

"morale" and self-confidence sufficient for line formations. But is the British soldier in the present day mentally and physically superior to the German?"

Would it not be wise to admit the possibility of our lines wanting in stability when facing Prussian infantry, if only for the sake of argument? The Germans had much experience, yet they attacked St. Privat with columns, and these were the *élite* of the Prussian army—the Guard. Their loss, as one might suppose, was enormous; still, to-morrow, they would adopt the same formation. The author trusts assistance will be given him in further discussion on so important a question.

If the distance between lines be decreased will the compromise suffice? A battle, when the sharpshooting business is over, must prove quick and decisive. There is no such a thing as throwing back a line of 1 16th of a circle on the centre company of a flank regiment in modern battles. When a weak point shows itself support must be at hand. The breaking up of a first line is the work of a moment, when quick firing and bayonet charge begins.

The writer deprecates any dogma being laid down on a theorem of such vital importance.

The official account of the campaign of 1870 ought to be translated and served out as food for the official mind; and if the peace manoeuvres of the British division in 1872 bear any resemblance to those in vogue for the last fifteen years, the military talent of Great Britain may be pronounced precarious. But why should this be the case? The Ditch book is second to none the army is daily becoming more professional; and who will dare assert that British generals are incapable of affording their subordinates practical demonstration of historical and theoretical truths?

On no single occasion did the French army of 1870 prove a worthy heir to the glorious name of a warrior race. Outwitted, outnumbered, outmarched, undisciplined, uneducated, unsupplied, by hundreds of thousands it glided into bondage, leaving a defenceless nation to rue the day when confidence first reposed in the peccant judgement of one human genius. Thus will it ever be when power is centralized and becomes the monopoly of one individual and his satellites. The individual may mean well, but it is not in mortal man to close the ear to flattery or resist the soothing comfort of a routine narcotic. Begone, spirit of unrest! Why torture me with novelty? I'm the king, am content—what wouldst thou more? The despot sleeps, the courtiers laugh, Diogenes returns to his tub, and the nation is ruined?

THE UNITED STATES COAST SURVEY.

Few persons who have not examined in detail the work of the Coast Survey have any idea of the magnitude and importance of the results which have been obtained, and of the credit which its management has brought to the country. From a very small beginning in 1807, it has gradually attained a position in which it holds the respectful attention of the whole scientific world. In that year, upon the recommendation of President Jefferson, Congress passed an act authorizing a full and accurate survey of the coast of the United States, and Mr. J. R. Hassler, who had some experience in the work of the kind done in Europe, was appointed to take charge. While he was in Europe attending to the construction of the necessary instruments and obtaining the necessary outfit, the war broke out between the United States and England. The work,

thus hindered and delayed, did not commence until 1817, when Mr. Hassler commenced operations on Long Island. It was almost immediately interrupted again by the want of funds, and in the following year the law appointing the superintendent was repealed. It was not until 1832 that the matter was again forced upon the attention of Congress. The existing charts had by that time been found so accurate, and the consequent danger in navigating the coast so great, that the Secretary of the Navy was compelled to declare them expensive and unsafe, and recommended a geodetic survey of the coast, as contemplated in the law of 1807. Thus urged, Congress again authorized the survey, and made an appropriation for the purpose. Mr. Hassler again took charge of the work, and continued its superintendent until his death in 1843.

Owing to the novelty of the work in all its branches in this country, Mr. Hassler had many difficulties to contend with, but notwithstanding, very creditable progress was made, as may be inferred from the fact that his triangulation covered an extent of about nine thousand square miles. But the fitting symbol of the United States is the flying eagle. Nothing is ever fast enough for its restless wings. Clamors arose in Congress that the work was too slow, and a committee was appointed to investigate. But, though anxious to find the clamors just, that committee was compelled to endorse the plan of Mr. Hassler in every respect.

