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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 419,

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QUANTITY OF WATER PER HORSE POWER.

It is well known that the evaporation of water per pound of coal differs largely in different classes of boilers, and even in those of the same class, but of different proportions. This difference ranges from an evaporation of say 5 pounds of water per pound of coal in a poor or indifferent boiler to about 11 or 12 pounds of water per pound of coal in boilers of a better class well proportioned.

For the purposes of this article, we will assume that 8 pounds of water per pound of coal is a fair average for good boilers as now in use. We will further suppose 150 pounds of coal per hour consumed; then the evaporation would be $150 \times 8 = 1{,}200$ pounds water evaporated. This is the quantity or weight of steam that the boiler can supply, or the gross quantity applicable to the engine, and if the unit of 30 pounds steam per horse power per hour be assumed, it would be a 40 horse power boiler; but whether the power actually realized be 40 horses, or more or less, depends upon the economy with which the steam is consumed.

Now if this power be supposed to be the gross power of a fall of water, it would be readily understood that the available or useful power to be obtained would very largely depend upon the character and perfection of the water wheel to which the water was applied; whether such wheel should give out 50 per cent or 80 per cent of the gross power of the fall. So it is in the use of steam in the engine; the boiler supplies a gross quantity or weight of steam per unit of time, but what shall be the available or useful power given out by that weight of steam must depend in a great measure upon the character, condition, and perfection of the engine by which the steam is consumed. We have in use: 1st. The plain slide valve engine, working with little or no expansion; 2d. The adjustable cut-off engine, working with a fixed ratio of expansion determined by the amount of work to be done, or by the fancy of the engineer. And 3d. The automatic cut-off engine, in which the ratio of expansion is determined by the engine itself to exactly meet the requirements of load or work of the engine at any given instant of time. The economy in the use of steam in these different classes of engines is in the order named, the first being that of least economy and the third that of the greatest economy.

But there is still the matter of the *condition* of the engine to be taken account in considering the question of economy. If there are losses from leaks at any point between the boiler and the working side of the piston of the engine, either from joints, valves, or piston, all such leaks militate against economy.

Now there being such great variations in the conditions under which the steam is consumed, it is quite evident that no *one* unit of horse power per pound of steam consumed would be applicable to the different classes of engines.

At the Centennial Exhibition of 1876, the committee to whom was referred the testing of steam engines and boilers had this question before them, and after full consideration fixed the unit of one horse power, generated in *the boiler*, at 30 pounds of water evaporated per hour, irrespective of the engine by which the steam might be consumed, and this unit has since been generally accepted by engineers.

It has been ascertained by direct tests that the best class of engines, in good condition, will furnish one horse power from the steam resulting from the evaporation of less than 18 pounds of water per hour; and on the other hand, poorly constructed engines in bad condition have required as much as the steam generated from the evaporation of over 60 pounds of water. But the average experience for the production of one horse power is the unit of 30 pounds of water, or approximately one-half a cubic foot of water evaporated per hour by the boiler.

ALCOHOL FROM BREAD.

In our paper of October 20, in discussing the modes of *raising* bread, and the chemical changes therein involved, we mentioned the fact that alcohol is one of the constant and necessary results of the process of yeast fermentation, and that it is safe to estimate that at least 1,000 gallons are wasted daily by evaporation in the baking of the bread for New York alone. Is there not here an opportunity for money-making by saving that which now goes to waste?

We alluded to the attempt made some years ago by a company formed in London to do this, which attempt was a failure. But the fact that one trial fails does not imply at all that another may not succeed. That company saved their alcohol easily, but they spoiled their bread, and we printed a note from a correspondent recently who remembered the attempt made in England, and the dryness and of course the tastelessness of their bread.

Now there can certainly be no occasion for this, that is, none excepting human greediness. Why is there need of looking for any more alcohol than that which regularly and normally goes off in the daily process of baking? If we will be content with that, we surely may save it, and we shall have just as good bread as that which we bake in our ordinary modes. But if we are bound to get all the alcohol possible, it is true we may do it, but we shall have bread which has lost its sweetness. We cannot have both at the same time.

We can scarcely deem that any special process is needed for doing the work; any opportunity for inventive skill. It is too simple for that. We are told that the London company expended $100,000 on their works, and it is not impossible that the very elaborateness itself was involved in the failure.

