### A PROJECT FOR THE REORGANIZATION OF THE ARMY.

The intelligent observer from the other side of the ocean has often, upon his return home, recorded his surprise that a nation of fifty millions of people should suffer its seacoast defenses to fall into decay, its army to sink into insignificance, and its fleet to lapse into the proportions of that of a power of the fourth class. To the European mind, wedded as it is to the theory that peace is only secure when sustained by the power to make war, the idea that there is safety in disarmament is incomprehensible.

The superficial observer, as we know, ascribes the lamentable condition of both our military arms to the temperament of the people themselves, who, to his mind, are too much absorbed in the race for wealth to guard against disaster when it shall have been acquired.

This is, there is reason to believe, only in part true. Recent events have shown that, when the matter is set before the people in its true colors, when the necessity for certain military precautions is shown and the reason for armament explained, they are quick to realize it. Hence it was that the scheme to improve the naval service and, above all, to manufacture heavy rifled steel guns for coast defense, was recently set afloat. Little, however, has been said about the army, notwithstanding the words of warning uttered by its late retiring chief. With a view of obtaining plans for the thorough reorganization of the military arm, the Military Service Institute recently offered a prize. The successful essay was contributed by Lieut. Arthur L. Wagner, Sixth U. S. Infantry. It is a concise statement of the military necessities of the United States, and, since it has been sanctioned by the best military authorities, may be looked upon as a correct estimate of our requirements.

The general plan outlined by Lieut. Wagner is the organization of what might be called the nucleus of an effective army, which, in time of war, could be readily expanded into a much larger body of trained fighting men, supported by a militia organization practically trained in the most minute details of the school of the soldier. He would have the peace establishment at 27,501 officers and enlisted men, which on a war footing should be raised to 56,356. First and primarily he would have each arm of the service—artillery, cavalry, and infantry—armed and equipped with the most efficient weapons and accouterments. The field artillery should be provided with Gatling and rifled guns, and so drilled that they could work quickly enough to operate at a moment's notice, even on an advance skirmish line; the gunners being protected by shields from the attacks of sharpshooters. He is sustained by the best modern authorities when he claims that cavalry, to be most effective, should fight afoot save upon those rare occasions when a sudden dash on an exposed flank or the like should be required of them. The saber, he thinks, ought not be discarded, but the principal weapon of the trooper should be an improved magazine rifle.

One of the most interesting features of Lieut. Wagner's paper will be found to be the description of a model national reserve, composed of a battalion from each congressional district in the country. This reserve, composed of the same material as the present militia, should be partly equipped by the Government, and be instructed under the personal supervision of army officers detailed for the purpose. It would consist entirely of infantry and heavy artillery, the latter being limited to companies and battalions in the seacoast cities, drilling usually as infantry, but at times serving the great guns mounted in the neighboring fortifications.

As a whole, this paper of Lieut. Wagner's will commend itself not only to the soldier, but to the people themselves; for, while providing for a powerful military organization, by far the greater portion of the power is arranged to be wielded by the people themselves, who are sovereign.

### SHAFTS AND BELTS.

In many cases the shafting is too light for the weight put upon it and the strain to which it is subjected. In many cases the bearings are too far apart to properly sustain the load when in motion. In many cases the directions of the belts are either absolutely improper or relatively wrong.

Recently much trouble was caused by the heating and rapid wearing out of the boxes on the receiving length of a main countershaft in an establishment which occupied a four story building. The length of shaft, which was only two inches diameter, was replaced by one of two inches and three-eighths, but the trouble still continued. Between two hangers, a little over eight feet apart, were hung pulleys, the aggregate weight of which could not have been less than six hundred pounds. The main driving belt, twelve inches wide on a six foot pulley, ran directly up and down—vertically—and every other belt pulled in one direction. The main belt that ran vertically weighed about two hundred pounds. With these data the intelligent millwright or other mechanic can readily see that economical running was impossible.

Objection is made to shafting, stiff enough to bear the load and strain, on account of its weight. This might be remedied in a great measure by substituting hollow for solid shafting. This subject was treated definitely in the SCIENTIFIC AMERICAN of May 12, 1883, under the heading "The Load of Shafting," showing that the change was entirely feasible.

Part of this objection might be removed, also, by sufficiently supporting the shaft, as it is evident that a shaft will run with less friction when running perfectly straight and level than when running on the "double wabble" principle: at least no deflection out of a direct line should be permitted on a shaft at any place in its entire length. Even if this deflection is not apparent to the eye, it can be detected by holding the finger against a shaft in motion.

