THE GREAT EXPOSITION—LETTER FROM UNITED STATES COMMISSIONER PROFESSOR R. H. THURSTON.

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VIENNA WELT-AUSSTELLUNG, JULY, 1873.

The work of the juries has, at last, been nearly completed, and the members of the international jury are leaving Vienna for their widely separated homes.

In Group XIII, which embraces machinery and means of transport, the work is all done, even including the awards of the great *Ehren Diplom,* unless, as is almost invariably the case at such exhibitions, a few tardy or careless exhibitors have been overlooked.

The publication of the awards will not be officially made for some weeks; but it seems well understood that the distribution has been made with unusual discrimination; although the usual error of too great liberality will, very probably, be noted here, and an occasional obvious mistake may subject the jury to severe criticism.

Of these awards, the United States section is generally supposed, and probably with good reason, to have received a liberal share, and to have taken a proportion of the medals for "Progress" entirely beyond comparison with that of any other nation. The richness of our own section in original and valuable mechanical devices is thus well illustrated.

Unsatisfactory and incomplete as our exhibit in the Machinery Hall appears to every American engineer, it seems, to the European, remarkably rich in valuable novelties.

It will probably be found that, should any of our people find themselves undeservedly overlooked, or their exhibits not as fully appreciated by the juries as they should be, their misfortunes will, in most cases, be a consequence of their own errors, either in neglecting to secure good representatives here, or in the still less excusable, although extremely frequent, neglect to prepare for the jury exact and minute descriptions of their apparatus and of their claims. American exhibitors have been vastly more careless of their own interests, as a rule, than have the exhibitors of any other nation. Should the result prove that we have been kindly dealt with, it must be attributed to the conscientiousness of the juries, and to the peculiar ingenuity and the exceptional merit displayed in our machinery department, rather than to the efforts of those most directly interested in securing careful examination and thorough discussion of the merits of individual exhibits.

One of the most interesting records in our notebook is that of a day spent in looking over the

STEAM ENGINES,

of which a large number, of all sizes and varieties, are distributed throughout the exhibition. The larger examples of stationary engines are, very generally, more or less exact copies of the Corliss. The Sulzer engine, which is one of the largest on exhibition and which has attracted special attention, would be considered a modified Corliss engine—a modification also which is, on the whole, in the wrong direction. It appears in my notebook under the denomination of "the Sickels Corliss-Greene engine of the Swiss section." It has a "drop cut-off"—the invention of Sickels—and has the poppet valve which is usually found on American engines of the Sickels type. Its governor determines the point of cut-off, and it is therefore, so far, a Corliss engine. The peculiar motion adopted for engaging and disengaging is something intermediate between that of Corliss and one of the systems of Greene. The engine has a condenser, and is said to work with a creditable degree of economy.

Comparatively few of the Corliss engines seen here are precise copies of the original. Builders have usually endeavored to produce some difference of detail, which they claim to be peculiar to themselves, and to be improvements upon the standard machines. They seldom or never succeed, however, in either avoiding its defects or in introducing improvements. The defects of the Corliss engine are not numerous, and those which exist are inherent in that peculiarly typical and unique design which has grown into its most perfect shape in the hands of its originator. To eradicate them necessitates a change in every detail and the complete transformation of the whole design. To effect improvement, the engineer who makes the attempt must excel all who have yet made a similar effort.

The Corliss engine is a quarter of a century old, and is, to-day, very nearly as it was then, one of the most complete illustrations of a mechanical type that can be found. It affords, to the student of mechanical "comparative anatomy," one of his most interesting studies. But the Corliss engine cannot be claimed to be a perfect machine. English builders, who usually exhibit quite a different style of engine, while forgetting that an effective expansion (variable by the governor) can only be obtained, so far as engineers have yet learned, by the use of a detachable valve gear, unless at the sacrifice of delicacy in regulation, have persistently adhered to the use of the steam jacket, a detail never seen in the Corliss engine. The best

ENGLISH EXHIBITORS

have usually presented a type of engine which is quite different from the Corliss. The bed is usually flat and broad, and carries the cylinder, the guides, and the shaft pillow-blocks, as was formerly the universal practice with horizontal engines. The steam cylinder is jacketed, and the jacket is fitted with independent pipes to supply it with steam and to drain off water of condensation. The valve gear is that of Meyer: two blocks united by a screw with right and left hand thread, riding on the back of the main valve. In at least one instance, the designer has shown his appreciation of the importance of allowing the least possible clearance by dividing the valve and making of it two, which cover ports at either end of the cylinder, instead of adopting the ordinary form with its necessarily long steam passages. The governor moves a valve in the steam pipe and the degree of expansion is determined by the engineer, who, by use of the screw, separates or draws together the cut-off blocks as occasion may seem to require.

