its gorge, may form either an equilateral, an iſoſceles, or a ſcalene triangle: the form of it depends upon the bend of the river, and the nature of the ground: in this inſtance it requires a ſcalene triangle, in which the ſaliant angle C is made as acute as it can well be, that the faces C *a* C *b*, may be protected by a nearer and more direct fire; and the detached flanks B, form an angle of about 100 degrees, with the faces C*a* C*b* produced: the face C*a* meaſures about 70 yards, and the face C*b* meaſures about 55 yards.

REMARK.

When the bank on this ſide is lower than that of the oppoſite ſide, Mr. Folard recommends a circular fort *, formed, if poſſible, with hewn trees, that is, with an abbatis; whilſt others prefer a work in which the ſeveral parts may reciprocally flank each other.

To cover a Bridge when the River is broad, and its Courſe forms an inward Bend.

FIG. 5.

If the river has much breadth, or the ground about it does not admit the uſe of ſmall arms

* That is, an arc, of which the cord is the river ſide.

from

from the oppoſite ſhore, the work, fig. 5, may be deemed ſufficient; eſpecially, as it is in general very eaſy to give this work ſome protection by artillery from the oppoſite ſhore: this work is much the ſame as that fig. 2, only that the ſides *g h* form a more obtuſe angle with the banks, that the defence may be more direct.

To cover a Bridge when the Courſe of the River forms an outward Bend.

FIG. 6.

In ſuch a circumſtance, the work, fig. 6, is generally recommended; and is formed upon half a ſquare, of which the diagonal is the river ſide: the perpendicular *a b* is the $\frac{1}{8}$ of CD, which meaſures 120 yards; the faces are the $\frac{1}{4}$ of CD; and the flanks form an angle of about 100 degrees with the lines of defence: by this conſtruction, every part may be ſaid to be flanked by ſome other part, and the flanked parts are within a very convenient diſtance from their flanking parts; but it has a great perimeter with little inward ſpace.

REMARKS.

REMARKS.

I.

When the bridge head is conſtructed with a deſign of ſome permanency, to increaſe its defence, it is not unuſual to add a rampart, covert-way, and glacis, and even a wet ditch: to the front fig. 3, and the two fronts fig. 6. ſome even add half moons before the curtains; this practice, however, would require a greater length for the faces than the $\frac{1}{4}$ of the ſide CD.

II.

To prevent ſurpriſes by the gorge, it may be neceſſary to lay acroſs the river, both above and below the works, ſome impediment or other, that without ſtopping the water will prevent boats, &c. from paſſing: this precaution is more neceſſary towards the head of the river.

III.

When the bridge head ſerves to cover a retreat, in which caſe it is generally made much larger, it will be found advantageous to raiſe a ſecond work within it, ſuch as fig 7, which without obſtructing the paſſage, may ſtill favour the retreat, if the enemy ſhould have forced the firſt work.

To

IV.

To defend the bridge, and prevent the enemy's paſſing over it, it will be neceſſary to conſtruct an intrenchment on this ſide of the river, either in a ſtrait line as G, fig. 1; or in the form H, fig. 2; or in the form K, fig. 3: this laſt conſtruction will be moſt advantageous.

V.

When the banks of the river are ſo low and marſhy, as to require the bridge head to be conſtructed at ſome diſtance from the ſhore; it will be prudent to incloſe it on all ſides, except where the entrance is made, to prevent its being turned or ſurpriſed by the gorge. The banks of the rivers in *England*, even the ſmalleſt, are generally low and marſhy, and ſo are thoſe of the *low countries*.

VI.

In all that has been ſaid on this ſubject, it is conſtantly ſuppoſed, that the attack can only be made on one ſide of the river, which is generally the caſe: when, however, there is danger on both ſides the bridge, both ends ſhould be covered with works, in which the ſeveral parts reciprocally flank each other.

VII.

When the river is large, and an iſland is to be found in the vicinity of the army, the bridge is generally made over it, not becauſe it ſhortens the bridge, but becauſe it is of eaſier conſtruction, and becauſe an intrenchment may be made to defend the head, or to cover a retreat: ſuch ſituations are frequently found on the *Rhine* and the *Danube*.

SECTION

SECTION V.

Of fortifying Camps and Fields of Battle.

The antients, eſpecially the Romans, conſtantly fortified their camps, but ſeldom their fields of battle. The moderns ſeldom fortify their camps, and but little oftener their fields of battle*. This practice was peculiarly neceſſary to the antients for preventing ſurprizes, to which they were much expoſed by the proximity of their camps, that in many inſtances were within half a mile of each other. The uſe of cannon, the range of which greatly exceeds that of any miſſive weapon of the antients, has prevented proximity between modern camps.

A camp fortified, has ſingular advantages: it ſecures againſt ſurprizes; it gives healthful employment to the troops, and prevents deſertion and maroding; by diminiſhing the number of grand guards and out-poſts, it leſſens thoſe fatigues that inſenſibly deſtroy the beſt army; it

* By *camp*, is underſtood the ſpace of ground on which an army pitch their tents; and by *field of battle*, the ſpot of ground on which the troops engage. From the preſent ſyſtem of encamping, all diſtinction between *camp* and *field of battle*, ſeems to be at an end; for one and the ſame ſpace of ground is uſed to anſwer both purpoſes. There are, however, many circumſtances which compel leaders to make choice of a field of battle that is incapable of being a camp.

facilitates foraging, and the ſending out detachments with ſecrecy and ſafety to watch the enemy, or for any other purpoſe; it delivers a General from the neceſſity of being forced to give battle; and it may ſerve as a retreat after a defeat.

But notwithſtanding theſe advantages, the practice of fortifying camps has been long neglected, and was in danger of falling into total diſuſe, if the preſent King of Pruſſia had not reſtored it. M. Daun followed the great example; but with this difference, that the king generally made uſe of continued works, and the Marſhal only of detached works: continued works afford greater ſecurity againſt ſurprizes, but impede the movements of an army; detached works give leſs ſecurity againſt ſurprizes, but protect rather than impede the movements of an army. The ſuperior number of light troops in the Auſtrian army, accounts for this difference in the works made uſe of by thoſe two able commanders. The camp of *Jauernick*, for ſituation, number, quality and quantity of works, is the moſt remarkable that has been occupied by the King of Pruſſia *.

* The King, to obtain with the leaſt labour the advantages of an intrenched camp, adopted the rules of antient rather than of modern *caſtrametation*; the Marſhall adhered generally to the modern. Few if any campaigns furniſhed more inſtruction, than the campaigns during the whole war in Germany, from

The antients, as well as the greater number of moderns, reluctantly fortified their fields of battle, not only becauſe while it limits and contracts the poſitions and movements of the army fortified, it gives full liberty to the enemy to make whatever diſpoſition or movements he thinks proper; but becauſe it diſcovers weakneſs: experience alſo proves, that troops ſtationed behind works, have leſs firmneſs, than when in the open field. Tho' the inſtances of forcing fortified fields of battle, are very numerous; there are, however, ſome, in which a proper choice and diſpoſition of the works has enabled an inferior number of men to withſtand the repeated aſſaults of a very ſuperior number, and even to obtain a final victory. What but the redouts raiſed in the front of the army of Peter the Great, at Pultowa, ſtopt the rapid and ſucceſsful progreſs of Charles XII?

The works employed to fortify a camp or field of battle, are diſtinguiſhed by the two appellations of *detached* works, and *continued* works.

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from 1756 to 1763. The hiſtory of thoſe campaigns will be tranſmitted to poſterity by a general officer, who ſerved in the Auſtrian army within that period. Part of this work was publiſhed in 1766, under the title of *The Hiſtory of the late War in Germany, between the King of Pruſſia, and the Empreſs of Germany and her Allies:* the remainder is ſaid to be in the preſs; and if we may judge of what is to come from what has already appeared, the whole will be a very valuable acquiſition to the military world, and exhibit an Engliſh *Feuquiere.*

The detached works are commonly either the fleche, or the baſtion, or the ſquare redout preſenting an angle to the enemy inſtead of a face: the continued works, which are alſo called *lines**, are alſo generally either the fleche, the baſtion, or the redout abovementioned, but joined together by an *epaulement* or *curtain*, in which a large opening is left for the paſſage of the troops, ſecured by an abbatis, or cheveaux de frize, or covered by a fleche. Some recommend two entrances inſtead of one, that is, one at each extremity of the epaulement or curtain.

* By *lines*, is ſometimes alſo underſtood the works formerly raiſed to ſecure a large extent of country, againſt the inroads of an enemy; ſuch were the works conſtructed in 1703, at *Bibel* or *Stolhof*, by order of the prince of Baden. This practice is now univerſally rejected, becauſe every part of ſuch *lines* cannot be ſufficiently lined, and becauſe it diſcovers weakneſs. *Lines* took their riſe in France, and were introduced in Germany, by the Prince of Baden, who was among the firſt that diſcovered their diſadvantages. For the advantages and diſadvantages of lines to ſecure a country againſt the inroads of an enemy, to prevent the raiſing contributions, &c. conſult M. Feuquiere's Memoirs, V. 3.

The works raiſed to ſecure the camp of an army beſieging a town, againſt the ſallies of the garriſon, and from any moleſtation from without the place, are alſo called *lines*. The works raiſed to ſecure a camp againſt the ſallies of the garriſon, are called *lines of countervallation*; and the works raiſed to prevent any moleſtations from without, are called *lines of circumvallation*. Lines of circumvallation are at preſent in diſuſe.

Of

Of detached Works;

The Fleche.

FIG. 1. PLATE VII.

The fleche *cAc* forms an equilateral triangle, in which each ſide meaſures 60 yards. The angle A is as acute as it can well be made, that the faces *Ac* may be as little expoſed as poſſible. The diſtance between the ſummit A of one fleche, and that of the next, is in general about 250 yards, that the flanked parts may be within muſket ſhot of their flanking parts; and that the number of fleches may be as few as poſſible.

By this conſtruction, however, oppoſite every angle A, there is a ſpace, as *x*, undefended *. Beſides, the ſhot do not croſs each other nearer than at about 70 yards from A, upon the capital produced, which makes the diſtance, before the nearer collateral fires can meet, to be about 250 yards: and though the point blank of our fire-locks, when attention is paid to the loading, is known to be about 300 yards, yet conſidering the inattention of men in time of action, there is ſome reaſon to believe that few if any ſhot will

* This ſpace increaſes, in proportion as the angle A is more obtuſe.

even reach the length of *c b* †; ſo that every fleche may be conſidered as left to its own defence.

REMARK.

When cannon are employed for the defence of the fleche, all theſe defects diſappear: when the defence is to depend on the uſe of ſmall arms only, ſome, to avoid theſe defects, prefer ſemi-circular forts, placed at about 200 yards from center to center.

The Baſtion.

FIG 2. PLATE VII.

The diſtance between the ſummit of one baſtion and that of the next, is in general the ſame as that in the fleche, that is, about 250 yards. To trace the baſtions, give to the perpendicular *a b*, the $\frac{1}{6}$ of CD, which meaſures 250 yards; take for the length of the faces, 60 yards; let the flanks meet the faces produced, and with them form an angle of 100 degrees: the ditch runs parallel to the parapet.

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† This conſideration has induced many to rate the range of muſket ſhot only at from 200 to 240 yards. That the ſhot may croſs the capital produced, it will be prudent to reduce the diſtance between the ſummit of one fleche and that of the next, to about 200 yards.

REMARK.

REMARK.

The detached baſtion is of much greater defence than the fleche; for there is not more ſpace undefended oppoſite the flanked angle, than what is unavoidable*; and the ſhot croſs the capital produced within a much more advantageous diſtance†: the intermediate ſpace is alſo much better defended. This work is, however, of much greater labour§: the counterſcarp running parallel to the parapet, there is neceſſarily a part of the ditch near the ſhoulders of the baſtion, which cannot be ſeen from the oppoſite flanks. This defect may be ſupplied by terminating the counterſcarp in that part in an inſenſible ſlope.

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* The ſpace may be leſſened by making the flanks to form with the faces produced a leſs obtuſe angle. The ſpace undefended will even totally diſappear, by making the flanks to form, with the faces produced, a right angle: this conſtruction is, however, productive of ſome inconveniences. See page 7.

† For the diſtance at which the ſhot croſs each other from D upon the capital produced, is about 40 yards, and the length of *c d* is only about 200 yards.

§ The labour will be nearly double, ſuppoſing the diſtance between the ſummit of the fleches to be the ſame as that in the baſtions, and that the height and thickneſs of the parapet be alſo the ſame in both; for the interior perimeter of the fleche is 120 yards, and that of the baſtion about 210, that is, nearly double.

Of

The Redout.

FIG. 3. PLATE VII.