The plan which seems to us perfectly practical is this: A baker's oven is of course a closed chamber. A pipe conducted from the crown of its arch would be constantly carrying away, during the baking, whatever vapors passed off from the bread, which would be a mixture, aqueous and alcoholic. If this pipe were led through cold water, like the worm of a still, those vapors would be condensed. What opportunity here for expense? The cost of the pipe is the only thing. The oven remains precisely as it was, the baking goes on as before, and without the slightest reference to the distilling process. When the bread is baked, it is taken from the oven; the fact that a pipe was attached above has made no difference. We were baking bread, and we have done it, and as good bread as we knew how. If as a collateral product we have condensed any alcohol, very good; so much the better, and we have not injured our bread. But if in our greediness we try, because alcohol is worth money, to run our bakery as a distillery, we shall fail; and serve us right too.

THE DEMAND FOR SKILL.

Notwithstanding the present slackness in business, there is a demand for skill in the mechanic arts now, as there usually is. The proprietor of a manufactory of machine tools recently supplemented a jeremiad on the dullness of the times by an inquiry for several first-class workmen. In explanation he said he had more than he needed of the qualities of "main strength and stupidity" in his establishment, but still had room for cultivated eyes and hands guided by judgment; in short, skilled workmen were in demand.

There is reason for this condition of affairs. The more nearly absolutely automatic machinery can be made, and the more exact hand tools and appliances can be made, the more exacting are the demands for personal skill and judgment. Machines are made, they do not grow, and they are made by the intelligent and skillful mechanic. They will not even keep in useful operation and continue in useful life except by constant care and the oversight of the skilled mechanic.

The time has passed when the idea of working materials was to hammer and bang them into shape somehow, with crude tools and cruder appliances. In the case of the metals, especially, the workman uses good judgment with fine tools. No finer work is done and no more perfect results are obtained in any department of human production than in that of the working of metals, and to accomplish such results the most exact of tools must be wielded and guided by the most skillful hands and the most careful judgment.

THE PONS-BROOKS COMET.

This interesting comet is approaching its brightest phase. As soon as the full moon of the 12th is out of the way, it will be in a most favorable condition for observation until it reaches perihelion on the 26th, and its course may be easily noted on every clear night. It was not plainly visible until the 21st of December, when it faintly beamed forth in the constellation Cygnus as a small nebulosity with a very small tail. Every clear night since, it has been distinctly seen, increasing in size and brightness, while its tail is lengthening into respectable dimensions. This is the naked-eye view. In the telescope, it is a beautiful object, a round nebulous mass larger than the full moon, with a bright nucleus in the center, and with a large tail extending east. Observers who watch it from night to night marvel at its rapid race over the sky. Making its way through Cygnus on the 21st, when first permanently visible, on the 23d it was between Gamma and Epsilon in the southern arm of the Cross. On Christmas night it was close to Epsilon, and on New Year's night it had passed the boundaries of Cygnus and entered those of Pegasus. Making its way through Pegasus, and passing near Zeta of that constellation, it will soon be found in the vicinity of Beta in the constellation Pisces. Traveling rapidly to the southeast, it will pass into Cetus, taking Phœnix next in its course, then Eridanus. On the last week in March it will be found in Horologium, when its luster will be about the same as at the time of discovery. After that time, it will soon be beyond the reach of the most powerful telescopes, and be seen no more until its return in the year 1955.

We give the following ephemeris taken from *Ciel et Terre*, by means of which observers in the possession of star maps or charts can easily follow the comet's course.

EPHEMERIS OF PONS-BROOKS' COMET.

DATE.	R. A.	D	LUSTER.
1884.	h. m.		
Jan. 2.	21 53	+22° 1′	3,5
" 12.	23 1	+ 2° 5′	4,1
" 22.	28 53	−15° 2′	3
Feb. 2.	0 34	−28° 3′	2,3
" 11.	1 2	−37° 2′	1,5
" 21.	1 23	−43° 7′	1,0
Mar. 2.	1 43	−48° 5′	0,6
" 12.	2 2	−53° 0′	0,4
" 22.	2 26	−56° 2′	0,4

It will be seen that, according to the Brussels ephemeris, the comet reaches perihelion at an earlier date than that given in the American ephemeris. In the matter of luster, 1 or unity corresponds to the brightness of the comet when it first became visible to the naked eye in 1812. It will be remembered that right ascension corresponds to terrestrial longitude, and declination to latitude. Any observer with a star-map, finding the right ascension and declination, as here given in the ephemeris, will find the approximate place

of the comet where the lines cross, and can thus follow its track.

