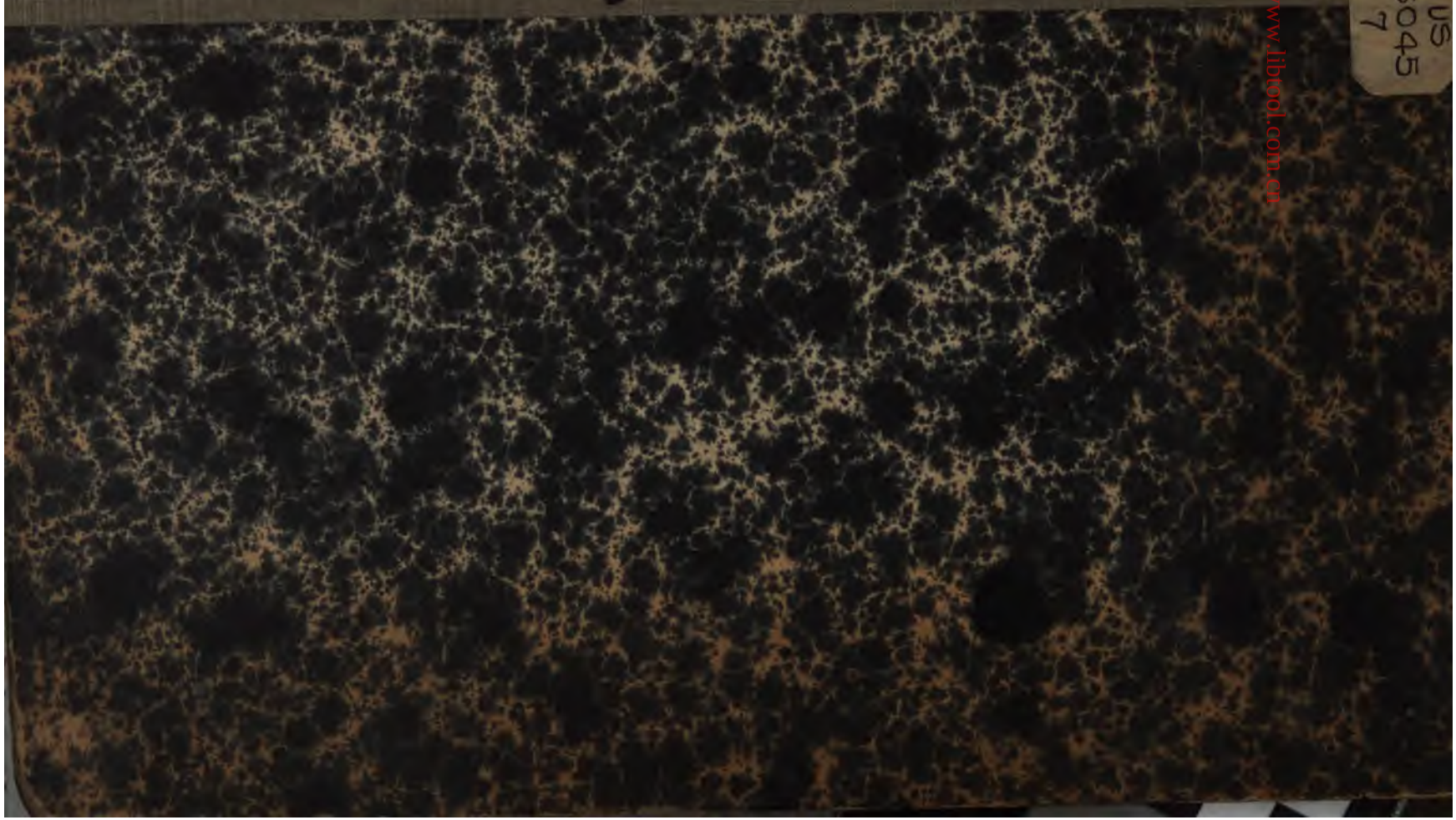
Dickerson - The Navy of the US 1864



THE

NAVY OF THE UNITED STATES.

AN EXPOSURE OF ITS CONDITION, AND THE CAUSES OF ITS FAILURE.

BY

EDWARD N. DICKERSON,

OF NEW-YORK.

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NAVY OF THE UNITED STATES.

AN EXPOSURE OF ITS CONDITION, AND THE CAUSES OF ITS FAILURE,

CONTAINED IN A SPEECH DELIVERED TO A

Jury in the Supreme Court of the District of Columbia,

BEFORE

CHIEF-JUSTICE CARTER.

BY

EDWARD N. DICKERSON,
Of New-York,

IN THE CASE OF

MATTINGLY vs. THE WASHINGTON AND ALEXANDRIA STEAMBOAT COMPANY.

REPORTED BY JAMES O. CLEPHANE,
REPORTER OF THE COURT.

New-York:
JOHN A. GRAY & GREEN, PRINTERS AND STEREOTYPERS,
FIRE-PROOF BUILDINGS,
CORNER OF FRANKFORT AND JACOB STREETS.

1864.

PREFACE.

To MY COUNTRYMEN: I trust that I shall not be thought insincere, when I say that the publication of the following pages gives me no pleasure. As an American, proud of my native land, with whose prosperity, for seven generations, my family has been identified, I can not contemplate this picture with any other feeling than pain; and although I have the consciousness of having done my duty, and have received the most flattering marks of the approval of my countrymen from all parts of the United States, both by letters and by verbal communications, yet these sources of gratification afford me little compensation for the destruction of an entire navy and the general disgrace to the country of this exposure.

My connection with the trial which has thus resulted, was apparently purely accidental. I received one day a telegram from Washington, signed by Mr. Mattingly, a gentleman with whom I had had a slight previous acquaintance, in these words: "Isherwood has sworn that there is no advantage in a cut-off. Important. Come on at once." How or in what proceeding he had so sworn I was not advised, nor did I suspect; but I knew that if I could once get him on the stand, where the law would hold him till I had done with him, it would be mere child's work to expose his ignorance and his corruption; for both are of so conspicuous a kind as to be obvious to the dullest vision. I at once went to Washington, and the following pages show the consequences: The jury rendered their verdict for a saving of thirty-four per cent, produced by the Sickels's cut-off as claimed.

The story of the decay of our navy is a short one, and ought to be understood. Before Mr. Welles undertook to change the system, our naval engines were built on the plans which the experience of the world has proved to be good; and all worked steam expansively *with an independent cut-off*. The plans for each ship were furnished by the builders, and a rivalry was established between the different shops in the performance of their contracts. The Department made conditional contracts, by which the contractors were stimulated by contingent compensation, in proportion to the success they achieved in speed and economy; and the general result was, that our navy was equal to any in the world in the excellence of its machinery. The Department also had spent some money on experiments, as the Government ought to do; for private persons cannot afford to risk the

loss of an entire engine, in order to test some new improvement; whereas, if the promised advantage is important, the Government can well afford to take the risk of an entire loss, either to gain the advantage or to establish that it cannot be gained. On this principle, the governments of Europe spend enormous sums yearly, and, of course, gain in the end by expenditures, which, in particular cases, may seem to have been wasted.

Under this wise system, such ships as the Iroquois, made on well-established plans, and only differing in some trifling details from others, had been produced, and could go about *thirteen knots an hour;* and the Pensacola had been made as an experimental ship, and had shown that her peculiar plans were capable of producing an immense advantage over the old methods.

At this point of time Mr. Welles took possession, and at once reversed the whole system, refusing to use what experience had proved valuable, and authorizing Isherwood to construct an entire navy upon an hypothesis of his own; the most striking features of which were: first, that it had never been suspected in the world till within a year of the time when it was thus adopted for an entire navy; and secondly, that it *did not promise any advantage;* for there is no pretense made by Mr. Welles or by Isherwood, that *a gain will result* by discarding the principles upon which all the navies of the world and all commercial steamers are built; but they claim that by this method they can get *within eighteen per cent* as much power from a given amount of coal as by the old method, and their theory is, that this eighteen per cent is not worth saving at the cost of the extra machinery called an "independent cut-off."

It was apparent at once to the most limited understanding, that this change must prove fatal; for almost every man in the country knows of some case where, by the use of a cut-off on an engine in some factory, a great saving has been effected; and I at once busied myself in the effort to arrest this mad career. I wrote letters in the papers, and to the Secretary himself, and I laid them before the Congress, in the hope of arresting this fatal work. The effect of my efforts was, that Isherwood was rejected last year by the Senate when nominated for the office he has thus abused; but by pressure from the Department he was finally confirmed, and entered upon his career of destruction and fraud, with the entire approval of his superiors.

Soon, however, the ships he had made began to tell the story of his ignorance, and those of them which could be made to go at all, could not be driven at a higher rate than *sixty* revolutions a minute, while the printed contracts on which they were built required them to go *ninety;* and the reports of officers came thick and fast upon the Department, condemning the whole fleet. In this situation, it occurred to the fruitful brain of some of the party to have a white-washing committee; and one was called, composed entirely of Isherwood's contractors, who were building these very engines, with one exception—Charles Copeland—and to him the Navy Department gave an order to have some work done for the Government about

the time they selected him to pass judgment on their work, although he was not a manufacturer of the thing ordered. But this committee would not serve the purpose; although it would be impossible to choose men whose circumstances would naturally make them more pliant; and their report condemned these engines as strongly as men could be expected to do, whose future prosperity was to depend on pleasing their employers. That report, I am told, has been "*accidentally mislaid*" in the Department; but the venerable Secretary has said that he "understood it was very favorable to Mr. Isherwood."

Still they went on in the same course, and now the shops are full of engines, building on these ignorant notions, while the ships are to be filled with boilers, in the hope of making them go.

What is to be done? The answer is very plain. Stop all the contracts just where they are. Spend not another dollar on engines which, if completed, must be useless, and must come out of the ships if put in. Have them reconstructed on well-known and tried plans — like the Iroquois, with such improvements as experience has shown valuable—and then go on as before this reign of ignorance and presumption began. The country cannot afford to do this work over twice. What is already done must be undone and done again; but let us have no more to undo. It is far better to submit to the delay of changing now than to throw all this money away. And, moreover, there will be no delay; for the Department, as if for the purpose of raising prices, has been bidding against itself, and has "shingled" the shops with contracts on which a blow cannot be struck for months to come—so that there is time enough to get the engines right. And it is cheaper to build the engine when right than to make them wrong. Such as the Iroquois, weigh less, take less room, and cost vastly less money than these abortions do, to produce the same power; so that it is economy of money, space, and weight, to alter them—to say nothing of coal.

And then there is another important change which the Congress should make, and that is in the so-called Engineer Department. It is an absurd system as now arranged, by which a person, arrayed beyond the glories of Solomon, is supposed to be an engine-driver. We don't want such men for such work—they are entirely too costly and too elegant. We want mechanics—such men as our engineers in the merchant service, and such as run engines for England and France—men who know how to chip, and file, and finish; and who are not ashamed to be seen with greasy hands and soiled clothes performing their honorable and responsible duties. What an absurdity is it to have a man with a sword and epaulettes, and more blue broadcloth and gold lace than an Admiral wears, to run an engine! If such a system is preserved, I would suggest an act regulating the sword—and I think I could draw the bill with advantage—by which the sword-handle should be made detachable from its blade, and fitted for a monkey-wrench, a picker to clean out oil-holes, and an oil-can to grease the machinery—for these are the appropriate tools of an engineer.

But the way in which the Navy Department operates now is this: They

hire mechanics under the name of "first-class firemen" — intelligent men who understand their business—and these are expected to act as dry-nurses to the gold-lace gentry and to run the engines. I learned a lesson on this subject one day, when I went on board one of Isherwood's boats, and noticed that the "starting-gear" was in a very inconvenient place, and much nearer to the fire-room than to the engineer's place. I remarked the fact to the engineer in gold lace, and wondered why the starting-gear was not placed more conveniently. "Oh!" said he, "we don't have any thing to do with that. *The muscle* does that"—by which he said he meant the firemen. It was plain to me then why the "gear" was placed where it was.

The true system should be to take into the Navy apprentice-boys just out of their time from the shops, and put them to the duty of engine-driving, as apprentices; and then advance them, as is done in the merchant service, as they acquire skill, to the different grades; affording them a uniform suitable to their employments, and a position such as a good mechanic is entitled to hold, where he will be respectable and respected.

As it is now, when a youngster can answer the questions out of a book, and has bought one of Isherwood's volumes, he is qualified; although, like Isherwood himself, he never has laid hands on a piece of machinery in his life, and knows nothing of the *art or trade* for which he is to be employed. For running an engine is a *trade* or art, and not a *science;* and it does not assist a man the least bit in practising that trade, that he has read Isherwood's nonsense or Regnault's science—that he can answer questions in algebra and knows the meaning of a logarithm. The qualifications for running a locomotive are much higher than those for running a steamer's engine. More presence of mind is needed, and more serious consequences depend on correct judgment. The changes in a ship's engine and boiler are very gradual, and a man can go to sleep over his work without much danger; but in a locomotive they are very rapid, and constant vigilance is required.

Then as to engineering — not engine-driving — let the Government do as England and France do—employ the best ability which the country affords, just as any merchant does; and if one man knows more than another, go to him and pay him for his services. Isn't it perfectly absurd to suppose that $3000 a year will pay for the services of an engineer, to sit in an office at Washington and answer the bell of the Secretary? Why, a good engineer can get more than that from any merchant for superintending *one ship*.

The whole system is wrong. Let us have a better one, such as rational people would have in their private business; such as England and France have in their public affairs.

For myself I see no personal advantage in all this, and I know the vengeance which will pursue me; but if I can avert further disgrace from the country I shall be content.

NEW-YORK, January 1, 1864. EDWARD N. DICKERSON.

ARGUMENT.

MAY IT PLEASE YOUR HONOR AND GENTLEMEN OF THE JURY:

I congratulate you that the tedious investigation to which you have listened draws near its close. I have no doubt that many of you, as you have said, have suffered great inconvenience from the confinement incident to it, the withdrawal from your business, and from attention to a subject which could not have interested you in many of its details, as it necessarily must have interested me and others who are connected professionally with the art to which it relates. But I feel sure, gentlemen, that no one of you—and perhaps I might say that not all of you together—have suffered a personal inconvenience greater than that which I have borne in prosecuting this inquiry.

I am not here, gentlemen, as a retained counsel to argue the cause of a client. I have other and different motives in being here, and other and different pursuits which call me away; nor do I receive any compensation from this plaintiff. And while I respect and honor the profession of the law, of which I am nominally an humble member—while I look upon it as the great means by which the rights of men are vindicated, and without which in a free country the rights of men cannot long be preserved—yet my tastes, my habits of thought, and my inclinations, all lead me in a different direction; and knowing that I am not capable of wielding with great power these weapons, which before a court of law and in the hands of honorable men are so potential for right; but so fatal for justice when in unworthy hands; I yet feel that there is a department of human learning and art in which I may hope to do some good to the day and generation in which I live, and in that I prefer to labor and, if need be, to suffer.

The learned gentleman who opened this case on the part of the defendants did me too much honor; although the compliment he paid me—if it were intended as such—was accompanied with so much of bitterness as to repress any vanity that I might have felt rising up within me. Yet he did me too much honor when he told you that I was here as an advocate of *my own peculiar views;* that this was a controversy in which I on the one hand was urging my opinions, and Mr. Isherwood, who has been upon the stand, was presenting his.

But I aspire to no such distinction. The honor is too great for me. The principles which I stand here to advocate are those which have made immortal the name of James Watt, who discovered them; of Marriotte, and Biot, and Gay Lussac, who defined them with approximate accuracy; and of Regnault, who has thoroughly explored them and fixed them forever in the great magazine of human knowledge. If I were entitled to the dignity and honor of calling these my "peculiar views," I might claim to have my name recorded in that niche of the temple of fame now filled by that of James Watt; and if I had even added a single truth to those discovered by him, I should rank a peer of those other great men whose names I have mentioned, and whose glory is the pride of modern science. But a far lower pedestal than that on which they stand is too exalted for me; and a far humbler monument than that proud one in Westminster Abbey, which is honored by the untitled name of James Watt, will mark the spot where I shall sleep when my hour shall have come.

No, gentlemen. I stand before you the docile pupil of those great men who first explored these deep secrets of nature—who first drank of the pure fountain at its source—who have borne in their giant arms the genius of modern civilization, from the hour when it breathed its first feeble breath from the printing press of the German printer, and through successive stages uttered its first loud cry from the gunpowder mortar of the German monk, felt its first throb of warm lifeblood in the steam-engine of James Watt, and thrilled with nervous energy in the electro-magnet of our own Henry.*

* It is a subject of pride to Americans that the electric telegraph, both in its suggestion and its completion, is purely American. Our great countryman Benjamin Franklin, suggested the idea of

Nor do I stand here because these great truths are questioned in the world of science and of art; but because an ignorant charlatan, having climbed into place and station by the practice of his base devices, has cast upon the American people the unjust accusation that they have defied these great principles, and has compelled them to give him their resources that he may make war upon all that is now settled by the science, the art, the experience, and the commercial success of a half-century. Let me not misstate the position. I read from his own book, in which he informs the world with unblushing impudence that he, and a couple more of engine-drivers, have at last found out that the whole world has been ignorant through all these years of light, and life, and power; and that the monuments which a grateful posterity has reared to those great men should be pulled down from their pedestals and trampled into the dust of oblivion. Hear him:

"The law of Marriotte, when practically applied to the use of steam expansively in an engine . . . *is so specious, and apparently so conclusive, that up to within the last one or two years* the assumption of economy passed unchallenged by the engineering profession."

And see him draw his own portrait and daub it over the canvass where the immortal Newton still shines brighter and brighter as we recede from him:

"The true characteristic of scientific genius, and which has contributed most to the advancement of human knowledge, is

communicating by electricity over insulated wires at a distance; but the means were not discovered by which that could be done, and his suggestion slumbered for new discoverers to carry it out. Two things were needed—the battery of Galvani, and the compound electro-magnet of Professor Henry. Oersted discovered, in 1820, that the galvanic current would magnetize soft iron, and Ampere traced the laws of the relation between galvanism and magnetism; but it was reserved for Henry to make the discovery upon which the success of the telegraph depends, and to invent the telegraph itself. His electro-magnet exhibited such sensibility to the galvanic current that it could be affected at great distances; whereas before it was invented the whole power was lost in a short and practically useless distance.

When Prof. Henry had made this discovery he erected a practical telegraph by its use in his lecture-room in Albany, where he had some miles of wire in action, and where he employed a bell as the means of communicating the signals. These facts he published, and they furnished Mr. Morse the material by which he made his out-door machine.

Mr. Morse is entitled to the credit of inventing a recording instrument instead of a sounding one, and of contriving a set of signals which are understood by the operator; although now this recording apparatus is generally out of use *as a recorder*, and the message is communicated by the "click" of the instrument as by the bell of Prof. Henry.

If Prof. Henry had patented his magnet and his Albany apparatus, as he might have done, his name would now be the one popularly associated with the electric telegraph.

that happy tact, so wonderfully possessed by Newton, which recognizes general principles throughout the multitude of various and apparently discordant objects in which they are enveloped."

No, gentlemen; this conflict is of an entirely different character from that which my learned friends would have you believe; and I thank God that he has given me the power, the means, the education, and the opportunity to come here at this time, when so much good can be done by stripping off these falsehoods which conceal the truth, and, as was done yesterday with that statue of Freedom on the Capitol, exhibiting in their majestic beauty those principles discovered by the brightest intellects which ever shone over the darkness of this world, and which have been adopted and used for a half-century to the great good of all mankind.

It seems to me, gentlemen of the jury, that there was a Providence in all this. I think I have seen, within the last two or three years, more evidence that the great Creator looks down and smiles upon our efforts in this country to struggle up to the light, than I have ever seen before in the whole history of our past, prosperous as it may have been. I say it seems to me that there is a Providence in all this; for heretofore, when this insignificant cause was tried in this court—this little squabble between two parties, one of whom was endeavoring to defraud the other out of a few dollars earned under an honest contract—this question of the merits of expanded steam was never opened. But just now, when so much good can be done by exposing the gross imposition which has been practised on the country, my learned friends opposed to me persuaded his Honor to admit the proof, and Isherwood went on to the stand. Bearing with him the sanction of the American Government—telling you that the United States had discarded the knowledge and experience of the past, and upon his newly discovered theory, unsuspected by man till within "one or two years," was spending hundreds of millions of our money—he spoke with tremendous weight. It could not be conceived possible that these momentous responsibilities should have been assumed by the Navy Department unless the foundation were stronger than adamant; and

he carried you away with him, as I confess upon all human probabilities, he was entitled to do. In this dilemma, when he had killed and nearly devoured poor Mattingly's case, I was sent for; and when I heard of the position in which he had placed himself, I came quickly. I saw the door open wide through which truth might again enter those very portals whence she has been so rudely thrust, and our country be saved from this eternal disgrace and this impending irretrievable loss and ruin.

When I reached here and entered this court-room, I felt that you were all carried away; for this human intellect of ours throws out its feelers upon the atmosphere surrounding it, and knows how other minds respond. I had read the testimony of Isherwood, and appreciated its effect; and when I entered this room, there stood upon that stand one of the cubs of this lion—an engine-driver from the Navy Yard—sent here to devour whatever fragments had been left from the destructive meal of the day before. He was a gorgeous creature as he stood before me; resplendent with gold lace, his delicate white hands unsullied by vile grease, and unhardened by vulgar toil; his magnificent apparel shedding an effulgence of glory around him, in which the rings of Saturn encircling his arms vied with the splendors of Mars all over his body for supremacy. There he stood as

> "The Assyrian came down like the wolf on the fold,
> And his cohorts were gleaming in purple and gold;
> And the sheen of their spears was like stars on the sea,
> When the blue waves roll nightly on deep Galilee."