The diſtance between the ſummits A is 250 yards; and the length of the faces is 35 yards each. This conſtruction has the ſame kind of defects as the fleche fig. 1, but in a greater degree, occaſioned by the flanked angle being a right angle. To avoid theſe defects, ſome recommend circular redouts, placed at about 200 yards from center to center.

REMARK.

The redout is deemed capable of deterring the enemy from an attempt to paſs the intermediate ſpace between two redouts: when once taken, indeed, the enemy cannot eaſily be diſlodged.

Some of the advocates for detached works, content themſelves with a ſingle chain; and others recommend a double chain, in which the works of each chain correſpond to the middle of the intermediate ſpace between the works of the other chain.

Of

Of continued Works.

Of Fleches joined together by a Curtain.

FIG. 4. PLATE VII.

The diſtance between the ſummit A of one fleche, and that of the next, is 250 yards. The fleche forms an equilateral triangle, each ſide of which meaſures 60 yards; the curtain meaſures 190 yards; and the ditch runs parallel to the parapet.

But this conſtruction has many defects; for, oppoſite the angle A, there is a ſpace, as *x*, undefended; the collateral fires do not croſs each other nearer than at about 70 yards from A upon the capital produced; the length even of *c b*, which meaſures about 250 yards, is too great to ſuppoſe that many ſhot will cut the capital produced *; the curtain is not flanked but at about 60 yards in front; and the ditch cannot be defended.

Mr. Vauban adopted fleches joined together by a curtain, and conſtructed them as follows: the diſtance between the ſummit of one fleche, and that of the next, meaſured 120 toiſes; the length of the capital was 22 toiſes, and

* The advantageous length for *c b*, is about 200 yards. To obtain this, the diſtance between the ſummit of one fleche and that of the next, ſhould be reduced to about 200 yards.

of

of the gorge 30 toiſes; and this made the faces to be about 27 toiſes. This conſtruction, however, has the ſame kind of defects, but in a greater degree, than the foregoing conſtruction, occaſioned by the flanked angle being more obtuſe.

To ſupply theſe defects, ſome recommend, inſtead of fleches, ſemi-circular forts, placed at about 200 yards diſtance from center to center. Mr. Clairac recommends only to *break** the curtain, ſo as to form a ſaliant angle, in which the ſummit is to be in a line with the ſummit of the two adjoining fleches †: by the former of theſe, the defects are ſupplied only in part; but by the latter, every defect is ſupplied, and the fire is more equally diſtributed throughout. In the common conſtruction, the curtain, which is the part leaſt expoſed, has the greater defence.

REMARK.

The opening C, left in the middle of the curtain, meaſures 10 yards, and is covered by a fleche, as G; the openings B and D, left at the extremities of the curtain, meaſure 10 yards

* *To break*, chiefly implies the changing of a ſtrait line, either into a ſaliant or re-entring angle, to obtain a croſs fire.

† To avoid the inconveniences when the re-entring angle is exactly a right angle, and to leſſen the labour, the curtain ſhould be broken ſo as to form an angle of about 100 degrees with the faces of the fleche.

each,

each *, and are ſecured by cheveaux de frize. The defects attending the conſtruction of fleches joined together by a curtain, are, in general, ſuppoſed to be ſupplied by the addition of the fleche employed to cover the opening left in the middle of the curtain. The entrance is ſometimes alſo ſecured by a traverſe.

Of Baſtions joined together by a Curtain.

FIG. 5. PLATE VII.

To trace this work, give to the perpendicular *a b*, the $\frac{1}{6}$ of CD, which meaſures 250 yards; take for the length of the faces 60 yards; let the flanks meet the faces produced, and form with them an angle of 100 degrees: the ditch runs parallel to the parapet.

This conſtruction is chargeable with ſome defects; for there is a part of the ditch near the ſhoulders of the baſtions, which cannot be ſeen from the oppoſite flanks; and the fires are not equally diſtributed, for the weakeſt part has the leaſt defence. The firſt of theſe defects is attempted to be ſupplied, by terminating the counterſcarp in B, in an inſenſible ſlope; and the

* Ten yards will, in general, be found ſufficient to file off troops; and, if neceſſary, it may eaſily be increaſed by levelling part of the curtain, an operation that cannot require much time.

ſecond

ſecond by breaking the curtain, ſo as to form a ſaliant angle, in which the ſides form with the flanks of the baſtion, an angle of 100 degrees: but this laſt defect is ſupplied only in part, for the collateral fires do not croſs each other nearer than at 180 yards upon the capital produced. That the fire may be more equally diſtributed, ſome would have the curtain to be concave, and others convex.

REMARK.

Mr. Vauban conſtantly employed the fleche in the conſtruction of his *lines*; but Santa Cruz, and the generality of engineers, give the preference to the *lines with baſtions*. The advantages of theſe over the *lines with fleches*, are, that there is not more ſpace undefended oppoſite the flanked angle of the baſtions, than what is unavoidable; the ſhot croſs the capital within an advantageous diſtance; and the intermediate ſpace is alſo much better defended. Lines with fleches, are, indeed, of leſs labour; but the diſadvantage of more labour in lines with baſtions, is generally believed greater than it is: ſuppoſing the front in both to be 250 yards, and the height and thickneſs of the parapet to be the ſame, yet, in one, the interior perimeter meaſures only 310 yards; and, in the other, about 325 yards; that is, the labour in the lines with fleches, will be only about $\frac{1}{16}$ leſs, than that in the lines with baſtions.

Of

Of Redouts joined together by a Curtain.

FIG. 6 PLATE VII.

The diſtance between the ſummit A, is 250 yards; and the length of the faces is 35 yards each. This conſtruction has the ſame kind of defect as the fleches joined by a curtain, but in a greater degree, occaſioned by the flanked angle being a right angle.

REMARK.

Works employed for the defence of a camp, but eſpecially of a field of battle, being expoſed to the attacks both with cannon and with *ſword in hand*, require not only parapets of much elevation and great thickneſs, but the uſe alſo of every poſſible obſtacle that can be raiſed to impede approach, ſuch as paliſades, fraizes, cheveaux de frize, and abbatis; and the preference and number of ſuch obſtacles depend not only on the ſituation of the works, and the number of troops, but on the greater or leſs degree of confidence with which the troops are animated.

The plans propoſed for fortifying camps and fields of battle, are now ſo numerous, that an acquaintance with every one, though a hard taſk,

taſk, is earneſtly recommended: they all boaſt of ſuperior advantages, and it is only by inveſtigation that it can be determined to which the preference is to be juſtly given †; and conſidering that in the variety of ſituations, two cannot be found that agree in every reſpect, it is, ſurely, of great importance, to know the comparative excellencies of every plan, and to be able to make choice of that which will beſt ſuit the preſent exigency. The King of Pruſſia's much admired retrenchment, formed of ſaliant and re-entring redouts, and propoſed in the *inſtructions for his general officers*, has this ſingular diſadvantage; that when any one ſaliant redout is taken, its adjoining curtains muſt be abandoned.

† Mr. Clairac by a minute and accurate inveſtigation of the different works uſually employed to fortify camps and fields of battle, has pointed out the advantages and diſadvantages of each with great preciſion. This excellent work diſcovers a depth of learning and judgment, that entitles it to univerſal attention; and it has, beſides, a peculiar claim to the honour of being the firſt profeſſedly written on this moſt important ſubject.

SECTION VI.

To fortify a Houſe or Church, or any other ſtone or Brick Building.

Though houſes and churches are not built with an intention of converting them into fortifications, yet experience has proved, that they are capable of great defence. There are, indeed, inſtances of their affording even a greater defence, than could have been expected from works raiſed for that purpoſe, which has greatly diſcredited field-fortifications in the opinion of men of known abilities and experience. Numbers, however, ſtill perſiſt in aſcribing the ſucceſsful defence made from houſes, to the imaginary ſecurity of the defendants, and the ignorance of the aſſailants.

Among the numerous inſtances which every war ſupplies, the following are mentioned as inconteſtable proofs of the ſtrength of this kind of defence. In 1705, Chevalier Folard defended the cottage called *Bouline*, near *Breſcia*, with four companies of grenadiers, againſt the choſen troops of the Prince Eugene's army, commanded by the Prince of Wirtemberg, ſo ſucceſsfully, as to force the Prince to retreat, after having made uſe of cannon and penetrated even into the court of the houſe.

During the war of Poland, in the ſame year, a Swediſh Lieutenant, with twenty-four men, being detached from *Petrickow* to raiſe contributions, was purſued by the renowned Poliſh partizan *Smelegſki* and 800 men. The Swede being overtaken at the entrance of a village, took ſhelter in a houſe, in which, contrary to Smelegſki's expectations, he made ſuch a gallant defence as to force the Pole to abandon the purſuit, with the loſs of ſeveral hundred killed and wounded. Smelegſki offered the Swede ſeveral times the moſt honourable terms, which were as often rejected with diſdain.

M. De Saxe, with eighteen men, defended himſelf a conſiderable time in a country inn, at *Crachnitz*, a village in Poland, againſt 600 horſe and 200 dragoons, who could neither force or take him, though he was wounded. The enemy, after many fruitleſs attempts, ſurrounded the inn, to prevent his eſcape during the night, which, however, he effected; for he ſallied out in the dark, and eſcaped to *Sandomir*, through a thick wood in the neighbourhood of the inn.

The ſucceſsful defence made by Colonel Muſgrave at German Town, when the Americans marched to attack the King's troops in 1777; and that made by Major Sheridan of the New York volunteers, at a houſe near Entaw's Spring,

in

in South-Carolina, in 1781, are too recent to require any deſcription.

If we conſider the number and great importance of ſuch actions as are juſt mentioned, it will appear ſtrange that hiſtorians ſhould forbear to embelliſh their writings by a faithful detail of every inſtance that occurs. This neglect, common as it is, cannot proceed from an opinion, that ſuch actions have not ſufficient merit to engage attention; for, as they ariſe generally in ſudden and ſevere emergencies, there are few that require greater talents in the plan, and more perſonal bravery in the execution: they are not only highly honourable to thoſe who perform them, but reflect honour on the corps to which they belong, and even on their country. Hiſtorians, therefore, could only concur in ſuppreſſing all notice of theſe actions, either from a fear, that becauſe they are in general performed by officers of inferior rank, a particular recital of them might bring a charge of inferiority on their own works; or from a deſire to flatter the prepoſſeſſions of the public, who, anxious only to know the greater events of the war, and the immediate cauſes of the loſs or gain of a deciſive battle, have no inclination to conſider ſecondary operations, or, by attending to the exploit of ſome ſubaltern, though ever ſo great in itſelf and important in its conſe-

quences, to divert their eye a moment from the full blaze of their hero's glory.

This cuſtomary ſuppreſſion of all mention of ſuch actions, tends, however, totally to deſtroy their value; and, becauſe they are performed by officers of inferior rank, deprives that uſeful body of men, on whom the hopes of future times depend, of the moſt powerful incentive to preſs forward in the path to military fame.

But the indiſcriminating apathy of a cold hiſtorian ought no longer to conceal from the world ſuch bright examples of ſkill and proweſs. If a collection of them was made by ſome ſoldier, truely zealous for the honour of his profeſſion, and the glory and good of his country, it would prove a fund of uſeful inſtruction, and furniſh young minds of great talents and generous ardour, with that motive to emulation to which they are entitled, and of which they have been unjuſtly deprived.

The

The defence of a houſe or church may be rendered of ſhort duration, either by battering the building with cannon, by forcing an entrance into it through the doors or windows, by undermining its walls, by ſcaling the roof, by ſetting the building on fire, or by two or more of theſe modes of attack employed at the ſame time.

When by Cannon.

The defence of a houſe or church againſt cannon, is ſeldom attempted, unleſs ſuccour is near, or there are poſitive orders for doing it, as it ſcarcely admits of any hope of ſucceſs; and the probability is the leſs as the building is leſs, and the enemy's pieces are of greater calibers.

This ſuppoſes a detached building, not ſurrounded by a moat, or other obſtacles: when ſurrounded by a moat or ditch, which is the common ſituation of antient manſion-houſes, there are hopes of maintaining the defence, however numerous and large the pieces of cannon may be, from the difficulty always attending the paſſage of a ditch.

REMARK.

Walls of brick are preferable to thoſe of ſtone, becauſe the ſhot makes its hole in theſe without much concuſſion; but in walls of ſtone a part is always deſtroyed by the ſhock, and upon the leaſt firing afterwards, the reſt tumbles down; beſides, when a breach is made, the ſhards or ſplinters do great miſchief.

Experience proves, that the thinner the wall is, the greater is the difficulty of making a breach, becauſe the ſhot, in its paſſage through the wall, ſhakes it ſo much the leſs, as the wall is the thinner; when the ſhot eaſily pierces the wall, it ſcarcely ſhakes it. Hence Artilleriſts, in effecting a breach, recommend leaden balls in preference to balls of iron: the leaden ball flattens againſt the wall, and looſens it ſo much as, with a few more additional firings, to tumble it to pieces.