The comet will rapidly diminish in luster after perihelion, when it will be about 71,000,000 miles from the sun. It will probably be visible in this latitude until the last of February. Its luster at perihelion will be four times greater than it was at its appearance in 1812.

An interesting incident conected with the comet was announced at a recent meeting of the Boston Scientific Society. The plane of the earth's orbit and that of the comet coincided on the 6th of December. Mr. Chandler, of the Harvard College Observatory, had suggested previously that when the earth reached that position in space, meteors would be seen moving in the comet's orbit. The prophecy was fulfilled. On the night of the 6th of December three members of the Society discovered twelve or more meteors radiating from this very point, in space.

It is confidently expected that the Pons-Brooks comet will grow much brighter, and project its tail farther into space before reaching perihelion. But there is always a fascinating uncertainty about comets. Our present visitor has had one or two sudden outbursts and has as suddenly grown dim. No one can tell what will come next; neither can any one understand why the comet that looks down upon us this year should be four times as bright as upon its former visit, seventy-one years ago! We must expect changes as the fleet footed visitor approaches the sun. A noteworthy change is now going on. A second tail is being developed while the original one is rapidly extending, and observers of the present generation may behold the long wished for sight of a comet with two tails, unless the second tail vanish as suddenly as it appeared.

DRILLING AND BORING GUN BARRELS.

To the unmechanical eye, and to some mechanics, the true drilling of a gun barrel or a rifle barrel appears to be an almost impossible job, but in reality it is as simple as many other processes that awaken no surprise. Some gun barrels are made hollow at the beginning of their formation. Those which are rolled from "skelps," and have a welded seam along their entire length, are rolled on a rod that is the rudimentary bore. So, also, the damascened, or "stub and twist" barrels are hand-welded in a spiral of about three-quarters of an inch wide—technically, a pitch of three-quarters—on a rod that leaves the beginning of the bore. Neither of these sorts of barrels is drilled—they are only bored or rimmed. But the best rifle barrels and pistol barrels are drilled bars of solid steel, and the drilling is a more exact job than the boring. The bars, cut to proper lengths and annealed, are placed upright in a drilling machine, each bar resting on a revolving disk or chuck, and held in place by a guide at the top. The drills are fed down by an adjustable weight. Usually the drills are twist drills, but even when they are used they must be removed for every two or three inches of drilling and the barrels emptied of chips. Some manufacturers prefer a half-round drill with a single projecting cutting lip on its end. In either case the rotation of the barrel and its upright position are expected to insure a true hole from end to end.

All barrels, whether formed hollow or drilled from the solid, must be bored to size. This is effected by means of a bar of cast steel, round except for from twelve to fifteen inches from the end, which is forged square and ground perfectly true to gauge, which is slightly smaller than the intended diameter of the bore. On one of the faces of this squared portion is placed a segmental slip of soft pine wood, the cross section of which corresponds nearly to that of a "half-round" file. This piece of wood goes in with the rimmer, and secures a perfectly round hole, and prevents chattering. If the bore requires enlarging, one or more slips of paper are placed between the wood and steel. This boring is the final finish of the barrel before rifling.

Improved Testing Machines.

At a recent meeting of the American Society of Civil Engineers in this city, a paper by Mr. A. V. Abbott, on "Some Improvements in Testing Machines," was read by the author, and illustrated by a stereopticon. A 200,000 pound testing machine was first described, its general construction providing for weighing the forces applied by means of platforms and levers somewhat similar to those used in ordinary scale work with special arrangements to reduce friction. To secure the direction of the pressure upon the test pieces in the axis of the machine, both ends of the piece are connected with segments of spheres moving freely in spherical sockets which take the proper position upon the first application of the stress.

Arrangements are also made by means of wedges to grip, and hold uniformly the ends of the test pieces. The machine is arranged to test in tension, compression, for transverse stress, for shearing, bulging, and torsion. In the machine exhibited the action of applying stress is automatic, and at the same time the same power gives an autographic record of the stress applied, and of any variations which may occur during the continuance of the stress, and with an instantaneous autographic record of the result at the conclusion of the test. The stresses are applied by means of weights which slide upon two parallel lever beams, the one registering up to 10,000 pounds, and the other up to 200,000. By means of a remarkably ingenious electrical attachment, connected with clock work, the movement of these weights is continuous and automatic, and the registering apparatus is also controlled by the same electric current.