I never behold one of these magnificent visions without thinking how striking is the resemblance between an engine-driver in the United States Navy of this day and the lilies of the valley. Not, perhaps, from any peculiar modesty which they have in common; but because, like them, "they toil not, neither do they spin; but I say unto you that Solomon in all his glory was not arrayed like one of these." Just then Isherwood entered, and I dropped the offspring to seize the parent of these wrongs; and you know the result. Many days have been occupied in the investigation, but not wasted; and

when my learned adversary, Mr. Brent, complained before you that we had taken so much time, and said that but for me this case would have ended two weeks ago, he reminded me of the complaint of the rebels after they had stolen Fort Sumter—that we would insist on trying to recover it, and would occupy time, to their great inconvenience, which they had hoped to spend in enjoying the prize they had thus seized. No doubt if I had not come, this case would have ended long ago; and my learned friend, having pocketed his fee, would have retired to his office, and, like any well-behaved spider, been occupied in again spreading his net for some other fly.

One of the amusing consequences of the struggle, however, was exhibited this morning, when my learned opponent, Mr. Davidge, withdrew Isherwood from your notice as a man of science. Said he: "Gentlemen, Mr. Isherwood is not a man of science, but only a practical man; and we rely upon his practical facts, and not upon his theories, for a verdict.' What a fall was there, my countrymen! What! this lion that roared so lustily when I came here, no lion at all! but only such an one as Shakespeare's lion; who, lest he might alarm his audience too much, lifted up his lion-skin mask and exclaimed:

> "You, ladies—you, whose gentle hearts do fear
> The smallest monstrous mouse that creeps on floor,
> May now, perhaps, both quake and tremble here,
> When lion rough in wildest rage doth roar.
> Then know that I, one Snug, the joiner, am."

So it seems, after all, we have got no one but Isherwood, the engine-driver, and no man of science at all—only "Snug, the Joiner."

Now, gentlemen, so much for the incidents of this controversy; so much for those insidious attacks of my learned friend who opened this cause yesterday, and attempted to disparage me and the interest I represent by insinuations unjust in themselves, unfit to be made in a court of justice, and unexpected by me. But I have no unkind thought nor unkind word for my learned friend. I can imagine how disappointed he must have felt at this sudden destruction of his well-laid

plans, and I am always willing to be called hard names by a man who has no other consolation at hand.

Now as to the case itself. This contract, on which this suit is brought, is just such an one as James Watt used to make, which led to the famous litigations of Bolton and Watt, in the Court of Common Pleas in England. James Watt had made that great improvement on the steam-engine which rendered his name immortal. He was not the inventor of a steam-engine; for a steam-engine was used before James Watt ever saw one; and I will tell you how it operated. It had a cylinder and piston, just as it now has; but the cylinder was not covered overhead as now. The steam was let into the cylinder at its lower end, and under the piston, which, by its pressure, was forced up against the pressure of the atmosphere; and thus one stroke was made. But, in order to make a second stroke, the steam now confined in the cylinder had to be condensed, or turned into water, and that was done by throwing cold water into the cylinder itself, and thus cooling it and the steam it contained. This was a very tedious and costly process; for at each stroke, the cylinder, thus cooled, had to be reheated to a temperature at which it would permit steam to remain in it before another stroke could be made; and all this heat was lost at each stroke. No very useful steam-engine could be thus made.

At this point of time James Watt, the Shakespeare of mechanics, appeared—a man whose equal as an engineer has not stood on this earth since, nor do I see any prospect that another will come; a man on whose intellect the Almighty had impressed that intuitive knowledge of his great physical truths, as he had impressed upon the intellect of Shakespeare an intuitive knowledge of his great moral truths. He was an humble man in station; but, illumined by the light of genius, he rose into grandeur which will never fade. He looked upon a steam-engine, and at a glance saw its faults. Said he:

"Take away this cold water from this cylinder; don't turn your steam into water in the cylinder; put your condenser on the outside; make a box somewhere, and carry the steam from the cylinder to that box, and there throw cold water on it and condense it, and then you won't have to reheat your

cylinder at each stroke; you won't have to get rid of this water in the cylinder, for the steam will flow out by itself into the condenser, and be there condensed."

There was the first great improvement on a steam-engine, and it was the intellect of James Watt which made it. It was James Watt who fought the battles of civil liberty in the early part of this century. It was James Watt—not Lord Wellington—who conquered Napoleon. He it was who, by creating that physical power, enabled England to produce out of its internal resources those means by which she sustained herself against the gigantic strength of the great Emperor, and carried on a war that resulted in his overthrow. Had James Watt never lived, the French Emperor would have wiped out from its place in the history of the world, and out of the catalogue of nations, that power and people who now domineer over land and over sea. James Watt was the great pillar on which they stood; and he it was who fought the great battles, that maintained them in their present position; and he did it chiefly by that simple idea.

He used to make contracts. He would go to a man who had a steam-engine running on the old plan, and say: "I will put an engine here which will run as well, and save largely in fuel. All the compensation I ask will be what one half of the saving in fuel will amount to, if there shall be any saving. If not, I get nothing." Those were the "ifs" upon which the great suits of Bolton and Watt were founded. Those suits became famous in the history of the world; and they form the dividing line between the past judicial determinations of England and the present.

The records of a court of justice are the evidences of the civilization of the times in which they are made—a dial upon whose face the index hand truly points whether that sun shines in the zenith, or lingers on the horizon. Turn back to the early records of the English courts, and what do you find? Controversies about the boundaries of land; but then the owner of the land, was the owner of the people who lived upon the land, and their rights had no place in a court of justice. A little later, and commerce unfolded her wings; and then the courts, under the inspiring genius of Mansfield and

Eldon, expanded those principles of the common law, whose boast it is, that while nothing is too minute for its care, nothing is beyond its power, and the greatness of England began to be seen in every zone. Still later, when the genius of invention had inspired creative man, the laws of patents appeared, and in proportion to the protection they gave, marched on the progress of the arts of life; until to-day the whole world is bound by one electric chain a common family, and the clod of the valley is instinct with life, as if with the nerves of the God-created human body.

But Watt made those contracts I have mentioned; and when the defendants, as in this case, found that his share of profit was great—though theirs was great also—like dishonest men, they refused to pay; and he, like this plaintiff, was driven into the courts for redress. Thus, you see, this is but an old story told again. It has been said that in the affairs of the world history but reënacts itself; and it is certainly true in regard to this matter. The moral character of the human species never changes. Since the first dawn of the historic epoch—from the time when that great man Solomon wrote his Proverbs—until now, this human heart of ours has never changed. What was true in that distant past is true to-day, and will be true until the "elements shall melt with fervent heat." We may change our customs and our laws, erect our monuments of civil progress in every department of the human arts; but the human heart remains constant to its original pattern, and the fall of Adam leaves its impress indelibly fixed upon all his descendants through all time. And all these men in England who turned against James Watt, the great benefactor of his day and generation, and refused to pay him what they had solemnly contracted to pay, were just such men as to-day turn against the benefactors of their time, and refuse to pay what they contracted to pay, when they find that they might have bought their advantages much cheaper if they had not been ignorant. Of all things on earth, gentlemen, which men hate and refuse to pay for, intellect most excites their animosity. They will raise no objection to paying for coal, which they can see and shovel in and burn, and the cost of which they can find out; but to pay for intellect — for that

which apparently costs its owner nothing — they won't submit to that. They would have all men five feet ten inches high, and when one man rises above the average all the rest cluster around to pull him down. It is the old savage instinct; we are all more or less given to it; and I suppose we cannot help it. It will never die out in the human heart; and courts are created to control such passions when they come into play to the injury of society and the destruction of those principles and laws upon which society alone can stand. We cannot prevent murder, arson, and all the crimes and wrongs of the catalogue; but we can punish those who commit them.

Let me now explain to you, gentlemen, what is meant by the "expansive power of steam," or "working steam expansively;" which is the principal subject in issue here, and of vital consequence to the whole country. I will suppose a little cylinder, one inch in diameter and of indefinite length, and a piston fitting in it steam-tight, but without friction; and I will further suppose a cubic inch of water to be poured into the bottom of that cylinder, and the piston to be then let down on that water; and I will suppose that on top of that piston there is a platform placed carrying a ton weight of bricks. Now we have the machine ready for the experiment which is to determine the absolute power resulting from the conversion of water into steam. Now hold a lamp under that cylinder till it evaporates that cubic inch of water into steam, and it will lift that ton of bricks just one foot high. These are convenient units to remember. A cubic inch of water turned into steam will lift a ton weight a foot high — no more, no less. That is not precisely accurate, but it is so within a few pounds, and it is near enough for all practical purposes. When the weight is lifted a foot high it goes no further; and a valve must be opened in the bottom of the cylinder, called the exhaust-valve, to permit another operation, by letting out the steam which has done its work. That machine is simply a full-stroke or non-expansive engine, making one stroke; and for each stroke made by such an engine all the possible power to be got is the equivalent of a ton lifted a foot high for every cubic inch of water evaporated — no more and no less. That is a law inherent in matter. It is the God-given quality of water and heat. We

cannot alter it. All we can do is to obey it. That is all we can get out of a steam-engine without a cut-off. But let us go a little further with our experiment. In place of opening the exhaust-valve when the ton is lifted a foot high, take one brick off that platform. The load now is not quite as heavy as it was before, and the elastic steam compressed by that ton weight will expand a little under the diminished load, and will raise the bricks a little further. It gives us out a little more power. Then knock another brick off; and keep knocking them off, one by one, and up goes the piston, still carrying up those bricks which are left, until, when you have knocked them all off except the last fifteen pounds of bricks, they will have been raised about one thousand seven hundred inches high; and if you still further diminish that fifteen pounds, by knocking other bricks off, the steam will keep lifting the remainder higher and higher, and we do not know how high it will lift some weight.* Now, you will observe, gentlemen, that all the power which has come out of that steam after I began to knock the bricks off, is a power which is, so to speak, a clear profit, since it costs no fuel or steam except that which had already raised the ton weight a foot high, and which was unable to raise it any higher unless by this diminution of resistance. James Watt discovered this principle — a law of steam — and measured its value remarkably well; and he also invented the best form of cut-off for carrying out this principle which has been made, except that called the Sickels cut-off, notwithstanding the hundreds of forms of cut-offs which have been invented and patented since. That form is now in use on the Cornish engines; and whenever in England to-day they wish to give an example of the great efficiency of steam, the Cornish engine of James Watt — which depends entirely upon this cut-off for its value—is cited as the most striking illustration.†

* This apparatus, of course, supposes the air to be pumped out from the upper side of the piston, so that a perfect vacuum exists. If not, its weight—fifteen pounds to the inch—composes a part of the load to be lifted, and amounts to fifteen pounds of bricks in the ton. If the air be not removed, the machine must stop at one thousand seven hundred inches of lift, because all the bricks being then knocked off, there yet remain fifteen pounds' pressure of air, which can only be knocked off, as is done in a steam-engine, by an air-pump and condenser.

† The word "cut-off" simply expresses the fact that the hole through which the steam from the boiler is admitted to the cylinder, is closed before the piston has perfected its stroke; so that the

But you would wish to know how this principle of diminishing the load or resistance, as in the case of the bricks knocked off the platform, can be applied to machinery in general; and I will explain that. It is done by the aid of the momentum of the matter which the engine is moving — it may be the fly-wheel, or the steamboat itself, or the train of cars; all of which, when once set in motion, will not suddenly stop, even though all power were suddenly suspended from driving them, and which, therefore, will continue to go on under the diminished pressure of the expanded steam. Thus you see that when the steam is cut off from the cylinder, that which is in it continues to push on the piston with diminished force, but still with some force; and as the piston cannot stop, it absorbs, and through the wheels which it drives gives out again to useful effect, whatever pressure is thus spent upon it; just as your watch will run all day although the spring which drives it grows weaker and weaker at each instant as it is relaxed.

The gain which can be obtained from the use of expansion is measured by the extent to which you carry it; or, in other words, how short you cut off the steam in the cylinder; and the amount of saving of fuel or increased power due to the different rates of expansion, or the different points of cut-off, has been ascertained with mathematical precision by Marriotte and Regnault, and the law or rule which governs this rate is called the "Marriotte law." I will give you a few figures settled by that law, and then pass to more general considerations. As I have said, a cubic inch of water made into steam without expansion will lift a ton a foot high, or whatever is equivalent to that. If the steam from that cubic inch, after having done

current of steam is *cut off* from the engine. The mechanisms by which a cut-off is effected, are very numerous, and are constructed with reference to the sort of engines employed. The invention called a "Sickels cut-off," is one of these forms of mechanism, and is peculiarly applicable to "poppet-valves." It cannot be applied to large slide-valves such as are used in the navy engines; although there is no difficulty in constructing propeller-engines with poppet-valves and by that means realizing the advantages on such engines which these valves always give to side-wheel engines. Still, if I had all power, I would not make that change suddenly, nor until the entire system of naval engineers was changed. An engine with a "Sickels cut-off" cannot be made to run by drawing a sword on it, as if it were a coward; and would probably pay no respect whatever to epaulettes or gold lace. Whenever the present absurd system is changed, and the navy has the services of practical engine-drivers — such as the merchants have—who don't know algebra or mathematics, but who do know how to run, keep in order, and repair an engine, then the navy can have good engines; but until then, the simplest forms of slide-valve machines, with a slide cut-off, which have no adjustments about them, must be used.

that work, is expanded into three times its bulk, it will by that expansion lift another ton a foot high without calling on the furnace for any more fuel; if it is expanded five times, it will lift one ton and six tenths a foot high in addition to its original lift of a ton; and ten expansions will do three times and a third as much work as no expansion, using the same amount of fire and steam.

Now these are well-settled facts in the world — as well as the rate of speed of a falling body—and are not disputed anywhere, except by our enlightened Secretary of the Navy and his enlightened Engineer-in-Chief. The navies of the world all use these principles by the aid of a cut-off; all merchant steamers in the world do the like; and steamers go fast and produce great results in proportion to the extent to which they use steam expansively. Mr. Forbes's steamer Foh Kien, of which I was the constructing engineer, and whose capacity we proved here before you, expands steam six or seven times; and she went nearly fifteen thousand miles in fifty-one days and a half, using about twenty-seven tons of coal a day, and carrying a full load of machinery in the hold; and she is a two thousand ton ship — much larger than those vessels in the navy, now building or built, which can not go that distance in seventy days, nor with twice the total coal she used. And Mr. Roberts's steamer America, of two thousand tons, as we proved before you, when loaded with coal for a voyage to the Pacific, averaged at sea nearly twelve knots an hour, and ran thirteen measured miles in fifty-one minutes, with an amount of coal which Isherwood swore here could not possibly have made her go nine knots an hour on his theory, and which would hardly keep his twelve hundred ton sloops-of-war out of their own way. And so certain is all this, that when the defendants put Mr. Reeder, of Baltimore—an engineer of large experience and intelligence — upon the stand, he was compelled to admit the truth; although you all know how reluctantly he yielded to my questions, (because he is building Isherwood's engine for the Government, and fears the vengeance of the Navy Department.) I asked him:

"Mr. Reeder, isn't it perfectly certain, that if you take out of the United States ships now building their small cylinders

and leaving every thing else just as it is, put in large cylinders and an independent cut-off, you will vastly increase their power with the same coal—double it or triple it, according to the size of the cylinder?"

He said:

"Yes, it is certainly true."

And it is true; and to deny it exhibits an ignorance or a wickedness beyond my imagination to conceive.

So much, gentlemen, for that part of the case. I will now show you that there were facts connected with this alteration of the Columbia — the steamboat to which the cut-off in this case was applied, and for the saving of fuel produced thereby this suit is brought — which render it perfectly certain that a great amount of fuel was saved; and this, too, entirely independent of the use of steam expansively: a saving about which they have called a witness on the stand — this Mr. Charles Reeder, of Baltimore — for the purpose of reducing it to ten per cent of the fuel burned; and that advantage resulted from the fact that the Sickels cut-off valve was close up to the cylinder, while the old cut-off was remote from the cylinder, with a large vacant space, called "clearance," to be filled with steam and lost at each stroke. Now, gentlemen, this advantage, you will observe, is entirely beyond that which results from working steam expansively. I will give you an illustration familiar to you all, by which you will see that advantage. If you have a barrel of sugar to sell, which weighs a hundred pounds, and you sell it out in single pounds, you will not get a hundred pound parcels precisely out of that barrel. If you have a roll of cloth on your counter, measuring a hundred yards, and you sell it out in yards, you will not sell one hundred yards of cloth from it. And why? Simply because with each pound of sugar you weigh, or each yard of cloth you cut, you give good weight or measure, and each time sell a little over; and the sum total of these little excesses will always use up a considerable amount of the barrel of sugar or the roll of cloth. Therefore persons who sell at retail have to add to the price to make up for this loss. That is exactly the case of the steam-engine. The piston travels ten feet in the cylinder; but it does not travel so as to fill up the entire space which the steam occupies. There

is still beyond that ten feet a space; so that when you take steam out of the boiler at every stroke of the engine, you take out more than the ten feet to fill up the "clearance." There is an excess which you measure out at every stroke, and that excess diminishes the original supply in proportion to the amount of that "clearance;" just as you lose cloth or sugar in proportion to the amount your clerk overruns the yard-stick, or to the quantity of sugar he throws into the scale more than is needed to balance the weight. That "clearance" is an absolute and fixed quantity in a given engine; and how much coal it will cost is entirely calculable and can be ascertained by measurement exactly; and that absolute quantity is entirely independent of whether you work steam expansively or not, although it becomes a larger *per centage* of loss when running with than without expansion.

Now, gentlemen, before I came here Mr. Isherwood had sworn that item clear out of this case, and had said it was "infinitesimally small" — "as eighteen is to infinity." But it was not necessary to swear so in order to show that there was no practical benefit in expansion; because there is no connection between these two things at all—none whatever. The loss by "clearance" is a loss that occurs in a steam-engine whether you work it with or without expansion; and you can save it just as well upon one engine as upon another. You can shorten the excess measured by the yard-stick, or the excess of sugar that weighs down the scale; and that, I say, is independent of the quality of the sugar or of the cloth. This man, therefore, was under no necessity to swear as he did. What, then, did he want? Why did he come here? He came here regardless of the rights of these parties, for the purpose of swearing for the verdict of a jury of his countrymen, and the judgment of an intelligent Court, which would tend to prove that the navy engines were built properly. That is what he came here for—to attempt to prove that the laws of Watt and Marriotte, and of all the eminent men who have preceded us in this great march of civilization, are mere fallacies; that the engineering of the world is entirely wrong; that this discovery, made within the last year or two, as Isherwood says, by himself, was entirely right. And if he could get that judgment from this jury,

the newspapers of the country would be filled with telegram after telegram, and paragraph after paragraph, to the effect that this great man, whom my learned friends heralded here under such flying colors, and whom they dropped so soon when I had stripped him naked and produced only "Snug, the Joiner"—that this great man had succeeded in establishing in a court of justice, after the most searching investigation, how he was all right, notwithstanding the notorious fact that his new ships cannot catch a blockade-runner; and he would then insist that their failures were not his fault, but the fault of the workmen, and of the material used, and all that sort of trash that we have heard him swear to on this stand. Because, I observe, gentlemen, that the country has begun to be alarmed, and the newspapers are teeming with these accounts of our naval failures; and it is necessary for these people who have produced these shameful results to find some means to help themselves out of this mire; and so he came here to lead you, and to lead his Honor into this train that he has following him, and to have the benefit of your support. Therefore it was necessary, in order to have a verdict, to strike out of this engine a saving which had no more connection with the use of steam expansively than the excess of your pound weight has to do with the quality of the sugar you weigh. For we are entitled to a verdict for whatever saving was effected by putting on the cut-off, even if it were true that no part of it arose out of the use of expanded steam; and we have proved that a saving of ten per cent at least was due to the closing up of this immense "clearance" by moving the cut-off up to the cylinder.

When, therefore, I read this man's testimony, and found that he had set out to swear this case through at all hazards, I at once comprehended his object, and saw how important it was to the Navy Department, just now, when so much public anxiety is felt at the constant failures of our navy, to have just such a verdict as this one would be if they could get it. But I was not a little surprised at the audacity of this particular piece of swearing; as I had in my hands a couple of books published by this Isherwood — one of them under the authority of this very Navy Department—in which he states the exact value of this loss by clearance, and reduces it to

precise figures for different rates of expansion, according to the well-known rules which govern this case; showing that in some cases, where the clearance is much less than in this engine, the loss it occasions is eighteen per cent of the total fuel. But I will read from his book, (Engineering Precedents, vol. ii. p. 74:)

"Collecting the above, we have in the different cases the following for *the loss of economical effect* from the steam due to the space comprised in the *clearance and port* of the cylinder, and expressed in per centum of the effect that the steam would have produced had there been no such space to have been filled with it: without expansion, 6.98 per cent; with an expansion of twice, 8.24 per cent; with an expansion of four times, 11.70 per cent, and with an expansion of eight times, 18.13 per cent."

This I read to him; and one would have thought it must have arrested him in his mad career to self-destruction; but it produced no such effect. He tossed it off as easily as if it were but a feather's weight. "Oh! yes," said he; "that was my theory before I tried the Lake Erie experiment. It was true in theory, but not in practice."

I asked him if it were not certainly true *practically*, and he swore on that stand that it was not. How true it is that of all men in the world such as he is stand in need of a good memory. He had forgotten that this very item was one of the losses stated in his Lake Erie report; and I turned to that report, convinced that it, at least, would paralyze the tongue that dared thus to defy this self-evident truth; but again I mistook my man. Allow me to read to you from his large book (p .113) his report on this subject; made as the result of those very experiments which he had just sworn had refuted his former calculations, and had enabled him to inform you that no amount of "clearance" produced any loss in a steam-engine. He thus explains it:

"There remains, lastly, to be noted one other cause *in the practical steam-engine* operating to reduce the economic effect of the fuel, and unequally for different measures of expansion. It is due to the fact that between the end of the cylinder and the piston, at the commencement of the stroke, there inter-

venes the constant space comprised in the *clearance and nozzles* . . to be filled with steam of the initial pressure, less the back pressure, the whole of which, when the steam is used without expansion, is exhausted into the condenser at the end of the stroke, without having produced any dynamic effect upon the piston."