To prevent the Enemy's forcing through the Doors or Windows.

Of the Doors.

When there is only a ſingle door, and that but ſmall, it is to be *barricaded**, or bricked up, leav-

* That is, blocked up on the inſide, with planks, boards, chairs, tables, &c.; but ſo as that it may be opened when circumſtances require it.

ing

ing an opening in it to fire through. Theſe openings, which are called *loop-holes*, generally meaſure in height about eight inches, and in width no more than is ſufficient to receive the muzzle of the muſket, that is, about three inches.

If the door is large, it is deemed more advantageous to throw it open, and ſtop up the paſſage with a tree or two, the branches of which are to be ſharpened at the end.

When there is a double door, the outer one, if large, is to be ſtopt up with a tree or two; and the inner, in which loop-holes are to be cut, if not capable of reſiſting muſket ſhot, is to be ſtrengthened with boards, planks, &c. the ſpace between the two doors alſo may be defended thro' openings made in the floor, above and between them.

If the doors are ſlight, and the enemy attempts to break them with hatchets, it will be advantageous to retire, if poſſible, to ſome diſtance, and keep firing at the place where the ſtrokes of the hatchets are given: an enemy may be deterred from ſuch an attempt by *machecoulis* of timber, projected either from the roof, juſt over the door, or from a window, if any, above the door. The machecoulis is formed by as many pieces of timber, equally projecting from the inſide, as will be ſufficient to receive two or

more men to prevent their falling from these projections, a rail is added to them; and to secure them against musketry, the rail should be lined with bedding, &c. They are also to be provided with stones to gall the enemy, as he draws near the door; for which purpose, the timbers that form the projection are not placed close to each other. If, notwithstanding these practices, the enemy should be likely to break open the door, two men should be posted at the jambs of it, to oppose him with their bayonets.

REMARK.

Gates and church doors may be covered and secured by a parapet of palisades, lined with planks, in which loop-holes are to be cut six feet high at least, that the enemy may not fire thro' them; but to enable the men to fire through these loop-holes, a banquette is raised, with the earth that has been dug for the purpose of making a ditch to this parapet *. The form of this work, which is commonly called *Tambour*, may be a fleche, or detached bastion, or a semicircle.

Of the Windows.

The windows of the ground floor, cellars, or kitchens, should be closed up either with brick,

* When no ditch is made on the outside, the earth, to make this banquette, is dug up within side.

boards,

boards, planks, &c. and to deter the enemy's approach, loop-holes are to be made in them. The windows of the ground floor are ſufficiently ſecure when cloſed up to the height of eight feet from the ground: the wood and brick of the partition walls may be employed for that purpoſe.

To increaſe the difficulty of approach, loop-holes are not only to be made in the doors and windows cloſed up, but alſo in the wall of the houſe, if not too thick, at the diſtance of three or four feet from each other. The ground floor has in general two rows of loop-holes, and every other floor only one row.

That the fire may be more equally diſtributed, the loop-holes of the ſeveral rows are not to be cut exactly above each other, but ſo as to correſpond to the intervals; that is, the loop-holes of each row ſhould anſwer to about the middle of the intervals between the loop-holes of that row either above or below it.

To prevent the enemy from firing through the loop-holes of the ground floor, the lower row is made even with the ground, and the upper row about eight feet above it: this practice, which expoſes not only the body but even the legs of the aſſailants, in their approach, requires a trench within,

within, to enable the men to fire through the lower row of loop-holes *, and alſo a *ſcaffold* †, by way of banquette, to fire through the upper row. Every other row of loop-holes, is about three feet and a half above the floor.

The lower row of loop-holes of the ground floor, to be advantageous, ſhould only have the height and width neceſſary to receive the muzzle of the piece; the upper row ſhould meaſure about a foot in height, and five or ſix inches in width; and the row of the firſt ſtory ſhould have a foot in height, and as much in width. When the wall is two bricks thick, the width of the loop-hole without, ſhould be greater than that within, to obtain a wider view of the enemy in his approach. The loop-holes of the firſt floor, ſhould be higher without than within; that is, the lower part ſhould be cut ſloping downwards, to obtain a nearer view of the enemy.

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* This ſuppoſes the want of cellars.

† For this purpoſe the tables and chairs in houſes, and the forms and pews in churches, may be uſefully employed: in churches, the gallery may ſerve inſtead of a ſcaffold; and in that caſe the loop-holes muſt be opened according to the ſtructure of the galleries. A knowledge of the ſtructure of the ſcaffolds made by bricklayers and plaiſterers, may be of ſome advantage in ſuch circumſtances.

REMARK.

REMARK.

If the defendants are not in number ſufficient to man the windows of the firſt floor, it will be prudent to block them up: this precaution will hinder the enemy from placing ladders to fire upon thoſe below, and to break into the houſe that way. The like precaution may be taken for the ſecond and third floors. Mr. Folard recommends the making a great opening in the floor before each window, ſomewhat broader than the window, to ſerve as a ditch, into which thoſe that attempt the window, muſt inevitably tumble.

Of Undermining the Wall.

To prevent the ſucceſs of this operation, ſoldiers ſhould be poſted in the upper part of the building, that they may diſcover the enemy at a diſtance, and be ready to fire upon him as he advances; and they ſhould be provided with ſtones and bricks, to gall him as he draws near.

As the wall is weaker towards the angles or corners than any where elſe, it is generally the part the enemy attempts to ſap. To ſtrengthen this part, beſides the loop-holes already mentioned, others ſhould be broke in the angles; a double,

double, and even a treble row, may be neceſſary. Nothing would more effectually ſecure the angles than fougaſſes.

That which is principally wanting to deter the enemy's near approach to the walls, is a croſs fire; this may be obtained by a tambour, that is, a parapet of paliſades, lined with planks, in which loop-holes are cut at leaſt ſix feet high. This parapet, which forms either a fleche, or detached baſtion, is made about the middle of each ſide of the building, if it is ſufficiently long; and is to be defended by as many men as can be ſpared, who, when found neceſſary to abandon it, take refuge in the houſe, and poſt themſelves at the loop-holes*. A croſs fire may alſo be obtained by *machecoulis* from the inſide over the window-frames.

In buildings in the form of a croſs, which is the moſt common form for churches, the advantage of a croſs fire is gained for moſt parts

* For the purpoſe of communication with the building, an opening ſufficient only for one perſon to paſs at a time (that is, about three feet ſquare, and about two feet from the ground) ſhould be broken in the wall or gate before which the tambour is raiſed, which opening when the defendants have abandoned, the tambour ſhould be barricaded, to prevent the enemy becoming maſters of the lower part of the building at the ſame time they force the tambour.

about

about it, by loop-holes broke in the wall; when it is of another form, the croſs-fire is to be procured by breaking loop-holes in the ſeveral projections*, and conſtructing tambours, or machecoulis, on every ſide which has no projecting parts. If there are no projecting parts, tambours, or machecoulis, muſt then be conſtructed on every ſide, if ſufficiently long, as has been already mentioned.

REMARK.

If the enemy, notwithſtanding the precautions recommended, ſhould have found an entrance into the lower part of the houſe, the defendants are to retire to the upper floor†, where ſome reſiſtance may ſtill be made, by breaking or ſtopping up the ſtair-caſe, opening the floor in different parts, eſpecially near the doors, and firing down through it‡. The defence of a building, when once the enemy is maſter of the ground-floor, though it proved ſucceſsful with Mr. De Saxe, cannot however be expected to be

* Such as porches and veſtries in churches.

† That is, into the galleries and ſteeples in churches.

‡ That is, theſe openings ſhould be in ſuch a part as to enable the defendant to have a full view of the ground floor, that the enemy may be every where ſeen and expoſed, and any fire he ſhould attempt to kindle may be inſtantly extinguiſhed.

of

of long duration, as the aſſailants have it in their power to ſet the whole on fire; all that can be done is to ſally or capitulate.

Of Scaling the Roof.

Beſides the precautions of barricading the doors and windows, of breaking loop-holes to fire upon the enemy, and of conſtructing machecoulis, or tambours, to obtain a croſs fire; it will be neceſſary, if the roof of the building is either tiles or ſlates, to take them off, at leaſt thoſe of the lower part*, to prevent the enemy from ſcaling the wall, and knocking the men within on the head: this precaution will enable the defendants to communicate with all parts of the building at the top, and to diſcover from within the roof the operations of the enemy. When the building is covered with thatch, or any other combuſtible matter, it muſt neceſſarily be all taken off, to prevent fire.

Soldiers ſhould be poſted within the roof, to fire upon the enemy as he draws near, and to

* This practice, however, facilitates the ſetting the building on fire: when the building is roofed like thoſe in and about London, the top may then be conſidered as a platform covered with a parapet.

overturn

overturn or beat down the ladders he may raiſe againſt the wall, which they can eaſily do, by means of their firelocks, or of a rafter. Beſides the tiles or ſlates which ſerve to gall the enemy, the men ſhould be provided with ſtones, aſhes, lime, or half-burnt dung, to ſhower down upon him, and prevent him gaining the top of the houſe.

For the purpoſe of overturning the ladders, the ſoldiers poſted at the loop-holes of the firſt ſtory, beſides their firelocks, ſhould have halberts or forked poles of ten or twelve feet long, eſpecially at or near the angles; theſe being the weaker part of the wall, and conſequently the more proper for placing ladders. If the windows of the firſt floor are not blocked up, two ſoldiers ſhould be poſted near it, furniſhed with forked poles, to overturn the ladders.

Of ſetting the Building on Fire.

To prevent the effects of fire, the evil moſt to be dreaded in the defence of a building, tubs filled with water, ſhould be provided in every ſtory ready to extinguiſh it. Water may alſo be employed to annoy the enemy, when they are maſters below; for, while it wets their arms, powder, and cloaths, it prevents them from ſeeing what is paſſing over their

heads, and fruſtrates any attempts they may make to ſet the houſe on fire.

If the roof is formed of combuſtible materials, it muſt be previouſly taken off: thatch ſhould be inſtantly deſtroyed; but boards*, as they will ſerve for many purpoſes, eſpecially ſcaffolding, need only be removed to a place of ſecurity, leſt the enemy, ſhould ſet them on fire and ſo demoliſh the building; for the ſame reaſon, it is recommended to deſtroy the wainſcot and all the houſhold goods that can eaſily take fire, and which cannot ſerve for the defence.

To hinder the enemy from throwing hand-grenades, dried facines lighted faggots, dipped in rezin, &c. through the doors and windows, it will be prudent to ſtop thoſe up †; and to ſecure the building as much as poſſible againſt the effect of theſe, ſhould any by chance be thrown into it, every floor ſhould be covered with dung or earth, five or ſix inches deep.

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* The buildings in the Weſt-Indies and America, are generally covered with boards, commonly called *Shingles*.

† When fire only is to be apprehended, the windows of the floor above the ground-floor ſhould only be ſtopt up with bedding, and in ſuch a manner, as eaſily to be ſet aſide to fire through them, to impede the enemy's approach.

REMARK.

REMARK.

The defence may be much increaſed, by raiſing a *curving* parapet of earth about the building, if it is iſolated; and, if not ſo, before ſuch parts of it as are open to attack: this parapet is to be defended by as many men as can be ſpared, who, when forced to abandon it, are to take refuge in the houſe. An abbatis, according to Mr. *Folard*, would anſwer the purpoſe full as well, if not better, than a parapet of earth.

If every war affords inſtances of the ſucceſsful defence of houſes unprepared, that have no other loop-holes than their windows, nor ſtronger barricades than their locks and bolts; how much greater reſiſtance muſt thoſe houſes be capable of making, that are previouſly prepared for defence! the beſt fortification, however, is a clear head, and an undaunted heart, in the commander.

Of Church-yards and Gardens incloſed by a Wall, either of Stone or Brick.

Church-yards and gardens require but little art to render them defenſible. The firſt object of attention is to barricade the gates and doors; and when beams, logs of wood, &c. are not at hand for this purpoſe, earth ſhould be thrown againſt them.

Of Church-yards.

In church-yards, the ground within ſide is commonly ſome feet higher than without.

When the wall is too high to enable the men within to fire over it, loop-holes are generally cut about four feet from the ground. It would, however, be more advantageous to raiſe a banquette of earth for enabling the men to fire over the wall, which will be at leaſt equally expeditious and admit of greater defence.

When the wall within is about 4 feet high, that is, breaſt high, nothing can be added but what muſt give great trouble without procuring adequate advantage.

When the wall within is very low, it muſt either be raiſed breaſt high, or a trench is to be dug almoſt cloſe to it, of ſuch depth only as to cover the men, and at the ſame time enable them to fire over the wall.