The direction of belts is a subject that is not usually sufficiently considered. If a belt is hung to run vertically its entire weight is upon the upper shaft, and it must be kept so tight as to take up the sag of its weight, which causes it to fall off from the bottom of the lower pulley. If a belt must run vertically, let the lower pulley be as much larger than the upper one as possible, so that the belt can have a bearing on its sides. Under no circumstances allow the lower pulley to be smaller than the upper one; it is best always in leading from a lower to an upper shaft, or *vice versa*, to give the belt an angle; the best running belts are those which run horizontally.

Never have the pull of the belts all on one side of the shaft; it is unnecessary to point out the reasons why. The pull of belts should be as equally distributed relatively as possible.

It is an easy matter to ascertain the proper position of the bearings of a shaft relative to its weight before the hangers are placed and the shaft hung. Place the bare shaft on boxes on movable horses, the bearings being at the desired distance apart. Then load the length of shaft with the weighed or estimated load of pulleys, and notice any deflection. The load test need not be the actual weight, but only a relative portion. Rig a lever over the shaft midway between the bearings on the horses, one end of the lever to be held by a rod bolted to the floor and the other end loaded. By estimating the difference (relative) between the fulcrum and the shaft and the shaft and the weight at the end of the lever, a comparatively easily handled weight can represent the total weight of the shaft, on the principle of the ordinary steam boiler safety valve lever. After testing the shaft by the actual weight of the pulleys and belts it has to carry, add fifty per cent more for the sagging, swaying, and vibration of the belts in motion, and when this total weight can be sustained without deflection, the position of your bearings is determined.

### POISONING FROM GALVANIZED IRON.

No questions can by possibility be of more intense interest than those which relate to the means of supplying pure water for use in our cities and towns. All the drift of modern research has been to show that diseases of various types are spread through the agency of drinking water more energetically than in any other mode. But of what use is it to search with diligence for a pure source of supply, if in the process of transmission to the consumer the water is to absorb that which shall carry with it death, or at least the seeds of ill health? The mode of distribution becomes therefore of equal importance with the source of supply.

With the primary conduits, channels of brick or stone, and street mains of iron, there seems to be no occasion to find fault. Pure watering entering them will be delivered pure. The practical danger must come, if it comes at all, in the smaller distributing pipes, the house service. For this purpose three metals are in use in all our cities—lead, iron, and galvanized iron, the latter being really zinc. With the two former we do not propose at present to deal; but inasmuch as recently attention has been publicly drawn to cases of supposed poisoning from drinking water which has passed through pipes of galvanized iron, it is worth while to look to the matter closely. We have been accustomed to believe that galvanized iron was a perfectly safe material; if it is not so, the public ought certainly to be advised of the fact.

The first question for us is, What are the chemical *possibilities* involved? We are to take the case only of water which is supposed to be sufficiently pure for drinking, thus necessarily excluding that which is to any perceptible degree brackish. We have not, therefore, to suspect the presence of chlorine or of alkalies in sufficient proportion to have any appreciable effect. Neither can we have to deal with any organic acids. The water, of course, carries with it free air, whose oxygen is a powerful agent, and we have thus the means of forming zinc oxide constantly present. But the oxide of zinc is as insoluble in water as the metal itself, and as an oxide we may discard it from the question. And it would seem then that a galvanized iron pipe of any length ought to deliver the water as pure as it receives it. And chemically speaking this is no doubt true. But another factor is involved, which can by no means be neglected; this is mechanical attrition.

That the galvanized pipes are constantly wasted by the water is certain; the zinc surface is destroyed, and accumulations in the pipes occur sometimes, almost choking them, but this is done apparently only by the force of the current cutting off and carrying with it either metallic zinc or the coating of oxide, two inert and innocuous substances.

Now if we could stop here our chemistry would surely carry us safe; but the very object for which we are bringing the water is that it may go into the stomachs of consumers, and here we encounter a new series of conditions.

The gastric follicles, called into special activity at every act of digestion, develop an acid secretion. The precise nature of this is still a matter of dispute among physiologists, though all agree that it is either lactic acid or hydrochloric. Either one of these would at once dissolve zinc oxide or metallic zinc. Of the physiological action produced by zinc lactate we have no knowledge; but inasmuch as the two acids are so closely allied as to be distinguished with difficulty, it is reasonable to infer that their salts would have a corresponding resemblance, and the chloride we know abundantly as a violent poison; we may doubtless fear the lactate.