Then follows a table showing how much that loss was "in the case of the experiments" on Lake Erie — which he had just sworn proved there was no loss in practice — and he thus concludes:

"An inspection of line four of the above table will show how rapidly *the loss* due to the *clearance and nozzle* space increases with the measure of expansion, *and how large a proportion it is of the total fuel* when the steam is cut off *shorter than about half stroke*—"

—as it was in the case of the engine on which he swore it produced no appreciable loss at all. That blow should have felled a moral ox; but it never even staggered him. Let me read the questions and answers which followed:

"Q. Did the experiment at Lake Erie show what you have here stated it did, or not? A. I have said it is impossible for any experiment to show that as a direct measurement.

"Q. That experiment, then, did not show it? A. No; it is a calculated result on it.

"Q. Then, notwithstanding that experiment, you do not know whether this calculated result be true or false? A. It is only as *a strong probability*. The actual experiment and calculated result in that case are given distinctly and separately, where direct experiment could reach."

And yet, gentlemen, in the face of a "calculated result" in one book, and of an experimental result raising a "strong probability" of the truth of that calculated result, showing a loss of more than ten per cent from this cause, he had the audacity to swear that no such loss exists in a steam-engine; and that, too, in the face of Mr. Reeder, one of his own witnesses, who admitted that the saving from this cause must have been at least ten per cent. That is what used to be called "swearing at a mark."

If I had not known this man as I have known him for

years; if I had not watched his sinuous course with astonishment, and at the same time with perfect admiration at the audacity and impudence with which he has pursued this career, that has brought our navy to its present degradation, I should have been appalled at these things, as you were; but I knew the man, and knew that these were but trifles in compaaison with what was yet to be done.

But there was still another cause of saving in the case of the Columbia, for which the change made, by applying the Sickels cut-off, was entitled to credit, and which was also independent of the principles of expansion; and that arose from the fact that the old cut-off valve on the boat was simply a damper turning in the steam-pipe—just as a stove-pipe damper is turned to shut off draft — and which, from its nature, must leak enormously; whereas the Sickels cut-off valve was a single poppet-valve—that is, a tapering or conical stopper set into a corresponding hole, which it fits, and upon which the steam to be stopped presses, thus making it tighter and tighter as the pressure is greater and greater. Now it is plain enough that this cause produced a saving; and so Mr. Reeder admitted, and said that the old damper-valve could not be made steam-tight, as, indeed, you must see yourselves, without his aid. But Isherwood had to swear that fact out too, for he was bound to get your verdict; and he swore that there was no difference whatever in the tightness of valves, and that with equal workmanship the damper was as tight as the plug. Now, as Isherwood is no mechanic, and never struck a blow as such in his life, he might have been ignorant of this simple truth, to which Mr. Reeder, a good mechanic, testified; and therefore, I looked again to his book to see whether he had not written down this fact about valves there—for every man who ever saw a steam-engine work knows this obvious truth—and behold, as in the case of the "clearance," he has fully stated the whole matter, and tells us that this single valve is the only one which can be made tight. I read from page 59 of his Precedents:

"Freedom from leakage, however, is from physical causes, and the forms habitually given to valves, *almost an impossibility;* and of the large number of indicator diagrams that I

have examined, from many engines of various types and proportions, I have never seen one which did not evidence a *very considerable leakage.*"

He then proceeds to describe the various valves in use; and, as if to prepare for his own destruction in this case, he thus concludes: "The single poppet-valve," (namely, the valve on the Columbia,) "which is one flat, thin disk, *can be ground tight;* but it is now scarcely ever employed." Thus proving that, when he swore these valves were all alike, he knew better, and had published his knowledge to the world. This same subject will become important hereafter, and I pass it over now without further comment.

And there was still one other cause why fuel was saved on the Columbia by the Sickels cut-off, which was, that by its use the valve cutting off the steam was closed very rapidly after it began to shut, whereas the old cut-off valve closed comparatively very slowly. Again, Mr. Reeder, their witness, admitted this to be a cause of saving; and again, Isherwood was called to discredit their own witness, and to deny that self-evident proposition; and again, he was ready for the emergency. The loss by the slow closing of the valve results from what is called "wire-drawing" the steam; a phrase which suggests that when the steam has been forced through a hole too small to pass the quantity required, it must lose some of its strength in forcing itself through—just as a wire is reduced in strength by being forced through a smaller hole. But Isherwood swore solid that there was no loss of power due to moving steam from the boilers to the engine; and when I put him the case of a steam-pipe a mile long and an inch in diameter, through which the steam had to travel from the boiler to the engine, as compared with a pipe of the usual length and size, he unblushingly swore that no loss of power would result, and that the steam at the end of the pipe would drive the engine just as well as in the ordinary way; for, said he, "steam has no friction," whereas if it were water—to which I compared it—he admitted there would be a loss due to the friction of water. Again, I had but to turn to his book to prove him to be false, and not ignorant; and again he was overwhelmed, but not abashed. I read from page xx of his large volume.

"According to the well-settled laws of thermodynamics, steam, in overcoming any force of any kind, must suffer condensation. For instance, in rising in vacuo in a vertical column against gravity, exclusive of overcoming any resistance except that due to its own weight, it will condense. It will condense in *transporting itself from the boiler to the cylinder*, and from the cylinder to the condenser, and in following the piston down the cylinder, supposing the load to be carried by an external power. In fact, it cannot produce movement in its own particles of any kind *without expenditure of mechanical force*, and consequently transmutation of heat and resulting condensation."

And it follows, of course, that the greater are the difficulties to be overcome—the longer the distance over which the steam must "*transport itself*"—the greater will be the loss of "*mechanical power*," and the less will remain to be used for some useful purpose at the end. It is not true, however, as he ignorantly supposes, that the steam is condensed, in thus losing its force; it only loses its *pressure or tension*, but it remains steam all the same unless cooled by external radiation. It does not become water.

I now approach the great question whose importance brought me here; a question whose magnitude is no less than to include in its consequences and its decision—not by you, gentlemen, but by the persons acting in behalf of the government of the United States—the efficiency of an entire navy—that great arm of our public service upon which, in our struggle for national existence, above all others we must rely for our safety, and in the superiority of which during the last war, exhibited at that time in fast ships like the Constitution, we were able to defy the mistress of the seas and to carry our flag in triumph to victory. It is the decision of this question: whether James Watt and Marriotte, and all those other great men whose names have been mentioned here, are to be annihilated by a newspaper reporter with a single dash of his pen, which just now interests the country—interests you, and me, and all of us, to a degree that is almost incalculable. It is the question of how the great American people are to stand hereafter before the peoples of the world. It is the question of

how, as a nation, we are to appear on the ocean, either as an ally to be courted or as an enemy to be crushed. In the great conflict that I see in the not distant future, looming up over yonder convex ocean, when the combined powers beyond it may think it their interest to endeavor to put their foot upon the flag of this young eagle of democracy in its ascent to greatness and power, upon which arm of the service is it that we must depend for our most effectual defence? Is it not the navy of the United States? Therefore, as an American citizen, I feel so deep an interest in this question; and out of love for my country I have come here to expose and drag out into the light of day the wrongs under which we are suffering, and the causes that have produced them. And when my learned friends sneered so bitterly at the motives I asserted for myself, I felt that if their sneers were well founded—if they were justified in assuming that in this country there was no man left who would spend a little of his time, and a little of his money, to serve his country for his country's sake—all that I could do, or you, or any one of us, would surely be in vain. I felt, however, that from their point of view, standing as they do the representatives of this man Isherwood, they told God's truth when, in the utterance of that sneer, they conveyed the idea that no man, to his knowledge, would do any thing from an honorable and patriotic motive; and it grieves me to think that such a belief, from such a source, should be so boldly avowed. But, gentlemen, I do not assume for myself any peculiar patriotism. I should be ashamed to claim for any such sacrifice of time, labor, and money, as I have made in this case the smallest of the rewards due to those who in this dark hour are exhibiting their real patriotism. When I see half a million of my brethren exposing their bosoms in the carnival of death to the leaden storm that is beating around them; when I see them leaving their wives, their little ones, their comforts, and their gains, to sacrifice their lives, their health, their homes, and their dearest affections on the altar of their country—I feel that no man who stays here, whatever good he may do, or however necessary he may be, has any right to assert for himself any peculiar patriotism. What do I risk? Nothing; or, at most, an imprisonment in Fort Lafayette, if this man has as much power

now as he has had with the government, and the fruitless loss of a few days of my busy life diverted from its accustomed pursuits.

But, gentlemen, I thank God that in this land I do not stand alone as the only man who is willing to serve his country for her dear sake. Thank God that the sneers which came out of the mouth of Isherwood's counsel here do not properly apply to the American people.

> "Breathes there a man with soul so dead
> Who never to himself hath said,
> This is my own, my native land!"

But, gentlemen, when my learned friends came here before you and attempted to array the mighty power of this great people to overwhelm this little case; to tell you that this government had decided that James Watt, Marriotte, and all those other great men were simply ignorant—that was a very imposing exhibition, to be sure. But who made that decision? Surely not the American people, for all of their private engines obey these laws. Who but that officer who sits at the other end of the avenue, intrusted with the duty of making that decision, and this charlatan that he has employed for the purpose of carrying it out? The one a very respectable and venerable gentleman, once discharging the onerous and responsible duties of postmaster in a country town in Connecticut with eminent success, and now removed from his field of usefulness and brought here to this highly important position of Secretary of the Navy; and the other a penny-a-liner by trade, making a scanty living by picking up news in Washington for the newspapers, and writing letters on both sides of the questions of the day—entirely uneducated in this art, and gaining his position by intrigue and brazen effrontery. And these are the two who have decided this question; and then my learned friends came into this court and held them up as the great American people, at whose bidding even the powers of nature must yield, die, and shrink into insignificance, no more to assert themselves on this side of the waters, whatever they might do anywhere else.

And what, gentlemen, is the foundation, in fact, for this de-

cision against the laws of nature, thus pompously paraded before you? Why, it appears upon the testimony of this man, and by his books here in court, that it stands upon a certain experiment tried by him and two or three other engine-drivers on an old steam-engine on Lake Erie, with the vessel tied fast to the dock; the results of which experiments are put into a book and printed. Upon that experiment—tried by these three or four obscure men, the leader of whom my learned friends, his counsel, at last told you was not even a man of science at all—has the whole navy of the United States been constructed in direct opposition to all the science of the world and all those splendid commercial steamers, which are the pride and glory of our country, and which carry our flag to the distant ends of the earth, under the auspices of private gentlemen—men of intelligence, who have risen to fame and fortune by obeying God's laws and not by fighting them.

Now, gentlemen, I will tell you why that experiment on Lake Erie was made. I will let you into the motives of all this horrible conduct which has been thus exposed before you. This man, Isherwood, came into the navy as he has told you himself, never having handled a steam-engine, never having touched a piece of machinery, entirely ignorant of any practical fact about it at all; having had a boy's common education at an academy, and having been turned out at an early age to pick up a living as best he could. At first he got employment on the Erie Railroad and Croton Aqueduct as a rodman and level carrier, along with numbers of other boys on these works. When he left them—and he left no enviable character on the Croton Aqueduct, as Mr. Craven, its engineer, knows—he came to Washington in the employ of two newspapers, to pick up news around the taverns, and write the usual daily letters. In this capacity, and while advocating in one of these papers the administration, he was rewarded for his services by the appointment of First Assistant Engineer in the navy—an appointment for which he had had no training whatever, and of the duties of which he was entirely ignorant. He bought the books and read up for an examination; and he swore that he had passed one with credit—which proves what I have often asserted, that under the present system no knowledge is

necessary to make a naval engineer, but only such parrot-like learning as a smart boy can pick out of a book in a week. At that time, however, there were in the navy several good practical engineers—men who had learned their trades in the merchant service, and had worked as mechanics in the shops, and who were competent to drive any engine and keep it in good order for a voyage round the world. In comparison with them this ignoramus was utterly worthless; and he saw that there was no chance for distinction if he had to pursue the path which these had trodden before him, and had to submit to the laws of nature as they were received by all mankind. His success in getting into a place for which he had not the first qualification, and his confidence in his own powers of intrigue, led him to look forward to promotion above his fellows, who had no practice in his arts.* Having read that "the pen is mightier than the sword," and holding that

> The daring youth who fired the Ephesian dome,
> Outlives in fame the pious fool who reared it,

he undertook to attain notoriety, at whatever cost. Leaving, then, the beaten track, in which he was infinitely behind the practical men of the navy, he arrayed himself in opposition to the principles on which they were practising, and astonished his little world by announcing that he had made a grand discovery in science; which was in substance that James Watt was ignorant and Marriotte a fool. In that attitude, at least, he might be notorious; and although he knew that he must

* It is amusing to see how ingeniously and laboriously this Isherwood, having crawled into this place, has attempted to secure himself perpetually in it; and he had supposed that his success was complete. His method was to procure an Act of Congress by which the Engineer-in-Chief must be appointed from the Engine Drivers of the Navy; and when the choice is limited to them, he concluded that his tenure of office must be perpetual; for no one would suppose that any of them was capable of the duties of a constructing engineer—between which and the duties of driving an engine, there is no more relation than there is between the science and art of making a chronometer and the knowledge necessary to wind it up and keep it running; while, he having scribbled a couple of books, might claim to possess the requisite scientific knowledge to deal with these difficult problems. On the stand, before his cross-examination, his arrogance was stunning; when with a majestic wave of the hand he demolished his own witness, Charles Reeder, of Baltimore—an educated engineer from boyhood—with the remark: "Mr. Reeder only displayed by that answer that he was utterly ignorant of the grandest discoveries of modern physics!" It can easily be seen how such presumption, when practised upon imbecility, might be eminently successful. In Mr. Reeder's case it failed; for it was applied to that testimony of Mr. Reeder in which he swore there was no foundation for Isherwood's deduction of sixteen per cent on account of "Joule's equivalent;" and on that point Isherwood was compelled to confirm him on cross-examination, out of his own book, both theoretically and practically.

be crushed by the principles he defied at some time or other, he had meanwhile the satisfaction of dishonest distinction and the chances for gain which it afforded. As he stood here on the stand, swearing down the laws of the great Creator, he reminded me of the bull who took a fancy to stop a locomotive—pawing the earth, with head down and tail up, roaring defiance at the great machine which must roll on in its fixed track forever; and the remark of the Hibernian came to my mind with comical effect: "Och, hony, I admire your courage, but the divil take your discretion." His first dash at the locomotive was made by publishing his "Engineering Precedents," in which he demolished James Watt and Marriotte without any trouble. In that book he used up just one half of the power of expanded steam by the very original and ingenious reason that because the coal in the furnace does not evaporate as much water as it ought, the economy of using the steam made from it could not have any effect on that portion of the coal which was wasted; or, in other words, because your wages are not so high as they ought to be, it is not worth while to economize in their expenditure. This complicated nonsense, however, was so well stated that the London *Artisan* adopted it for sense, and republished it with approval; and Isherwood was becoming famous. I exposed it, however, in a letter to the Secretary of the Navy, written about a year ago—a part of which I have read to you—and after that even Isherwood's impudence could not carry that deception further. How he explained it to the Secretary I never knew; but he so far satisfied him on the subject that, although the Senate rejected Isherwood when nominated, he was not withdrawn, as is usual, but forced through by the Department in spite of the rejection.*

* This act has the darkest look of all which have characterized the Navy Department in this business. The rejection on the first nomination was founded upon statements made to the Senate of the real condition of the ships built on this new discovery, as well as upon circumstances which clearly pointed to corruption; and it was generally supposed that a successor would be named. As the choice was limited by the general act to the Engine-Drivers of the Navy, and as I had taken an active part in procuring the rejection, I signed the petition of Mr. Wood for the appointment; although I had just then publicly protested in writing against his official conduct in endeavoring to prevent Mr. Webb from having a cut-off in his "Dunderberg;" and I signed it for the purpose of showing that I had no friend to propose for the place, and because I understood from Mr. Wood's friends that if he were there he would not undertake to dictate any new system for the navy engines, but would go back to the well-settled plans on which the navies of the world

When I presented this book to him on the stand, it was comical enough to hear him claim the protection of the court, and insist that I should not cross-examine him on it, but should confine myself to his second book, which, he said, was all right; but he soon found out that he was in a court of law, before a judge, and not in the Navy Department, before the venerable Secretary. How he was to explain this swindle I could not imagine; but his resources never failed. "That," said he, "was an error; and it got into that book by accident. It was intended to be published in another place." "How did it happen, then, that in the article containing the error which used up one half of Marriotte's law you should have announced its presence in the commencement of the paper, and restated its effect in the final resume?" His answer to that was a paragon of its kind; let me read it: "That portion of the subject," said he, "I admit is confused and mixed up;" and for once, gentlemen, I agree with him. But what an excuse is this! He is detected in passing counterfeit money, and he exclaims: "Oh! I knew it was bad, but I didn't mean to pass it on you; I meant it for your neighbor." The article is false, he admits; but he claims he meant to print it in some other book, not in this. His moral obliquity is so intense that he could not perceive that the fraud would have been as great in the other place, where he might have published this false statement, as in this book; and that for the purpose of exposing his ignorance or his chicanery it would have been as useful to me in any other book as in this one.

It would have been the part of an honest man to have said that he did not know any better—that he was mistaken or ignorant—and not to pretend that this trash was printed in the book by accident. But his insufferable vanity would not permit him to acknowledge what was the obvious truth, and com-

are built, and on which such ships as the Iroquois and others of our navy have proved themselves very good. But during all this time a pressure was brought to bear on the Senate from the Department; and in spite of the fact, *well known at the time by the Department*, that the Ossipee, Juniata, and Lackawanna, as well as all the gunboats, were entirely worthless, and were costing immense sums for repairs *before they had ever done a single day's work*—as was the case with the Ossipee, Juniata, and Lackawanna—the Department forced Isherwood's nomination through the Senate; and having accomplished that piece of work, they at once proceeded to reproduce just such machines as their past experience had found to be worse than useless. How such a performance as this can be explained to a plain man, is more than I can at present conceive.

pelled him to swear that he never meant to have in the book at all, that which is all there is of the book, and without which the book would not be any thing.*

After the publication of this absurd book, and while enjoying the triumph which the success of so monstrous a deception must have occasioned him, it occurred to him to give some consistency to his hypothesis by bringing to its aid an experiment; and with his capacity for intrigue he had no trouble in moulding the Secretary to his purpose. Instead of trying a vessel in motion, and near the centres of commerce, where his frauds would have been exposed and arrested, he selected an old steamer on Lake Erie, frozen fast in the ice and tied to the dock, where, unobserved, he might manipulate the machine and mislead his ignorant victims. There, blinding the persons whom he employed, by a parade of preparation; occupying their attention in watching and weighing the feed-water, as if it cost money—in holding thermometers around the engine, as if it ran by their aid, and in various other harmless employments—just as a juggler on the stage does when he is about to deceive your senses in some other particular—he produced a set of results which are the most transparent swindle that ever yet gained a moment's credence in the world. That report, and the figures which give it an air of reality, are in this big book; and you have seen and heard them exposed.

The question which he pretended to try was, whether a certain amount of power could be derived through the aid of a steam-engine with less coal when working the steam expansively than it could when working it without expansion? That was the simple question; and it might have been tried on that engine in an hour, and the result would have shown that the laws of the great Creator have not fled this continent, notwithstanding the edict of the Navy Department banishing them forever. Isherwood knew this too; and it is curious to see how his silly

* Isherwood swore that he never had read the proof-sheets of this book, but was "out of town" when they were read by some person for him. Bailliere Brothers, who published this book, will, I have no doubt, be astonished to hear that its author did not read the proof, and that the most material part of the whole book is false, and got into the volume by accident; and the London *Artizan*, which commended this particular piece of jugglery as full of science, will no doubt entertain an exalted opinion of its judgment hereafter on such subjects, after hearing that the author they praised has sworn the theory they lauded to be a mere error accidentally intruded into his work. It is some consolation to know, however, that all the fools are not on this side of the water!

juggle should have misled even the ignorant men he was using for his purpose; because, gentlemen, I entirely acquit his associates of any participation in the fraud, and am glad to admit that they were as ignorant as men in their stations of life might be expected to be on a subject so profound as the laws of heat, whose determination has engrossed the attention and often baffled the skill of the ablest intellects of the world. But Isherwood knew some plain facts about that engine of which they were ignorant, and in which he gained the advantage. He knew that the valves leaked enormously; for as I have read to you from his book, then just published, he had stated that such valves as they were leaked "of course;" and he knew that that leakage alone was the means whereby, under his manipulation, he could juggle the others. Now let us open his tables and see the swindle. You will observe that instead of running this engine with equal amounts of power, with and without expansion—which would have settled the case at once—he ran it so as to develop three hundred and forty-three horse power *without expansion*, and only eighty-six horse-power *with expansion;* thereby only proving that on that engine a small amount of power could not be developed, even by the aid of expansion, as economically as a larger amount could be developed without its aid; and one of the chief reasons was that the leakage of steam was as great in one case as in the other, and therefore *cost much more coal in proportion* to the amount needed to produce a horse-power in the case of the smaller power than the larger one. To show you that this man knew this result would follow from leaky valves, I turn you to his "Precedents," (p. 59,) where he devotes a section to that proposition under this title:

"*Of the modification of the theoretical result of expansion made by the leakage of the valves.*"

And, after explaining, although very ignorantly, how this leakage would affect the loss, he thus concludes, (p. 64:)

"Consequently we perceive that while we have been expecting the gain due to the *greater measure of expansion*, because the cut-off valve closed at the proper point to produce it, we ought, owing to the *leakage of the valves*, to have expected only the gain due to the lesser measure of expansion.

