# SCIENTIFIC AMERICAN.

**MUNN & COMPANY, Editors and Proprietors.**

PUBLISHED WEEKLY AT
**NO. 37 PARK ROW (PARK BUILDING), NEW YORK.**

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☞ "The American News Company," Agents, 121 Nassau street, New York.

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VOL. XVI., No. 4....[NEW SERIES.]....*Twenty-first Year.*

NEW YORK, SATURDAY, JANUARY 26, 1867.


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(Illustrated articles are marked with an asterisk.)



## THE CARE OF TOOLS.

We believe—although we are not certain that it is capable of demonstration—that more tools are ruined by want of care than broken or worn out by proper use. It is surprising how easily the man forgets the "bridge that carried him over," how ready even the thoughtful workman is to leave to neglect the tool which has just subserved his purpose. Carelessness in the use of tools is a source of enormous annual expense to manufacturers and others, an expense which, if aggregated would probably surprise even the most observant. On the farm the plow is left in the furrow, the hoe between the rows of corn, the shovel in the pit, the scythe on the tree, and the ax in the log—left to rust and to the liability of accidents. The wood-worker, called away suddenly from the job he is doing, leaves his plane on the board he has been smoothing, to be knocked off by the first passer-by, or allows the auger bit or the saw to remain in the half-pierced timber to be broken by the first swinging board in the hands of the apprentice. The blacksmith leaves his tongs at the vise when he needs them at the anvil, and the machinist drops tap, drill, reamer, or hammer, where last used.

Order is the "first law" in the shop as in heaven, and care, no less than cleanliness, is "next to godliness." Next to the advantage of having a place for every thing is the wisdom of keeping every thing in workable condition. In the machine shop the use of impure oils in drilling, tapping, etc., is an expensive economy. Oil containing mineral or earthy matter is only a grindstone in solution. It cuts and abrades the edges of the tool, while in use, precisely as does the grindstone or buff-wheel. Gummy oils are scarcely less injurious. They add to the friction of the tap or drill and demand increased strength to resist torsion. A "gummed-up" tap or file is almost useless until thoroughly cleaned. The application of warm soapsuds, benzine, or turpentine, will not always remove this gum. In such a case they can be readily cleaned by covering them with oil, turpentine, or any inflammable substance, and exposing them for a moment to a flame until the liquid takes fire; then card or wipe them and they will be found to be in excellent order. Finishing files not unfrequently become clogged, and when the card is useless to remove the "gurry," this process will be found efficient.

Sometimes, also, in filing wrought iron the tough particles of the iron are torn off by the teeth of the file and lodge, producing scratches on the work, and thus impairing the efficiency of the tool. A simple device, which we used for years, that easily and quickly dislodges these clinging particles, is a piece of soft iron wire flattened under the hammer at one end to a chisel point, or disintegrated like a broom and used thus: The point of the file resting on the bench, the handle held by the left hand; then strike across the face of the file, in the direction of the "first cut" teeth, with the flattened end. It certainly and thoroughly dislodges the snags, and the file is ready for work. The wire instrument may have a ring turned at the handle end, or be affixed to a wooden handle. No. 8 wire is large enough.

Turning tools, after being tempered and ground, are frequently left wet from the stone until wanted for use. In this state the keen edge is acted upon by rust, and a re-grinding becomes necessary. If not put at once to the oil stone they should be wiped with oily waste. These little matters are more important than they seem at first sight. A saw or chisel which has been used in unseasoned wood, should be carefully wiped and oiled, otherwise it contracts rust and wears away fast. A new file should not be put upon the scale of cast iron or of unannealed steel, and a file kept for brass or bronze should not be used on a harder metal. Back saws for cutting iron and other metals are often ruined in inexperienced hands. If drawn forward and back too rapidly they heat and lose their temper, when they become almost useless.

A hundred other instances might be adduced to show the depreciation of tools by neglect and the necessity of paying attention to these "little things." The real economist, however, needs but a hint, while the constitutionally careless are slow to see their errors.

## PRESERVATION OF MEAT.

It is a well known fact that lean meat, as beef, for instance, becomes dry, hard, and innutritious by salting. Salt being chloride of sodium, and its chlorine having a great affinity for the soluble portions of the flesh—albumen, fibrine, etc.—it attracts the juices, forming a brine, containing the larger portion of the nutritious qualities, with the elements of phosphoric acid, potash, and other mineral ingredients. As these are removed from the meat so is its fitness for food diminished. When lean meat is subjected to the action of salt, the deliquescent properties of the salt attract the juices of the meat, and the brine resulting contains the mineral bases of the meat—the phosphoric acid, potash, etc—with the albuminous elements, all being held in the saline solution.

