water in the event of its rupture, as compared with the tubes in the common form of boiler, where the pressure is external.

Another advantage to be secured by using separate feed is that it favors the use of a very simple and reliable device for securing automatic feed. It is self evident that any so-called automatic feed must be absolutely reliable, for the reason that the knowledge that such a feed has been fitted to a boiler will cause the stokers to pay less attention to the water level.

The device shown in the cut has proved very successful on a boat fitted with engines of 300 horse power; though it remains to be seen how it would work on a large scale. About the center of the steam drum is arranged an inverted funnel, which is perforated so as to insure that the water level within it shall be the same as the general level in the drum. The funnel serves to prevent any violent ebullition of the water within it and maintains it at a steady level. Above the water in the funnel and near its surface is fixed the steam supply pipe for the donkey pump. So long as the water is below the pipe the donkey will supply the boiler; but when it reaches the pipe, water, in place of steam, will pass to the pump and actuate the steam piston. Now, since the steam piston is larger than the pump piston, it follows that, as long as water flows through the steam pipe, the boiler will be relieved of water, and this will go on until the level falls again. It is thus evident that a double advantage is secured by this system—the boiler is pumped up if the water is too low and it is relieved if it be too high, both actions being automatic.

The Pool of Siloam.

The excavations which are being made in Jerusalem have disclosed much that was hitherto unknown about the pool of Siloam. The identification of the site of this pool is important, because of its bearing on the situation of the city walls. It has hitherto been considered that the pool of Siloam, shown to every visitor of Jerusalem, was one of the few undisputed localities in the topography of the sacred city. Now, however, as investigation progresses, doubts have been raised on this point. Among archæologists a contest has arisen as complicated as that concerning the site of Calvary, the sepulcher, and other sacred places in Jerusalem. The pool of Siloam is in size the least of all the Jerusalem pools, which from the most ancient times have been relied upon by the inhabitants to store up water from the springs. It had, however, the singular characteristic of suddenly increasing in depth as the water poured in from some unknown source.

The pool of Siloam, although small in size, played an important part in the sacred history of Jerusalem. It was to Siloam that the Levite was sent with the golden pitcher on the "last and great day of the feast" of tabernacles; it was from Siloam that he brought the water which was then poured over the sacrifice in memory of the water from the rock of Rephidim. It was to this Siloam water that the Lord pointed when he stood in the temple and cried, "If any man thirst, let him come unto me and drink." The Lord sent the blind man to wash at the pool of Siloam, the sacredness and efficacy of whose waters are still believed in at Jerusalem. The pool of Siloam, which has now been almost wholly uncovered and which is the one formerly shown to visitors, is 18½ feet in depth, 14 feet wide at one end and 17 at the other. The water in it is maintained at a depth of 3 to 4 feet, but is likely to rise a foot or more at any moment. It is faced with a wall of stone, now greatly out of repair. Several columns stand out of the side walls extending from the top downward into the cistern. The water passes out of the pool through a channel cut in the rock, which is covered for a short distance. This subsequently opens and discloses a lively, copious stream which empties into a garden planted with fig trees. Jerome, who lived only six miles from the pool of Siloam, refers to the intermittent character of its waters, which has led some historians to identify it with Bethesda. Josephus speaks of its waters as having been very abundant, but recent investigations do not bear this out.

There are a large number of somewhat similar pools in Jerusalem, which has thirty or forty natural springs within a radius of eight miles. If it could be shown that one of these was in reality the pool of Siloam, whose location has not hitherto been questioned, it would add a still further confusing element to the discussion of the historical sites in Jerusalem. Many of the most important places depend for their identification upon their nearness to or remoteness from the pool of Siloam. The mysterious ebb and flow of the waters of the present pool has been largely relied upon as sufficiently proving its identity with that referred to in the Scriptures. It has now, however, been found that a similar phenomenon takes place in the Fountain of the Virgin, which is close by. There the water rose a foot in five minutes, and within five minutes more it sank to its former level. It is believed that the excavations which are being made in Jerusalem may explain this apparent mystery, which nobody has yet been able to account for.—Public Opinion.

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OUR SEMI-CENTENNIAL ESSAY COMPETITION.

We would draw the attention of competitors for the $250 premium, offered for the best essay on the "Progress of Invention During the Past Fifty Years," to the fact that the date limit set for the reception of manuscript is drawing very near. There is a danger of the essayist underestimating the time which will be necessary for him to do justice to so comprehensive a subject. Although the paper will be comparatively short, covering about two and a half columns of the SCIENTIFIC AMERICAN, it is liable to involve an amount of previous reading and general reference which will cover more time than the intending writer may estimate. For this reason, and in order that the judges may have ample time to examine manuscript which will be submitted to them, we trust that intending competitors will not defer the transmission of their essays until the last allowable date.