One English firm exhibits an engine in which this is done by a link motion, the link being moved by a Porter governor. The Porter governor, it may be remarked, is to be met with in every part of the Machinery Hall and its annexes. Even the rough and awkward looking engines which drive the machinery of the breweries and the sugar mills are frequently supplied with this American regulator.

The crank is usually given up for engines of short stroke, and a disk, carrying a counterbalance, takes its place. The workmanship of these standard British engines is usually excellent, and several firms present machines of the best of workmanship and having a most magnificent finish. Such a style of finish I have never been fortunate enough to see at home, even on engines "gotten up for the occasion," as these evidently are. One English engine, of considerable size, has a plain steam valve at each end of the cylinder, and, on the top of each, is an expansion valve, apparently of the "gridiron" sort, sliding *transversely.* The time of its movement, relatively to that of the main valve, is determined by an ingenious system of ponderous gearing, intermediate between the valve motion shaft and the main shaft, whose axes are varied in position by the action of a large fly ball governor. It may work well, as a number of certificates exhibited by the builder claim that it does; but the first impression of the stranger is that such a weight of gearing must add seriously to the cost of the engine, even if it does not impede the action of the governor, and add perceptibly to the resistance of the machine itself. It looks like a monstrosity of engineering.

Two compound stationary engines are exhibited. One, in the British section, by Galloway, has cylinders of 14 and 24 inches diameter, respectively, and a stroke of 2½ feet. Its cranks are set opposite each other. Regulation is effected by a peculiar governor, resembling Porter's in being weighted and running at high speed, which adjusts the link operating the main valve. The steam jacket is not used, this important defect being supposed to be compensated by the resulting simplicity of the cylinder castings, and by the convenience with which the intermediate valves may be reached. This engine is rated at 100 horse power, is well made, and moderately well finished. The

FRENCH

exhibit no stationary engines worthy of special notice, except, perhaps, in one case, where an engine has been built with crank shaft bearings spread far apart with no other apparent object than that of placing the eccentrics inside. The awkwardness of the arrangement is something remarkable and not at all to the credit of the designer. The

SWISS,

beside the Sulzer engine already noticed, exhibit two Corliss engines, and a fourth engine which combines the Corliss and the well known device known among our engineers as the "French cam." In this example, the condenser and air pump are contained in the engine frame.

The other engine, which would generally be considered the best of all from the fact that it least departs from the standard design, is well built and prettily finished. Its balance wheel is a mortise gear, and a very common feature of those foreign built engines. The only stationary engine presented by

BELGIUM

is that of the great firm of Bede & Co., which seems, in the opinion of engineers here, to divide the honors with that of the *Gebrüder Sulzer.* It is a "mixed Sickels-Corliss," and is one of the least objectionable of the new departures from the familiar American design. The steam valves are moved by two separate heart-shaped cams. The trip and the regulating apparatus are essentially the forms of Sickels and Corliss respectively.

GERMANY AND AUSTRIA

exhibit several Corliss engines, usually with useless changes, miscalled "improvements," and also a few engines of less creditable form.

The Dingler compound engine is one of the quietest engines in the Exposition, and attracts attention by its noiselessness and its rapidity of rotation. It seems to be fitted with continuously revolving valves, and to possess many peculiarities which will require further investigation.

On the whole, it may be said that the now well established principles of steam engine economy: dry steam, high pressure, a maximum expansion, high piston speed, efficient steam jacketing, and perfect regulation: are not fully recognized in the design of any one steam engine exhibited here, and that the best machines, of considerable size, which are found in the exhibition, are more or less exact copies of a well known standard American engine. Of this, or of any other of the several leading forms of steam engine which are so familiar at home, no single example is to be seen in the

UNITED STATES SECTION.