Fat meat, or rather fat itself, is impervious to salt. The outside becomes indurated by the salt, and refuses entrance to the decomposing gases. Still, salt is a solvent, and it assimilates with the substances with which its solvent properties harmonize. If not adapted to its action as a chloride of sodium, readily uniting with the elements of animal substances except the fatty principle, it drains the meat subjected to its operation of its most valuable qualities. The action of salt, it will be seen from these brief remarks, is almost confined to the lean flesh to which it is applied; although, in fact, it is a necessary element in the preservation or preparation of animal food for the market.

In this connection we desire to say a few words as to the management of animals designed for the slaughter house and the market. Animals which have been subjected to considerable fear and agitation before being slaughtered have their flesh relaxed. They have been in just the worst condition to preserve the fat already deposited on their bones, and in just the best condition for them to make good the waste, if offered the opportunity, to which they have been subjected. How necessary it is then, for the cattle brought from peaceful pastures to the abattoirs of the metropolis to have some days of rest, with proper shelter and good food, before being hurried to the shambles.

The albumen, from which waste of exercise or work is to be made up, is exhausted. Why? Simply this. Muscular action is supported and sustained by the decomposition of carbon in the food eaten, and violent exercise, like a high chimney, induces a strong draft. The carbonaceous or life-giving elements burn out rapidly, when either forced exercise is demanded, or the agitation of the mind is allowed to react on the physical organism; and we are among those who believe that mind, or reason, or intellect, exists among the lower orders of animals as well as in the *genus homo*. These animals, then, intended for the slaughter, may, by the exercise or the excitement of driving, or the fear of unknown harm while *in transitu* on the cars, waste the vitalic force stored in the cellular tissues of their fat and be in a collapsed condition, to speak mechanically, when they arrive at the shambles.

A few weeks ago we made a notice of the new abattoir at Communipaw, and we had something to say as to the matter of bringing meat to market. We then approved of the principle of the management at that establishment, especially in regard to its humanitarian tendencies, believing that what is merciful to the beast is merciful to the man, thereby reversing the form of the old saw: "A man that is merciful to his beast, is merciful."

In fact in this preservation of animal food for human consumption there is involved a law of nature. We have not time nor space to detail the particulars. There is a latent force, or there is a latent heat—in this respect synonymous terms—in all substances, and especially in substances taken by the animal as a part of its organism. Vegetable substances are taken up by grazing animals and as soon as the processes of digestion act, in fact sooner, become a living force in the animal. This force can be expended by violent exercise or by anxiety or trouble, reaching through the sensual or the mental perceptions and affecting the tissues of the physical structure. This may be seen every day. A worried man is never a fleshy man. Swine sometimes refuse to be fatted. They have trouble on their minds. To be made fat they must be free from care and take to their food kindly. Care in their case is dyspepsia. In the case of men, anxiety, producing or at least inducing dyspepsia.

The flesh of wild animals, those we obtain as food, is lean. They are full of anxiety, have no time to get fat, and their meat when salted is not nutritious. Take our domestic animals and they live "in clover," having no care, not harassed nor troubled. They grow fat, and not only put layers of fat over and under the muscles but extend it through the lean tissues. This is the meat, when properly killed, that delights the taste of the epicure and nourishes the frame of omnivorous humanity. We seldom think of preserving the meat of wild animals, especially those which hold their lives by a tenure of grace from unresting enemies, by salt. We view them like fish as fit to be eaten only while fresh. We do not salt down lean animals. Even from the meat of those given to fat we select, the fat for salting, the lean for eating fresh or at most "corning."

Our meat for preservation by salt must be either fat in itself or have fat enough in the lean to neutralize the deliquescent quality of the salt and leave us the juices which contain nutriment, otherwise our "corned beef" would be only the whaleman's "mahogany" or the soldier's "salt horse," and we should be subject to the mishaps of the long sea voyagers or the commissaries of the camp.

## PATENT LAW OF PRUSSIA.

The recent extraordinary military success of Prussia, and the consequent expansion of her dominions, have attracted great attention in this country. We notice a manifestation of this interest very marked among the large class of our citizens known as inventors. They are making many inquiries of us concerning the patent system of Prussia, which we regret to say does not correspond in its scope and application to the liberal and enlightened character of the past, present or future of the kingdom.