To impede the enemies approach, a ditch made near the outſide of the wall, but not ſo cloſe as to endanger the foundation, will be found advantageous in every caſe, but eſpecially in the laſt. This ditch ſhould be 10 or 12 feet broad, 4 or 5 feet deep, and pointed at the bottom: the earth dug up ſhould be immediately ſcattered about, or, which is moſt proper, employed to raiſe a glacis to the ditch. When

trees

trees are at hand, the difficulty of approach may be greatly increaſed by laying them in the ditch with their branches turned towards the enemy.

REMARK.

When the church-yard is incloſed only by open pales, to render it defenſible, it will be neceſſary to dig a trench within ſide, 5 or 6 feet from the incloſure, for the purpoſe of forming a parapet with the earth dug up capable of reſiſting muſketry. As the interior height of this parapet, and the depth of the trench, muſt be ſuch together, as will juſt cover the men, and at the ſame time enable them to fire over the parapet; it follows, that this cannot be an operation of ſo much labour as to diſcourage the practice of it.

Of Gardens.

In gardens, the ground within is commonly on a level with the ground without.

When the wall is very high, and wood is at hand proper for ſcaffolding, loop-holes ſhould be cut in the wall even with the ground *, and a ſcaffold raiſed all along the inſide, or at leaſt

* This practice requires a trench dug within, to enable the men to fire through the loop-holes.

at certain diſtances, by way of banquette, to fire over the wall †.

When the wall is very high, and no wood to raiſe ſcaffolds is to be procured, a part of the wall ſhould be thrown down, and the rubbiſh employed to form a banquette: this precludes the uſe of loop-holes at the bottom.

When the wall is only 7 or 8 feet high, which is the common height of a garden wall, a banquette of earth of ſufficient height ſhould be raiſed all along the inſide, or at leaſt at certain diſtances, to enable the men to fire over the wall.

REMARK.

When the garden is incloſed only by open pales, the method recommended in the Remark, p. 115, may be employed to render it defenſible.

When incloſed by cloſe pales, or by a quick-ſet or other hedge, the leaſt trouble will be to conſider them as a parapet; obſerving to raiſe a banquette if the pales exceed breaſt high, and to cut the hedge ſo as to enable the men to fire over it.

That the enemy may not find ſhelter, the buildings within muſket ſhot of the church yard

† The ſoldiers ſhould mount theſe ſcaffolds either by ladders, or by planks with pieces of lath nailed acroſs, in the form of a ladder.

or

or garden, and which are not to be occupied for defence, ſhould be entirely demoliſhed, eſpecially thoſe that are contiguous and overlook it: for when the enemy becomes maſter of the houſes that overlook the church-yard or garden, the ſituation of the defendants will ſoon be rendered untenable by the fire of muſketry from within the garrets and through the upper windows.

The defence of a church-yard or garden, which is not commanded by any heights or buildings within muſket-ſhot, may be very important; it may be conſidered as the outworks, and the building as the body of the place: when commanded, however, the defence can be but of ſhort duration.

To obtain ſecurity againſt this dangerous advantage, works are raiſed with earth, dung, logs of wood, planks, filled gabions, faſcines, &c. When the work is raiſed againſt the *commandment d'enfilade*, it is called *epaulement*; and when againſt the *commandment of the rear*, it is called *parados*.

REMARK.

In fortifying churches and church-yards, houſes and gardens, the chief objects of attention are:

1. To increaſe as much as poſſible the difficulty of acceſs: for this end, beſides the precautions already recommended to impede the enemy's approach, ſuch as paliſades, &c. the roads and avenues leading to the poſt, ſhould be encumbered and blocked up with trees laid acroſs the road; with waggons and carts filled with dung, of which one or more wheels are to be taken off; with harrows laid with their points upwards and faſtened to the ground by ſtrong ſtakes; with deep trenches cut acroſs the roads*; with chevaux de frize; in ſhort, with every thing that can ſerve to obſtruct or encumber the paſſage. Theſe obſtacles, to be very advantageous, ſhould, however, be within muſket-ſhot of the church-yard, or garden.

2. To have a croſs fire, that the poſt may be more equally difficult of attack, and of greater defence: this end may be obtained by breaking loop-holes in the ſeveral projections, and by tambours, machecoulis, or works of earth, ſuch as fleches and detached baſtions.

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* In which men ſhould be poſted to fire upon the enemy.

SECTION

SECTION VII.

Of Fortifying Villages.

A village in the vicinity of a camp, is fortified to keep the enemy's detachments at a diſtance; and on the day of battle, it may ſerve to ſhelter a corps, or perhaps a wing of the army. An army in the rear of a fortified village, has not only its movements protected, but its diſpoſition and movements concealed, an advantage of which able Tacticians never fail to avail themſelves.

Villages are fortified to ſecure the troops in cantonments, or winter quarters, againſt ſurprizes.

A village is fortified for the ſecurity of detachments, that are at too great a diſtance from the army to receive any ſuccours from it.

When in the Vicinity of a Camp.

The ſide of the village towards the enemy, ſhould be fortified with works of earth raiſed at ſome diſtance from the houſes, that if they catch fire, the heat may not oblige the men to abandon the works, which ſhould be cannon-proof, and may either be *detached* or *continued**.

* See pages 85, &c. of theſe Elements.

The

The hedges, pales, &c. which incloſe the gardens of the village, are generally ſo diſpoſed, that, by throwing earth againſt them, they may ſerve to form the retrenchment, or at leaſt a great part of it.

The form of the retrenchment depends upon the ſituation of the particular ſpot, where the ſeveral parts which compoſe the retrenchment are raiſed; and the circumſtances of the adjacent ground, which are ſo various as ſeldom to admit them to be entirely regular: it follows, therefore, that no rule can be preſcribed to determine the form of the retrenchment.

The chief objects of attention are: 1. To make the ſeveral parts of the retrenchment reciprocally flank each other. 2. To ſecure the extremities of it as much as poſſible, and prevent its being turned.

That the enemy may be ſeen and expoſed to the cannon from the works, every thing that lies next to him, and which may conceal his march, ſuch as hedges, thickets, and even ſingle trees, ſhould be cut down to about 2 or 3 feet from the ground; and at the ſame time every obſtruction ſhould be laid in the way to impede his approach, and prevent his advancing in a great front, ſuch as deep trenches, trous-de-loup, &c.

The

The ſide of the village next to the camp is left open, to prevent the poſt being of any great advantage to the enemy, if he ſhould force the retrenchment: for the purpoſe of ſupporting with eaſe and expedition the troops in the village againſt any attack upon the works, or to diſlodge the enemy when in poſſeſſion of any part of the poſt, the communications between the camp and village ſhould be made as free as poſſible.

REMARK.

When there is not ſufficient time to raiſe works of earth, or there are reaſons againſt that practice, the houſes * neareſt to the enemy ſhould be put in a ſtate of defence, eſpecially thoſe where the roads meet; and the intervals between theſe houſes ſhould be barricaded with parapets of earth, abbatis, dung carts, ploughs, &c. the church and church-yard which may ſerve as a place of *rendezvous*, ſhould alſo be fortified.

Now if we conſider what defence a ſingle houſe is capable of making, how much ſuperior muſt be the defence made by a whole village, eſpecially when there is any degree of contiguity

* This ſuppoſes the houſes to be of ſtone or brick, and covered with tiles: when of wood and thatched, the apprehenſion of fire is too great to derive any benefit from the uſe of them.

among

among the houſes; for beſides the particular and direct defences from each houſe, many may ſerve, by their diſpoſition, to flank each other.

The roads and avenues between the village and the enemy, ſhould be as much encumbered as poſſible with abbatis, deep trenches, &c. Soldiers ſhould be poſted behind the abbatis, within the deep trenches, and behind the hedges, pales, or walls, that incloſe the gardens, to impede by their fire the enemy's approach: the more obſtacles are oppoſed to the enemy, the more hope there is of maintaining the poſt.

To ſecure Troops in Cantonments, or Winter Quarters.

The ſeveral villages that are occupied, eſpecially thoſe which by their ſituation are moſt expoſed to the enemy, ſhould be fortified on all ſides, with either detached or continued works of earth raiſed at ſome diſtance from the houſes.

To prevent ſurprizes, and increaſe the difficulty of approach, the houſes and gardens, if any are left without the works*, ſhould be put in a ſtate of defence, and be employed ſolely to cover and ſecure the advanced guards: to prevent the ill conſequence of a ſurprize, not only the neareſt houſe within the works, and the intervals between them, ſhould be put in a ſtate of defence, but alſo the church and church-yard, which may ſerve as a place of rendezvous in caſe of any alarm.

When detached works only are employed, they ſhould, if poſſible, be raiſed at the angles, and within muſket ſhot of each other. The fences of the gardens may ſerve to protect the communication, and be uſefully employed to ſecure the intermediate ſpace between the works: when the fences cannot anſwer this purpoſe, the intermediate ſpace ſhould be ſecured by abbatis.

* This in villages muſt generally happen to prevent the defects of extenſive works.

REMARK.

The villages moſt proper for cantonments, &c. are thoſe in which the houſes are not much ſcattered about. The fortifying the villages occupied by troops in cantonments or winter quarters with works of earth, will avail but little againſt ſurprize, unleſs the advanced guards and out poſts are eſtabliſhed in proper places, and the commanders of theſe are both intelligent and alert: the leaſt degree of inattention and indolence may be of fatal conſequence, eſpecially if the enemy follow in ſtrength.

To ſecure a Detachment.

When there is any degree of contiguity in the houſes of a village, it is generally environed with continued works of earth; but when the houſes are much ſcattered about, it is commonly only environed with detached works*, raiſed upon the moſt advantageous places, and to cover the entrances into the village. In each caſe, however, it will be neceſſary to put the outermoſt houſes and gardens in a ſtate of defence; to barricade the intervals between theſe houſes with carts filled with dung, ploughs, harrows, &c. and to encumber as much as poſſible the roads and avenues to the village.

* The detached baſtion with great flanks, claims the preference.

The

The church and church-yard, which may ſerve as a place of rendezvous in caſe of any alarm, ſhould be fortified alſo for a retreat, if the aſſailants ſhould prove ſucceſsful in their attack: this may enable the defendants, if not to force the enemy to abandon the attack, at leaſt to obtain the moſt honourable terms of capitulation. If neither the church nor any other building can be found capable of anſwering this purpoſe, a work of earth ſhould be raiſed, if poſſible, on ſome eminence within or near the village, with which the communication ſhould be ſecured.

This ſuppoſes that neither time nor means are limited: but when there is a limitation in reſpect of time, the practices of encumbering the roads and avenues, of putting in a ſtate of defence the outermoſt houſe, of barricading the intervals between thoſe houſes, and of fortifying the church or church-yard or other convenient building for retreat, ſhould, however, be attempted.

The acceſs to villages in low and level countries, is rendered difficult with little trouble, requiring only that the common roads ſhould be made impaſſable, by cutting deep trenches in them tranſverſely, or by placing abbatis in the ſame direction at certain diſtances; for the fields in ſuch countries are divided by thick hedges and deep ditches, which ſerve as boundaries

boundaries and drains, and to which there is no acceſs, but by lanes and other avenues leading from the common road. This is the caſe of many villages in the vicinity of London.

When the detachment is not ſufficiently ſtrong to defend the whole village, a part of it, proportional to the ſtrength of the detachment, ſhould only be fortified; in which caſe it may be neceſſary to burn the houſes that are not included in the works, to prevent the enemy advancing under cover, and eſtabliſhing himſelf in the part not fortified. When the detachment is very weak, they muſt at leaſt endeavour to fortify the church and church-yard, or other building proper for the purpoſe of defence.

REMARK.

All villages are not equally capable of being fortified. A village ſituated upon an eminence, is, from that natural advantage, fortified with leſs trouble, and rendered more reſpectable; and many things may be omitted, which cannot be diſpenſed with when it lies on a plain. When the houſes of a village are ſcattered about in long narrow vales, ſurrounded with mountains and woods, as well as gorges and hollow ways, by which the enemy can eaſily penetrate; it is ſcarcely poſſible to make a defence in ſuch a ſituation,

ſituation, with much hope of ſucceſs, for any length of time. Every village has, however, ſome natural advantages, ariſing either from the diſpoſition or conſtruction of the buildings, or the circumſtances of the adjacent ground; which, if properly attended to, may prove more effectual than any contrivance of art.