Of a smaller class, the two beautiful little vertical engines of the New York Safety Steam Power Company, which are in operation in the American department, are excellent examples. Their elegance of design, fine workmanship, and high finish attract attention and elicit many compliments from visitors. The neat horizontal engine of the Norwalk Iron Works represents also another of our best efforts in small powers, and another small engine, furnished by Pickering & Davis, is always under inspection. This latter engine has been designed especially for the use of the Underwood angular belting. Its fly wheel is in line with the piston rod and is driven by a pair of rods and cranks, one on either side. The narrowness of the face of the wheel which is allowed by the cord like belt permits this arrangement to be adopted without too great lengthening of the crosshead.

Judging by what is to be seen here, it must be concluded that the building of stationary steam engines for general purposes has made very little progress during the interval which has elapsed since the Paris Exposition, which last permitted a similar international competition, and indeed, it may perhaps be said, during the last score of years. Correct principles are but little more completely, although much more generally, applied now than many years ago, notwithstanding the fact that the great scientific principles which underlie all successful engineering practice have, during this same interval, received their most wonderful and essential development.

It is to be hoped that the same observations may not be called forth by the study of the American International Exhibition of 1876. Yet it rarely happens that marked changes in engineering practice take place in so short an interval of time as that which separates us from that event.

R. H. T.

Correspondence.

Boiless and Boiler Owners.

To the Editor of the Scientific American:

Your article on "Boilers and Boiler Owners," on page 38 of your current volume, reminds me of a specimen I saw three or four weeks ago. While in an engine room near here, the engineer showed me a piece of the feed pipe and mud drum taken from under his boiler. Two weeks previous to the time of taking the mud drum out, the boiler had been tested to a pressure of 125 lbs. per square inch, the pump and boiler gage agreeing. By examining I found that a hammer could be driven through the pipe and drum at any place, while, in some places, the blade of a pocket knife could be thrust through.

Query: Why is it that boilers and mud drums are enabled to sustain so high a pressure, in such a condition as the above, and the one at Bay City, Mich., were in? A. J.

Austin, Texas.

Jumping from Railway Trains.

To the Editor of the Scientific American:

The query of J. B. T., on page 27 of your current volume: "Why is it that engineers, etc., jumping from moving trains, invariably jump in the direction of the moving train?" induces me to write a few words on the subject; a subject that every one who rides, whether by horse or steam power, ought to fully understand for all such are liable to be sometime exposed to danger. They should know what is best to be done at the last moment of an emergency, never before; for jumping is so dangerous that it is only when the case is desperate that it should be attempted. The reason for jumping forward is that that course is the safest; the experience of engineers confirms this, and it is easily demonstrated by theory. Your correspondent argues that it is the most dangerous. If every one could, like him, jump with the velocity of 15 miles an hour, =21 feet per second, the difference might not be so great, but I consider only the case of average humanity. But in his case, if the velocity of the train is 30 miles an hour, and he jumps in the opposite direction 15 miles an hour, he will then move 15 miles an hour with the train, and strike the ground with a force that will almost certainly be fatal.

In the hope that some lives or limbs may be saved by a more general understanding of what should be done in such cases, permit me to explain this; I have not yet seen it in print.

The comparative safety of jumping from a moving vehicle does not depend on the velocity of the jump, which should not exceed the velocity of the vehicle, if it can be helped, but entirely and solely on the anatomical build, if I may use the term, of man. The jump should be made facing, as nearly as possible, in the direction of the motion; select if practicable the place; turf is best, sand is next. Never jump on a pile of stones; for a collision with stone is as dangerous as any possible casualty. One foot should be in advance, so that it will come in contact with the ground first. Follow it instantly with the other foot, and each will receive a part of the blow, and each will check the speed little. Then first one hand, then the other, will take a part of the force, and serve to protect the head and trunk. If the patient is then alive, he may pick himself up, if he can, and count his broken limbs and contusions.

