

case. But for years past the American cheeses have been growing in favor, not only here, but in England. A late number of the *London Grocer* says:—"The Americans and Canadians are emulating our most successful dairymen, and really choice American and Canadian cheese may now be obtained from those English importers who have made themselves well acquainted with the best sources of supply."

If cheese could be afforded at a fair price as compared with meat, there is no reason why it should not become, in a measure, a substitute, as it seems to be especially adapted to restore the force expended by those whose work is extra laborious and exhaustive; and, indeed, it may be questioned, now, whether it is not as cheap, all things considered, as fresh meats. It is a subject worthy some consideration.

ITEMS OF THE STATE OF IRON MANUFACTURE IN PORTIONS OF THE EASTERN STATES.

One of our reporters has recently made a flying trip through some of the Eastern States, and noticed that in general iron workers appear to be doing well, having orders enough on hand to last some time.

In Hartford, Messrs. Geo. S. Lincoln & Co., an old established and well known house, are doing their usual line of castings and machine tools. Messrs. Lincoln & Co. have built most of the tools for Colt's Armory, and large numbers of milling and other machines for Wheeler & Wilson and various sewing machine factories. Their work is first class, and in the dullest times they have been busy.

Pratt, Whitney & Co., have one of the handsomest and most convenient machine shops in the state, and the proprietors are both known as superior mechanics. They manufacture machine tools of all classes, and also the Weed Sewing Machine. Pratt & Whitney's engine lathes are most excellent machines, and are fitted with a patent attachment for turning tapers without moving the centers out of line with each other, as is the case when the tail stock is set over.

Woodruff & Beach have a lot of orders for stationary engines on hand. They make a strong, substantial, and highly-finished machine. They have built engines for the United States Government, and also for many factories throughout the country. Their engines are fitted with a variable cut-off of Green's patent which gives great satisfaction.

In New Britain, Conn., Messrs. Landers, Frary & Clark have recently erected a large and splendidly appointed cutlery establishment, near the depot, which is now in active operation. The Stanley Works are also about taking up another line of manufacture, for which they have put in one of the Shaw & Justice Hammers. Messrs. Thomas Humason & Beckley are running on their usual class of goods, cast-steel hammers, etc., etc.

In New Bedford, the Gosnold Mills are at work on horse shoes, employing a few men at present. In this town, however, we were much pleased to notice an innovation in the machine line that is creditable to the employer and beneficial in a moral point of view; namely opening a new branch of trade to female labor. These opportunities are so few that it is matter of congratulation that another chance is offered them. The Morse Twist Drill and Machine Company employ twenty-four female machinists in the manufacture of their tools, and we saw them hard at work a few days ago, cheerful and contented. These girls do filing, of a light nature, just as well as men could, and much better than boys who were "so full of the devil," as Mr. Morse stated, that nothing could be got out of them. They earn good wages, are exposed to no bad influences, being in an apartment by themselves, and seemed contented and prosperous. Beside filing they tend light machines, grind drills, and do other miscellaneous tasks. This is certainly much better than being stifled up in a noisome workroom, cramped over a needle for a miserable stipend. We wish our space permitted further mention of this admirable little shop. Mr. Morse is an alive mechanic, takes the *SCIENTIFIC AMERICAN* as a matter of course, and believes in going ahead. He has just built a large addition to his shop, and is prepared to do machine work of all kinds. Mr. Morse is an inventor of a remarkably original turn of mind, and has got up special machines for almost all his work.

In Worcester, Mass., Messrs. L. & A. G. Coes are making their celebrated screw wrenches which they have had in market for many long years. The Coe wrench is an "indispensable institution," as their orders prove conclusively.

Messrs. Ethan Allen are making their celebrated Damascus guns, and also pocket pistols and revolvers. The several machine-tool makers are doing a fair amount of work.

In Winsted, Conn., the scythe and axle makers are doing well. Mr. Hurlbut, axle maker and general forger, informs us that he has no reason to complain.

In Seymour and in various towns along the Naugatuck Railroad we find a fair activity for the season, particularly in cutlery establishments. The axle trade of this country must be something enormous, for we find establishments very busy and more going up. The Aetna Spring and Axle Company are just starting at Bridgeport, and the Spring Perch and Axle Company of that place, some time established, are doing a good business.

New Year's.

J. B. Aiken, of Franklin, N. H., has sent us a nice bundle of warm stockings knit on his patent machine. He also sends us a package of photographs, taken by him last summer in Colorado—being his first attempt in the art. The specimens would do credit to an experienced artist. Another friend in Pittsburg has forwarded some "Old Rye," put up in one of Stoekel's patent graduated bottles. Will the donor be kind enough to inform us what he wishes us to do with the contents?

SHOES VS. SANDALS.—THE CLASH OF ATOMS.

BY PROFESSOR CHARLES A. SEELY.