Though it is generally preſumed, that a few books are ſufficient to ſupply all the inſtruction that is neceſſary for the fortification of villages; it will, however, be found, that the information to be derived from the moſt enlightened writer, is rendered ſo limited by the boundleſs diverſity in the form and diſpoſition of buildings, and the circumſtances of the adjacent ground, that there is no poſſibility of eſtabliſhing rules capable of application to all particular caſes; nay, that even thoſe that in ſome caſes are evidently advantageous and neceſſary, will in others prove not only uſeleſs but detrimental. It will alſo be found, that the plans inſerted by different writers on this ſubject, each of whom boaſts of ſuperior merit, are not much calculated for the illuſtration of it, as they are all formed upon this one aſſumed ſuppoſition reſpecting the ground, that every where it is always upon the level, which the reality itſelf proves is but ſeldom the caſe.

SECTION

SECTION VIII.

Of Fortifying Small Towns.

Small towns are fortified for much the ſame purpoſes as villages; that is, to ſecure troops in cantonments, or winter quarters, to cover magazines, and to preſerve communication. They claim the preference over villages; becauſe, from the diſpoſition and conſtruction of the buildings, they are more capable of defence; the troops may not only be better accommodated, but being more united, they are leſs liable to ſurprize; and for which reaſon the troops of the firſt line are always, as much as poſſible, quartered in towns, rather than in villages. Many towns are alſo *walled round**, which greatly increaſes the ſecurity of the defendants.

Towns *without walls* differ in nothing from villages but in the greater number of houſes, and their cloſer contiguity; and, conſequently, the method preſcribed in Section VII. for fortifying villages, may be employed for ſuch towns.

In towns without walls, as well as in villages, the houſes commonly extend along one or two

* On the continent of Europe, many towns, however ſmall, are walled round; but in England, this is ſeldom the caſe.

roads

roads that run through them, with only yards or gardens behind, which renders the perimeter very great in compariſon to the number of houſes: but the diſadvantages inſeparable from an incloſure of great extent, are juſtly deemed great obſtacles in fortifying villages and towns, ſo ſituated, with works of earth.

In towns walled round, the houſes, on the contrary, are generally ſo diſpoſed, as to admit the greater part within an incloſure of moderate extent: they are not extended in one or two rows only, but in many; and little or no ground is occupied for yards or gardens. The circular form admits the greateſt ſpace within the leaſt incloſure.

The firſt object of attention in putting ſmall towns, walled round, in a ſtate of defence, is to barricade all the gates with large beams, ſtones, or caſks filled with earth, dung, and other ſuitable materials. That there may be no obſtruction to a ſally when it is found expedient, or to a retreat when it becomes neceſſary, many are of opinion, that one or two of the gates, moſt proper for this purpoſe, ſhould be kept open, but to have the materials for barricading near at hand, to be employed when the enemy indicates an intention of attacking theſe gates. It would, however, be more prudent, previous

to the attack, to barricade every gate, obſerving only to barricade thoſe that are deſigned to have a communication with the country in ſuch a manner, as that they may be eaſily and quickly opened whenever occaſion requires it.

To deter the enemy's approach to the gates, beſides the precaution of barricading them, it will be advantageous either to have a row of palliſades on the outſide of each, with a pointed ditch, or to cover each by a tambour, fleche, detached baſtion, &c. which may ſerve alſo to furniſh a croſs fire.

The next object of attention is to repair the wall either with maſonry or wood, as will be moſt practicable.

When the wall is very high, loop-holes ſhould be cut, and a ſcaffold raiſed all along the inſide, by way of banquette to fire over it; or, at leaſt, at the angles and on each ſide of the ſeveral gates, which are deemed the weaker parts. When the wall is but low, a banquette of earth, rubbiſh, or ſtones, of ſufficient height, ſhould be raiſed all along the inſide, or at certain diſtances, eſpecially at the angles on each ſide of the gate, which will preclude the uſe of loop-holes.

If there are any projections in the wall, particular attention ſhould be paid to put them in a ſtate

ſtate of defence, not only by a ſingle or double row of loop-holes, but, if poſſible, by a treble row, to procure a croſs fire, which is principally neceſſary to deter the enemy's near approach to the wall: if there are no projections, the croſs fire is to be obtained by tambours, fleches, &c. raiſed at certain diſtances from each other.

That the enemy may not find any ſhelter, all the bruſh-wood, hedges, and trees, within muſket ſhot of the wall, ſhould be cut down; and even the houſes within that diſtance from the wall, ſhould be demoliſhed.

SECTION IX.

Maxims of Field Fortification.

The following maxims comprize the eſſential principles of field fortification.

MAXIM I.

THE ſize of a work depends in general upon the number of men who are to defend it.

If labour is the ſole object of attention, the advantage muſt neceſſarily be the greater, in proportion as the ſize of the work is leſs; but if the accommodation of the troops is only conſidered, the advantage depends greatly upon occupying much ground.

MAXIM II.

The form of a work ſhould be ſuch as to contain the greateſt ſurface with the leaſt perimeter.

By an adherence to this maxim, we obtain the greateſt accommodation for the troops, with the leaſt labour. The form of a field-work ſeldom depends upon choice, but generally upon the ſpot where it is to be raiſed, the purpoſes for which it is conſtructed, and the ſituation of the circumjacent ground.

MAX-

MAXIM III.

The ground occupied ought to be ſo covered by the parapet, as that the men from no part within, except when placed upon the banquette, may be ſeen from any part without, at the diſtance of cannon ſhot.

Unleſs this precaution is taken, the troops employed as a reſerve may be brought into diſorder by the fire of the enemy; which, when diſcovered, muſt naturally intimidate thoſe employed in the defence of the parapet, and inſpire the aſſailants with the greater confidence of ſucceſs: this accounts for the neceſſity of giving ſometimes more elevation to the parapet in ſome parts of the work, eſpecially at the ſaliant angles, than in others.

MAXIM IV.

The circumjacent ground (to as great a diſtance as poſſible) ought to be cleared, that the enemy may not conceal or ſhelter himſelf againſt the fire from behind the parapet.

The nearer to the work an enemy finds ſhelter, the more advantageouſly he can form his diſpoſitions; and as his attacks can be made with greater vigour and be more eaſily ſupported, the ſucceſs will be the more probable. Beſides,

it will be very difficult to diſtinguiſh the real from the feint attacks: a feint attack may be taken for a real, and a real attack for a feint one, which would be ſtill worſe.

MAXIM V.

The parts that flank ought to be capable of containing the men, &c. neceſſary for the defence of thoſe that are flanked.

MAXIM VI.

The flanking parts ought to have nearly a direct view of thoſe that are flanked; that is, the defence ſhould be nearly at right angles: the advantageous angle is about 100 degrees.

The defences in field fortification like thoſe in the permanent, are, in general, deemed moſt advantageous when exactly at right angles, not only becauſe the right angle has the moſt ſtrength, but becauſe (as the men generally fire before them) it is the angle of which the ſides afford to each other the greateſt mutual defence; but the ſcrupulous preference given to the right angle, ſeems to ariſe more from an expectation of what the men ought to do with the advantage of ſuch a conſtruction, than from what experience proves they are always capable of doing: it is, however, productive of ſome inconveniencies, eſpe-

cially when the parapets are low and narrow; for, in time of action, ſome moments of confuſion may intervene, when the fire may be badly directed, and the men conſequently injured by each other. An adoption, therefore, of 100 degrees in preference to 90, as it creates no defect, muſt be advantageous. Beſides, flanking parts in field-works are not, like thoſe of permanent fortification, the worſe for being ſomewhat expoſed. It is not neceſſary to graze the flanked parts; for there is no danger of being expoſed to the defence of a breach, or a lodgment of the miner. The worſt to be apprehended is a ſudden attack by a ſuperior force, which it will always be found advantageous to check as ſoon as poſſible.

MAXIM VII.

The parts flanked ought to be within muſket ſhot of their flanking parts, which is generally deemed to be point blank about 300 yards.

Though the point blank of our firelock, when attention is paid to the loading, is known to be about 300 yards, yet it will be prudent to rate it at ſomewhat leſs, conſidering that men ſtationed behind works, are apt to pay ſo much attention to the fire of the enemy, as to give very little to the effect of their own fire: this conſideration has induced many to rate the range of muſket ſhot from 200 to 250 yards.

MAXIM VIII.

The fire, which is beſt as it is moſt *razant* or grazing, ought to be equally diſtributed, that the work may be rendered more equally difficult of attack.

This maxim, though of the utmoſt importance, is ſeldom attended to; for in the conſtruction of many works, even thoſe moſt generally admired, the moſt expoſed parts have the leaſt fire for their defence.

MAXIM IX.

The work ought to be equally ſtrong in all its parts, that it may every where equally reſiſt the enemy; and the parapet ſhould be able to withſtand the machines that can be brought againſt it.

MAXIM X.

The dimenſions of the parapet ſhould not only be ſufficient to ſecure and cover the troops within the work, but ought to be of ſuch a form as to afford a full view of the enemy in his approach, and at the ſame time diſcover as little as poſſible the men employed for its defence.

If inconveniencies ariſe from an enemy being able to ſecure himſelf againſt the fire from behind the

the parapet when at a diſtance, how diſadvantageous muſt it be when he can find ſhelter at the foot of it? This defect, however, is inſeparable from every parapet of the preſent form when the works have no flanks, and can only be remedied by digging *trous-de-loup*, fixing paliſades and other obſtacles within and without the ditches.

REMARK.

In every parapet of the common form, there being neceſſarily a ſpace at the exterior foot, that cannot be defended by a direct fire, which is the greater, as the ſuperior talus has the leſs plunge, and the parapet the greater height, (ſee page 13 of theſe Elements); ſome engineers have of late attempted to ſupply this defect by altering the form, from which, it is preſumed, they have derived little credit; for while they ſupply but imperfectly the ſingle defect natural to the preſent form, they add many to which it is not liable.

SECTION X.

Of the Conſtruction of Works.

To trace Works upon the Ground.

TO thoſe that are acquainted with the method of tracing works upon paper, the method of tracing them upon the ground cannot be difficult; for the rod or chain ſerves as a ſcale, the pick-ax as a pencil, the ſtring ſtretched between two pickets, may be employed as a rule; and when one of the pickets to which the ſtring is faſtened, is ſtuck in the ground, and the other picket left moveable, it may be uſed as a compaſs.

But, as a previous knowledge of practical geometry is indiſpenſably neceſſary to the ſtudy of fortification, the further conſideration of this ſubject can be of no other ſervice than to ſwell the work. Time being moſt precious in the field, the methods which are moſt ſimple and expeditious, will be preferable to thoſe that are more difficult and tedious, though more exact.

Of the Excavation of the Ditch, and the raiſing of the Parapet.

When all the lines of the works are traced upon the ground, the workmen begin to break it.

Becauſe

Becauſe workmen, in ſpite of any direction to the contrary, are apt to dig perpendicularly, the general mode of digging the ditch that the neceſſary ſlopes * may be obtained, is to begin, not immediately at the lines terminating the berme and the counterſcarp, but at 3 or 4 feet from and within theſe lines: when it is dug to a ſufficient depth, the more ſkilful workmen are then employed in cutting the ſlopes, which depend not ſolely on the nature of the ſoil, as is commonly underſtood, but alſo on the height of the ſlopes. For a demonſtration of this, ſee page 18 of theſe Elements.

The excavation might, however, be more regularly made, and the neceſſary ſlopes more eaſily obtained, by digging in trenches of about one foot in depth, making a retreat of 6 or 8 inches according to the ſlope required. (See Fig. 3. Plate VI.). Thoſe retreats which may ſerve as ſteps, and be of great uſe during the excavation, are cut by the more ſkilful when arrived at a ſufficient depth.

Becauſe the advantage encreaſes as the parapet has the leſs ſlope; and becauſe the moſt adheſive

* When common earth is ueſd, the ſlope is generally recommended to be equal to the height; and when clay or loom, two-thirds of the height: late experiments, however, prove that when of clay or loom, the baſe may be taken only one-third of the height.

earth

earth cannot long ſupport itſelf, unleſs formed with a ſlope of very gradual aſcent; it is uſual to give it a revetment, that is, to line the parapet with *ſods*, *faſcines*, *hurdles*, &c.

Of Sods.

See A, Fig. 3. Plate VI.

The form generally given to the Sod, is that of a brick, in length about 1 foot and $\frac{1}{2}$, in breadth about 1 foot, and in thickneſs about 3 inches. Sods are laid in the ſame manner as bricks, that is, alternately a *header* and a *ſtretcher*; and the better to unite the Sods together, the green ſide is laid downwards; and ſmall pickets are drove through them.

The rows ſhould not be placed horizontally after the common manner of brick work, but nearly perpendicular to the ſlope: by this method, a firmer compaction is obtained for the lining or revetment; for when the earth at the top preſſes the uppermoſt row of Sods, inſtead of diſordering that row, it preſſes it only ſo much the cloſer to the ſecond, the ſecond to the third, and ſo on.