A diagram will, perhaps, best explain the succession of events that the jumper should endeavor to procure, for the greatest safety to his person. He should try to have his limbs act like the spokes of a wheel. One foot, *a*, in advance touches the ground, the other foot, *b*, will pass by and touch, then the hands, *c* and *d*, and the head will follow. The momentum may be enough to cause the feet to turn over the head in a somersault; but this is the best that can be done, that is, to check the momentum a little at a time.

If a person takes the advice of J. B. T., and jumps in the contrary direction, what follows? If the vehicle is moving only 15 miles an hour, and he jumps with the force of 5 miles an hour, he is actually moving backwards with the velocity of 10 miles an hour; and as soon as his foot touches the ground, it stops, but his head and body describe a curve through the air with a force due to the speed, the back of his head and his back strike the ground simultaneously. Results, a broken spine, a cracked skull and a general destruction of the action of the internal organs.

Not many years ago I was the involuntary witness of an experiment of this kind. A horse car was being driven pretty rapidly by me, on the opposite side of the street. I noticed a passenger, with an apparently heavy bundle in his hand, preparing to get off; the conductor was looking another way; I saw the man's danger, but was too far off to interfere. He deliberately stepped off the car as if it were motionless, but the instant his foot touched the pavement, his body and head, retaining the speed of the car, were thrown down with great force on the stones; his hat and bundle flew in different directions, accompanied with the unmistakable sound of breaking of iron castings. The man, for a wonder, did not appear to be much injured, but picked himself and his property up, a much astonished and probably a wiser man.

Let every one remember that the only safety in leaving a moving vehicle is to face in the direction of the motion.

Boston, Mass. CHARLES STODDER.

Explosive Projectiles.

To the Editor of the Scientific American:

I have read in your volume XXVIII., page 394, a description of a compound explosive projectile, which is, in my judgment, similar to one I invented in the year 1868. I offered it to the British Government in that year for trial, but it was refused. On September 2, 1869, I sent one to the Emperor of Russia for his approval; it was received, but the answer is not yet returned. I offered it to the present British Government, accompanied by a drawing, November 25, 1870. It was politely refused, and the drawing kept.

My projectile contained three bullet chambers attached to the main cylinder, grooved from top to bottom in center of chambers to one half the thickness of metal in main cylinder, and also grooved all round the center of the main cylinder. Each chamber contained 106 bullets, or 318 bullets in all. Outside size of projectile was eight inches; the chambers were tapped, screwed, and plugged air tight. It can be filled in chambers with small shells and liquid fire, bullets and powder, fulminate, or other materials, as wished. A brass time fuse was fitted inside the powder chambers, and screwed in.

My projectile was considered by many to be the most destructive known. When proved with only a minimum charge of powder, 13 lbs. of the main cylinder could not be found. This distribution of bullets and fragments took place without either fuse or plugs being in the chambers. The difference between my projectile and F. A. Morley's, according to the account, is that he has a separate fuse for each chamber, and possibly more chambers.

On page 368, same volume, on "Electrical Fire Arms," by Professor S. Gardner, you wish him to drive the bullet by electricity. I presume that can easily be accomplished. There is yet one further stride: to kill by electricity itself, at any distance, paralyzing those who may not be killed outright. J. T. FRASER.

Liverpool, England.

Composite Lenses.

To the Editor of the Scientific American:

F. H. R. (see page 100 of your current volume) does not show the flint lens in his section drawing, and the central lens may be made thinnest; but his views are eminently sound. As inventor of the composite object glass, I will call attention to its main defects.

First, the diffraction around the edges of the lenses will slightly injure the definition, as may be seen by placing a network over the glass of an ordinary telescope. Secondly, the segment lenses are harder to correct by hand than the zones of a single lens, and the local polisher machine will spoil their extreme edges, which must be cut off, reducing their size. The third difficulty is the adjustment of the parts. The iron frame must be protected from unequal expansion; and the lenses must not differ in focus the one hundredth part of an inch. The heliometer with its divided object glass, and the success of Mr. Sellack, at Cordoba, in mending a broken eleven inch photographic objective, show that the plan is a feasible one.