We are now prepared to see this leakage appear on this engine; and here it is. In table No. 1, (p. 100,) under the title, "Number of pounds of feed-water pumped into boilers per hour," we find that, when taking steam eleven twelfths of the stroke, he used 12,040 pounds of water an hour, and at seven tenths he used 7,335 pounds an hour; while, when cutting off at one sixth of the stroke he only used 2,761 pounds an hour, and at the shortest cut-off he used 2,806 pounds an hour. Turning now to table No. 2, (p. 104,) we find an account of how much of this water thus pumped into the boilers disappeared in the shape of steam, and therefore produced no power on the engine; and these figures prove the fraud just as the trial balance of a set of books exposes false entries, if any are made. Now, you see that, in round numbers, ten per cent of the feed-water disappeared when using 12,040 pounds an hour; fifteen per cent when using 7,335 pounds an hour; forty-two per cent when using 2,761 pounds an hour, and forty-five per cent when using 2,806 pounds an hour. If, therefore, the loss were what Isherwood in his book says it should be "of course," in steam-engines having such valves as this one had, we ought to expect that these variable percentages of loss should all amount to the same total quantity; and so it is. The exact percentage given in the table shows that the total steam leaked was 1284 pounds, 1122 pounds, 1162 pounds, and 1262 pounds an hour, at these respective points of cut-off I have mentioned—being the two extremes of the experiment. When I had brought him down to this plain and self-evident exposure, I then asked him the question whether the results of that experiment were not as well explained by the fact that the valves leaked as by his theory that the laws of nature were mistaken by such men as Marriotte and his associates; and by the aid of his Honor I forced him to answer truly once, and to admit that they were. His refuge was in denying that the valves leaked a particle—a denial made in the face of his own publication, and of the well-established fact in regard to these valves, which have no exception in the world. As I showed you here, the best balanced valve-engine I ever saw—that of the Foh Kien—on which no pains were spared, and which would stand all day without heating the condenser—leaked three hundred horse-

power out of thirteen hundred, as proved by indicated diagrams taken to test it. And the man who invented double-balanced valves has cost this country untold millions in coal to supply their leakage, which Isherwood described in his book, and which on this Lake Erie engine "in good order," amounted to nearly one half of the steam made, when that amount was small compared with the size of the engine.

There is also another item of loss on that engine which Isherwood charges to expansion, but which, like the leakage, belongs to another account; and that, too, like the leakage, he knew was fraudulently charged, as I shall show you by reading again from his book. It is the item of about twenty horse-power needed to run *this large engine itself*, without transmitting any power to any useful purpose; and which, being a uniform quantity, became one quarter of the power made by expansion, while it was only one fifteenth of the power made without expansion. So that, in order to get fifty-three useful horse-power out of that engine, it was necessary to make *and pay for* eighty-six horse-power. And as he only gave the coal credit for the useful horse-power, in stating his conclusions from these experiments, he defrauded expansion out of this enormous loss; which, of course, did not in any degree depend on the fact of expansion, but only on the fact that he was using an engine too large for the work it had to do. His associates, I admit, did not see this transparent juggle; but *he* did, and I read out of his book again (page 338) to prove it. He there says:

"If the engines be properly designed in themselves and for their work, the *proportion of the total power utilized will be a maximum and the cost of the useful work done a minimum;* and just in degree as they are improperly designed, either in themselves *or for their work, will the cost of the useful work done increase.*"

And in addition to these two causes, the loss by radiation and external leakage of this immense engine and boiler, when used to produce only fifty-three horse-power of useful work, must have been very great in proportion to the work; and of course it weighed heavily against expansion, on the assumption that it was a loss *which always must attend a fifty-three horse-power*

engine when running with expansion; but as I do not find in this book that he knew that a big boiler and engine would radiate and leak more than a small one would, I cannot say that this was a fraudulent item omitted.

But you see, gentlemen, that if he had carried the trick a little further—which he was wise enough not to do, for fear of exciting suspicion—and had cut off short enough to make only one horse-power with this engine, he could have shown that by expansion one horse-power would cost about two hundred and seventy pounds of coal an hour; for you see he would have had to burn, to get this one horse-power, first, coal enough to evaporate twelve hundred pounds of water an hour, which was leaking; and secondly, coal enough to make twenty horse-power, which the engine required for its own motion; and all this would have had to be charged to the one horse-power, and by his method of reasoning, to the fact that expansion was carried out too far for economy. If he had done that, even the stupidity of his dupes would have been alarmed, and his trick would have failed; so he stopped just where the gain by expansion became too small to balance the enormous losses by the causes I have mentioned; and then he had but to explain to his ignorant associates, in the clear language of his book, that the "condensation *per se*" would "*cæteris paribus*" "in rapport of fuel," produce "bladders" in the steam, and so destroy the "law of Marriotte" and all other "*idolon foris*" who should come around the Navy Department when he got to be Engineer-in-Chief; and you can see, gentlemen, how clear that must have made it to them.*

Now if you will follow me one moment I will show you how, even in that engine, and in the hands of an enemy, Marriotte vindicated his law, and for a dead man made a most splendid defence of his principle against this swindling assault. The

* This compound jargon made by collecting into a sort of bouquet what he considers the choicest gems of his work, may be supposed to do him injustice; but I think it will compare favorably with the following true quotation, which I make from page 189: "In physical science an inquiry into causes is altogether vain and futile. Hume makes the keen observation, that no copula has been detected between any cause and effect. We employ the language of causation because it is convenient, and gives precision to our ideas, but it is gratuitously applied to that which we know only as consecutive." When Isherwood read this magnificent sentence to the Secretary, he must have concluded, that if it would not make a steam-engine go, there would be no use in trying expansion.

total horse-power which the engine gave when cutting off at one eleventh of the stroke is set down at eighty-six, and the coal burned per hour, was three hundred and seventy pounds. Now, how much of that coal is chargeable to the power produced, and how much of it to losses which are merely accidental ones, and which do not occur in a good engine? And first, there was a loss of one thousand two hundred and sixty-two pounds of water by leakage. How much did that cost in fuel? The table answers and says that every pound of coal evaporated seven pounds and eight tenths of a pound of water. We therefore have but to divide one thousand two hundred and sixty, by seven and eight tenths, to know how much coal that loss cost; and we have one hundred and sixty-one pounds of coal an hour wasted on unnecessary leakage. The table also informs us that one quarter of this whole power was spent on running the engine itself, which is a clear loss in order to get fifty horse-power; and we must, therefore, deduct one quarter from the coal remaining, after paying for leakage, in order to know how much the real power cost. When you deduct from three hundred and seventy pounds of coal, one hundred and sixty-one pounds for leakage, there remain two hundred and nine pounds; and from that, when you deduct one quarter for the friction of this large engine with its wheels running in the water without buckets on, (as they did,) there remain one hundred and fifty-seven pounds of coal, which produced eighty-six horse-power; and dividing one hundred and fifty-seven pounds of coal by eighty-six horse-power we have the cost of a horse-power at one pound and seven tenths of coal an hour. Some small deduction would have to be made from eighty-six horse-power, thus produced, to pay for the friction of a proper engine to produce it — say ten per cent; but, on the other hand, the radiation and external leakage from these enormous boilers and engines would use up much more fuel than enough to pay for similar losses on a small machine and for the little friction incident to producing so small an amount of power — thereby still further reducing the cost of horse-power by expansion, and showing that James Watt and his pupils are not the idiots which this penny-a-liner would have you believe them to have been. By the law of

Marriotte the cost of a horse-power — supposing steam to be expanded as much as is shown in this table, and coal to evaporate as much water as is here claimed for it, and supposing the machine to be perfect in all its parts, and to lose nothing by radiation—should be one pound and thirty-five hundredths of a pound of coal an hour; while here we find that it costs only one pound and seventy hundredths an hour, after deducting from the amounts falsely charged to it those quantities whose magnitude the table itself gives us, and making no allowance for losses other than those.

So much, gentlemen, for this famous Lake Erie experiment; which was a discredit to the government under which it was made, and a disgrace to the one by whom it was published to the world, under an official sanction, as containing a new truth in science worthy to be received by men as something more than a mere juggler's trick.

But when Isherwood found that his first book was exposed to public contempt, and that his Lake Erie juggle was beginning to be discovered—for several others besides me have taken some pains to expose its fraud—he bethought himself of a new trick; and *it* appeared in the shape of this second great volume. One half of his old battery for beating down James Watt had been spiked, and then there was urgent need to find a new one, whose guns might be so concealed by learned jargon that no one could unmask and capture them. And to effect this concealment he dragged to his assistance what you have heard so much about, under the name of "Joule's equivalent," and by which he proposes to use up James Watt and Marriotte, instead of by the old trick of the imperfect combustion of coal in the furnaces, which I exploded. He has, besides these, a half-dozen other weapons not yet brought into use, which, when this battery is spiked, he will probably produce.*

* On page 138 of his book he thus parades his spare store of weapons: "The causes of the great discrepancy found to exist in steam-engines using steam with different measures of expansion between the economy as promised by the law of Marriotte and as realized experimentally, may be summed up as follows, premising that the same initial and back pressures are supposed to be employed in the cylinder, namely:

"1st. The law of the expansion of steam is not rigorously that of Marriotte, even when condensation is prevented by superheating; the pressure decreases in a higher ratio than the volume increases.

"2d. The condensation of steam in the cylinder due to the production of power.

Now I will explain this simple matter to you, as it is just now much talked of in the world, and but little understood. It had been supposed, long ago, by profound thinkers, that

"8d. The condensation of steam in the cylinder due to superheating the back pressure vapor as a gas.

"4th. The condensation of steam in the cylinder due to its expansion *per se*.

"5th. The condensation of steam in the cylinder due to external radiation.

"6th. The condensation of steam in the cylinder due to the re-evaporation of water deposited on its internal surface.

"7th. The loss of dynamic effect in the cylinder clearance and steam-passage.

"8th. The influence of the back pressure in the cylinder resisting the stroke of the piston.

"9th. The influence of the pressure required to work the engine *per se*.

"10th. The difference of dynamic effect due to an equal weight of steam used at the average cylinder pressure and at the boiler pressure."

Now, each and all of these statements are either false "*per se*," or do not affect the economy of *expansion* any more than the economy of *non-expansion*.

1st. The first one is false "*per se*," and as I show on page 47, Isherwood knew it. Expanded steam *increases* its pressure—not diminishes it—in a higher ratio than the volume increases; and this is the discovery of Regnault.

2d. The second one is false "*per se;*" no such condensation occurs; but if it did, as Isherwood on p. 126 of his book shows, there would be "no difference of practical consequence," between expansion and non-expansion. This is exposed on pp. 47, 48, and 49.

3d. The third one is of itself immaterial, and not adverse to expansion. Isherwood thus describes it, (p. 131:) "And we have seen that the loss by *superheating the expanded steam and back pressure vapor* is not only *very small, but sensibly equal, whether the steam be used with or without expansion*"—thus proving that he knew it was a false charge to make against expansion.

4th. This is mere trash. If the steam does not condense by expansion in an engine, as Regnault shows it does not, and as even the crude experiments at Lake Erie proved it does not, it probably will not condense in Latin—*per se*, or otherwise.

5th. The loss by external radiation from the cylinder is too insignificant to mention; but Isherwood says of it that "the radiation from the exterior surface of the cylinder and the condensation by the interior surfaces will be about the same," whether expansion or non-expansion is used. (Precedents, vol. 2, p. 51.) So he knew that this was a false charge.

6th. This division is disposed of on page 50 of this book, where the reference is given to Isherwood's own statement in regard to it, and where he wrote that this loss was to be excluded from a comparison between expansion and non-expansion. But no such effect is produced—no "water is deposited on the interior surface of the cylinder," and of course none is re-evaporated.

7th. The loss by "clearance and steam-passages" of an engine has always been one of Isherwood's arguments against expansion, and all his books abound with its explanation. In the "Columbia," however, these clearances had been materially lessened by the use of a Sickels cut-off, and a saving had been thereby effected; but Isherwood swore that all his calculations were false where he had charged losses from clearance, and he said that in practice there was no such loss. He is false, however, both in his calculations and in his assertion that there is no loss. The truth is, that the total loss of power by clearance is perfectly calculable, but is *less* with expansion than without it, although it is a *greater per centage* of the total power with expansion than without it. A few figures will make this plain. Suppose a cylinder with *one tenth* of its stroke in "clearance." Now, if you use steam *without expansion*, there will be a loss of one tenth of the power; but as steam without expansion only does one duty—only lifts a ton a foot high for each cubic inch of water evaporated—there will remain *only nine tenths of one ton lifted a foot high* for each cubic inch of water evaporated. If, however, the steam is expanded ten times in that cylinder, then no work will have been done by the boiler pressure at all, because the steam will be cut off after it has filled the "clearance," and before the piston has moved; but by its expansion it will raise *two tons and three tenths of a ton* a foot high for each cubic inch of water evaporated, which is *two and a half times as much work* as the non-expanded steam performed. But if there were no "clearance," the same steam would lift *three and three tenths* tons a foot high; so that by clearance more than one third of the power is lost. Yet there remains so much more than the *whole power*

there was somewhere in the universe a measure or standard by which all the causes and effects seen in physical phenomena might be brought to some common unit; just as all the things we buy and use are brought to the standard of a pound weight or a pint measure. Dr. Mayer and Count Rumford investigated the problem with great effect, and they ascertained very closely the true ratio which exists between motion and heat; but it was left for Mr. Joule, a careful and laborious experimenter, to fix with precision the standard and to give his name to the fact thus ascertained. The phrase, "Joule's equivalent," now signifies what Mr. Joule discovered, that the mechanical power required to lift seven hundred and seventy-two pounds a foot high is the *equivalent* of the heat needed to raise the temperature of one pound of water one degree of Fahrenheit; and that is all it means. This beautiful discovery is the first step in the bright pathway of light by which man, created in the image of his Maker, will some day disclose the now hidden links which bind us together, and will be able to show scientifically, as with poetical inspiration the poet hath taught us:

of non-expanded steam as to enable it to lose this enormous per centage and yet give twice and a half the power of non-expanded steam. A man worth three millions can pay a tax larger than the whole property of one worth a hundred thousand, and yet be much richer than he, afterward; and that is this case.

8th and 9th. The back pressure against the piston and the friction (done in Latin) have been favorite arguments of Isherwood against expansion; but I do not find in his book that he knew them to be false, so I must assume them to have been ignorantly used. The answer is that the back pressure and friction are just like all other resistances which oppose the steam in its effort to drive down the piston—just such resistance as the friction of the boat going through the water, or of the mill-stone which grinds the grain—and by whatever means *any of these resistances* are overcome with less steam than otherwise would be needed, by that same means *all of these resistances* are overcome more economically. Thus, if in a given engine the piston is required to exert a force of a hundred thousand pounds moved ten feet at each stroke, and ten thousand of these pounds are needed to overcome the "back pressure," ten thousand to overcome the "friction," and only eighty thousand are finally used to grind corn—then if that hundred thousand pounds of force is got without expansion, it will cost just twice as much steam or fuel to produce it as if the steam were expanded three times; and it is obvious that this saving of half the fuel will produce its effect as well upon the back pressure and engine friction as upon the grist-mill stones, and that the cost of grinding grain will be reduced *just one half*, and not some less amount.

But "back pressure" is diminished by increasing expansion—that is to say, a lower "*vacuum*" is produced by cutting off short than by following full stroke—and therefore, in respect to this item, there is a reduction of resistance to be overcome, effected by the very act of economizing the means by which it is to be overcome.

10th. I trust I shall not be considered intensely ignorant when I confess that I don't understand what this means—either philologically or scientifically considered. It may be an "*idolon fori*," which Isherwood describes in his preface; but whatever it is, we can only pray him not to let it out on the steam-engines of the country till after the war is over, for at present they need all the power which by the laws of nature they can possibly develop.

"All are but parts of one stupendous whole,
Whose body nature is, and God the soul;
That, changed through all, and yet in all the same,
Great in the earth, as in the ethereal frame;
Warms in the sun, refreshes in the breeze,
Glows in the stars, and blossoms in the trees;
Lives through all life, extends through all extent,
Spreads undivided, operates unspent;
Breathes in our soul, informs our mortal part,
As full as perfect in a hair as heart;
As full as perfect in vile man that mourns,
As the rapt seraph that adores and burns.
To Him no high, no low, no great, no small—
He fills, He bounds, connects and equals all."

From this discovery of Joule many erroneous conclusions have been drawn; among which is the assumption that because heat and power are found to be equivalent to each other in a certain ratio, therefore the one is converted or transmuted into the other. This is not true, any more than it is true that when a roll of greenbacks disappears out of your pocket and a barrel of flour appears in your kitchen, the greenbacks are transmuted into flour. They are the *equivalent* of flour and you can buy flour with them, but you can't "transmute" them into flour.

Isherwood, however, considered that as this subject was a little "confused and mixed up," like his book, he might use it as a cloak to cover his new juggle; and so he asserted that, in consequence of Joule's equivalent, the steam in an engine was condensed into water and lost, and therefore that there was no benefit in expansion. In his first book there was no room for this theory; for already he had used up all the benefit of expansion by other devices of his active imagination, and although he knew of Joule when he wrote that book, he did not assign to him any of his losses; for if he had, he would have *more than used up* all the benefits and left poor Watt in the minority entirely. But when I spoiled his first book, he produced Joule to fill up the ranks; just as a fresh regiment is brought forward, after a crushing discharge of artillery, to carry on the fight.

And here opens a chapter of barefaced fraud, which has no precedent in the history of the world in this department of swindling. In this book it appears that this fellow, by delib-

erate false entries, made with an entire knowledge of their intention and effect, simply "forced the balances," and wilfully published the fraud to the world—published it under the sanction of the great people of the United States of America, and under this imposing title:

"Experimental Researches in Steam Engineering, by Chief Engineer B. F. Isherwood, United States Navy, Chief of the Bureau of Steam Engineering, Navy Department, etc. The whole being original matter composed of extensive experiments made by the United States Navy Department."

In this book he attempts to retrieve his falling cause by asserting more boldly than ever that there is no practical benefit in expansion. I read his own statement of its object, (p. xv.:)

"A large portion of the volume is devoted to experiments made to ascertain by practical results the relative economy of using steam with different measures of expansion. These results are so opposed to the popular belief in the great economic gain to be obtained from the use of steam with high measures of expansion, according to the hypothetical law of Marriotte, which *has been so long an undisputed article in the creed of engineering*, that a reformer exposes himself to the usual fate given by the worshipper of an *idolon fori* to those who attempt its overthrow. Nevertheless when the subject is properly examined, subject to even the erroneous assumptions of the law, considered as the expression of a physical truth, it will be seen that the fallacy of this expectation can be demonstrated by a plain application to the case of a steam-engine. Such an application, made by *simple arithmetic and level to the meanest capacity*, will be found in the following table, in which are given *the data* and calculated results, showing the relative theoretical economy in rapport of fuel of using steam of forty pounds per square inch total maximum pressure in a condensing engine with different measures of expansion under normal conditions."

Was there ever any thing more fair than that! Who would expect to have a forgery passed off on him under such an introduction? Yet that is just what is done. Before coming to his table, however, he yet devotes some pages to still further allaying suspicion, and finally thus states his results:

"It is interesting to know, however, that with the pressure

actually employed in the *best practice* with condensing engines, and with the engine properly proportioned in size to its work, the commercial theoretical value in fuel of using the steam at the most advantageous point of cutting off (one fourth of the stroke of the piston from the commencement) is only seventeen and three quarter per centum more than when cutting it off at two thirds of the stroke of the piston from the commencement. That is to say, using the steam with an expansion of four times, is, *theoretically*, only seventeen and three quarters per centum more economical than using it with an expansion of one and a half time. *Practically*, there must be made from this seventeen and three quarter per cent the *very serious reductions* due to the well-known and considerably greater condensations in the cylinder, additional to that included in the table, when using the steam with the higher measure of expansion, leaving it doubtful whether gain or loss will be *practically realized* by cutting off shorter than about two thirds of the stroke of the piston from the commencement, and *making it certain* that the difference upon either side will be practically insignificant."

This is a plain declaration that no gain of importance can be got from expansion by cutting off at less than two thirds of the stroke of the piston; and that the *true theory*, as shown by the accompanying table, will prove the position. Then follows the table, which of course but few men would attempt to dissect after so bold an avowal of its contents, and of its simplicity; but which, as you have seen, is a plain forgery. It commences by giving twelve columns of figures, purporting to state the different values of expanding steam, at twelve different rates of expansion; and the first one assumes the cut-off to shut at one twelfth of the stroke, while the last one assumes the steam to follow the piston from the boiler for the entire stroke, without any cut-off. Intermediate are various other rates of cut-off; but we will use only the extremes to avoid confusion.

Now, by the law of Marriotte, steam expanding twelve times, should give three and a half times as much power from a pound of coal, as it would do if it were not expanded; so that to equalize or balance these two columns it is necessary to destroy

twice and a half of the total power of unexpanded steam which twelve expansions produce. This task did not appal this man; and acting upon the theory that "paper will not refuse ink," he found no trouble. The first fraud in the table consists in assuming that the "clearance and nozzles" of a twelve foot stroke engine are equal to one foot of the stroke of the piston; which is utterly unwarranted by any engine in the world; and by which (notwithstanding he had sworn that these clearances were of no consequence) he reduces the economy of expansion about twenty per cent. But I pass that; it is only the petty cash account in a set of books where balances are forced for thousands and the money has been stolen. The first grand fraud occurs on the fourth line of the table, where he proposes to make this reduction:

"Per centum of the steam entering the cylinder condensed to furnish the heat transmuted into the total power of the engine."

Now, Isherwood knew, first, that *in theory* there was no such "condensation;" and secondly, that *in practice* there was none. The true theory, founded upon the researches of Watt, Marriotte and Regnault, is, that steam when it expands, instead of growing cooler in proportion to its pressure and condensing, grows hotter; or, to use the term of science, is "superheated." This Isherwood knew as well as I did when he asserted the contrary in this table; and I cross-examined him on his knowledge. I read the questions and answers:

"Q. I ask you the simple question whether Regnault has not stated in his memoir that the expanding of steam, in place of cooling it superheats it? A. No, sir; he has not stated that anywhere in his memoir.

"Q. Now, think awhile. Did not he state that in consequence of the fact that there is more heat in high steam than in low, when you expand down from the higher to the lower pressure you liberate that excess of heat, and that it then operates upon the steam with which it is mingled to superheat it? A. He does not state that anywhere."