The better to bind the Sods with the earth, layers of ſmall twigs, if ſuch are eaſily got, ſhould be intermixed, obſerving to lay the thickeſt part of the twig upon the Sod; for this purpoſe alſo,

alſo, bruſhwood, broom, brambles, briars, dock, couch, and even ſtraw, may be uſefully employed.

That the parapet may be the more ſolid, the earth, as it is thrown out of the ditch, ſhould be trod or rammed down: unleſs this precaution is taken, eſpecially for the lower part of the work, there is every reaſon to fear that the lining, after a very little while, will, if not tumble down, at leaſt be much diſordered.

What gives moſt trouble in the execution of the work, is the obtaining the neceſſary ſlopes, and *dreſſing* the Sods. The ſlope being known*, fix a picket of ſufficient height at each angle, to which give the ſlope required for the revetment: from theſe pickets ſtretch a ſtring to ſerve as a guide for dreſſing the Sods, which raiſe at every row along the pickets. This precaution for giving the neceſſary ſlopes and for dreſſing the Sods, will, however, avail but little, unleſs the Sods are carefully laid down and united with the earth, which of all neceſſity muſt be rammed down.

It is obſervable that a ſtring ſtretched horizontally, whatever force is employed, is always lower in the middle than at the extremities; and

* The exterior ſlope of the parapet has in general for ſlope about the $\frac{1}{3}$ of the height, and the interior ſlope about 1 foot and a half.

ſtill

ſtill the lower, as the ſtring has the greater weight, and the extremities are at a greater diſtance from each other: this accounts for the neceſſity of employing the ſmaller cords, and fixing intermediate pickets, when the diſtance between the angles is in any degree great.

REMARK.

Many deem the wedge to be the form moſt advantageous for the Sod, which muſt be laid with the green ſide downward, and the point towards the parapet: to obtain this form they cut Sods of about a foot ſquare, and about 3 inches thick, which they divide afterwards diagonally, each Sod making two.

Of Faſcines.

Faſcines are a kind of faggots, made of broom, bruſhwood, ſmall branches of trees, &c. tied in 2, 3, 4, 5, or more places, and are of various dimenſions, according to the purpoſe for which they are intended: they meaſure, in length, from 2 to 18 feet, and are from 6 to 18 inches diameter: when the length exceeds 7 or 8 feet, by way of diſtinction, it is called *ſauciſſon*.

Thoſe employed for burning the works of an enemy, in which caſe they are to be pitched over,

over, are only about two feet long; thoſe employed to fill up ditches, meaſure about 6 feet; and thoſe employed to raiſe works, are from 6 to 18 feet; the moſt advantageous length is, in general, deemed to be about 10 feet.

Six men are commonly employed in making a fauciſſon; two cut the boughs, two gather theſe together, and the remaining two bind them. It is deemed rather an eaſy taſk for theſe men to make 12 fauciſſons in an hour.

They are made as follows: Six pickets of about 3 inches diameter, and about 5 feet long, are ſtuck at about one foot and an half in the ground, two and two, forming three little croſſes, at the diſtance of three or four feet from each other.

That theſe croſſes may anſwer the purpoſe of treſtles, or wooden horſes, they are to be bound ſtrongly together in the middle with twigs of willow or birch.

Upon theſe treſtles the boughs (which are to be previouſly cut or ſawed of the length required) are laid; and when a ſufficient quantity is obtained, they are bound round with withes from end to end, at the diſtance of ſix or nine inches from each other.

RE-

REMARK.

The goodneſs of the ſauciſſon being neceſſarily the greater as the materials which form it are the cloſer to each other, the binding them firmly is a circumſtance that requires the greateſt attention.

In binding the ſauciſſon, the following expedient may be advantageouſly uſed (ſee Fig. 4. Plate VI.): take a ſtrong cord of about 3 feet long, and to each end of it faſten by the middle a ſtick of about 4 feet long; ſurround the ſauciſſon with this cord, and whilſt two men draw towards themſelves the ends of the ſticks A and B, a third has an opportunity of binding the ſauciſſon tightly. An inſpection of the figure will be a ſufficient illuſtration.

To line with Sauciſſons.

See B, Fig. 3. Plate VI.

Fix a picket at every angle, &c. with the neceſſary ſlope for the revetment; to which ſtretch a ſmall cord to ſerve as a guide for dreſſing the ſauciſſon; theſe, to form a revetment capable of reſiſting the preſſure of the earth, are laid in rows and faſtened to the ground, and to one another, with ſtrong ſtakes of about 4 feet long, drove through them at about 2 feet aſunder; that is, 5 ſtakes to every ſauciſſon.

That

That the foundation may be the ſtronger, the lower row is to be ſomewhat ſunk; and that the preſſure of earth may be more eaſily reſiſted, the ends of the ſeveral rows muſt not come exactly over each other, but thoſe of the firſt row ſhould be covered by the middle of thoſe of the ſecond, and ſo on of the other rows.

REMARK.

The goodneſs of this ſort of revetment depends much upon the ſtakes that are driven through the ſeveral rows of fauciſſons, which, it is obſervable, acquire, like all other elaſtic bodies, a greater power of reſiſtance by being bent in a ſmall degree; it will, therefore, be advantageous to drive the ſtakes, not directly downwards, but ſome what inclined to the parapet, and to ram down the earth at every row ſo as to force the ſtakes to bend a little. Beſides, the ramming down the earth renders alſo the parapet more ſolid.

Of Hurdles.

Hurdles are made of twigs of willows or oſiers, interwoven cloſe to each other, and ſuſtained by ſtakes. They meaſure, in general, from 5 to 6 feet in length, and from 3 to 5 in breadth; and are deemed the better the cloſer

they are wattled together: they ſerve to conſolidate the paſſage over muddy ditches, to line works, &c.

To line with Hurdles.

Strong ſtakes, meaſuring 7 or 8 feet in length, placed about 2 feet aſunder, and in the direction of the line terminating the parapet, are to be driven ſomewhat inclined to the parapet, and about 3 feet in the ground: when the hurdles prepared are laid along the inſide of theſe ſtakes, the work is lined.

To increaſe the ſolidity of the parapet, and the power of reſiſtance in the ſtakes which ſupport the hurdles, the earth is to be well rammed.

REMARK.

The twigs of willows or oſiers are recommended to be interwoven with the ſtakes driven in the ground; by this practice the work may be carried on more expeditiouſly, and be more of a piece. The revetment with hurdles, which is not ſo common as that of ſods or faſcines, is, however, by far more advantageous

Sods have the preference for lining the exterior part of the parapet, becauſe the ſhot makes leſs havock in theſe than in faſcines or hurdles: ſods

ſods alſo are preferable for lining the inſides of embrazures, as they are not liable to take fire.

Faſcines and hurdles, on the contrary, are deemed moſt advantageous for lining the interior part, becauſe they are ſuppoſed to be capable of reſiſting the preſſure of earth with leſs ſlope than ſods, and conſequently enable the men within to ſtand and fire with more eaſe: the lining of the interior part, when there is a banquette, need not begin ſomewhat below the horizontal line, as is the caſe with the lining of the exterior part, but within a little below the terreplein of the banquette. See Fig. 3. Plate VI. There is no earth, however adheſive, that does not require the interior part to be lined, when there is a poſſibility of doing it: the lining of the exterior part may be diſpenſed with, when it is a clay ſoil, or when the work is to be fraized.

Of raiſing the Banquette.

The earth to form the banquette, which is conſtructed at the ſame time as the parapet, is commonly taken out of the ditch: it is ſometimes taken within the works, which is advantageous when the parapet has but a moderate

height, as by this the ground within becomes leſs expoſed.

When the banquette is lined, it is commonly done with ſods.

Of the Excavation of the Ditch and the raiſing of the Parapet continued.

The earth to form the parapet and banquette, is to be thrown upon the parapet, as long as it is poſſible for the men within the ditch to reach it eaſily; when this can no longer be done, whilſt ſome of the men are employed to throw the earth upon the berme, others ſhovel it upon the parapet.

The earth at every layer of ſods or faſcines, is to be levelled, and be well trod or rammed down: this precaution is not only neceſſary to render the parapet more ſolid, but alſo to prevent the earth from having too much preſſure upon the revetment.

In a ſtoney or gravelly ſoil, the banquette and lower part of the parapet are to be raiſed with whatever earth can be got; but the upper part of the parapet is to be raiſed with fine mould, that the troops may not ſuffer more from the ſtones flying about, than from the bullets of the enemy.

When

When the ſoil requires ſuch ſlopes for the ditch, as will not admit the paſſage but by leaping into it, a few additional feet in depth may be a conſiderable advantage; for if it does not deter the enemy from attempting the paſſage, it will at leaſt force him to fill up the ditch previous to any attempt, which is an operation that takes up much time, and greatly expoſes him to the fire from behind the parapet; to obtain this advantage, it is probable that more earth will be required to be dug than can be diſpenſed with in forming the parapet, banquette, and glacis; and to prevent this earth from being of any uſe to the enemy, it is to be ſcattered about, ſo that no little heaps may be left.

When the ſoil requires great ſlopes for the ditch, no advantage whatever can be derived from giving it any additional width or depth: the defects can only be remedied by paliſades, &c.

In raiſing the parapet, attention ſhould be paid that its dimenſions are ſufficient to ſecure and cover the troops within the works: two reaſons require that the parapet ſhould not be of equal height in all its extent, the inequality of the very ground upon which it is conſtructed, and the nature of the circumjacent ground,

ground, which may be ſuch as to oblige ſome parts to be raiſed higher than others, to cover the troops in front, flank, or rear, againſt an enemy ſtationed upon one or more eminences.

The ſaliant parts, though the ground be ever ſo much on a level, are commonly raiſed at leaſt one foot more than the reſt, as being the weaker parts, and to prevent the works from being enfiladed by the enemy's cannon.

That the upper part of the parapet, in ſuch circumſtances, may in its whole extent be capable of reſiſting the machines of the enemy, the baſe of it ſhould be taken throughout of an equal width, and ſuch as will anſwer to a parapet capable of receiving any elevation required: and though this practice renders the upper part unequally wide, and, conſequently, in ſome parts ſuperfluouſly ſtrong, it is yet advantageous as preſerving a regularity within the work.

But the neceſſity of raiſing ſome parts more than others, does frequently not appear till after the work has been traced, and even partly conſtructed; ſo that it is more than probable that the parapet will be too weak in thoſe parts that require greater elevation, if this circumſtance has not been attended to: the common practice of remedying this defect, is to raiſe a freſh interior part, anſwering to thoſe parts that require greater height,

height, and as much back within the work, as will, when added to the original baſe, be capable of receiving a parapet ſufficiently ſtrong at the upper part of it: this practice, which is indiſpenſably neceſſary when the original baſe cannot admit a parapet ſufficiently ſtrong in all its extent, is however apt to create confuſion, loſs of time, and much irregularity within the works. To avoid this inconvenience, it will be prudent on all occaſions to take a greater baſe for the parapet, than what may be expected to be required to give it ſufficient ſtrength.

That the ſoldiers may fire over the parapet, the banquette anſwering to the parts that require greater elevation, muſt be raiſed of proportional height.

When the work is only expoſed to the fire of ſmall arms from a neighbouring eminence, a row of gabions, as Fig. 5. Plate I, filled with earth, is to be placed along the top of the parapet on that ſide which is oppoſite to the eminence; and upon theſe a ſecond row of gabions of a cylindrical form, if neceſſary, to ſupply the defect.

Of

Of the Superior Talus or Plunge.

This ſlope, which is given for the purpoſe of diſcovering the enemy in his approach, and of more effectually levelling at him, is, in general, allowed to have two inches for every foot in the height of the parapet: thus, ſuppoſing a parapet to have ſix feet interior height, then the ſuperior talus or plunge will be one ſpot, and the exterior height five feet. This ſlope, to be advantageous, ſhould be ſuch as that the enemy may be expoſed at the very edge of the ditch.

When the work is conſtructed on a height, this proportion for the plunge is laid aſide: the practice, in ſuch a circumſtance, is to give the parapet ſuch a plunge as will diſcover the enemy at the very bottom of the hill.

Of the Tools neceſſary.

To make faſcines, hurdles, gabions, paliſades, and other materials for the conſtruction of field works, a number of wooden mallets, rammers, hatchets, bill hooks for cutting boughs, carpenter's axes, and turf irons * are required; and alſo a number of pick-

* Spades anſwer the purpoſe of turf-irons: as ſods can be more expeditiouſly cut with turf-irons than with ſpades, theſe ſhould be procured if poſſible; there are machines in uſe that cut many ſods at once: there is one at Chatham.

axes,

axes, ſpades, and ſhovels for the excavation of the ditch.

In a clay ſoil the ſpade is preferable to the pick-ax and ſhovel, both to dig and throw up the earth; and in a dry or gravelly ſoil, the pick-ax and ſhovel, which are jointly required, claim the preference to the ſpade.