We have consulted oracles on the subject with the following responses: Professor Winlock thinks that a solid object glass would be the best, if we could get one. Clark & Sons believe it possible to build an equatorial with solid object glass five feet six and a half inches clear aperture, less than seventy-five feet focus, with a useful power of 3,325 (50 for each inch of aperture) for the sum mentioned. They think it would be easiest to mount it between walls, allowing a movement of only two or three hours in right ascension. They recommend importing the glass makers, as they had to wait three years and paid $12,000 for their pair of glass disks from Birmingham. Henry G. Fitz considers the adjustment of the composite lenses difficult, but that, if this were attained with sufficient accuracy, the telescope might readily be corrected photographically by the addition of a third lens, and thinks this a better plan than using monochromatic light for the purpose. S. H. M., JR.

[For the Scientific American.]

The Composition of the Tails of Comets.

At the conclusion of my communication on the subject of the cause of the zodiacal light, I suggested the question whether the tails of comets might not be accounted for upon similar principles. As I believe that the application of the optical principles concerned in this case (as well as in the other), to account for the appearances observed, is new, I have since considered the subject more fully; and as a result, I submit these explanatory diagrams for the consideration of those who may take an interest in the subject.

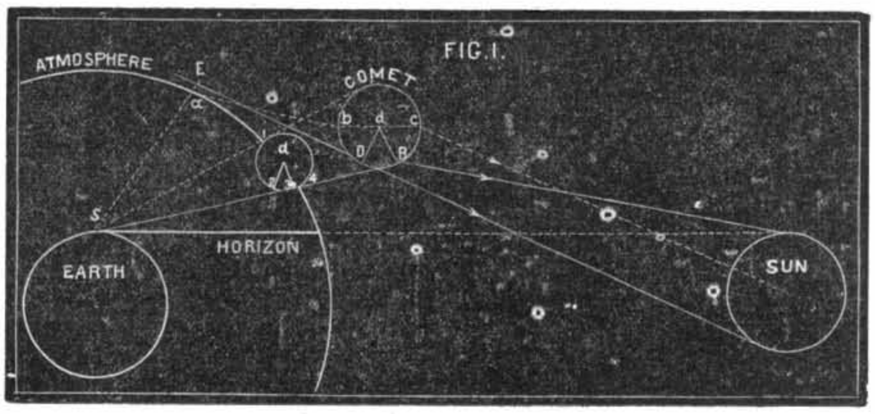
FIG. I.

The proposition which I have here attempted to demonstrate is that the tail of a comet is an optical phenomenon, caused by the reflection of the sun's rays from the surface of the comet to the earth's atmosphere and thence to the spectator.

Fig. 1 is a section, in the common plane (which, for convenience, we will call the ecliptic) of the earth, comet and sun (the sun being in the direction of the arrows); S is the spectator; D B is the portion of the illuminated surface of the comet which is visible to the spectator. All the space comprised between the points E, D, B, S, would be illuminated by reflection from that portion of the surface of the comet between the points D B. But the atmosphere which renders the light visible only extends to a, 1, 4; therefore the spectator would only see that included between the points a, 1, 2, 3, S. The comet would therefore appear to him to be at 1, 2, 3. The line a, 1, 2, 3, would appear as the line E, D, B; and the line S, 3, would appear as the line S, B. It will be observed that the line a, 1, does not touch the illuminated portion of the comet, but is interrupted by the interference of the dark portion of the surface between the points 1 and 2. That space, therefore, would appear darker than the rest of the illuminated space. This fact will be noticed among our conclusions.

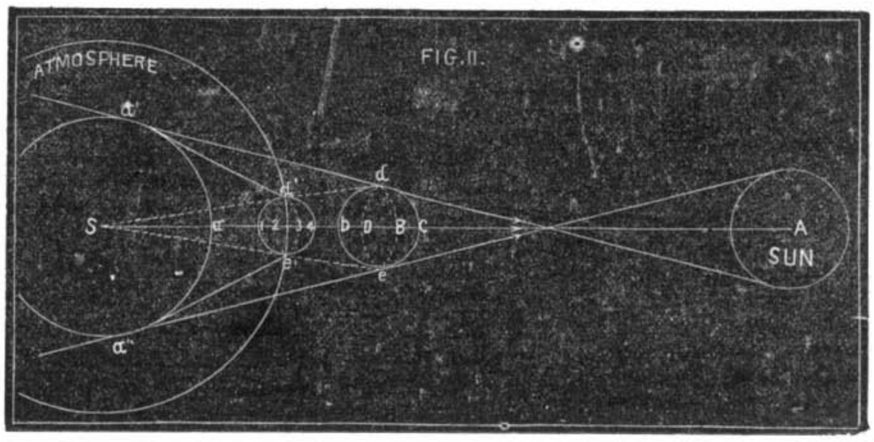
FIG. II.