We also direct attention to the card which is appearing in our current issues, by means of which we are endeavoring to obtain an expression of opinion on the part of our readers as to what invention introduced during the last fifty years has conferred the greatest benefit upon mankind. The answers that have already come in indicate that opinion will be far from unanimous; and the value and interest of the vote will depend largely upon the number who favor us with a reply. We hope that the majority of our readers will find the matter of sufficient interest to send a card expressing their views.

PATENT SOLICITORS AND THE PROPOSED PATENT BAR.

Such relations as those of lawyer to client or of physician to patient have always been recognized as sacred. In the professions also so much depends upon the competency as well as honor of the practitioners that the law very properly takes cognizance thereof, and requires proof of standing and of competency before any person is allowed to practice in the professional role. In the lawyer's care are placed the rights of his client to property, to freedom or to life itself. He very justly is subject to rigid investigation before being admitted to the bar and is required to serve a clerk's apprenticeship before practicing independently. A similar condition obtains in the case of the physician. He must possess definite and statutory qualifications before he is allowed to practice his profession and take upon himself the dispensing of remedies against the ills of mankind. His adjunct the apothecary is subject to similar requirements. Exhaustive examinations, practical and theoretical, have to be passed before the pharmacist can legally put up a single prescription. He is obliged to understand the qualities of all drugs; to watch every prescription for the detection of possible error in it. If an error has crept in involving danger to the patient, he is to note it, and guard against it, and must act as a constant check upon the physician, thereby giving additional protection to the patient.

There is another case where relations just as sacred and confidential exist as between members of the above professions and those whom they serve. We refer to the relations of patent solicitor and his client.

The services of a specially trained patent solicitor are essential, and the inventor has to enter into intimate and confidential relations with him—relations precisely comparable to those of lawyer and client. His secret work is all disclosed. The steps of his invention are discussed; he tells what led to it, what was his first conception, in order to enable the fundamental idea to permeate specification and claims. It would be hard to find a more confidential relationship than that of inventor and his patent attorney. Honor is the first essential in the practitioner's character. The papers are prepared, the solicitor, under his power of attorney, is given carte blanche to prosecute, and fees are paid. Competency is now required to properly conduct the work.

Within the past two or three years the country has been flooded with pamphlets, tracts and circulars from patent solicitors whose irregular practices are widely known in the profession. To warn the widely scattered class of inventors against such offenders is a slow, unsatisfactory, and impracticable process. The inventor is left to be enlightened only at the hands of that hard master bitter experience.

These irregulars are often possessed of capital and by extensive advertising are able to lure the unsuspecting into their clutches, and in some cases these "gentlemen" have a quite extensive practice before the Patent Office. Their business methods are widely known and are thoroughly understood in the Patent Office, whose officials would gladly embrace any opportunity to disbar such attorneys from practice, were not the provisions of the law for attaining this end so very circumscribed that it is practically impossible to procure the evidence necessary to convict.

The remedy for these evils is suggested in the annual report of the United States Commissioner of Patents. He proposes the establishment of a patent bar analogous to the bar of courts of regular procedure, but a bar whose members should be solicitors of patents. There

is no thought of restricting the membership to lawyers, but the idea is to insure proper representation of the rights of applicants for patents. The essentials for practice before the office having been determined on, and the conditions for the issuance of a license or diploma being fixed, none save those holding such license or diploma should be eligible to appear as attorneys in the prosecution of patent cases before the office. Such an association could take cognizance of practices over which the Patent Office would have no jurisdiction and could punish offenders against common professional morality. Such a course of common self-defense has been found necessary in England, and resulted in the establishment some few years ago of the Chartered Institute of Patent Agents.

The necessity for such an association arises from the very limited powers of the Commissioner of Patents in disqualifying those who are known in the profession to be disreputable and dishonest. Stories constantly reach us of inventors who have lost their fees or who have had their interests jeopardized or their patents lost at the hands of irregular attorneys; but the Patent Office, although perfectly aware of the practices of such attorneys, is not able to protect such victims or punish such offenders, as the latter are sufficiently clever not to commit an act of "indiscretion" after the Patent Office has jurisdiction over the case. The Commissioner has pointed out in his report the only solution for these abuses, and the establishment of a patent bar would elevate permanently the standard of the profession, and would redound alike to the advantage of the profession and to the great mass of inventors, who number many thousands, and who deserve to receive every protection from harm and imposition.

THE RIVER AND HARBOR BILL.