Of course, as in the former case, I had but to turn to his book to convict him of a deliberate falsehood, and I read it to you, (p. 125:)

"The experiments of Regnault have determined that the total heat of steam increases with its pressure; consequently, when the same weight of steam is expanded—that is, reduced from a higher to a lower pressure—there is less heat required to maintain it in the vaporous form than before, *and instead of being condensed it will be superheated. Such, indeed, is the deduction made by Regnault in his celebrated memoir.*"

Therefore, gentlemen, when he undertook to make a charge for this condensation, he knew it was made against the *theory* of the world.

But he knew that *practically* the pressure of steam in an engine under expansion almost exactly agrees with the pressure required by Marriotte's law, and that there was no such deduction to be made on any engine in use. I read again:

"Q. You found on the Lake Erie engine, as a matter of fact, that the steam did give the pressure which the law of Marriotte requires, with a trifling difference, did you not? A. That the mean pressure in the two cases was substantially alike. The curves did not agree. In one case the curve is smaller at one extremity and larger at the other; but in the main they are nearly alike."

And by referring to his table of the Lake Erie experiment, you will find that the actual pressures there set down do not vary from the Marriotte pressures, also stated in the next line of the table, more than one per cent; so that he had before his eyes the experimental fact settled that there was no deduction to be made from Marriotte's pressures.*

And yet in this table, on line three, he sets down the pressure, which, by Marriotte's law, ought to be produced; and then

* The following is a copy from the table No. 2 of the Lake Erie experiment:

	$\frac{11}{12}$	$\frac{7}{10}$	$\frac{4}{9}$	$\frac{3}{10}$	$\frac{1}{4}$	$\frac{1}{6}$	$\frac{4}{45}$
Mean total pressure on piston in pounds per square inch, by Marriotte's law,	34.5	31.3	27.6	23.1	21.2	17.2	12.6
Mean total pressure on piston in pounds per square inch, by *experiment*,	34.0	31.1	27.1	22.9	20.1	16.4	12.5

This is just such a result as any engine in average condition will give; and it proves how true is Marriotte's law, when such results can be produced on such a machine, showing an almost perfect agreement between it and practice.

But when he came to construct his "*True Theoretical*" Table, by which the young men of the Navy were to be educated, he found that he could not destroy expansion by any theory he could invent, which recognized the truth of his own experience, and he was compelled to resort to the fraudulent method I have exposed. Here are the two corresponding lines of his "*True*" Table:

has the impudence to make a deduction for this condensation which both theory and his own experience forbade, and to strike the false balance in line five under this title:

"*True theoretical* mean pressure of the steam above zero during the stroke of the piston in pounds per square inch."

But even this fraud would not serve his purpose; for you see, gentlemen, that if you deduct the same per centage from two numbers, the remainders will yet bear the same ratio to each other as if no deduction had been made; and, therefore, a still further fraud had to be practised, and that consisted in deducting from the expansion column *sixteen per cent* of its power, while from the non-expansion column he only deducted *five per cent.* Here these forced balances began to tell on Marriotte, and his column began to shrink; but again the forgery was nailed to the counter by his own book. Before turning to it, however, I indulged him with another opportunity to swear falsely, which he, of course, embraced, and I read the question:

"Q. I find on line four that you strike out from the non-expansion column only *five per cent* of steam for the power produced, whereas on the expansion column you strike out *sixteen* per cent. Do you mean to tell this jury that it is a law which Mr. Joule, or somebody else found out, that the more you expanded steam the larger per centage of the steam was condensed into water?

"A. On the theoretical law of Marriotte, assuming it to be

	1/12	1/6	1/4	1/3	5/12	1/2	7/12	2/3	3/4	5/6	11/12	1
Mean pressure of the steam above zero during the stroke of the piston, by Marriotte's and Gay Lussac's laws, in pounds per square inch,.....	14.63	20.25	24.75	28.52	31.53	34.00	36.03	37.51	38.67	39.42	39.87	40.00
True theoretical mean pressure of the steam above zero during the stroke of the piston in pounds per square in.	12.22	17.39	21.66	25.32	28.33	30.85	32.96	34.57	35.88	36.79	37.40	37.71

It will thus be perceived that he deliberately, in the face both of theory and of practice, with the practice recorded in the same book, wrote into a set of tables the necessary amount of false entries to make the tables agree with his hypothesis. If this were done by a bookkeeper, who had need of the money to support his family, the penitentiary would be thought not too good; but here, when it is done merely to keep in office, and at the cost of a ruined navy, this man is sustained by the Department, and kept in place in the face of a rejection by the Senate. *O tempora! O mores!*

true, which that table does, the more expansively you use steam the larger will be the per centage of its condensation to produce the power."

When I had thus gratified him, I turned to his book (page 126) and thus read:

"As regards the condensation of steam by the transmutation of heat into the power developed by the engine, it is plain that as the quantity thus condensed does not vary greatly from the direct proportion of the power developed, it will be so nearly proportional to the total weight of water evaporated, whether the steam be used *with or without expansion, that no difference of practical consequence can result in the two cases.*"

When this was read to him I watched his countenance closely, and, so far as I could perceive, he never blushed or faltered. In all my experience in courts of justice, where I have often before seen men thus convicted, I never saw one so utterly insensible. He stood as if cast in monumental brass by my friend Mills, and as if, like his statue of Jackson, he was self-poised by the eternal principles of truth and justice.

But this was only the beginning, and I lost all further interest in him, satisfied that conscience in him was dead beyond the power of *man* to awaken it, and I passed on to the other necessary exposures of his frauds.

You see, gentlemen, that the immense gain by expansion can endure an enormous amount of this sort of loss before it compares with non-expansive steam, and that Isherwood yet had heavy work before him to make his table agree with his introduction to it; but he found no trouble in doing it. He knew that "paper would not refuse ink." Accordingly, on line ten of the table he makes another grab at expansion, by which he reduces it three times as much as he reduces non-expansion, under this title:

"Additional fuel required to re-evaporate the water due to the condensation of the steam in the cylinder, to furnish the heat transmuted into the power of the engine, in per centum of the weight of steam entering the cylinder to produce the pressures."

Now, in plain English, this means that one sixth of the steam

made by the immense boilers and furnaces of an engine is first condensed in the cylinder into water, and then that the cylinder and water are together hot enough to re-evaporate it into steam; which is, of course, sheer nonsense. But Isherwood, when pressed by some questions addressed him by his Honor from the bench, in order to give this assertion an air of practical reality, swore that unless this water were re-evaporated, no steam-engine could run a hundred strokes, for that it would be overflowed by water. On cross-examination I had this repeated thus:

"Q. And you asserted yesterday, did you not, that if this water was not re-evaporated, a steam-engine could not work one hundred strokes without being stopped by water?"

"A. Yes, sir."

When this was all settled, again I opened his book, and again he stood before you convicted, but without a quiver. I read from page 126.

"Further, it is nearly certain that the water of condensation due to this cause is not deposited at all upon the cylinder surfaces, but remains suspended amid the steam like *water bladders*, or as a fog or cloud is suspended in the air. For the condensation must take place throughout the entire mass of the steam, as would happen by sending a chill through it. If the water of condensation due to this cause should not reach the cylinder surfaces, *as it is nearly certain it does not*, it can have no effect in producing any further loss by its re-evaporation from those surfaces. Consequently, *in comparing the different condensations when using steam with and without expansion, or with different measures of expansion*, the comparison should properly be confined to the quantities that remain *after omission of what is due to the production of the power.*"

When this was presented to him, Isherwood took it with his usual composure—just as if it were one of those misfortunes of life from which no man is exempt—and contented himself with the explanation that one of these statements was practical and the other theoretical; as if true theory were any thing but a generalization from the facts of the world.

But after all these forced balances—and another which I

will not take time to review*—yet the benefits of expansion were forty-five per cent greater than non-expansion; and another trick had to be resorted to, to conceal that fact, which you will see by inspecting the footings of the table. If the unit of comparison had been taken at either end of the line—that is, at twelve expansion, or at full stroke—then the number 45 would have appeared in one of the columns, and the trick was to keep it concealed; so he assumed his unit of comparison about the middle of the line, and ran out the comparative figures each way from it. On one side of this unit, which is marked with a zero, the gains by expansion are predicated by a cross—which in algebra means that the number is to be added; and on the other side of the unit the losses by non-expansion are marked with a dash, which means that the numbers are to be subtracted. But it is not every man who would wish to know the true facts about steam who understands algebra; and such men would naturally read this line of numbers as if they were all of one quality; and in doing so the highest is twenty-eight and the lowest five; but when read by their true signs the twenty-eight on one side must be added to the seventeen on the other—making forty-five per cent as the difference shown on this table between expanded and non-expanded steam. And this balance stands admitted after defrauding expanded steam of more than half of its power, well established by the scientific investigations of the world, and shown to belong to it by these very experiments on Lake Erie, which are now tortured to disprove it—experiments which Mr. Reeder, their own witness, swore "neither proved *nor tended to prove*" any thing regarding the laws of expansion. And yet, gentlemen, you have heard him swear here several times that there is only eighteen per cent of pos-

* That other fraud consisted in assuming in the table that the back pressure in the condenser would be five pounds, and the same whether the steam was used full stroke or cut off at one twelfth. By that false assumption he reduced the expansion column fearfully. It began with an average pressure of 14.63 pounds. It was then reduced by the "Joule's equivalent" fraud to 12.22 pounds. Then it was assumed that five pounds of back-pressure would be found in the condenser to resist this 12.22 pounds of plus pressure; and the result is, that the average pressure is reduced to 7.22 pounds to the square inch, or less than *one half*. In fact, the reduction ought not to have exceeded two pounds for back-pressure—and I have engines running whose back-pressure is less than two pounds—and then the average pressure would be 12.63 pounds to the inch; whereas, by these false entries, it is reduced to about five pounds.

sible saving to be affected by the best cut-off, over no cut-off at all!

Another fact came out in this case, in connection with these experiments and this book, which sheds a flood of light upon them, and exposes the Secretary of the Navy in a most unfortunate position to the country. After all this immense expense had been incurred; after the Department had built a vast number of steamers on this new discovery, and after those steamers by their failure to run the speed which they were specified to run, had proved the truth of the laws they were built to defy; but while untold millions were yet being expended in every shop of the country on the assumption that Isherwood had refuted the world of science—the Department asked and received last winter from Congress an appropriation of twenty thousand dollars to try these experiments again. It seems to me that the Secretary ought not thus to have acknowledged his own doubts of the truth of that theory upon which he had already staked tens of millions of our money, and upon which he was still proceeding to squander much more. In that situation he should have concluded, with Macbeth:

> ——— "for mine own good
> All causes shall give way; I am in blood
> Stepp'd in so far, that should I wade no more,
> Returning were as tedious as go o'er."

But he did the next best thing; and that was, to so arrange the matter that the deception might be carried out till his back was turned on the Department, and he no longer could be arraigned in Congress or before the country; and his plan was well conceived.

I asked Isherwood the question, and he had to admit here before you, that when this appropriation was made, he himself, in his own handwriting, wrote the order placing that money in his own hands and in those of one of his contractors, whom he nominated to assist him, in order that they might bring the past acts of the Navy Department to the test, which the appropriation contemplated, and that the Secretary signed that order just as he wrote it. When he mentioned the name of Horatio Allen as the colleague he had chosen to

assist him in this new juggle, it occurred to me that I had heard that name before; and I do remember that some years ago such a person had, like Isherwood, blown himself up into immense proportions, filling the whole world with his pretences that he could defy the principles of the universe, and

> "Like little wanton boys who swim on bladders,
> These many summers in a sea of glory,
> But far beyond his depth,"

he, too, had found his high-blown pride at length break under him, and had suddenly disappeared from the sight of men. And I do recall the fact that, as I happened to be near at hand when the explosion occurred, I was suspected of having pricked those bladders; though quite unjustly, for they burst from their own excessive pressure. But, however that may have been, he disappeared, till now he again appears in this fitting company, again to renew the battle in which he so signally failed long ago.*

* This Mr. Horatio Allen is no novice in the business of trying experiments to establish an hypothesis to order. He performed the principal part in such an operation about 1854, on what was then called the "Cloud engine;" in which the object was to sell stock in Wall street, which object was accomplished. I had occasion to publish this matter once before, and I quote from that publication:

"This 'Cloud engine' enjoyed a remarkable existence at the Novelty Works, about as long as its relative, 'The Vampire,' both belonging to the genus humbug. 'Cloud' was ushered into public notice with more imposing circumstances than 'Vampire,' however—Mr. Horatio Allen starting it out with a 'first-rate notice,' every line of which was redolent with wisdom. After giving some rows of figures for the purpose of appealing to the popular credulity, which is expressed in the maxim, 'figures can't lie,' the certificate concludes as follows:

"'What the proportion of saving is to be remains to be determined by more extensive use; but I am constrained by the facts which have been developed by these trials to state my belief, that the Cloud combination will take the place of the high-pressure engine, and prove itself one of the most extraordinary and valuable inventions of the age.

"'Yours, respectfully, HORATIO ALLEN.'

"And again:

"'As the result of the trials referred to, I have to state the increase of pressure arising from combination of steam and air is proved beyond a doubt; and that the increased useful effect resulting from this increased pressure, as shown by these trials, is *over fifty* per cent.

"'In building a high-pressure engine for myself, or for parties who would leave the question of the *kind* of engine to me, I would unhesitatingly adopt the Cloud engine; and in taking this position I rely upon the facts which have come to my knowledge in the trials made under my directions. HORATIO ALLEN.

"'*Novelty Works, New-York, July*, 1854.'

"This was satisfactory to the proposed victims, and numerous gentlemen in Wall street, relying upon the 'sagacity' of that paper, invested in the 'Cloud,' which has gradually but rapidly been dissipated into thin air, and now no longer obscures the daylight of truth.

"A similar humbug, about the same time, called the '*Bi-sulphate of Carbon* Engine,' under the auspices of another distinguished engineer, and sporting his certificate, vied with the 'Cloud' for public favor. It would be curious to know which one cheated the most people. The certificate of

Gathering wisdom, however, from the past, and from Isherwood, it appears that they have concluded, with the Scriptures, that "no man goeth to war at any time at his own cost," and they have called upon the American people to furnish them with $20,000 of their money to make another attempt on James Watt and Marriotte.

What an exhibition is this! Either it is established, by *certain demonstration*, that all the navies of the world, and all the private steamers in existence, are, and always have been wrong, and that only Secretary Welles and Isherwood are right, or it is not. If it is, why do they take our money to test this settled question again? If not, how have they dared to build an entire navy as boldly as if they had the experience of the world, and the common consent of mankind in their favor? And then, how do they dare thus, in the face of the world, to become their own triers, and to pronounce judgment on their own works, by the use of money which, if it were appropriated for any thing useful, was appropriated to expose these monstrous frauds and to arrest these fatal iniquities?

the 'Novelty Works' was, on the whole, the more imposing indorsement, but the hard name of the other, so scientific and sonorous to the ear, was almost as good. I should be rather inclined to back the 'Bi-sulphate' against the 'Cloud,' notwithstanding the odds in favor of the indorser of the Cloud.

"The example of 'Vampire,' proves that it takes about eighteen years for one of these animals to revive and afford its happy owner the means of 'turning an honest penny' by making up a stock company, and, on the strength of a *certificate*, selling out to others. We may, therefore, expect 'Cloud' and 'Bi-sulphate' back again in that time with a new certificate; leaving again, as now, in their trains, an army of victims, who ever afterward will look upon a man who claims to have invented something useful, as a knave, and will slam their doors in his face. Thus real merit is sacrificed that charlatans may grow rich!"

Of course this "Cloud engine" certificate was as sheer a humbug as Isherwood's books, and the machine itself has disappeared forever, to the intense disgust of the victims of this certificate. Mr. Allen is now ready for Isherwood's case.

One of the consequences, however, of this former exposure has been that Mr. Allen has devoted his talents to infringing Mr. Sickels's patents, with considerable success, in several ships of the Pacific Mail Company; although the machines, by reason of the ignorance exhibited in the infringement, will not give within twenty-five per cent, at least, as much power from a given amount of coal as they would do if properly made; but he has his revenge. Not long since it was proposed at the Board of the Pacific Company, that these improvements should be used in their perfection, as now exhibited in the most successful steamers in the world; but Mr. Potter, representing Brown Brothers & Co., who are the advocates of Mr. Allen, protested against it, and said, as I am informed and believe, that if these improvements were adopted by the Company his principals would sell their stock; for, he said, they never would consent, after my exposure of Mr. Allen, in the case of the Metropolis, to have me do any thing for a company with which they were connected. What a charming thing it is, to have a great concern like the Pacific Mail Steamship Company to participate in one's private quarrels, and pay the losses incident to the gratification of one's private malice! However, I presume the business of that Company is profitable enough to stand it, and the stockholders ought to be thankful that it is no worse.

The appropriation itself was absurd enough; for you might as well appropriate money to build a new leaning tower of Pisa in order to refute some fool who should deny the laws of gravity, as proved by Galileo from that curious monument of architectural art; but infinitely more absurd is it to see those scales, thus paid for by the people, held in the hands of Isherwood and one of his contractors, while in the one basin sits Gideon Welles, Esq., and in the other James Watt, Marriotte, Regnault, all the navies of the world, and all the commercial steamers in existence. Isn't that a picture for an artist!

But I follow these gentlemen into their operations with this $20,000 of our money. Have you asked my opinion, said I, or the opinion of Mr. Coryell, or of any other engineer who is known to denounce your naval blunders, as to how these experiments ought to be tried? Oh! no; not they! But, gentlemen, I have seen their programme—it is printed, and on its face it is a plain preparation for a fraud.* They do not even propose to try this experiment with a steam-engine at all; (by which I mean an engine whose piston works *in steam*, and whose power results from the difference between the pressure of steam in the boiler and in the condenser, commonly called a "low-pressure engine";) but they propose to use a mixed steam and air engine, (by which I mean an engine in which the steam drives the piston on one side and the air resists its motion on the other side, commonly called a "high-pressure engine";) by which instrument any thing can be proved which is desired by the juggler who uses it. You can prove by it that expanded steam won't drive a steam-engine at all, if you please, although your boiler may be

* I saw it accidentally in Captain Comstock's office, where it was brought by one of the persons favored with a copy, who was building engines for Isherwood, and was not expected to interfere, therefore, with this nice little scheme. The moment I read it I saw the trick, and, as Captain Comstock will remember, I pointed it out then, and denounced it as a fraud.

I presume it needs no argument to convince any honest man that if Mr. Welles had really desired any other result than a juggle, he would have invited some engineer—Mr. Coryell, for example—who was in the Board called by him to examine these Isherwood engines, and who denounced them, to furnish the plan of an expansion engine to be brought into competition with a non-expansion one, to be made by Isherwood. Or he would have invited the Academy of Science to take charge of the experiment, and decide how it was to be made. If he had done either of these things, an engine working expansively would have been produced, which would have done three times the work for a pound of coal that can be done by any non-expansion engine possible to be made. But to let Isherwood appoint himself, and one of his contractors, to take that money to try himself with, and then to allow them to spend it on a half air, half steam-engine, is monstrous. The Cloud juggle which stuck Wall street in 1854, is hardly worse than that!

ready to burst with pressure; and to do it you have but to cut off so short that the average of the steam pressure will be less than the pressure of the air—that is, less than fifteen pounds to the square inch—in which case the engine would stand still. And of course, if you can make an engine so that it will stand still, you can make it go as feebly as you please, and at whatever cost of fuel you may choose; and if you are prepared to charge expansion with the consequences of your own fraud, you can show that it is even less than valuable. In his book, Isherwood had prepared for the perpetration of this new swindle by announcing this sort of machine to be the true one to try this experiment with. I read from page 123: "In fact, all accurate experiments on steam should be made with non-condensing engines, and with steam *not expanded below the atmospheric pressure.*"*

Is it not time, gentlemen, that such outrages as these should cease? By way of consoling us, however, Isherwood told us that they intended this time to report the results truly—no balance is to be forced nor false entries made on this experiment. That was an unnecessary assurance, surely. No one who has heard Isherwood examined here would ever suspect

* That Isherwood understands this juggle perfectly is proved by his Precedents, p. 66, where he shows that if the back pressure is sixteen pounds to the inch, the usual amount of a high-pressure engine—a case can be made in which non-expansion will excel expansion immensely. He gives the figures in detail, to show how this can be done, and thus generalizes his result: "That is to say, the economical effect of the steam used *without expansion* exceeds that which is obtained from the steam used *with expansion* in the ratio of 8¼ to 2."

It must not be assumed from these remarks, however, that expansion will not give as good results *relatively* to non-expansion, on a high-pressure engine, as on a low, if the comparison is honestly made. The high-pressure engine is only a convenient instrument to make a *dishonest* comparison. Thus, for example, if the problem on a high-pressure engine is to obtain an average steam pressure of thirty pounds to the inch on the piston, (which being resisted by the air, and the friction of the escaping steam, would leave about fourteen pounds for effective work,) that pressure can be got more economically by expansion than otherwise, in the exact ratio of the laws of Marriotte and Regnault. But if you will get 30 pounds average pressure *without expansion*, which gives 14 pounds to do work with, and then get only 17 pounds *with expansion*, which gives only 1 pound to do useful work with, and then compare the cost of the *useful work*, it will be found that the expansion is the more costly; but the fraud is plain, and consists in charging expansion with a much larger per-centage of useless work than is charged to non-expansion. But if a *steam* engine were used, this trick could not be played so well, for the back pressure would go down with the increased rate of expansion, and the per-centage of *useless* work done by the steam would be more nearly constant, for both cases.