To avoid the delay which muſt be the conſequence when the men are only provided either with a ſpade, ſhovel, or pick-ax; it will be advantageous to provide ſome of the men, if not all, both with a ſpade and pick-ax; for when the ground is dry or ſtoney, whilſt thoſe who are provided with pick-axes are employed in picking the ground, the reſt are idle.

The number and nature of the tools cannot eaſily be aſcertained; it depends on the ſort of materials wanted, and the dimenſions of the work to be conſtructed: ſcarcity, however, cauſes diſappointment and delay, and it ſhould always be obviated.

REMARK.

The precaution of taking the tools neceſſary to form entrenchments, though one of the moſt important things to be obſerved, is too commonly neglected by the generality of young officers

ders ordered upon detachments. Mr. Vauban aſcribes to this neglect in the French, their want of ſucceſs in defenſive operations: many deem it too trifling a buſineſs to merit their attention, and others think it diſgraceful to be encumbered with the ſpade and pick-axe as the companions of their arms.

Of the Quantity of each Material.

When the ſituation of the ground upon which the work is to be raiſed, and the ſtrength of the detachment appointed for its defence have determined its dimenſions, the neceſſary materials may eaſily be aſcertained.

Suppoſing the detachment to conſiſt of 200 men, and that the work is a redout, of which Fig. 1. Plate VI. repreſents the plan, and Fig. 2. the profile.

The number of fauciſſons required for lining the interior ſlope of the parapet, ſuppoſing each to have in length 10 feet, and one foot in diameter, will be 160: for as each ſide of the work meaſures 25 yards with a height of 4 feet and $\frac{1}{2}$, each ſide will require 5 rows of 8 fauciſſons each, or 40 fauciſſons; and conſequently 4 times that quantity, or 160, for the whole interior ſlope: each fauciſſon requiring 5 ſtakes, the number of ſtakes will be 800.

The

The number of ſods for lining the exterior ſlope of the parapet, ſuppoſing each ſod to be 1 foot and $\frac{1}{2}$ long, 1 foot broad, and 3 inches thick, will be 5472; for as each ſide of the work meaſures 95 feet*, with a height of 4 feet and $\frac{1}{2}$, each ſide requires 18 rows of 76 ſods each, which makes 1368; and conſequently 4 times that quantity, or 5472, for the whole exterior ſlope.

The number of paliſades required for the middle of the ditch, ſuppoſing theſe to be 6 inches broad, and to be placed 3 inches aſunder, will be 592; for the length in the middle of the ditch on each ſide meaſures 111 feet, and requires 148 paliſades; and conſequently 4 times that number, or 592, will be the quantity required for the whole.

The number of fraizes required, ſuppoſing theſe to be 6 inches wide and placed 4 inches aſunder, will be 456; for each ſide meaſuring 95 feet, will require 114 fraizes; and conſequently 4 times that number, or 456, will be the quantity required for the whole. The whole length of the exterior ſleeper will be 380 feet, and that of the interior ſleeper will be only 356 feet.

* Ninety-five is the meaſure of the length at the bottom; at the top it meaſures only 91 feet; ſo that the number 5472 is by ſome few ſods too many.

In

In calculating these materials, the work has been considered as inclosed on all sides, that is, no deduction has been made for the entrance into it. No deduction, however, will appear necessary, considering that the excess in sods and fascines may be employed for raising the traverse; and that the excess in palisades or fraizes, will scarcely supply the defect that is likely to arise from accidents of different kinds.

The solidity of the parapet, banquette, and traverse, is about 590 yards, and that of the excavation of the ditch about 557 yards, which, though less by about 33 yards, is more than necessary for the construction of the work, supposing the interior part to be lined with saucissons, and the exterior slope with sods; for the solidity of the saucisson will be about 48 yards, and that of 2500 sods, more than what could be taken out of the ditch, were it covered with turf, which is about 35 yards added to the excavation, exceeds by about 50 yards the quantity 590, necessary to construct the work.

This excavation is, however, necessary to render the ditch of sufficient depth and width; and to prevent the earth, which cannot be employed, from being of use to the enemy, it is to be scattered about so that no heaps may be left.

RE-

REMARK.

That the ſeveral materials may be readily found without any hindrance to the workmen, they are to be regularly laid up in ſeparate arrangements; that is, the faſcines and pickets wanted for the interior ſlope, within the works; the paliſades, fraizes, faſcines, pickets or ſock, wanted for the exterior ſlope, on the edge of the ditch without the work.

Of the Time neceſſary to finiſh Field Works.

This depends on the dimenſions of the works, the nature of the ſoil, the quality of the materials, the number of men to be employed, and on ſo many other circumſtances, that it is impoſſible to aſcertain, with any degree of preciſion, the time required to finiſh a field-work.

The time required is, however, in general, determined to be the time neceſſary to make the excavation of the ditch: this ſuppoſes ſo judicious a diſtribution of the workmen, as that thoſe ordered for procuring the neceſſary materials, and thoſe employed in fixing them, are enabled to keep pace with each other, ſo as not to cauſe any delay to thoſe employed in the excavation.

Expe-

Experience proves, that one man, in a middling ſoil, may very eaſily make an excavation of 9 or 10 feet in one hour: it follows, therefore, that if 100 men are conſtantly employed in the excavation of the ditch of the redout, Fig. 1. Plate VI. about 17 hours will be required to finiſh it.

Of the Diſtribution of Workmen.

The diſtribution of workmen depends on the ſituation of the work, whether it is or is not liable to be interrupted by the enemy.

When expoſed to Interruption or Surprize.

Two-thirds of the detachment ordered for the defence of the work are to be kept under arms, while the other third part are employed in the conſtruction: that the men may work with ſpirit, the part employed at the work is to be relieved every two or three hours.

This third part is divided equally: one half in the excavation of the ditch and in throwing up the earth; and the other half in procuring the materials neceſſary, ſuch as ſods, faſcines, &c. and in laying and fixing them.

RE-

REMARK.

That the work may be carried on with expedition, a number of peaſants ſhould be procured, if poſſible, provided with ſpades, pick-axes, &c.

Some attention ſhould be paid not to overfatigue the men, that when relieved they may keep alert.

SECTION XI.

Of the Attack and Defence of Field Works.

No operation is ſuppoſed to require more ſkill and greater exertions of unremitted valour and perſeverance than either a victorious attack or a ſucceſsful defence: hence it is pre-ſuppoſed that he who commands has great abilities, and that thoſe who obey have much confidence and ſubordination.

Troops acquire confidence, not ſo much from what is told them, though ever ſo true, than from the faith they have in what is told; nothing, therefore, ſhould be offered to their conſideration but what is analogous to the manner of thinking, and within the reach of the conception of the generality. To ſpeak of the advantages of the angles for being this or that number of degrees; of a line for having this or that particular length, makes no impreſſion on the minds of the men, from their not being able to appreciate the advantages which any of theſe things can procure.

Soldiers meaſure difficulties by the eye; hence it is that men within a redout with a parapet of much elevation and great thickneſs, however ill ſituated, have more confidence than if placed within

within any other work, however perfect, that has a parapet of leſs thickneſs and elevation.

Though the diſpoſitions neceſſary to be made, and the conduct to be obſerved, both before and at the time either of an attack or defence of a poſt to render it ſucceſsful, depend on many circumſtances which are almoſt endleſs in their combinations, it is preſumed, that an inveſtigation of it's firſt principles, which cannot be many, will neceſſarily lead to ſuch a general theory, from whence rules may be deduced, if not for every particular caſe, at leaſt for a great number.

Of the Defence.

The defence is ſuppoſed to require more talents and more precautions than the attack, and not without foundation: conſidering the confidence derived from the prepoſſeſſions natural to thoſe who act offenſively, and the circumſpection derived from the prejudices attendant on thoſe who act defenſively; even the appearance of a fault will produce irrecoverable ruin to thoſe who defend, while thoſe who attack often ſucceed by the moſt hazardous diſpoſitions and manœuvres. This is daily evinced, for fortune ſeems moſt inclined to favour the aſſailants.

It is, however, probable, that the liberalities of fortune beſtowed upon the aſſailants might be leſſened, if more judicious diſpoſitions were made for the defence. This knowledge, which cannot be acquired but by an inveſtigation of the principles of defence and attack, is too generally neglected: conſidering the ſtate of things, there is too much reaſon to agree with that celebrated military writer, that an officer, however brave, if ignorant, is generally forced to give up the defence, whereas a madman even may and does often ſucceed in the attack.

The firſt object of attention in the defence of a field work, is to diſpoſe the troops in ſuch order, and after ſuch a manner, as to be able to reap every poſſible advantage ariſing from their number and valour.

The evil moſt to be dreaded is a ſurprize; to ſecure againſt which, precautions ſhould be taken not only againſt every thing that an enemy may probably attempt, but againſt all contingencies.

Two extremes are to be avoided in the precautions taken to prevent ſurprizes: if the troops are over fatigued, a very ſhort time renders them unfit to act with vigour; if to ſpare the men ſome neceſſary precaution is neglected, the work may be attacked before the men can be in a ſtate of defence.

A work

A work may be carried by attacking it with ſuch a ſuperior force, as will put it out of the power of thoſe employed in its defence to withſtand its firſt ſhock; or by making ſo many ſucceſſive attacks as will at laſt enſure ſucceſs, by gradually decreaſing the number of defendants.

Maxims of Defence.

MAXIM I.

The parapet ought to be ſo lined with men, as that an enemy may every where find a reſiſtance ſuperior to his greateſt effort.

MAXIM II.

The reſerve ought to be ſo placed, as to inſpire confidence in thoſe engaged at the parapet; and be able to give them ſuccour, when and every where as it may be wanted.

MAXIM III.

To ſtation as many guards and ſentries as will be neceſſary to receive information of an enemy's approach, time enough to admit the troops being in a ſtate of defence, before the poſt can be attacked.

Of

Of the Attack.

A principal object of attention both in the attack and defence of a poſt, is not to over fatigue the troops with uſeleſs movements, nor keep them any length of time under arms before the action begins: nothing is more likely to take away their ſpirits.

Maxims of Attack.

MAXIM I.

Make choice of the time, and manner of attack, moſt likely to meet the enemy when capable of making the leaſt reſiſtance.

MAXIM II.

The troops ſhould be in ſuch order as to be able to engage the whole or any part, as may be deemed convenient; and that the troops which are kept in reſerve, may either be able to ſupport any attack, or to ſecure a retreat if neceſſary.

FINIS.

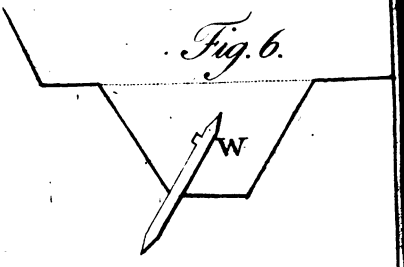

Fig. 6.

Fig. 4.

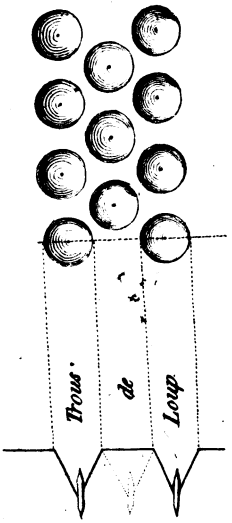

Fig 5

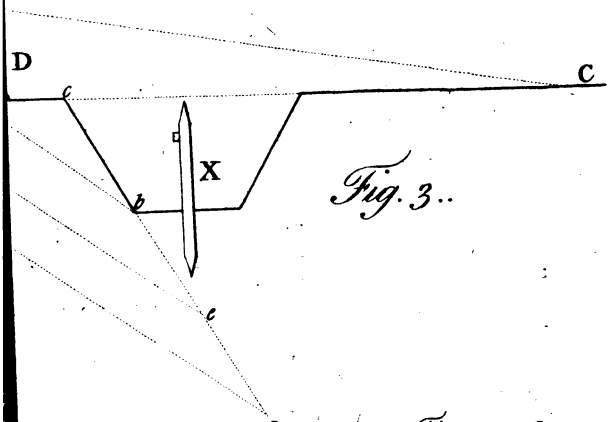

Fig. 3..

Scale of the Fig. 2. 3. & 6.

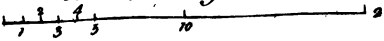

PLATE II.