The River and Harbor Bill has been passed over the President's veto in the House by a vote of 220 to 60, and on the following day it was similarly passed in the Senate by a vote of 56 to 5, the vote in the House being taken without any debate, that of the Senate being preceded by a debate of four hours. There is one important feature of the bill that has now become law which will commend itself to all engineers who have had any practical experience in river and harbor improvement: we refer to the provision which it makes for the letting of the whole of a contemplated scheme of improvement by contract, and the authorization of the expenditure of the whole sum necessary to carry it out.

It is safe to say that there is no department of public works in which the old system of executing work by piecemeal has proved more extravagant and wasteful than in this. In river and harbor improvement the exigencies of the case generally demand that the work shall be pushed through with dispatch. To place a certain sum of money at the engineer's disposal, and tell him to go ahead and do as much as he can with it, is in some cases to invite disaster. This has been proved time and again in the construction of jetties, training walls, revetments, etc., where the construction of the trestle, mattress, or other preliminary and more or less unstable structure has necessarily to precede and keep well ahead of the stone riprap and ballasting which is subsequently added to give it stability. It has been a common thing for the harbor jetty, which has been built in the summer, and left without rock ballast because the year's appropriation had run out, to be swept away by the winter's gales. Moreover, the intermittent system of work involves the idleness and depreciation of a vast amount of valuable plant, which under the present arrangement will be kept continuously at work.

It is unfortunate that the annual report of the engineers in charge of this branch of work, or at least a brief digest of it, is not more widely read by the public at large. The mere recital of the vast improvements which have been made in both harbor and river navigation would make the large sums annually asked for this work appear more reasonable and less extravagant than they are popularly supposed to be. A few feet more depth of water on an ocean bar, or as many inches gained on the gravel bar of an inland river, will mean many thousands of tons increased capacity for the channel or river in question, and an enormous advance in the trade of the districts which are served thereby.

COAST DEFENSE.

The nation has received another emphatic reminder of the necessity for improved coast defenses in the shape of a statement by a member of the Senate Committee which recently inspected the fortifications of the port of New York. At the close of the inspection Senator Squire stated that the committee was instructed "to visit and examine the harbor defenses of the city of New York, it being known that the port of New York was better protected than any other of the twenty-seven ports from Portland, Maine, down." At Sandy Hook they found "just two of the direct fire guns in readiness for firing." There were "sixteen mortars ready for placing, but without conning towers or rangers." At Fort Wadsworth there were "five 8 inch guns, not yet emplaced, and it will be some time before they are ready. At Fort Hamilton" the committee "found a 10 inch gun not yet mounted." The senator drew attention to the fact that "few people stop to think an enemy can come in through Long Island Sound and Hell Gate." On the Sound they "found at Willets Point two 10 inch guns not yet emplaced," and three or four 8 inch guns. "Here is the seat of the great torpedo school, having the only complete casement in the United States." The torpedo arrangements are very complete; and "they undoubtedly form a most deadly defense, if properly protected with guns; but they are not protected."

As compared with the above mentioned guns already on the ground, "the committee in its report will say what is absolutely needed for the defense of New York. First of all, ninety-three direct fire 8, 10, and 12 inch long range, high power guns. In addition to these, one hundred and seventy-six 12 inch steel rifle mortars and twenty-five rapid fire guns."

Such is the present condition of the New York defenses, and New York is the best defended of the twenty-seven ports. It must, moreover, be remembered that the building of high power guns and the preparation of emplacements is the work of years. "If all the manufacturing facilities now available were put into use, it would be impossible properly to fortify New York alone in less than three years." Of all the contemplated national expenditures none is more urgent than this, for there is no other point at which an enemy could deliver a blow with such immediate and lasting effect. The spirit which prompts military preparations of this kind is not aggressive, but, as its name indicates, strictly defensive, and therefore pacific.

In view of the statements of Senator Squire, it is gratifying to note that the agreement just reached by Congress on the Fortifications Bill gives the country by far the most liberal appropriation for coast defense ever made. The bill now carries $11,572,964, of which $7,377,888 is an outright appropriation and $4,195,076 an authorization of contracts. We note, moreover, with pleasure, that the House and Senate conferees have provided for the manufacture of a 16 inch gun, being prompted thereto by the consideration that improved methods of manufacture will enable us to turn out a reliable gun of this caliber, and that its superior smashing effect upon hard-faced armor renders it a desirable weapon for coast defense. The arguments in favor of these large guns will be found in detail in our issue of May 30.

Superheated Steam.*

The practical difficulties in the way of realizing the promised economical gains resulting from the use of superheated steam have thus far more than balanced the advantage derivable by its application in all ordinary and usual cases. It was at one time the most attractive and common field of invention.

Of the four principal and recognized methods of reducing that waste which comes of initial, or cylinder, condensation—compression, jacketing, compounding, and superheating—the last named, could all mechanical difficulties be overcome, would be by far the best and most effective. The two kinds of difficulty to be overcome are those attending the construction of a superheater incapable of injury by the process of superheating and the introduction of the required and variable amount of superheat at the engine without injury to cylinder, piston, valves, or packing.