Of course any engineer will see at a glance—but the people on whom this self-appointed Commission is about to operate will not see—that if the two pistons are to be resisted by the atmosphere, with its constant pressure, it is necessary, in order to make a fair comparison, that they should be impelled by the same amount of mean pressure; and then, as the back pressure is a uniform per centage, it is immaterial how much it may be, for the remainders, whatever they are, will preserve the true ratio to each other, and expansion will be found to be what Marriotte has said it was.

him of making false statements. We have heard him here admit under oath that if a steamboat could go faster with expansion than without it, he was in error and the navy all wrong; yet when we went to the Potomac river and tried that very experiment on the first boat we came to, and it showed that with six hundred pounds of coal an hour the wheels would turn twenty-seven revolutions a minute when using the steam with expansion, and with seven hundred pounds an hour the same wheels could only be turned twenty revolutions a minute without expansion, he still came back to the stand, and without pretending to explain or question the fact, he repeated the oath with which he started, that no such thing was possible.* We have heard him admit that if the

* No more striking illustration of the ignorance or the villainy of this man could be found than this fact presented. That he could be ignorant of so simple a truth about a steam-engine as that without a cut off it is almost disabled when it has to rely upon the usual amount of boiler-steam for a supply, is almost incredible; for there is scarcely an engine-driver in the United States whose *experience* has not shown him that, as we proved by numbers of them on the stand. And yet how he should dare to deny it under oath, if he knew better, when it is capable of being proved on any steamboat, in a few minutes, anywhere, is equally remarkable. His usual cunning forsook him on this occasion, for he probably did not anticipate that I would try an experiment, or that I could produce the witnesses. His usual answer to such facts is, that they prove nothing—that an experiment is of no value unless it is tried for an "entire cycle;" which in his jargon means, for seventy-two hours. But here he did not use that shield. I quote my questions and his answers:

"Now take another instance—take the steamer Foh Kien, she is 38 feet wide, 275 feet long, and draws 14 feet of water. She has the Sickels cut-off, as well as the others," (meaning other boats which had been named,) "and if there is no difference between working steam expansively and non-expansively, except eighteen per cent, that is the only advantage. Now if, with the cut-off, the wheels of that ship, 32 feet in diameter, will turn sixteen times a minute, and without the cut-off will turn only twelve times with the same furnaces, and under the same circumstances, is it possible your theory is true?"

"*A.* Not if these facts are true; but they cannot be true. I have no hesitation in answering that."

"*Q.* Then if it be true that with a given engine in a steamboat, burning its fire in the same manner, at the same time, under the same circumstances, that when you make the cut-off shorter and shorter, the engine goes faster and faster, while at the same time, and under the same circumstances, when you let it out it goes slower and slower, is your theory true?"

"*A.* Not with these 'ifs.' It is the same thing as saying that if a thing is smaller and smaller, it will be smaller and smaller."

Upon this state of the testimony I proved the truth of the assumption in regard to the "Foh Kien," and also tried the experiment on the "Collyer;" both of which showed his profound ignorance or his knavery. Now these experiments may be tried any day in the year, on almost any steamboat, with similar results; and to my certain personal knowledge Isherwood has known it to be so for several years; for I have shown him such facts and invited him to go with me and see them for himself, which he refused to do; as they refused to go in Washington, although we invited them, and challenged them to allow the court and jury to be witnesses of this obvious fact.

What conclusion is left for the country to draw, which is consistent with common integrity, when we see the Engineer-in-Chief of the Navy admit on the stand that his theory is false if certain facts can be proved; and yet, when these facts are proved, and can be seen by the Secretary himself any day in an hour, our millions are yet spent right on in accordance with this false system, just as if it were unquestioned in the world! It requires charity enough to qualify a man for the next world, to attribute such conduct to *mere imbecility*.

steamship America could make seven hundred revolutions of her wheels an hour, then he was all wrong, and the navy a botch; and yet when we proved more than that here—when we proved the hours of her run, and the distances made over measured miles—all much greater than the facts I assumed, which he swore to be impossible—yet he still adheres with brazen effrontery to his text; as if he were the chief witness for the defence to prove an alibi after an Irish murder, and could hope to defeat the eternal laws of nature as he might have cheated the laws of man. No doubt he is reliable to report any results of experiments which he might make!

What has been the result of all this ignorance upon the ships built by the navy? You have heard Mr. Isherwood explain that the various failures have been occasioned by the bad workmanship and the poor material of the engines—all of which is an idle pretence. Merchants use the same materials and the same workmen; but their ships go when they are finished and never stop till they are worn out. But the fact still remains that all of these sloops-of-war, built on the plans of this man, have been weeks and months at the docks of Philadelphia and New-York undergoing repairs and alterations, after they first got steam, before they could go to sea. The Juniata had her officers and crew in commission for several weeks ready to sail, during which time they tried frequently in vain to make her go; and at last she was put out of commission, and her crew ordered to another vessel, while a telegram was published stating that the engine was all right, but the ship leaked. The Ticonderoga was six weeks in New-York being altered, after she was first tried, before she went to sea; and the Lackawanna broke down at the dock, and had extensive repairs before she could go. The Ossipee reached Washington from Boston, on her trial, broken down, and remained here months for repairs. One of these vessels—the Ticonderoga—went from New-York to Fortress Monroe, and was forty hours on the passage, or seven miles an hour; and the Lackawanna took thirty-six hours to run from Sandy Hook to Cape Henry, which is at the same rate or less. The Sacramento attempted to catch a blockade-runner and broke down twice in the effort—although she was only running sixty turns a minute

—and gave up the chase, as Captain Boggs reported to the department about ten months ago;* and the Ossipee, in the Gulf of Mexico, starting at ten o'clock in the morning in pursuit of a blockade-runner, was overtaken and passed at about ten o'clock at night by the De Soto, an old New-York and New-Orleans packet, which certainly cannot go twelve knots an hour, but which, starting five hours later than the Ossipee, from the same place and in the same chase, went, in eight hours, further than the Ossipee could go in thirteen, and captured the prize which the Ossipee could not overtake; as may be seen by a report on file in the department, made by the captain of the De Soto. Off Wilmington the fastest blockader now is an old New-York ferry-boat. And I heard the commanding officer of the Mobile squadron declare in the Navy Department that schooners would run away from these United States steamers with jib and mainsail set; and say that he would like to have a steamer which at least would compel them to set their foresails.

* After his magnificent fight with the Varuna on the Mississippi, in which he fired his guns while the turbid stream swept his sinking decks, Captain Boggs was ordered to the Juniata, at that time nearly completed, in order that he might have an opportunity in a fine ship to reap some substantial reward for his gallantry, out of the prizes he might capture. The ship, however, wouldn't work, although she was in commission several weeks at Philadelphia, making frequent trial-trips, and always becoming disabled; until at last Captain Boggs and his crew were removed to the Sacramento, another one of the same breed, which was then ready.

After various efforts she got away from Boston, and it was a subject of considerable rejoicing at the department, that she went to Fortress Monroe without breaking down. When she went to her station, however, she was found utterly worthless. I had written and printed a letter to the Secretary, a year ago, and long before these vessels were brought to the test of service, in which I said:

"And any attempt to drive these engines *up to the power of the boilers* will result in disabling them in a few hours, as every engineer knows who knows the machines; so that it is *perfectly certain* that these engines *must come out of the ships*, and new ones take their places, before the vessels can be used for any purpose which requires the *ordinary speed of such ships*—which result no human ingenuity can avert. Of course, if the ships are not required to go at the usual speed, or are left at the dock, the engines are as well polished and handsome as any in use, and as useful."

When the Sacramento undertook to chase a blockade-runner, she proved the truth of my prophecy by breaking down; and it was soon found that it was useless to attempt a pursuit, after the vessel escaping had passed; for then the further they went the more they couldn't catch one. Complaint was made by the Admiral to Captain Boggs, and a correspondence ensued, in which the entire inefficiency of the ship was asserted; but the Admiral went down to the Wilmington station to see for himself, and came back satisfied. The Navy Department, however, was not satisfied that Captain Boggs should tell the truth about these miserable abortions of theirs; and he now is suffering under their displeasure, on shore-duty; but the department is making as many more of such engines as they can get built.

I would add, in justice to Captain Boggs, that these statements are made without his knowledge or consent, and that I have not the pleasure to know him personally; although I should be most happy to add my mite to the great flood of admiration which overwhelmed the hero of the Varuna, whenever it is my good fortune to meet him. I hope, therefore, he won't be punished any more for what I now say.

In the printed specifications issued by the department, under which these sloops were built, their engines are required to run *ninety* revolutions a minute, at which rate they would go as well as such vessels usually go; but in fact they do not exceed *sixty*, and that speed they cannot maintain. At that speed their screws run but ten and a half miles an hour on their average pitch,* supposing they were running in a solid block, instead of in water; and, after deducting the "slip," the speed does not exceed nine knots an hour; while the Iroquois, a ship built under the last administration, whose engines were made in New-York on well-known plans—such as are used generally by the English and French navies—can go thirteen knots an hour, as her logs show, and as her sailing-master, Captain McRae, will at any time prove to any one who chooses to ask for the information.† And all these facts have been well

* The "pitch" of a screw means the distance between two consecutive "threads" measured on the length of the axis of the screw; or, supposing the screw to be like an ordinary "wood screw," the "pitch" is the distance it will enter the wood at each turn the screw-driver gives it. Thus when the "pitch" of a ship's screw is known, and the number of times which the engine—the screw-driver—turns that screw in a minute, the speed of the screw through the water is ascertained by multiplying the "pitch" by the number of turns. But the ship does not go as fast as the screw runs through the water; because the water being mobile, does not resist the thrust of the screw as a solid block would do; and this loss of motion is called "slip." It is generally about twenty per cent on usual screws, but may be much more. On the Ossipee and her class it is not less; although Isherwood swore that those ships went faster than the average speed of their screws. Their average pitch is seventeen and a half feet; which, multiplied by sixty revolutions a minute, produces one thousand and fifty feet of motion of the screw through the water a minute. And as every *hundred feet a minute is a knot an hour*, within a trifle, *ten and a half hundred feet a minute* are *ten and a half knots an hour*, supposing there were no "slip." Deduct about twenty per cent for slip, and the true speed of about eight and a half miles an hour remains.

† The Lackawanna averaged about seven knots from New-York to Cape Henry; but Isherwood had an "official report" that she went *twelve*. In order to go twelve, however, she must have gone about two knots an hour further than the screw went through the water which drove her—which isn't a very great excess; for when you have once produced an effect greater than the cause which produces it, there is no limit in nature to the excess, and it might as well be reported a hundred knots a minute as any other amount, and I wonder at the modesty which limited it to two knots an hour. The following comical cross-examination of Isherwood occurred in regard to this performance:

"Q. The Lackawanna, for instance, came from New-York to Fort Monroe, and there was an official report made of the trip, was there not?

"A. Yes.

"Q. You have seen the log?

"A. I do not recollect of seeing the log; I saw the official report.

"Q. And that official report was the twelve knots an hour?

"A. Yes, sir.

"Q. Does a vessel go any faster than the screw moves through the water?

"A. It does not.

"Q. Does it go any faster than any part of the screw?

"A. It may.

"Q. Does it go as fast as the *mean* of the screw?

"A. It may go faster than the mean.

known to the Navy Department for a year or more—are well known to the country—and yet they are now building a vast number of ships on the same plans to produce the same results; refusing to listen to any one, and utterly ignoring their own experience of the past, the lessons of all the navies of the world, and the self-evident truths of science which you have heard in this case. Finally, however, goaded to madness by their shocking failures, the department is determined to have speed at any cost; and to accomplish that they have put out *six contracts* for engines, whose cost is *seven hundred and eighty thousand dollars each engine*, which are to fill up the entire ships below deck with boilers and machinery, so that the coal has to be carried on the berth-decks, where men usually live; and to accommodate the crew thus driven out by having their quarters turned into coal-bunkers, they are building forecastle

"Q. Does it in fact?

"A. I suppose the speed of the vessel goes about midway, or with the mean of the screw, and that is about eighteen feet motion.

"Q. Then there is no slip at all for two thirds of the screw?

"A. No slip at all, though at the same time it is necessary to explain that the screw does not drag, although it does not slip. I suppose, however, the laws of the screw are not in question in this action.

"Q. Then sixty turns a minute of the screw would give ten knots an hour through the water?

"A. It would go ten and eight tenths knots.

"Q. And yet the vessel in question was reported as having gone twelve and a half knots?

"A. The maximum speed was reported as twelve knots an hour—that was the report of the officers.

"Q. If they reported the vessel was going twelve knots and the screw was only making sixty urns per minute, was not the report necessarily false?

"A. I think not. I knew nothing about the circumstances.

"Q. Is it possible for these ships to go more than ten knots an hour with only sixty turns to the minute?

"A. I suppose about ten and a half knots."

Here then we have an explanation of the jugglery by which these ships are reported as going twelve knots. The truth, however, is much worse than Isherwood makes it out to be—bad as his showing is. If the ship could go ten and a half knots an hour, they could capture any blockade-runner I have yet seen. But, in fact, when the screws are turning ten knots and a half an hour the ship cannot go within about twenty per cent as fast—that is, the *slip* is about twenty per cent on such models as these are—and the speed is less than nine knots an hour.

But why should this be left in doubt? A year ago I wrote to the Secretary and begged him to have one of these ships run over a measured distance, say from Sandy Hook Light-Ship to Delaware Light-Ship and back for a day, and by that means, ascertain the speed, but he won't do that. Whenever that is done *nine knots an hour will beat the ship*. But until that is done, any amount of lying can be resorted to, and as in the case where Isherwood swore about it, the speed can be made up to order, even at the expense of performing impossibilities. These figures have all been before the Navy Department for several months, and their certain demonstration exhibited, which Isherwood was compelled to admit; and yet the Chairman of the Committee of Ways and Means, of the last House, told me that the Assistant Secretary of the Navy had assured him that these ships did go more than twelve knots an hour—and that, too, long after these very figures showing its impossibility, had been explained to him.

When I talk to these people, they don't make such pretences to me, but say: "Oh! Isherwood has made mistakes just as others have."

and poop-decks above to swing hammocks.* And all this is done upon the insane idea that a steam-engine can be made to go by enormous boilers; which in these cases fill up the ships below, but which will not give speed, for the plain reason that as the steam is to be used without a cut-off, on this new discovery, so much more weight of boilers and coal is needed to produce the increased quantity of steam thus required, that the load thereby produced will more than neutralize the power incident to the steam so wastefully and fruitlessly used; and the more boilers a ship has after a certain point, the slower she goes. Isherwood's idea is the same as that of a fellow, ignorant of horses, who proposed to drive a horse from New-York to Philadelphia and back in one day. "Why, you cannot do that," said the livery-stable man. "Vy not," said the cockney; "ve 've got a vip?" So Isherwood thinks that if he only has got a "vip," his engines must run, whether they can use the steam or not; and in this case, his "vip" is composed of boilers having more grate surface to burn coal than the Adriatic, the Foh Kien, and the America all together, while his ships

* This outrage exceeds all its predecessors. Grown bold by impunity, they seem to think that even shame need no longer deter them. After having succeeded in reducing the speed of the navy from about *thirteen knots to less than ten*, notwithstanding the assurance often given by the Secretary himself to numbers of persons, that the ships they were building would be the fastest and best in the world; the Secretary one morning ordered the same people who had been so successful in that direction to make a number of sloops-of-war which could go *fifteen knots an hour;* just as if such things could be bought in a corner grocery—although it is true that there is no *ship* now in existence, whether it be a passenger or war vessel, a side-wheel or a screw-propeller, which can go, when carrying its coal for a voyage, fifteen knots an hour. Even the "Scotia," which crossed the ocean last summer in eight days and three hours from Queenstown to New-York, never on that voyage made fifteen knots an hour for a single day—her longest run having been three hundred and fifty-six knots in twenty-four hours. The size of the ships proposed to be built was three hundred feet long, forty feet wide, twenty-two feet deep, and to draw sixteen feet of water; carrying a light battery on the spar-deck, which was to be flush. When Isherwood, however, had calculated out the quantity of boilers which on his ignorant idea were necessary to drive such a ship at that speed, it was discovered that the machinery could not go into the length proposed, and the ships were ordered to be about three hundred and twenty feet long instead of three hundred. And when the weight of this immense mass of boilers was taken, it was found that instead of sixteen feet draft, the ships would go down about eighteen feet in the water. Mr. Delano, of the Brooklyn yard, was ordered to build one of these "beasts of burden," and made his model—a very good one—laid his keel, and had begun to get out his frames, when he received the drawings of the engines from Washington, and found that they would not go into the ship. He was in the situation of the Vicar of Wakefield with his picture. After remonstrating in vain, he had to stop work, reconstruct his plan, spoil his model, and swell out his ship at both ends in order to include these boilers — that is, he built a box around the machinery. But when the distribution of space began to be made, it was found that the coal had to be carried on *the berth-deck*, and then it became necessary to find other accommodation for the men; and I am now informed (the other facts I know myself) that they are to build forecastle and poop decks to accommodate the men.

Now, to show the absurdity of all this. The Adriatic is nearly twice as large as one of these

are only about sixty per cent of the size of the Adriatic alone.* Thus folly is added to folly by this combination of imbecility and knavery, until, unless checked by the country, we shall have squandered all our money on a navy whose value will be

ships, and she has about eight hundred square feet of grate bars, which were found in her to be too much for the engines. These *sloops* have *one thousand one hundred and forty square feet of bars*. The advertisement called for eight blowing-engines, but I am told they do not mean to have them. If they do use blowers, those furnaces can burn sixty pounds of coal an hour to each square foot, (on Long-Island Sound they burn seventy with blowers,) which will enable the sloop to use up thirty-four tons of coal an hour, or to burn all she can carry in less than a day. If she does not use blowers, she can burn fifteen pounds an hour on a square foot; and then she can burn eight and a half tons an hour, or two hundred and four tons a day. The Adriatic, with natural draft, could burn on eight hundred square feet of grates one hundred and seventy tons a day easily, and did it.

But a man-of-war differs from a merchant ship in this essential particular — that a man-of-war should have the capacity to go slow with great economy, so as to stay at sea a long time, combined with the capacity to go fast when the emergency requires it, without regard to the economy of fuel during that emergency; whereas a passenger-ship is required to go her full speed all the time with as much economy as may be. By using blowers to force the fires, any amount of steam can be got, but not so economically as if the fires burnt with natural draft; and therefore in a merchant ship, where the largest amount of steam is needed all the time, (except in storms,) it may be advantageous to carry boilers enough to make it without blowers, (although I think differently even there;) but in a man-of-war, where the greatest amount of steam may never be needed an hour in her existence, and where her usual speed in cruising ought not to exceed eight miles an hour, it is the height of folly to fill up a ship full of boilers, to the utter destruction of her value for a man-of-war, which will not give more steam with natural draft than one third of them would give under blast. In the Ossipee and her class there are blowers; but they cannot be used because the engines cannot work off the steam which natural draft would make; and so if blowers are put into this ship, they cannot be used because the engine cannot work off the steam they would make; and indeed they cannot work off the steam of natural draft.

The only advantage of this arrangement is, that it makes an enormous job, and is a gold mine for some one. Four million six hundred and eighty thousand dollars for six engines will make several people rich. The entire original cost of the Adriatic did not exceed the cost of one of these engines alone.

These are the ships to which the Secretary refers in his recent report, in these words, "We need and should have steamers of high speed, constructed of wood, with which to sweep the ocean and chase and hunt down the vessels of an enemy. Fortunately we are able to supply ourselves with vessels of this description; *and a competent and healthful competition exists for their construction*"—from which one would infer that the Department had invited competition in regard to the plans and means for producing speed; whereas in fact nothing of the sort exists, and the shops are allowed to do nothing *but build from drawings furnished by the Department*.

* The Navy Department has had a lesson on the folly of attempting to make an engine go with a "vip," in the cases of the Ossipee and her class. Their cylinders are built on the new hypothesis, and are much smaller than the cylinders of the Iroquois. When running at their respective rates—that is, sixty and eighty—the cylinders of the new sloops open to the steam a cubic space, which bears the ratio of thirty-two to fifty-one, as compared with the Iroquois. Yet the new vessels have 8950 feet of heating surface in boilers, while the Iroquois has only 7500; and they have blowers to drive their fires, and she has none. But they can turn their screws, whose average pitch is but seventeen feet and a half, but sixty revolutions a minute; while she can turn her screw, whose average pitch is twenty feet, eighty-six times a minute. That is to say, the screw of the Iroquois runs through the water 1720 feet a minute, and the screws of Isherwood's boats run only 1050 feet a minute; and deducting twenty per cent from each for "slip," which is about the true allowance, one ship will go *thirteen and a half knots* an hour, while the other will go *eight and a half*. All this while the "vip" is of no use, because the animal is doing all he can.

The attempt to make an engine go on this principle is like attempting to get more power out

less than the raw material of which it is composed, and will find ourselves a prey to the first naval power which chooses to drive us off the ocean. I verily believe that if our navy had

of a water-wheel by overflowing it with water, or to utilize the power of Niagara by putting a water-wheel under it. The measure of power is not the steam, but how much of the steam the engine can use *with advantage*. It is a very common error to suppose that power may be increased with an engine of given size by increasing its boilers beyond a certain limit. In the Lake Erie Report this ignorant notion is presented as a valuable discovery, where it is asserted that an engine taking steam for seven tenths of the stroke is producing its "maximum power," as well as its maximum economy of fuel. But the fact is, that if steam cost nothing—if one had the Atlantic Ocean for a boiler, and the fires of Pandemonium for a furnace—there would be no increase of power derived from an engine by following the piston with the steam more than half-stroke; and when the question of the economy of power comes in, then the shorter the steam is cut off, the more power results from a given amount of it.

Ignorance of the first of these propositions is not uncommon; but of the second, the Navy Department has the monopoly—no one else disputing their claim. An explanation of the first one—that an engine is giving all the power it can yield when cutting off at half-stroke—may be instructive; and, at the risk of prolixity, I will give it. The power of an engine is derived from the relaxation of the temperature of combustion, in two ways: first, by the conversion of the water into steam; and, secondly, by the expansion of that steam after the cut-off valve has separated it in the cylinder from the boiler. Both of these operations are attended by a fall in temperature; the steam which comes out of the water is not so hot as the heat which entered the water from the furnace; and the steam, after expansion, is not so hot as it was before expansion. These are the losses of temperature which "Joule's equivalent" represents. Now it is ignorantly supposed by Isherwood in his book—and many paragraphs are devoted to exhibiting his ignorance in this particular—that the steam *in the cylinder*, so long as it is in communication with the boiler, *does some work;* and he tells us how, by reason of doing that work, it is condensed. But, in fact, it does *no work* until after the cut-off valve closes, and it begins to expand. Till that time, it might as well be hot mush, or oil, or any other mobile substance: it only performs the office of a plug, or filling, through which the steam, which is *rising out of the water in the boiler*, pushes the piston—which steam, after having done its work, takes its place in the row, to be pushed forward, stroke by stroke, through the pipe and cylinder till it is exhausted. The work, therefore, of an engine taking steam for the whole stroke, is done *entirely* in the boiler, and the only *quality* of the steam in the engine which is of any value is its mobility; and this is true of so much of the stroke of the engine as is performed by means of the boiler pressure, and before expansion has begun in the cylinder. This fall of temperature produces an amount of power equal to one ton lifted one foot, for one cubic inch of water evaporated; and no more can be got out of it.