It is impossible in this abstract, and without the aid of a diagram, to fully describe the details of these movements, but they seem to be very complete and accurate. Diagrams automatically made by the machine were exhibited and described.

A number of broken pieces of steel were exhibited, and also specimens of woods which had been tested in various ways. Machines of smaller powers were also described, and a number of briquettes of cement were broken upon a small automatic machine, which was exhibited.

Boston's Sewerage Experiment.

The public will follow with interest Boston's experiment of leading its sewage into deep tide water. This morning the pumps will be set in motion at Old Harbor Point, the final discharge being at Moon Island. The entire cost has been $4,544,272, and the building of the sewerage is spoken of as "one of the greatest engineering feats of the age." It may seem a little hypercritical to express a regret on this inaugural day of great enterprise that Boston did not see fit to include in its plans all the possibilities in the case. London has taught the world that a nuisance can be turned into a profitable product available for agriculture. The market gardeners about the city eagerly take up all the sewage fertilizers turned out at the London works, and find them even better than what they buy in the market.

At Pullman, the infant city of Illinois, also, the revenue derived from the sale of the manipulated sewage is a good and fair interest upon the money invested in the works, to say nothing of the incalculable benefit to the community in the solution of a serious difficulty. A glance at the North Cambridge and Arlington meadows, and, in fact, the market gardening section of Middlesex County, ought to satisfy any one as to the extravagance of the policy which dumps the refuse of a great city into the sea. It is an open question, moreover, whether the "deep tide" will take and hold this sewage. Nantasket and the contiguous beaches may have occasion hereafter to thank Boston heartily for perfuming the surf and giving a new value to their bathing privileges. Of course the present works need not be abandoned, even if they prove to be a nuisance. The pumping station can be turned into a fertilizing factory, but the roundabout way of getting at it will certainly be very expensive.—*Springfield Republican, January* 1.

The Planet Jupiter.

We never look upon Jupiter at opposition without rejoicing that, when the vast nebulous mass that once filled and extended far beyond the limits of the solar system quickened into life and threw off the concentric rings of which the planets were formed, the largest rings condensed into the planet Jupiter. Thus, the lesser members of the brotherhood may behold the magnificent spectacle of a planet second only to the great sun himself, a miniature solar system with a quartet of revolving satellites, a telescopic wonder on which the eye rests with ever new delight. The huge planet has not yet cooled down; his primeval fires still blaze, and he gives out light and heat to the moons that surround him, and as readily yield to his sovereign power as their mighty lord bows to the sun's resistless sway. Observers on the earth, nearly five hundred million miles away, may watch the process of world making on this distant sphere. In the belts that diversify his disk, in the huge spots that from time to time agitate his mass, in the immense cloud atmosphere that conceals his fiery nucleus, we behold, on a grand scale, the progress of the cooling process that millions of years ago stirred to the depths the earth's lesser bulk, before it developed to the perfection of its present condition as an abode for animate life. Just as surely will the prince of planets reach, latest of all the sun's family, the same perfection of development, when millions of years hence the earth, like the moon, has arrived at the period of inevitable decay, and, preceded on the list by Mercury, Mars, and perhaps Venus, will be floating through space as a dead world. Viewed in this light, every changing belt, every new spot, and every sudden rift are a revelation in Jovian language of the tremendous commotion that will eventually bring order out of chaos.—*Providence Journal.*

The Importance of the Mechanic.

Each ensuing day makes more prominent the fact that we have come upon the time when the mechanic is master. We have crowded professions and ill-filled trades. A chance to fill the position of sub-assistant clerk in a wholesale house is eagerly grasped at by a hundred applicants, though the wages received be scarcely more than "a chance to learn the business." Let a master workman try to obtain an apprentice at three times the salary offered the clerk and his applicants will be poor alike in quantity and quality. A skilled workman in any trade need never want for hire; he is eagerly sought after by a hundred employers; he is independent of the condition of the market; the skill and cunning of his hand and eye are too valuable to lose, and must be paid whether the products are slowly or rapidly consumed. If business ceases, the master hand is eagerly seized by some rival house, which knows and values the product of his skill. He who would crush down the obstacles to success in our own days must have, as well as the wit to see the crevice, the strength to deal the blow. This is an age of the steam engine, and it is the engineer, not the conductor, who is master.—*Boston Commercial Bulletin.*

Patent Office Affairs.

WASHINGTON, Dec. 31, 1883.