The existing ordinance relative to patents in Prussia went into operation, if our impression is correct, as long ago as October, 1815, and has as little in common with the modern age in spirit as in date. Under it, the tenure of a patent right in Prussia is analogous to that of real estate in Turkey: it can be held only by a subject of that power. Foreigners can obtain no foothold in the kingdom for their ingenuity or enterprise, but in the name of some Prussian and dependent on the equity of a private contract with such representative before the law as they may be able to employ. Furthermore, the patented manufacture must be actually introduced within six months, or the protection is forfeited. These two restrictions operate to deter ingenious Americans from undertaking to procure Prussian patents. The protection is too indirect and uncertain, and the time allowed for introduction is much too short to be of any use in most cases, especially with the more important class of inventions. In the absence of available protection, without which men will not engage in new branches of manufacture, the introduction of many valuable improvements and industries that enrich a nation, is retarded or wholly prevented, to the great detriment of that country. It cannot be that a government so enlightened and enterprising as that of Prussia should remain insensible to the mistake in principle and policy contained in this obsolete kind of legislation. Our own patent system is very liberal, and does not discriminate against inhabitants of other nations unless the laws of those nations discriminate against our citizens. The impulse which has been given to invention in this country since the liberal Patent Amendment Act of 1861, has been truly wonderful. During the five preceding years, from 1856 to 1860 inclusive, the number of patents granted was about 18,000. From 1861 to 1865, inclusive, the number increased to nearly 22,000, and that in the midst of our deplorable war, which shut off nearly one half the states from the privilege of the Patent Office.

It seems most probable that the subject will come before the re-organized German Federal Government of which Prussia is the predestined and acknowledged head. Demands are already put forth through the German press, for a uniform patent system for the whole German Confederacy embracing the following points:

Patents to be issued for fifteen years, securing the article patented to the inventor, his heirs, administrators and assigns; no preliminary examination to be required, and inquiry into novelty or priority of invention to be made only when protest is entered against the application; patents to be refused on general principles, without reference to the particulars of construction or use, excluding such articles as may be opposed to public morals or welfare; no limitation of the period for introducing patented articles; patents to be granted without charge until after a limited period, when the fees will be exacted and will be gradually increased; the Government to have the right of appropriating a patent to its own use by paying a suitable fee to the inventor; aliens and citizens to have equal rights before the German Patent Law, and local laws conflicting therewith to be over-ruled.

## CHEESE AS FOOD.

Compared with other people the Americans place but little value on cheese as an article of food. We use it as a condiment, sauce, or side dish, rather than as necessary or proper food. In England, Scotland, Ireland, Wales, and in many parts of continental Europe, it is regarded as a common and sometimes a necessary article of food. There is reason why it should be so regarded. Its composition is very similar to that of flesh, the casein representing the muscular fiber, and the buttery matter the fat portion. Casein is an albuminous substance, useful in building up the muscles, and the buttery matter is a concentrated carbon as useful, in its way, for food as fat meat. The Swiss chamois hunters take on their expeditions among the higher alps, where they remain sometimes for days together, exposed to intense cold and undergoing the hardest of exercise, only a small quantity of cheese and a flask of brandy. The English harvesters live on ale, cheese, bread, and occasionally a bit of mutton. The Germans and Hollanders use cheese as a common article of food.

With some persons cheese is not in favor because of its constipating qualities. Eaten raw it is less so than when toasted or made into the popular dish known as Welsh rarebit. In this form it is scarcely fit for the human stomach. The fatty particles are separated from the albumen and appear simply as liquid oil, while the albumen is changed to a tough, stringy substance, without nutritious qualities and almost as indigestible as sole leather.

Cheese derives a factitious and market value from the districts in which it is produced. The Stilton cheese is a synonym of superior excellence to the English palate, and those who have made themselves acquainted with Teutonic tastes understand well what is meant by Limburger and Sweitzer

kase. 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 Ætna 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: $6{,}276{,}000 \div 33{,}000 = 187{\cdot}15$ 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 $60 \times 187{\cdot}15 = 11{,}229$!

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 $(\frac{1}{7\frac{1}{2}} \times \frac{V^2}{2} = 8{\cdot}000)$ 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 aquay wall, and then running the engines, usually for a pariod of seventy two hours. During