But the second, and the most important operation, is performed when the second fall of temperature occurs; which is after the cut-off valve has shut, and the steam in the cylinder ceases to be a mere plug or filling to transmit power, and begins to give out the power by expansion which was compressed into it by the heat of the furnace. Then the question is, how much of this fall have you got; and how much will you use? The higher the steam is carried, the higher is the fall; and the longer the expansion is carried, the more of that fall will be utilized. It is exactly the case of a pond of water, with an overshot water-wheel so many feet high—the higher it is, the more power may be got from the water; and how much power will be got depends upon the size of the water-wheel used. If the wheel is as high as the fall, all the power will be got; if only half as high, the water will fall half-way without doing any thing *for you*, and only half of its power will be used. So with steam: if the pressure is forty pounds to an inch, and it is expanded down to one pound—say forty expansions—all of the power due to that head of steam will be utilized; if it is expanded only once and reduced to twenty pounds in the cylinder, and then thrown away, only *so much* of its power will be utilized.

Now a steam-engine is like a water-wheel in another particular—it is troubled by "*back-water*," that is, by back-pressure steam, or steam which is in the condenser, and which resists the piston in its motion through the cylinder—just as the back-water in a tail-race piles up on a water-wheel and resists its motion, if too much water is poured over the wheel. And there is a point where an increase of steam in the cylinder, or of water on the wheel, will cease to produce power, and only cost steam or water for nothing. In a steam-engine as generally organized—

been effective on the blockade, this rebellion would have been crushed long ago; but as it is, the rebels have their supplies from abroad, and if any of their blockade-runners ever pass

that is, with the usual condensing capacity, or tail-race (to carry out the illustration,) that point is about half-stroke, beyond which steam gives no power, and is wasted.

A few figures and the accompanying diagram will make this plain. Suppose an engine to be running with a boiler-pressure of forty pounds to the inch—that is, twenty-five pounds above the atmosphere; and suppose the back or condenser-pressure to be five pounds, which Isherwood assumes in his tables, and which is correct enough for full-stroke engines, although too much for expansion; and suppose that engine to be run, first, with the cut-off closing at half-stroke, and then with the steam-valve open to the end of the stroke, so as to give full pressure to the piston all the way to the end. Now that engine will use just *twice as much steam* and fuel in the latter case as the former, and do no more work. To show that, a comparison must be made between the powers produced in the two cases. In the first case—that of half-stroke—the piston will be pushed down half-way, with the pressure of forty pounds to the inch, and then no more steam is taken; but the steam then in the cylinder will still drive the piston to the end of the stroke with a diminishing pressure, whose average will be twenty-eight pounds to the inch during the second half of the stroke; and consequently the average of the whole stroke will be thirty-four pounds to the inch; or the effect will be the same as if the piston had a pressure of thirty-four pounds to the inch, from end to end. But when the exhaust-valve opens to let out the steam into the condenser, its pressure is only twenty pounds to the inch, and its temperature has fallen in the proper ratio; so that it is condensed rapidly and got out of the way of the returning piston—just as the water which falls out of the water-wheel into an open tail-race, runs off with little resistance to the wheel.

But in the second case—that of full-stroke—twice as much steam is taken from the boiler, and the piston is driven down with an average pressure of forty pounds instead of thirty-four pounds; that is to say, one half the steam with expansion gives eighty-five per cent of the power of the whole steam without it; and to get that additional fifteen per cent costs as much as it cost to get the first eighty-five per cent. But there is a heavy loss to be encountered, which will use up all of that fifteen per cent, and leave the engine no gainer by the double quantity of steam thus used. And this loss arises from the difficulty of condensing *twice the steam at twice the pressure*, which, in this case, has to go into the condenser; for it will be seen that, whereas in the half-stroke steam, the pressure was only twenty pounds to the inch at the end of the stroke, it is forty pounds in the full-stroke steam, and there is also twice as much steam in quantity. The result is, that the condenser is unable to condense this double quantity at double-pressure, in less than four times as much time as in the former case, and the back-pressure incident to this difficulty uses up the fifteen per cent of advantage which was derived from thus wasting twice the steam. Practically I have tried the experiment frequently to exhibit it to others, and any engine properly constructed will show it.

The annexed diagrams will make it clear to any one. The figure represents two indicator diagrams, taken from the same engine working under the two conditions above supposed. Without going into a full explanation of them, it is enough to say that the areas contained within the lines here shown represent *power*, and that the power is exactly in proportion to the area contained within the boundary lines in the two cases. In the first case, the piston is driven from A to B with forty pounds pressure to the inch, and from B to E with an average of twenty-eight pounds, which the falling curve represents; while at the same time the area F, L, K, D, represents the loss by back-pressure, which leaves the area A, B, E, F, C, D, to represent the actual available power which was got from that stroke.

But if the cut-off were not applied, then the piston would be driven all the way to G with forty pounds pressure, and so far would have given the increased power in the ratio of forty to thirty-four; but when the exhaust-valve opens and the steam has to be condensed, then, instead of falling as at E to F, and so getting out of the way, it must take more time, and get out of the way more slowly; for it is twice as much steam and under twice the pressure, and it falls in the curved line G, C, producing the area A, B, G, C, D, which represents the power of the full-stroke steam; and it will be seen by inspection that the corner G, B, E, which is gained on the pressure side of the piston by going full-stroke, is about balanced by the corner G, F, C, which represents an amount of back-pressure incident to the use of this large quantity of steam.

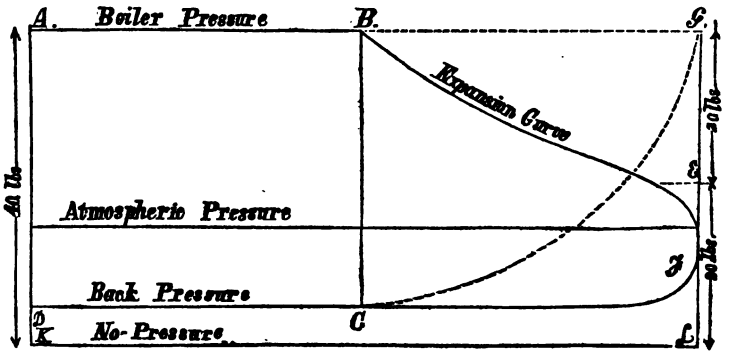
our ships, they never are overtaken, although none of the captured ships that I have seen ever did or ever will go ten knots an hour with a load.

While Isherwood was writhing under the cross-examination which was unmasking his villainies, his vengeance got the better of his discretion, and he thought to sting me by calling up the "Pensacola"—a steamer the engines of which he said I had built, and which had turned out a "complete failure," even after I had sent a man to New-Orleans who had put them in "complete repair." When he said "Pensacola" I thanked him for that, as you heard, and at once sent to New-York for the proofs which have exhibited to you the atrocities committed by this man and the Navy Department on that ship, in order to enable him carry out his other designs on the navy. The "Pensacola" was built during the last administration as an experimental ship; not for the purpose of finding out whether there was any benefit in expansion; for, as these books tell you, no fool in the world doubted that, till long since the time the Pensacola was begun; but for the purpose of testing whether various plans which are in successful use on

Such diagrams as these I have in my possession, taken from engines, and any one can try the experiment in five minutes, and find the result I have stated.

Still it is obvious that the steam can be put through the engines, and although they won't go any faster, they will take the "vip"—just as the poor horse has to do at the hands of some ignorant brute, who thinks to force him by its use beyond his powers. But even if this fifteen per cent could be all got without any loss, how absurd it would be to get it at the cost of double the fuel, as Isherwood is proposing to do on these six ships, when the same fifteen per cent might be got by enlarging the cylinder a trifle, and shortening the cut-off a trifle, with one half the coal.

Upon the infinitely stupid idea of using cylinders full of steam, these engines are being built, having no cut-off; simply repeating the Ossipee and her class, made worse by increased size and by a ship-load of cog-wheels.



side-wheel engines could not be applied to screw steamers; and among other things whether these tight valves, called "single poppet-valves," could not be used instead of the leaky slides now generally employed. The understanding with the department was, that when the ship was completed we should have her for six months to experiment with; for it was conceded by all the engineers of the government of that day—and it does not admit of doubt—that if these plans could be made to work on a screw propeller, they would vastly improve the efficiency of the navy.* Unfortunately, however, the ship was not finished till this man came into power; and he knew that if she were completed and succeeded there was an end of his carefully prepared scheme to climb into place and wield the resources of this nation to his own great profit. So he at once began to fill the papers day by day with little telegrams from Washington that Chief-Engineer Isherwood pronounced the Pensacola's engines a failure—and all this before they ever had steam. Mr. Sickels was here attending the completion of the engines, and

* It was expressly for the purpose of experiment that this ship was built. Mr. Toucey took the true view of the subject, which is, that whenever any real advantages are conceded to result from certain improvements, if they can be made to work, and there is a fair probability of their working, the Government ought not to hesitate in trying the experiment on a scale sufficiently large to test the result. Upon this idea all the enlightened governments of the day spend large sums of money in experiments; some of which prove that the proposed thing *cannot be done*, and some that it can—but in either case the result is important; for it is often as valuable to know what can't be done as what can. The chief question on the Pensacola was the use of poppet-valves, which all the engineers of that day declared could not be used in a screw engine, but which they all admitted to be vastly better than slides if they could be used. The Pensacola has settled that question, and on the stand Isherwood did not dare to say that there was any trouble about the poppet-valves. Several other valuable ideas were tested by the Pensacola; and the only good things in the recent ships are copied from her drawings, which were made for her against the most earnest opposition of the whole Navy Department except the Secretary; and if the Pensacola were to sink to-morrow, she has paid the country by those improvements copied from her, and adopted in the navy. In order that the importance of the experiments on the Pensacola may be appreciated, it should be understood, first, that the Pensacola is at least fifty per cent larger than the Ossipee and her class; second, that she has only five thousand square feet of boiler surface against nine thousand feet in these ships; and that she has run more than twelve knots an hour with these conditions, whereas they can't go ten. She has turned her screw more than fourteen knots an hour, while those small vessels can only turn theirs about ten knots, and she cannot be made to burn more than half the coal they can burn. But there are in that ship a dozen of untried experiments, all of which are important, and all of which, I believe, have succeeded; although it might well enough have been expected that some would not have succeeded. The fact that they were experiments implies the possibility of their failure. If the ship had been put in our hands when finished, and we had been allowed to give her a fair trial, she would have produced results which would have astonished the country; and as it is, in the hands of the enemy and disabled, she does so much better than Isherwood's ships can do as to make them ridiculous. When, as they showed on their own logs, produced in court, she went seven knots an hour on a thousand pounds of coal, they showed the reason why they would have her destroyed; for the ship has a cross section of seven hundred and forty square feet, and *no such result as that was ever produced in the world before.*

I was coming to make the final adjustments, when all at once Mr. Sickels was imprisoned by an order from the Navy Department on board the ship; and it began to be given out from that delectable place that Mr. Sickels and I were traitors—that we were preparing this ship to fall into the hands of the rebels—and that my well-known intimacy with Mr. Yulee, Mr. Mallory, and other leaders of the rebellion, accounted for the fact that the Pensacola was not ready.* Isherwood had studied the great villains of Shakespeare for a model, and had selected Richard for his instructor in this part of his plot; who, when he was about to murder the princes in the Tower, by way of preparing the public mind, thus instructed Buckingham:

> "There, at your meetest vantage of the time,
> Infer the bastardy of Edward's children."

And so he prepared for the atrocious work he had to do by thus slandering us, who had done him no harm. All this while I submitted without a word; for it was a dark hour in our country's fate, and private griefs had no right to raise their cry for justice. But I staid away from Washington, as my friends all know, because I would not submit to this gross indignity of imprisonment by this fellow; and Sickels, who knew my nature well, bade me stay away; for he said they would probably shoot me if I should rebel at this outrage. Sickels, however, had no redress; no *habeas corpus* could reach him, and, choking down his indignation, he finished the engines as well as he could, surrounded by hostile people, and hearing day by day how Isherwood's vengeance was to overtake all who helped him.

* This piece of villany has made Mr. Sickels an exile from his native land. When he got out of their clutches, he came to New-York utterly disheartened and disgusted, and just ready to faint by the way. He knew that the ship was to be destroyed; he had had fair notice of it, and had told Captain Morris so; but he knew that there was no use to struggle against it. It was the dark hour of our country's fate; and such villains as Isherwood could revel in their crimes with impunity—and how Isherwood did gloat over this triumph! It is true that they even made Sickels pay his own board while they kept him a prisoner; and then refused to pay him $1200, which, under the contract, he was entitled to, and they still refuse it. Isherwood had his revenge, with interest, on poor Sickels, who having paid Isherwood $400 out of his patent fee for putting his cut-off on a United States steamer, refused to pay him $400 more, which Isherwood demanded on the pretence that he had to bribe some other officer, and so would get nothing himself unless his promised twenty per cent were raised to forty. When Sickels saw himself in this man's power, and felt that remonstrance was in vain, he resolved to go to England, where such outrages as this could not be done—where personal liberty at least is safe—and he went, taking with him more knowledge of steam-engineering than exists in all Europe besides. Thus it is that it becomes necessary for the success of ignorance that merit should not only be ignored, but destroyed.

At last the engines started, and you now know the result. They ran the screw of that ship at a rate which Isherwood on the stand admitted must have taken the ship near fourteen knots an hour; and, in fact, she ran from Indian Head to Washington in five minutes' less time than the mail steamer's schedule time from Acquia creek. But where was Isherwood? He has admitted to you that he refused to go on board the ship on her trial, and exultingly boasted that he would have nothing to do with her. He, the Engineer-in-Chief of the Navy, refused even to look upon the performance of a ship which had been built to test important principles. It was wise, if not honest, at least; for his mouth would have been shut if he had seen what our witnesses have proved about her. And we all know how she ran the Mathias Point batteries, which the rebels said would stop her; and their papers were full of accounts of her great speed, by reason of which they could not strike her.

Now all these things we have proved here and much more, uncontradicted; while the two men, Hibbard and Magee—the one the chief engineer and the other an assistant in the ship, who were with her at this time and during the other outrages committed on her—were both in Washington, in Isherwood's office, where they are receiving the reward of their share of this dark business; and, although I have called daily for their production, neither of them has dared to show himself here. And the reason why, I will tell you. If Mr. Hibbard had appeared I should have asked him this question: Did you not say to Mr. Sickels that you regretted that you could not do justice to these engines, but that you were in Isherwood's power, and had to obey his wishes for your own protection? And Mr. Hibbard would have seen the State prison on one side if he had said no, and himself publicly disgraced if he had said yes—which would have been the truth—and *he* did not come. And if Magee had appeared I should have asked him: Did you not swear vengeance against Mr. Sickels, because he exposed you in defrauding the government by having a hundred dollars overcharged on a bill of gauges which you were sent to New-York to buy for the ship; and was not this transaction brought by him to the notice of the captain on the quarter-deck; and did you not publicly say that you were not afraid,

for that Isherwood had received, to your knowledge, fifteen hundred dollars apiece from the Novelty Works for the two gunboats just then building there, and that you thought you might get a little hundred dollars out of these gauges? And as this was just the transaction as it occurred, Mr. Isherwood did not want to see Magee on the stand, and so *he* did not come.*

But let us follow this ship in the hands of this precious party on her voyage. She struck on Florida Keys, and there remained eight days, beating on the rocks, until her armament and stores were taken out, and she was got off with great difficulty. In this operation the ship was "hogged," and her "skin" broken between the engines and condensers; so that the pipes which connect the engines with the condensers were torn out of their fastenings, and the air admitted to the engines. Still, when the ship floated, the engines worked in that disabled condition, and she went on. Finding that the engines would not break down, even under this trial, there was one thing left to be done, and that was to take away the oil from the machinery; and that was done, as we have proved. But even then a person in the engineer's department, whose name I will not mention, because he is still in the service, and I do not wish to subject him to the vengeance of the Navy Department, but who can be produced when needed, used privately to smuggle oil from the tank to the journals, and so kept her going; but he could not be there always, by night and day, and at last, in his absence, the brasses were melted with fervent heat, and ran off in great drops of molten metal; and the machine stopped with a shriek, as if it were a living thing, reproaching its murderers. But still the engine did not break down, although in all probability it should have done so, and the ship was got to New-Orleans. There she lay at anchor in this disabled condition, and the attempt by the Department was made to have her condemned and sold for old iron there. At this point of the proceedings, my friend, Mr. Forbes, offered to buy these engines to be used in a private ship—for these are the best propeller engines which now are running—and that

* One of the evils of having such a man as Isherwood in office is the utter demoralization of the entire service under his control; for when the subordinate knows such things as this Magee asserted that he knew, and publicly states them, all restraint is at once thrown off, and a reward is offered for corruption.

baffled the scheme to have them destroyed; for Isherwood knew that if they went into a private ship, their record would condemn him forever, and that could not be allowed. But they reported from New-Orleans that the engines could not work and that the ship was useless; and at the request of Mr. Forbes I consented to send a machinist there to put them in such order as that they might be brought to New-York; although I warned him and the Government that the machinery was badly disorganized by the breaking of the ship, and could only be got right in the dock and where there were shops and good workmen. When Mr. Cameron went there, he found, as he told you here, that the condensers were full of mud, of which he took two hundred and four buckets full out of each one; that the pumps were all choked up, and had been cut to pieces by running them when the packing was screwed down so hard that the brass itself was melted into globules; that there were no tools in the ship, not even a chisel to cut a piece of metal with; and that he had to send ashore for so simple a thing as a cold chisel. There, however, he worked with such facilities as he could get, doing such things as the engine-drivers of the ship ought to have done—or rather such as they ought not to have made necessary to be done—until he got the engines into such order that they could work; but he reported expressly in writing, and here are the papers on the table, that the engines could not be put in order until the ship went into dock, and there was repaired and brought into line. When ready, the ship was run; and the log and the report of the Commodore are on the table—by which it appears, that in that disabled condition, with the screw loose on the shaft, with the condenser sucking air till the vacuum showed only thirteen inches of mercury, instead of twenty-seven, (as it would have done if the engine was air-tight, as it ought to be,) this great ship, whose cross-section is as large as the Persia's, went seven knots an hour burning only *one thousand pounds of coal an hour.* Now, these facts are official reports, which I drew out of the Department by a subpœna, and which are now before you. I should not dare to tell these things of my own knowledge, for they are too great to be believed; but here they are proved by the enemy, and not in question. Here I turned to Isher-

wood's book again, and found that of the ships of which he gives account, very little larger than the Pensacola, none of them are reported by him to go seven knots, and all of them burn more than three times as much coal as the Pensacola—they being in perfect order and she disabled. I then asked him to name any vessel, small or great, in the navy, which could go seven knots an hour on a thousand pounds of coal; and he swore that the Ticonderoga could, but said that her log was not in the Department. Now, I will undertake to say, gentlemen, that the Ticonderoga, which is scarcely half the size of the Pensacola, but which has nearly twice as much boiler surface as the Pensacola; cannot go seven knots an hour with twice the coal used by the Pensacola; and I have no doubt her log will show that, when produced. It will astonish the officers of these ships when they hear that they can go seven knots with about ten tons of coal a day; for they know that seven knots is near their full speed, and that their coal is nearly three times ten tons a day. And to make the record of the Pensacola's outrages complete, I proved to you by Isherwood himself, that they had taken out of her, and *put ashore on Ship Island*, the blowers by which her air-tight fire-room was kept cool; in consequence of which the intense heat of a closed furnace-chamber, unsupplied by the forced circulation on which air-tight fire-rooms depend for coolness, and by which they are the most comfortable of all fire-rooms, became insupportable; so that they were enabled to have the assistance of the complaints of the firemen in their attempt to destroy and put out of sight the engines of the Pensacola; which they themselves show are capable of driving that ship seven knots with a thousand pounds of coal an hour, and which, when in order, did turn that screw forty-eight revolutions a minute—whereas now they can only turn it twenty-two, and yet can produce these immense results. The history of the Pensacola is more diabolical than any thing I have ever read of in the world; and its monstrous nature has deterred me from telling it except to my intimate friends; for no man who should relate it in its simple atrocity, as it has been developed before you by the testimony of those most interested in denying the truth of the charges made, would be entitled to be believed; because

it is more probable that any one man in the world should be mistaken in his information, or should lie, than that such deeds as these should be perpetrated. But Iago and Uriah Heep are realities, and not the inventions of an overwrought imagination. *

* The deliberate plan to ruin these engines which has been thus disclosed, has not yet been given up, although it is probable that it is near its termination just now. What the ship did before she was on the Florida reefs—what she did when she elicited the praise both of the enemy and her officers — that she can do always under the same conditions; for an engine is not a thing of passions like a man, and does not change its mind. But after the ship was "hogged" by her beating on the reefs, the opportunity for destroying the engine was favorable; and in the confusion of the ascent to New-Orleans, it could be done without exciting much attention; for at that time, the loss of one ship was nothing. In order to destroy the engine, they took away the oil; but on account of the immense strength of the machine, they only disabled her, but did not break her down. The general impression on board at that time was that Hibbard had done this from fear, and in order to escape from the fight, and such was the talk on board; but they did not know the real motive. The ship was got to New-Orleans, and there the department had a survey with a view to condemn her—her engineer preparing her for it by allowing her condensers to fill up with mud, and by not repairing her disabled pumps, etc. The interference of Mr. Forbes probably saved the ship at this time; and I sent Mr. Cameron down to put her in such order as to bring her to New-York. The report of her performance made by Commodore Bell, was very favorable; but a man named Shock, one of Isherwood's gang, and the fleet engineer, wrote, that in his opinion, all the engineering skill in the country could not keep the engine going for twenty-four hours. The ship was then left by Mr. Cameron; and then began a new set of operations, which are now going on, whose object is to disable the ship anyhow, and so prevent her from being brought here for repairs; and, by way of preparation for it, the papers are publishing letters from New-Orleans dictated by Isherwood's tools, as was done from Washington in the first case; of which the following, taken from the *Herald*, is a sample: "The flag-ship Pensacola will shortly leave this port for the North, for the purpose of effecting numerous repairs necessary to keep her afloat, if such a thing is desirable, after the following *truthful statement* is made: . . . The contract for her engines was given to an inexperienced party who botched the whole affair by putting in engines that would not budge a stroke. He then applied for Congressional relief and got it. He then took out the first engines and put in others, which were only a fraction better than the first; but they managed, with a high pressure of steam, to propel the ship six miles an hour. The ship and engines have cost the government more than any two monitor batteries now afloat. To repair her is worse than useless. It would be money saved to the government to take her out in mid ocean and send her to Davy Jones's locker. A trial trip of this vessel was made a few days ago, and she reëstablished her character for slowness. She could hardly stem the current of the Mississippi."