Here then seems a real source of danger from water flowing through galvanized iron pipes, and if really any injury has ever been produced by such water, it is doubtless in this manner that it has been done. But the remedy is plain and sure. The metal and the oxide are both insoluble, and can surely be filtered out. If, therefore, the water could always be filtered no danger would ever occur, but unfortunately this is done in so few instances that the practical bearing of it is small. And we come then to the question, Is this evil, thus shown to be chemically possible, anything more than a mere matter of theory? Have we any proof that poisoning has ever been produced by the use of the so-called *galvanized*, that is, zinc coated pipes?

We have examined with very great care all the accounts available, and so far we can find nothing to convince us that injury has ever occurred. Various reports have appeared of injurious effects, but none of them have been substantiated by satisfactory proofs. So many other causes of ill health, even of sudden attacks simulating the effects of poison, are liable to be intervolved in almost every case, that newspaper statements are to be received with extreme caution. And considering the small numbers of even these which have appeared in comparison with the countless myriads of those who are constantly using the water from zinc pipes, we are fairly entitled to believe that practically no danger can be attributed to them, and that the public may rest satisfied to hold them safe and harmless, the amount of material presented for the chemical action in the stomach to which we have referred being in fact too insignificantly small to produce any result.

### The McCormick Observatory.

At the recent meeting of the American Association, Professor Ormond Stone, director of the Leander McCormick observatory of the University of Virginia, gave an elaborate description of that observatory, now approaching completion, and to be devoted entirely to original research. The telescope, which will soon be mounted, is the twin in size of the Washington twenty-six inch, and like it in most of its details, except the driving clock, which is like that of the Princeton twenty-three inch, with an auxiliary control by an outside clock, and that it has Burnham's micrometer illumination. The observatory has a permanent fund of seventy-six thousand dollars as a beginning; and eighteen thousand dollars have been expended in observatory buildings, and eight thousand dollars for the house of the director. Situated eight hundred and fifty feet above the sea, and on a hill three hundred feet above surroundings, the main building, circular in shape, is surmounted by a hemispherical dome forty-five feet in diameter. The brick walls have a hollow air space, with inward ventilation at bottom and outward at top.

Mr. Warner, the builder of the dome, gave an interesting description of the ingenious method of adjusting the conical surfaces of the bearing wheels, so that they would, without guidance, follow the exact circumference of the tracks; and then of the adjustment of the guide wheels, so that the axis of this cone should be exactly normal to the circular track. The framework of the dome consists of thirty-six light steel girders, the two central parallel ones allowing an opening six feet wide. The covering is of galvanized iron, each piece fitted *in situ*, and the strength of the frame is designed to stand a wind pressure of a hundred pounds per square foot. There are three equal openings with independent shutters, the first extending to the horizon, the second beyond the zenith, and the third so far that its center is opposite the division between the first and second. The shutters are in double halves, opening on horizontal tracks, and connected by endless chain with compulsory parallel motion of the ends. The dome weighs twelve tons and a half, and the live ring one ton and a half; and a tangential pressure of about forty pounds, or eight pounds on the endless rope, suffices to start it. If this ease of motion continues as the dome grows old, it is certainly a remarkable piece of engineering work.

### Wells and Cholera.

The New York Board of Health condemns the use of water obtained from the artesian wells of the city, maintaining that it is unfit for human use, and recommending that all the wells be immediately closed. Dr. Cyrus Edson, of the Board, says he does not believe there is one well in New York city that is safe, for the reason that the substrata beneath the city are contaminated in some degree by leakages from the sewers and other drainage. Paris can have good wells, because the watershed is 182 miles away, and London has a like advantage. But the watershed of New York is the city itself situated right over the wells. The chief reason urged for the closing of the wells is of course protection against disease, and especially against cholera. Dr. Edson is certain that in ninety-nine cases out of a hundred cholera gets into the human system through the germs in water used. The judgment of the intelligent gentlemen composing the Board of Health that the wells are really dangerous will justly carry great weight, especially in view of the possible advent of cholera here. Those who have expended large sums in sinking wells for the supply of their buildings, the *Insurance Critic* thinks, will naturally be reluctant to yield to these conclusions. But all will admit that public health and safety should be the governing consideration.