In the state of nature the feet of man are the least vital parts of his body, and as they were intended to perform heavy service they were endowed with extraordinary powers of endurance. But fashion and art long ago ignored these good designs of nature, and now our feet are proverbially weak and sore. Every one at some time has his corns, or that other disease quite as common, which make his presence hateful to his best friend. Although the feet are not the seat of fatal diseases, yet they are the open portal which invites to the lungs its most terrible enemy. We learn from the ancient poets that the feet were regarded as objects of beauty, but now our feet are so pinched out of shape, that we may search a long time for a well formed foot, unless we go to the ancient statuary, or among the semi-barbarians of the east.

This state of things did not exist in ancient times: if corns had been invented in his time, Job would surely have told us about it. And at the present day the poor Indian of untutored mind knows nothing of our fashionable diseases. Corns and mis-shapen feet are incidents of modern civilization.

Such a statement of the case as this is sufficient to suggest to the minds of most people, the cause and perhaps a remedy. The radical view of the subject is, that the cause is leather and the remedy is sandals: leather obstructs the healthful perspiration and ventilation of the feet almost as effectually as would sheet iron: the feet need no more protection than the hands or the face: down with leather. But I am no radical. The fashion of centuries is too respectable to be dealt with in a violent way. "Nothing like leather" has been too long a household proverb to be forgotten in a day.

It is entirely practicable however, to institute the beginning of reformation without making ourselves obnoxious to the reasonably fastidious. Thus: We may refuse to wear shoes which pinch us or tend to press the feet out of shape, we may prefer thin porous leather, and wear cloth shoes whenever fashion will permit us. And we may think of the reform and reason upon it with our neighbors. In these little ways, we shall strengthen ourselves in the faith and hasten so much of the millennium as pertains to the feet.

In my opinion here is to be a fruitful field for the inventor. I suggest a few problems: How to make leather less unsuitable for shoes: Better ways of uniting cloth uppers to leather soles: How to weave a shoe and attach a sole: The best fiber for a cloth shoe: How to protect the feet from rain and yet secure ventilation: To make a shoe of net work, or of perforated leather.

THE CLASH OF ATOMS.

Prof. Tyndall and others advocate the theory that the heat of combustion and chemical action generally is only the heat of collision or percussion. In combustion of coal, for example, the atoms of carbon and oxygen rush upon each other and thus strike fire. This view of the case involves some very interesting consequences.

One pound of carbon in burning, as determined by experiment, gives out 8,000 units of heat, that is, heat sufficient to raise 8,000 lbs. of water one degree. Now the theory implies that an equivalent amount of force (*vis viva*) has been expended or converted. The mechanical equivalent of 8,000 units of heat is $772 \times 8,000 = 6,276,000$ foot pounds. Now on the supposition that the pound of coal is burned in one minute we have the force represented in horse-power, thus: $6,276,000 \div 33,000 = 187.15$ horse-power. But we know that by pulverizing the coal and burning it in pure oxygen it may be consumed in an indefinitely short space of time. Suppose that the time taken be so long as one second, then the number of horse-power concerned in that time is $60 \times 187.15 = 11,229$!

Yet this calculation gives still a very imperfect notion of the immensity of the force involved in the burning of a pound of coal. The distance through which atoms move to unite chemically is unmeasurably and insensibly small. The velocity which a pound of matter must attain in order to evolve 8,000 units of heat by percussion is $(\frac{1}{2} \times \frac{1}{2} \times 8,000) \div 3,514$ feet per second. What must be that force which can start matter from a state of rest, and in an insensible space give it such a velocity? What the resistance that instantly destroys the momentum? Gravity, which moves the universe, requires 1,600 feet of space and 20 seconds of time.

OUR STEAM NAVY.

It may be said with some truth that a man's rivals are his true critics. So in nations we learn of our failings from rival nations. We copy a critique on our present steam navy, from *The Engineer*, which embraces a very sensible discussion of a subject that concerns deeply the interests of our country. We may say *en passant* that the management of the engineering department of our steam national marine has offered the opportunity of which *The Engineer* avails itself. There is evident need of improvement, as may be seen by the comparison which the English periodical institutes between English and American vessels.

MARINE ENGINES IN THE UNITED STATES NAVY.

If reliance is to be placed on the reports which reach us from America, it is not only probable but perfectly certain that the efficiency of the new navy now springing into existence in the States, will be seriously impaired by the defective nature of the machinery with which it is being supplied. The American press denounces the Bureau of Steam Engineering—a Government department of which Mr. Isherwood is chief—in no measured terms; and apparently the complaint is not without foundation. It is quite possible that all that is said of the engines of the new fleet is not perfectly true; but the arguments put forward by such of Mr. Isherwood's subordinates as have ventured to defend the practice of their chief are so weak, and the results of practical trials of his

machinery are so inferior to those obtained with the marine engines of the old world, that we are forced to the belief that the tales which are told of official incompetency and the failure of engine after engine are substantially correct. Nor is it to be supposed that engines defective in design and workmanship are supplied to Government ships only by Government officials. Even private manufacturers appear to be singularly unfortunate in their dealings with the American navy. Those are not wanting, however, who with much plain speaking to use somewhat of a euphemism—assert that the fact is due to the interference of men who are unable to supply good engines themselves, and who are unwilling to be beaten by others. In a word, both the theory and practice of American marine engineering as far as concerns fighting ships is, at present, in an extremely anomalous condition, while the literature of the subject as represented by both the editorial and correspondence columns of the scientific and daily press is simply unique in its character.