Soon after this, in consequence of Mr. Hassler's death, the work passed into the charge of Professor Alexander Dallas Bache. This gentleman soon became impressed with comprehensive and just estimate of the magnitude of the work, and urged a more extended system in accordance with which the survey should be commenced and carried on in many places at the same time, each independent of the other for the time, but finally to be combined in one connected whole. His recommendation was immediately approved and the appropriations made. In five years the work was in successful operation along the whole coast and in the Gulf of Mexico, and when California was annexed the Pacific coast was included in the general plan. The survey continued in the charge of Prof. Bache until his death, which occurred in February, 1867, and was universally and deeply lamented by his scientific associates and a multitude of personal friends.

Professor Benjamin F. Pierce, the distinguished astronomer and mathematician, succeeded Prof. Bache, and now superintends the operations of the coast survey. Some idea of the extreme accuracy with which the survey is carried on may be obtained from a description of the manner of measuring the base lines of the primary triangles. Four bars, each a little over two yards in length, are clamped together, end to end making a combined length of eight yards, or of exactly eight French metres. These bars are stiffened by being placed in a wooden box, allowing the ends to project beyond the box, the whole forming a measuring rod which is used as follows. The compound bar is carefully placed in position in the line to be measured, and a powerful microscope placed over the forward end and adjusted so that its crosswise exactly coincides with the edge of the bar. The bars are then advanced until the rear edge comes into exactly the same position under the microscope that the forward edge has just left. A microscope is now adjusted over the forward edge again, the rod advanced as before and adjusted to its second position. This process is repeated until the base line

of six miles more or less, is measured. During the whole time the temperature of the bars has to be carefully observed. The base line apparatus now in use was devised by Prof. Bache, and has superseded the one here described on account of its greater accuracy. The measuring bar is so constructed that its length is not affected by changes of temperature, and greater nicety is obtained in making each successive length of the bar commence precisely where the previous one ended. Such accuracy has been obtained in the use of this apparatus that repeated measurements of the same mile do not differ from each other more than the one-twentieth of an inch. The necessity for such accuracy does not at first sight appear, but becomes evident when we remember that an error of one-thousandth part in the base line is reproduced in such a way that all the lines measured will be an error one-thousandth part. This in a line of one hundred miles would be about five hundred feet. An error of five feet in that distance would disgrace the survey. In order to verify the triangulation a line is established by means of it at a considerable distance from the base, and then measured with the base line apparatus. The length of the line by the two methods should agree. It is a source of gratification to those who take pride in the successes of their own country that our Coast Survey, tried by these checks, is not surpassed by the most careful surveys of any other country. The accuracy which is indicated by this method of measuring the base lines is an example of the accuracy required in every part of the survey. In every triangulation the form of the earth has to be rigorously taken into account, and the angles are obtained by repeated measurements with the most accurate instruments. The geographical positions of the various stations have also to be fixed by the most refined astronomical observations, reduced by the most elaborate and accurate methods. In this way the assumed figure of the earth is constantly tested, and the effect upon the plumb line of its irregularities and want of homogeneity shown. Two methods of making astronomical observations, first introduced into work of the kind by the United States Coast Survey, have drawn very flattering commendation from the old astronomers and masters of survey in England and Europe generally. They are that of determining the latitude with the zenith telescope, and that of determining the longitude with the aid of the telegraph. The accuracy obtained by these methods is such that they have nearly superseded all others.

Following the determination by triangulation and astronomical observation of the position of points on the land, comes the survey of the sea bottom. Here, also, valuable accuracy is only obtained by great labor and faithful attention in all the details of the work. It involves the production of an accurate chart of the earth beneath the water along the whole coast, giving the form of sandbars and the position and shape of rocks, and showing how these are affected by tides and currents. It thus relieves the tempest-tossed sailor from dangers which in times past have put so many lives and so much wealth to the hazard—dangers more scorned, it is true, by the sailor than by the landsman, safely housed at home, whose pockets are depleted and his wealth buried in the sailor's watery grave.

Some of the best fruits of the survey are brought out in the topographical branch of it, where the mapping of the shores is carried as far inland as is required for the purposes of navigation and the defence of the