The boiler, as well as the cylinder, is the gainer by superheating, for the reduced expenditure at the cylinder means less demand upon the boiler, and the added heating surface at the superheater gives a still further gain.

The economical effect of a small amount of superheat is seen in the securing of dry steam at the engine and in the reduction of cylinder condensation, and, if the superheating be carried far enough, the engine is transformed into a superheated steam engine. The effect of superheating, so far as employed in the steam engine, ordinarily, is the checking of heat waste by initial condensation. The real limit of gain at the engine is found when the gain by reduction of initial condensation reaches its economical maximum. A more serious difficulty is found in constructing superheating apparatus that shall be safe, adjustable to the varying demands of the engine, and costing little for maintenance.

The economy of superheating comes of the fact that it is possible to reduce the waste of condensation by the expenditure of but a fraction of the amount of heat in superheating the charge that would otherwise be expended through such condensation. The application of one thermal unit in superheating invariably saves several units of heat which, with saturated steam, would be stored temporarily in the metal of the cylinder, to be later discharged without performing its share of the work. "The limit in superheating is, today, considered to be practically somewhere inside of 500° F. or within a range of not much above 100° F. above the usual maximum temperature of saturation." The results of some fifty authentic and well conducted experiments show that the gain in fuel ranges from ten to fifty per cent of the fuel used with wet steam; that about 100° F. gives complete extinction of initial condensation; that even fifteen or twenty degrees will make an important gain in reduction of internal wastes; that every discreetly applied use of this system returns from two to ten times its cost in heat expended; and that the indications are, judging from past and present practice, that good engineering in this direction pays well. The average of fifty-two cases observed by the writer gives a gain of twenty-six per cent with a superheat of 105° F.

Taking an average case in which the quantity of heat brought over from the boiler is 1,100 B. T. U., and twenty-five per cent condensation occurs at entrance into the cylinder, the heat wasted per pound is 275 B. T. U. To supply this amount of heat by superheating the steam would demand an increase of temperature of 570° F. The economy is measured by the difference between this equivalent of the waste and the quantity of heat expended—wasted in a certain sense—in its reduction.

The conclusions of practical importance are:

1. Superheated steam, as hitherto employed in the steam engine, has absolutely no thermo-dynamic value. The value of the maximum measure of ideal efficiency, $(T_1-T_2)\ T$, is in no manner altered by its introduction into the system.

2. Superheating has for its sole purpose and result in the steam engine to-day the reduction of the internal thermal wastes of the engine, consequent upon the phenomenon known as initial or "cylinder condensation." Here it is extraordinarily effective, and a small quantity of heat expended in superheating the entering steam effects a comparatively large reduction in the expenditure of steam in the engine.

3. Superheating is superior to any other known means of reduction of internal waste, such as jacketing; while the multiple cylinder engine has also its limitations.

4. The introduction of metallic packings and of high test lubricants has enormously reduced the difficulties resulting from destruction of packing and decomposition of lubricants under the action of superheated steam.

5. The low temperature of gases in the uptake of modern boilers, while it lessens the difficulty of destruction of superheaters by heat, necessitates a correspondingly large area of superheating surface. One of the most serious and attractive problems for the engineer to-day is the production of a superheater which will withstand gases of high temperature, transfer their heat to steam, and have a reasonably long life.

6. Small engines will gain by superheating more than large, slow engines more than fast, and simple engines more than multiple cylinder systems.

7. The larger the waste to be checked in the engine, the farther should the superheating be carried.

8. The extent of superheating should be adjustable—not only to the particular size and type of engine in view, but also in the same engine—to the extent to which expansion is carried.

9. The average simple engine consumes an annual amount of fuel about equal in value to its own first cost. Five dollars being returned in saving to each dollar paid for superheating, it will pay annually to expend the full equivalent of the interest on the price of the engine in maintaining a good superheating system. When, however, as has hitherto usually happened, this account includes such large interest and wear and tear accounts as cause the total annual expense to exceed this financial limit, the engineer will wisely decline to thus invest capital.

10. Given an efficient superheater, and the engineer can adjust his temperature and pressures of working fluid to the character of material in boiler and engine, and secure the best adjustment of the thermal to the dynamic limit.

11. This is to-day the greatest problem presented to the designing and constructing engineer, unless it be that of rendering the interior of the cylinder non-conducting, so as entirely to prevent initial condensation, thus making the steam engine a purely thermo-dynamic machine.

*Abstract of a paper by Prof. R. H. Thurston before the St. Louis meeting of the American Society of Mechanical Engineers.

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