That Congress not only made no increase in the clerical force of the Patent Office last year, but actually reduced their number by twenty, is being prominently brought to the attention of Congressmen. It is undeniably a strong argument for ample force in the Patent Office that there is now a surplus of $2,500,000 in the National Treasury belonging to the Patent Department. A system of lessening the cost of patents by a graduated scale of fees has been proposed, but excessive cost is not so often complained of as the sometimes inevitable delays, many of which might be avoided by a more generous use of the money of patentees in paying for help in the Patent Office.

The Commissioner of Patents is required by law to make a report to Congress at the close of each calendar year, and I have made some inquiries as to the statistics it will embrace. There has been an increase in nearly every branch of the office over last year, and the receipts for moneys paid in during 1883 over 1882 is, in round numbers, $135,000. This, however, does not equal the increase of 1882 over 1881, which was $155,556.66. The increase in correspondence has been about ten per cent, and in applications of every kind nearly twenty per cent. The number of patents forfeited during the year is about 2,000. These figures are not exact, for in none of the divisions have any steps been taken toward furnishing the data for the Commissioner's report, which must be presented to Congress within the next month, but they are sufficiently close to show that the patent business throughout the country is not retrograding; it is rather constantly increasing in importance and demanding more rigid attention of the lawmakers and those who administer the laws.

The Civil Service Committee has completed its rules for the examination of applicants for positions in the Patent Office, and they will be published on Thursday of this week. For the position of assistant examiner the applicant will be required to show a knowledge of arithmetic, of algebra to equations of the second degree, of geometry and trigonometry, of chemistry and physics. For draughtsmen, drawing from mechanical models and explanations of certain rules for mechanical drawing will be required. For the position of assistant librarian, which is now vacant, a knowledge of French and German, and the ability to properly translate those languages into idiomatic English, is required, as well as explanations of methods of cataloguing, and the proper arrangement of books by classification of subjects. This knowledge of German is also made desirable in those seeking positions as assistant examiners.

The controversy respecting the electric railway is now fairly inaugurated in the Patent Office. The proceedings have been somewhat delayed by the taking of testimony abroad under a commission in support of the claims of the celebrated German scientist, Dr. Werner Siemens, of Berlin. Counsel were heard in argument upon the merits of the case last week, before the Examiner of Interferences. The point is to construct a commercially practicable railway, which can compete with the existing modes of transportation.

A small section of road was built and operated by Siemens, at the exposition at Berlin, in 1879, and there are now several short lines in operation in various parts of Europe, and notably one at the Giant's Causeway, in Ireland, familiar to travelers. Edison has a line two miles and a half long, at Menlo Park, N. J., fully equipped and in daily operation, for the benefit of visitors and pilgrims to the shrine. There is also an experimental road at Saratoga Springs, and another claimant is Stephen D. Field, of New York, a nephew of Cyrus W. Field.

The Commissioner, on Friday, gave a decision in a case which has been long pending, the application having been filed January 6, 1883, wherein it was claimed that John T. Berchers had discovered a method to effectually and fully preserve fish in cans. His method he described as cutting the fish longitudinally and in thin slices, instead of transversely and in thick lumps or chunks. Both the examiner who had the case in the first instance and the Board of Examiners-in-Chief decided that there was nothing patentable in the application, and the Commissioner, after fully setting forth the facts in the application, sustains the opinion of the examiners.

The new classification of subjects of invention, which is the official guide of the office in the distribution of applications for official action, when ready, will be published as a supplement to the *Gazette.*

The House Committee on Patents, as announced by Speaker Carlisle, is as follows: R. B. Vance, N. C.; O. R. Singleton, Miss.; C. S. Mitchell, Conn.; J. E. Haskell, Ky.; George W. Dargan, S. C.; J. Winans, Wis.; W. P. Hepburn, Iowa; H. L. Morey, Ohio; L. E. Alkin, Pa.; and W. W Rice, Mass. This is considered a good committee, some of the members having had experience in the committee heretofore.

The Senate Patent Committee is as follows: Orville H. Platt, Mass., chairman; George F. Hoar, Mass.; John I. Mitchell, Penn.; Elbridge G. Lapham, N. Y.; Richard Coke, Texas; Wilkinson Call, Florida; and J. N. Camden, W. Va.

Already a number of applications for extension of patents, which can only be done by Act of Congress, have been filed and they will all be carefully considered before action.

FRANKLIN.