The first thing to do is to have some suitable tools for the purpose ordered to the ship, and to remove those whose presence might prevent it, and then the Pensacola will be used up. There is an engineer on board named Purdy, whom I do not know, but Mr. Cameron says he is an intelligent and honest man, and he will be removed. There is also a first-class fireman named John Martin, there, who will be a troublesome witness, and he must be disposed of. They have begun the work, however, and Mr. Cameron has just received a letter dated on the Pensacola, Dec. 12th, from this John Martin, which he has handed me, and which is as follows:

"U. S. STEAMER PENSACOLA,
NEW-ORLEANS, December 12, 1868.

"DEAR CAMERON: I received yours of date Nov. 10th, and was very happy to hear of the improved condition of your health. I would not write before returning home, were it not for the circumstances I am about to relate.

"On the night of the tenth inst., the Commodore received a dispatch from Fort Jackson, stating that a mutiny had occurred in the forts. We were therefore turned out at midnight and ordered to get up steam with instant dispatch. I was out first, and all went on well under the superintendence of Mr. Purdy, but it was impossible for him to be present in all places at the same moment. I heard him four (4) times within ten (10) minutes asking how much water was in the boilers. He was answered that there were three and a half (3½) cocks. While he was standing by the throttle-

But, you will ask, how does this man "count his gains" out of all this villainy? Again, I have but to appeal to him for an answer. He has admitted on the stand that he extorted from Sickels a share of the money paid to Sickels by the Government for a cut-off put on a United States ship; and he did it, he says, under the plea of advocating Mr. Sickels's plans, which he then approved. But he did not tell you all

valve, a young man, Mr. Burchard by name, was attending to the water and steam. It seems that he was one of the number sent out from Washington who had never seen the inside of a fire-room before; he did not know the name of the throttle-valve, as I heard him asking a coal-heaver what it was. While he was engaged as aforementioned, he took it into his *block* that there was too much water in the boiler and wished to be shown what to do. Accordingly some of the men, John O. Hogen, I believe, showed him how to blow her down. He then blew her down below the *crown sheets*, and as soon as the flues melted or broke for want of water, all the fires in the boiler commenced blowing out on the poor fellows' faces, until they were obliged to leave in order to save their lives—which is the same as to save the Union—and not to be blown up with boys scarcely out of their mothers' milk, and yet strapped with sword and wearing gold band. I was not on watch at the time. Mr. Purdy, therefore, sent for me, and told me to shut off the steam of the starboard boiler from the port and run her with her port boiler. At this time three strange engineers came on board by order of Com. Bell, from other ships, who acted in the place of the three (3) belonging to this, (namely, Mr. Purdy, Goiin, and Abel.) With the assistance of the port boiler and the small boat Holly Hock, we then steamed down the river fifty or seventy miles, when a dispatch-boat overtook us, informing us that all was settled at the fort; we then turned back and returned to New-Orleans.

"It seems that Mr. Shock is prejudiced against Mr. Purdy, as shown from his directing strange engineers to take the place of himself and Second Assistants. Now why not send away the three Third Assistants? I mean the one that burned the boiler and his two comrades, and not those who have had some experience.

"I pity Mr. Purdy from my heart, and I assure you that the engines worked admirably without the slightest trouble. I am constantly employed about them and keep all things in good order. Four boiler-makers are working on her now, and if Mr. Purdy stops on her, I am sure she will work well, for then they cannot manufacture in Washington engineers by the case, and distribute them through the fleet to criticise on what they know nothing about; all they do know being what they read. This Mr. Burchard is one of the last imported box. We have three of the same sort. Were it not for the old hands of the firemen who are left, I do not know what Mr. Purdy would do. I am not sorry, in a manner speaking, as it will assist Mr. Sickels in proving the capability of the engineers who tried to spoil his work, but only succeeded in killing and crippling firemen, and trying to condemn Mr. Sickels's work, as his noble productions in the line of steam cut-offs are too deep for their experience to comprehend.

"In the event of Mr. Purdy's leaving, may God only pity his successor, as I am sure the firemen will not, provided they escape from the navy with their lives; this I assure you will be more than we expect, through the incapacity of these freshly-manufactured engineers. I am, sir,

"Your obedient servant,

"ROBERT CAMERON, "JOHN MARTIN.

"Chief Engineer, U. S. N."

Well done Isherwood; Good for Shock! Keep on a little longer, and the poor old Pensacola will trouble you no more. Send away Mr. Purdy and Mr. Martin, and put her in charge of some of your people fresh from Washington, and she will never come North, but will go sure enough to "Davy Jones's locker," as your letter would foreshadow.

When the Pensacola went to sea, I proposed to the Department to appoint, and pay out of my own pocket an engineer for her—Harry Holland, now in China—who knows more about driving an engine than all the brass-bound, gold-laced, and sworded beauties in creation; but they utterly refused my request; and afterwards my friend Mr. Cameron offered in writing recently to run that ship six months without charge, and he was refused. This letter shows the reason why. Now what is the use of Fort Lafayette and Sing Sing, when such fellows as these are at liberty?

of that story; nor all of the other cases where he has advocated other people's plans. He did not tell you that he advocated the plans of Sewell's condensers; whose object is to make fresh water for the boilers, but which, from the first one tried till now, have made no fresh water, and have left the boilers as salt as if there were no surface-condensers, although immense sums have been paid for the patents. He did not tell you that he advocated Martin's boilers, the patent for which is now owned by Montgomery, and had compelled contractors to pay the wrong man—as, indeed, is true of the Sewell condensers, the patent for which, as now used, is owned by Barnum.*

* This condenser swindle is the most barefaced of any yet practised. Sewell, an ex-engineer of the navy, and a sort of go-between for Isherwood, who speaks with authority on his account, has a patent for a very poor but very expensive way of packing the ends of the tubes used in a surface condenser, but has no patent for the surface condenser itself. Mr. Pirsson, of this city, a highly honorable and truthful gentleman, has a patent for a surface condenser; one of the features of which is, that the tendency to leak is counteracted and no packing is needed for the tubes. This condenser is in considerable use, and on the San Jacinto has worked well many years, as certified by Isherwood himself, when he was the driver of those engines. Isherwood makes the condensers now for the navy, which infringe Pirsson's patent, but which yet need to have their tube ends packed, and then he requires the builders in their contracts to pay Sewell any price he may charge. But Sewell's method of packing the tubes is good for nothing, and Daniel Barnum has the patent, granted to him by the Patent Office after an interference with Sewell, who also claimed it, for a good way of packing the tubes, which the United States ships are now using under the name of Sewell, and for which he is being paid; while poor Barnum, with his patent in his pocket, is left out in the cold and laughed at by this precious pair. Meanwhile Sewell is negotiating with Barnum to buy his patent, while he is receiving the cash which Isherwood compels the contractors to pay him as if he owned it; and Barnum has asked my advice what to do. I have advised him to sell it cheap, for I have seen enough of these villainies to be satisfied that they will rob him of all if he don't take their price. But there is another patent which has to be used also in connection with these condensers by which they are prevented from making any fresh water, even after they use Barnum's packing; which consists in making one pump double-acting, and using one end of it for salt water and one for fresh—the piston between being packed with hemp. This piston of course leaks; and if it leaks one per cent, it passes into the fresh water an equal quantity of salt, and at once destroys the whole effect of the surface condenser; and it is impossible on these fast-moving engines to make that pump tight. The consequence is, that from the first one till now, each and every one has made salt water just as if there were no surface condenser; and it has been well known for two years by the Department; yet they are going on reproducing them, and the contractors are compelled to pay Mr. Lynch his patent fee for the means whereby the boilers are salted, and all the cost of surface condensation wasted. Meanwhile Mr. Pirsson would be glad to take for his patent fee *the saving in cost of construction alone* between his good machine and this worse than useless one, and he cannot be heard. All this I wrote to the Secretary a year ago, but without avail.

The Martin boiler is a similar case, and almost as bad. James Montgomery in December, 1845, took a patent for vertical water tubular boilers, so arranged as that there were water spaces each side of the tube-boxes for the water to circulate downward. The patent was extended in 1859, and now is alive; and it covers this *peculiar form*, called Martin's boilers in express terms. But when Montgomery took his patent for this general principle of construction, he had various forms of it shown in drawings, and among other forms that in which the water-tubes are placed above the furnace—now called Martin's boilers—and he deposited in the Patent Office a book of drawings containing this, among other forms, by way of protecting himself against having patents issued which might exclude him from using some of his own forms if he chose to do so. But when Martin was Engineer-in-Chief he succeeded in getting a patent for this peculiar form of the Mongomery

In this sort of business, gentlemen, as in killing sheep, when the dog once tastes blood his appetite is never cloyed till the flock is all killed or the hound is throttled — and so in this case. This sort of corruption thus admitted by himself—admitted because he knew I had the proof at hand to convict him if he denied it—has ripened into a system and is carried out by rule in the engineer department. They have boldly written letters—and I have seen them and advised parties not

boiler by some mischance; the only legal effect of which, however, even if Montgomery had not invented that form, would be to prevent Mongomery from using it, not to authorize Martin to use Montgomery's new mode of construction merely because he had arranged it in some new form. But as the form itself was old, and Montgomery's own invention, he applied to the office for a patent for the same thing, and on the production of the proof that he was its real inventor, and not Martin, the office, under Judge Holt, did him all the justice they could, and granted him the patent over Martin's head. The claim of the patent is in these words: "I claim the arrangement of the series of the tubes placed vertically or nearly so between an upper and a lower and connecting vertical water spaces, when said lower water space is made *directly over the fire-chamber, and if the draft is returned over said lower spaces, and among the vertical tubes as set forth.*" This patent issued in 1858, and in 1861 Mr. Montgomery, being in embarrassed circumstances and much out of health, addressed a letter to the Department demanding the recognition of his rights, to which he received an answer as follows:

"NAVY DEPARTMENT, June 22, 1861.

"SIR: Your communication of the fifteenth instant has been received.

"As the payment of all the patent fees is assumed by the contractors for the machinery, who engage to hold the government harmless against any claims on account of patents *they may use*, your notification should be addressed to the contractors.

"I am respectfully,

"Your obedient servant,

"JAMES MONTGOMERY, Esq., GIDEON WELLES."

"Brooklyn, N. Y.

Now what does that letter mean? I presume no one will differ with me when I say, that it means that the contractors were bound to find out for themselves who owned the patents which they were to use, and to pay the fees on their own responsibility to the real owners; and so Mr. Montgomery took it to mean. But he soon found out that the Department required the contractors to pay Martin the patent fee for these boilers, and so put it in print in their contracts, and that no contractor could get his money unless he could produce Martin's receipt; and so the fact remains to this day. The Secretary of the Navy himself does not hesitate to aid in this operation, in which the contractors are compelled to pay the wrong man, by writing a letter *misleading the true owner*, who, in poverty and sickness, was struggling to get something out of his property, thus lawlessly taken from him.

That these boilers are a plain infringement of Montgomery's patent of 1845, no man can question; that he holds a second patent for them specifically is apparent on reading the paper; and yet the Department requires the contractors to pay Martin the patent fees, as if his title were unquestioned. By what right is that done?

That this condenser they are using is a plain infringment of Pirsson's patent is apparent on reading the paper; and yet the Department selects one subject of a patent, and requires the contractors to pay Sewell any fee he may charge, while at the same time Barnum owns the patent for the very thing used, and both he and Pirsson are unnoticed, except to be plundered. By what right is this done?

If there is any doubt about the rights of parties, the duty of the Department is clear enough; and that is to refer it to the Courts to settle who is the owner—meanwhile pay no one. And to use their power to compel the contractors to pay any one, when there is doubt, is an outrage; but to use it in this way to compel payment to the party against whom the decision of the Patent Office has been had, is simply a fraud.

to submit to the wrong — in which they call upon contractors to pay a thousand dollars for advance copies of the drawings on which the engines they have contracted for are to be built; and, as the contractors know that they can be much inconvenienced by this bureau by delays, as they perhaps have workmen waiting for drawings, they pay these extortions rather than do worse.*

And this book of Isherwood's is another sample of the same sort of rascality: a book teeming with fraud, and of no possible interest to any man of science on earth, except the metaphysician and moral philosopher engaged in defining the shadowy boundary which separates the dark regions of moral depravity from the scarcely less obscure limits of intellectual insanity, to whom it would afford abundant material for researches in either direction. This book he made the contractors publish for him at their cost—and it was very costly, as you see — while he can compel every engine-driver in the navy to buy them for ten dollars apiece. When he was levying this tax on the contractors, I protested against it to some of them; saying that I did not care how much money they paid him, but I did object to their vitiating the sources of

* The way they work this gold mine is this: A young man named Murdock, a clerk in the Engineer's office, visited the different contractors for these engines, offering to furnish them a set of detailed drawings in advance of the general drawings for one thousand dollars a set; which he said were to be made by another person named Whiting, also in the office, out of office hours. The contractors took it into consideration, and soon had letters from Whiting asking for their decision. They understood what all this meant, and said that if Isherwood approved they would do it, of course, and he did approve. Whereupon the one thousand dollars were paid, and photographic copies of the drawings—worth about five cents a sheet when once the originals are made—were distributed to the shops. One concern saw the merits of the arrangement so strongly that they took *two sets at one thousand dollars each*, although they are building but one engine; and if they wanted duplicates, they could get them for a few shillings by having them traced, or copied, as these are, by the photographers. This mine will yield between twenty and thirty thousand dollars, as there are between twenty and thirty of these engines building; and as no doubt all have done as those I know have done, and as they understood perfectly they must do, or suffer worse consequences in rejected work, delayed payments, etc. The concern that took two sets, so as to have them in the house handy—like Mrs. Toodles when she bought the door-plate with Thompson on it—understood the game to a charm.

Time was when I should have said this was simply a piece of knavery; but I have some doubt now, since it has been decided by high authority that the Government does not pay such moneys as these, and that a person employed by the Government to deal with contractors may lawfully derive any advantage he can out of the contractors' money, so that it first gets into their hands before he receives it; whereas if he takes it directly from the Treasury before they receive it, the transaction is fraudulent. Under that principle I cannot see how this sort of business can be condemned; but it exhibits a sort of spontaneous eruption of greenbacks all over the engineer department at Washington, and makes one feel so happy to think that the Government don't pay these sums, while our faithful and deserving public officers grow rich, as it were, out of nothing, that I am almost sorry even to disturb the arrangement by suggesting a doubt as to its honesty.

public information, and poisoning the channels through which our young men coming up to this business will be compelled to draw their instructions. And you see, gentlemen, how serious is the consequence; for he boldly avows the patronage of the Navy Department, and says that it "granted permission for its publication;" thereby giving the sanction of our Government to all this fraud and all this ignorance, and overwhelming the minds of the unlearned and ignorant who are looking for instruction, by the formidable authority of the most intelligent people on earth, acting through their chosen officers. It is a most serious misfortune.

For my own part, however, I am free to admit that I have had the full value of the ten dollars I paid for the book in its perusal, in pure fun; for I laughed over it in my own chamber alone, as I have seldom laughed over the master-pieces of humor or wit which have delighted the world. The farce which amused me so much occupies fifty pages of the book, and gives an account of an operation performed by this adroit juggler and a solemn-looking man in New-York, named Waterman, on a very worthy and wealthy gentleman of that city, named Hecker. The proposition which this pair of beauties had made to Mr. Hecker, and on which he furnished funds for the show, was, that they were going to prove to him how steam could "super-heat itself"— I read from the book (p. 5) — which is all one with proving how a man could hold himself out by his waistband at arm's length. Isherwood describes this very worthy gentleman, Mr. Hecker, as "an amateur engineer of considerable experience, *who provided the funds* and gave the benefit of his advice." And it ended, as it generally does when an amateur falls into the hands of the "professionals," that the amateur lost his money, and they carried off the spoils. Still, of course, steam would not "superheat itself;" although they resorted to the very ingenious contrivance which Isherwood says was the "*ne plus ultra* of simplicity," of taking the steam out of the boiler in a pipe, cooling it off in the air, squeezing it through a small hole so as to wire-draw it, and then passing it again in a pipe through the original boiler steam, in the expectation that somehow it might pick up more heat than it set out with; on the principle of Mr. Micawber, who always stepped back a few steps so as

to get a fair start to go ahead. And Isherwood has devoted fifty pages of this book to explaining why it was that the man could not hold himself out at arm's length, accompanied by tables in which millions of figures are spread out with the industry of a demon, and in which coal-weights are carried out to the one hundred thousandth part of a pound. And the general conclusion is, that if the engine had been bigger—the man larger—he might have lifted himself up with great advantage.

The end of the business is, that Mr. Hecker is using steam to grind grain, without expansion, and at a cost of about sixty pounds of coal to the barrel of flour, while his neighbors only use about twenty; but they console him with the reflection that his mills are like the mills of the gods, which it is said, "grind slow, but grind exceeding fine."*

When I cross-examined Isherwood, and proved by him that he was the son of a widow named Eliza Green, who had been left in poverty, and had been supported by him, you perhaps might have thought that I was intruding too far into the private relations of his life; but I had a motive which was not mere curiosity. I had in my hand when I asked that question the evidence of the fact that on Saturday last, when Isherwood was in New-York "on public business," this poor widow, Eliza Green, subscribed for eight thousand dollars of New-York City stocks at six per cent premium; and I know that for the last two years she had more than once aided our New-York finances out of her great resources. And I brought forward the subject merely to express my pleasure that, as in the days of Israel, we have a poor widow whose barrel never wastes, and whose cruse never fails; and to say that I think there should be an act of Congress compelling the families of public officers, when they invest their immense surpluses like these, to invest them in United States securities at par, and

* This Waterman is the person who came to the rescue of Isherwood last winter when I was exposing these outrages in the *Times* over the signature of "Vindex," by answering me over the signature "Crucis;" and to the extent of his poor ability he has done his share towards imposing these abortions upon the country. In one of the letters he thus explains the resemblance of Mr. Hecker's mills to those mythical ones I have referred to: "*If* the Messrs. Hecker find it beneficial to the success of their business to conduct their milling operations by a system requiring more power to grind a barrel of flour than the Brooklyn mill proprietors do, and *if* they use the power of the engines for other than milling purposes, at the same time, then it is a commercial question for them to decide, and not one in relation to cut-offs." They *might* use more power than their neighbors, but they *don't*.

not to pay a premium for State stocks, by which the credit of the Government is injured. Or perhaps I do Isherwood wrong —and if I do I must ask his pardon—for perhaps he went to New-York to induce this lady to invest in United States stocks, and failed in his persuasions.*

And now, gentlemen, I have but one more remark to make, which is this: that having exposed to the country the ignorance, fraud, and corruption, which disgrace our Navy Department; having shown you the reasons why our navy is a failure, and the certainty that these people are going on still further to destroy its value forever; I call upon the President to interpose his power to arrest this evil before it becomes irreparable. And if that amiable, honest, patriotic, and very able man, Abraham Lincoln, (for I believe him to be all these, although I voted against him,) cannot bring his mind to the disagreeable task of cleansing this Augean stable, then let Congress come to his aid, and abolish the Navy Department entirely; substituting for it Commissioners of Admiralty, as in England, and filling the commission with such men as Roberts, or Forbes, or Vanderbilt—men who have built navies themselves, and have borne the flag of our country, in association with their own private signals, to the uttermost parts of the earth, with credit and profit to themselves and to our great national honor. And I now say that such a system is vastly better than our present one, even if such men as now wield the power so disgracefully had never lived, or were to die to-morrow.

I thank you, gentlemen, for your patient attention, and I trust that our labors will not have been in vain.

* It may seem from these exposures that I have some personal or private cause for punishing this man; but I certainly have none. Life is too short to be spent in pursuing every knave who, in the providence of God, is permitted to afflict the world by his presence; and until their crimes become too injurious to the public, I never interfere. I have frequently said of Isherwood, that I consider him the right man in the wrong place; and that I would at any time sign a recommendation for his promotion to the situation where his abilities could be usefully employed—the position of Secretary of the Treasury. And my reason is this—that beginning in poverty, and having no visible means of increasing his store except his wages as an engine-driver in the navy, (always excepting these little matters of advocating plans he approved,) he has grown rich, and does not hesitate to say to his friends that he has more money than he knows how to spend. Now if such talents had been possessed by Secretary Chase, and applied by him to the sixty millions of gold income which the country has, we should never have had to issue greenbacks, and the treasury would be full of real money. But it may not be too late yet; and no doubt the patriotic and very able Secretary of the Treasury would take pleasure in recognizing such superior qualifications—for it is the mark of true greatness that it has no jealousies—and in resigning in his favor if Isherwood would only show him how he does it.