Mr. Isherwood's screw engines of the largest class are for the most part similar in type to those of the Miantonomah, already described in our pages. They are back-acting, and so far resemble Maudslay's double piston rod engines, but there the resemblance ceases. They have single piston rods laying hold of a rectangular frame consisting of a crosshead, to the center of which the piston rod is affixed; a cross tail, off which the connecting-rod works; and a pair of round side rods, one of which passes above and the other below the crank shaft. In all this there is nothing remarkable. But the capacity of the cylinder for a given power is very much less than English engineers consider sufficient; while the dimensions of the boilers and the weight of the machinery, taken as a whole, is much greater. Mr. Isherwood does not believe in expansion, and therefore his cylinders are small, because the terminal is nearly as great as the initial pressure. But his boilers are large because he uses steam uneconomically. As an illustration of his most recent practice, we may select the machinery of the *Franklin*, one of those magnificent wooden unarmored frigates intended to steam at a high speed and to carry very heavy guns, with which it is proposed to keep American commerce safe from *Alabamas* in future. Much has been heard of this new fleet in this country, and all that relates to it possesses great interest. We learn from our American advices that the *Franklin* is an enormous ship of splendid model and as strong as wood and iron can make her. It is obvious that in ships intended to act the part of police of the seas, speed is the first essential, yet Mr. Isherwood promised that he would get ten knots! out of her, and it appears more than probable that even this poor result will not be realized. The *Franklin's* machinery consists of two "back-acting"—return connecting-rod—engines with cylinders 68 inches in diameter and 3 feet 6 inches stroke. These are obviously moderate proportions for a ship of the class, and if the boilers were designed in accordance with English practice we should simply say that the vessel was underpowered. But the boilers are designed in accordance with Mr. Isherwood's practice which is sufficiently original. There are four main boilers constructed with vertical tubes under Martin's well known patent, and two superheating boilers of similar construction, the only difference being that very little water is carried in them; the steam being dried in the upper portions of the tubes. Without going into details, for which we have not space here, we may give a fair idea of the steam generating powers of these boilers by stating that they have no fewer than 583 square feet of grate area, and about 14,500 feet of heating surface. Let us compare these proportions with English practice. The *Lord Warden*, of 1,000-horse power nominal, has 700 feet of grate and 19,000 feet of heating surface. Her boilers are designed to supply three cylinders, each 91 inches in diameter and 4 feet 6 inches stroke, the steam being cut off at about one-sixth of the stroke. The displacement per revolution, omitting clearance and waste in ports and passages, being 1219.5 cubic feet. The *Franklin* has, as we have said, 583 feet of grate, and 14,500 of heating surface, intended to supply two cylinders 68 inches diameter and 3 feet 6 inches stroke, representing a displacement per revolution of 353 cubic feet only. Assuming that the engines of the *Lord Warden* are properly designed—and Messrs. Maudslay and Field do not make mistakes—we find that the proper displacement for the cylinders of the *Franklin* would be 1015.66 cubic feet, equivalent to a pair of cylinders of 113½ inches in diameter, the stroke remaining 3 feet 6 inches; or 100½ inches diameter if the stroke were increased to 4 feet 6 inches—that of the *Lord Warden's* engines. The accuracy of the deductions to be drawn from a comparison of these proportions depends, of course, on the piston speeds being the same. Assuming the number of revolutions in the case of the *Lord Warden* to be 60, we have a piston speed of 540 feet per minute. It is not likely that the pistons of the *Franklin* will be run at more than this, which is equivalent for a 3 feet 6 inches stroke to rather over 77 revolutions per minute. It is therefore obvious that her cylinders are out of all proportion too small for the boilers. Indeed they could not possibly work up the steam which the boilers ought to make, were it not that the cut-off valve does not close till the stroke is nearly completed.

It is not in the cylinders alone, however, that Mr. Isherwood's design is objectionable. Catching at the idea that plenty of surface is essential to the life and easy working of a bearing, the chief of the Bureau of Steam Engineering carries out the principle like an amateur, manifesting an utter disregard for the teachings of practice. The bearings of the crank shaft are made half as long again as the longest in use in English marine engines, and as a result they bind and cut. Americans are peculiarly attached to a system of trial which consists in lashing a vessel to quay wall, and then running the engines, usually for a period of seventy two hours. During