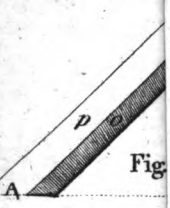

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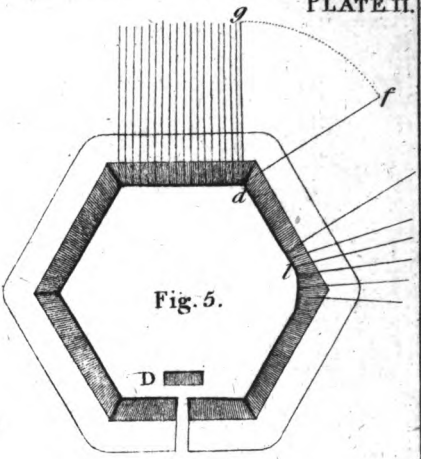
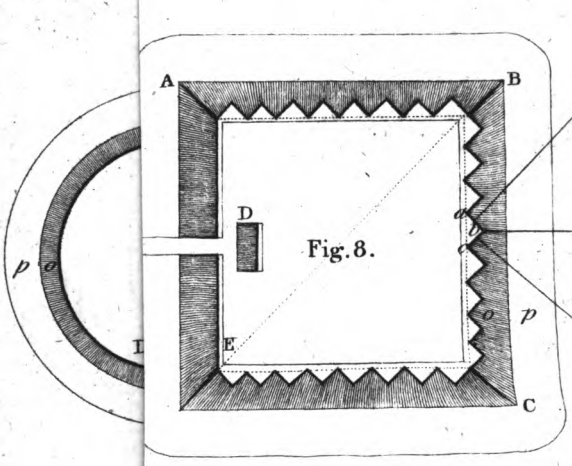
Fig. 2





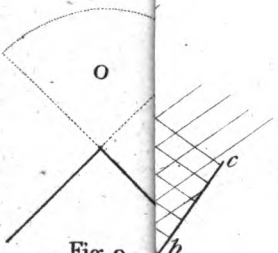


Fig. 9.

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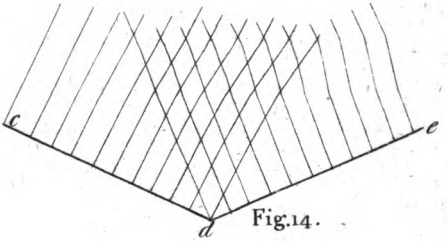
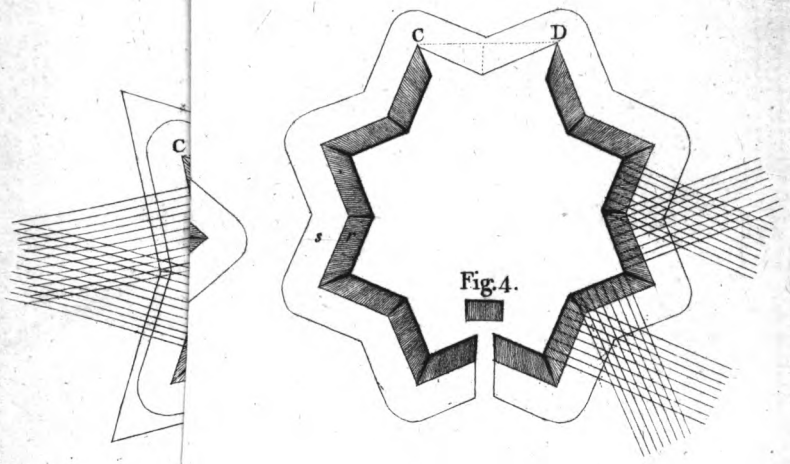


Fig. 14.



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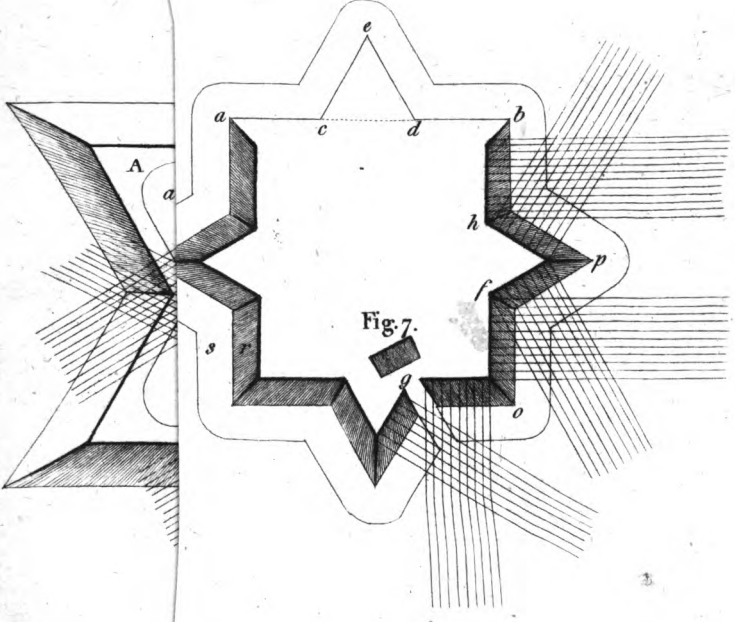

Fig. 7.

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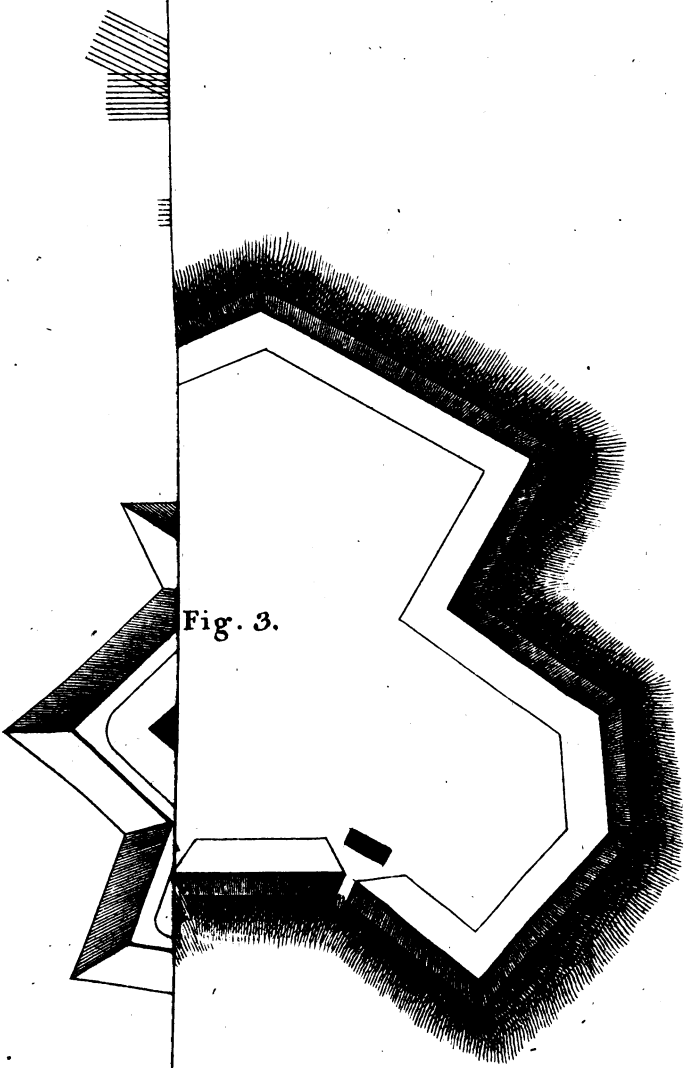

Fig. 3.

PLATE V.

Fig. 1.

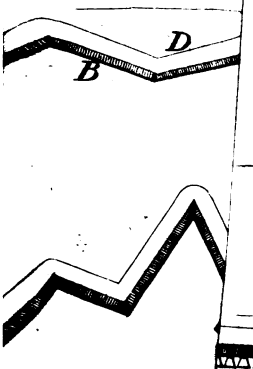

Fig.

Fig. 3.

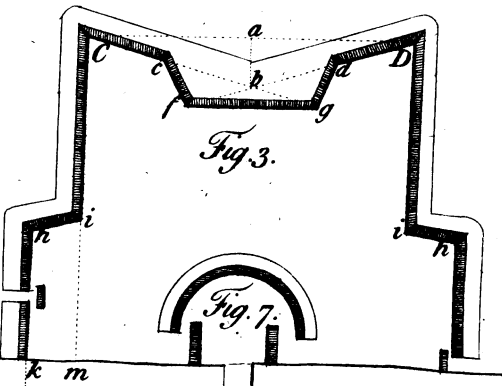

Fig. 7.

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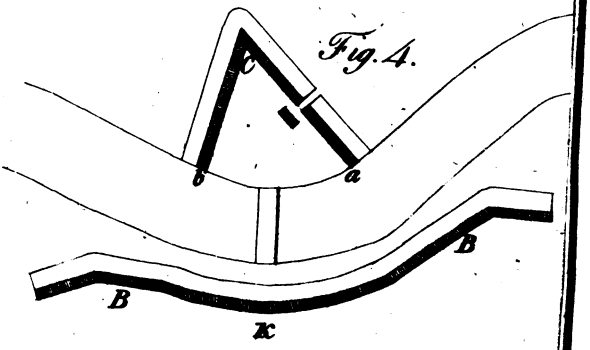

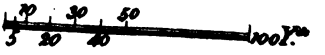

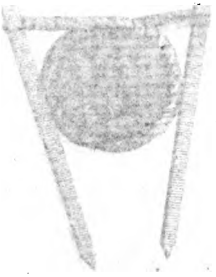

PLATE VI

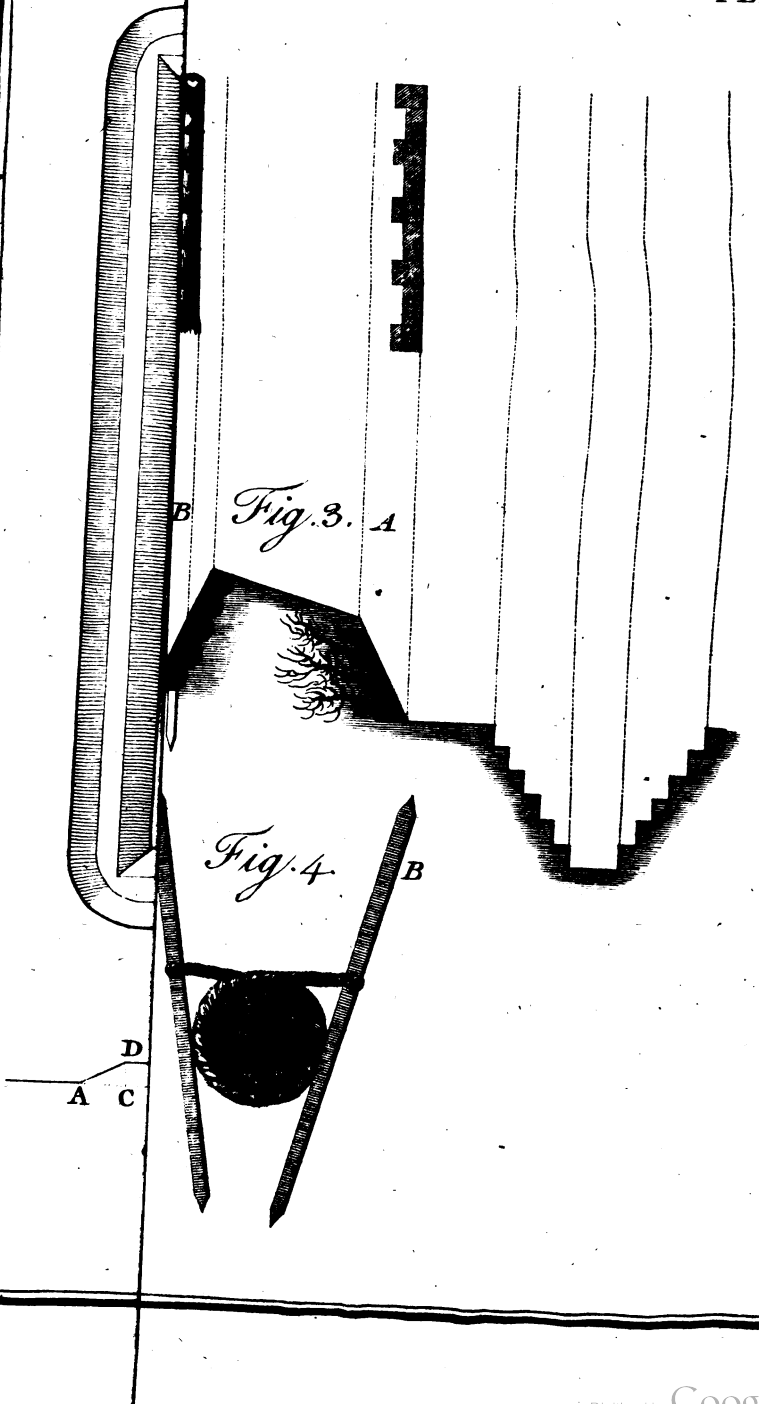

Fig. 3.

Fig. 4

PLATE VII.