Fig. 2 is a section perpendicular to that of Fig. 1, on a line drawn from the point S (Fig. 1), through a, b, c, and thence to the center of the sun. S, A, (Fig. 2) represents that line, the letters and figures indicating similar points, as in Fig. 1, and the sun being in the direction of the arrows. With regard to the spectator at S, all the space comprised between the points a', d, B, e, a'', would be illuminated by reflection from that portion of the surface of the comet between the points D, d, B, e; but for the reason assigned in describing Fig. 1, the spectator would only see that part included between the points a', d', e', a''. The comet would appear to be at d', e'; the line a', d' would appear as the line a', d; and the line a'' e' would appear as the line a'', e. The appearance therefore to the spectator would be that of a crescent-shaped comet on the confines of the atmosphere, with a tail spreading out from the nucleus, e', 2, d', 3, in a direction opposite to the sun, having at its extremity a width equal to a' a'' (Fig. 2) and a depth equal to S, a (Fig. 1).

The following conclusions may, I think, be drawn from the foregoing explanation; 1. When the spectator, comet and sun are in the same plane (which, in this case, we have supposed to be the ecliptic), the tail of the comet would be straight, and divided through its axis by the plane of the ecliptic. 2. If the comet's position were south of the ecliptic, the tail would incline towards the south, and would be curved convexly to the south, on account of the spherical shape of the atmosphere; and if the comet were north of the ecliptic, the inclination would be to the north, and the curve would be convex to the north. 3. The length and breadth of the tail would vary inversely as the angle between the comet, sun and spectator increased or diminished; that is, it would appear longer and broader as the comet approached the sun, and shorter and narrower as it receded. 4. In this position of the comet, there would appear to be a lune-shaped, darker space between the brightest part of the tail and the nucleus of the comet; that is, the brightest part of the tail would appear to be attached to the nucleus only at the two horns of the crescent. This is caused by the interruption of the line, a, 1, (Fig. 1) by the interference of the dark portion of the surface between the points 1 and 2 (Figs. 1 and 2). (See explanation of Fig. 1.)

The reason why the planets have no tails, when in the same relative position (with regard to the earth and sun) as the comet, is that they are, comparatively, so large that the reflection embraces nearly the whole of the atmosphere, and therefore no part is brighter than another. Comets on the contrary are, comparatively, exceedingly small; the diameters of some of them do not appear to exceed thirty miles. This is why, in the diagram, the tail appears so disproportionately broad.

If the principle of this theory be understood, it will be evident that the shape and direction of the tail may be varied almost infinitely, as they depend upon the relative positions of the three bodies, the earth, the comet and the sun.

T. R. LOVETT.
Mount Airy, Philadelphia, Pa.

Bisulphide of Carbon Engines.

To the Editor of the Scientific American:

An Irishman, on being told that an addition of quinces improved an apple pie, remarked that an apple pie made entirely of quinces would be better still. I am not an Irishman, but it strikes me that, if the attachment of a bisulphide of carbon engine to a steam engine is a great improvement, it might be better still to apply the heat directly to the bisulphide. The boiling point being lower than that of water, and the specific heat and latent heat of vaporization, perhaps, also less, it would require less fuel to produce a given quantity of vapor of given tension; and, as the products of combustion could be allowed to pass off at a lower temperature, the heat of the fuel would be more fully utilized. Also, it would seem that a second vapor engine might be driven by the waste heat from the fire flues of the first engine.

In your article on the loss of power in steam engines, it seems to me that you have overlooked two important points, in fact the most important. In your calculations, you start with steam instead of water, neglecting entirely the enormous quantity of heat required to convert water into steam, which is only very imperfectly utilized in heating the feed water, one pound of steam sufficing to heat five pounds, nearly, of water to the boiling point. That this "latent" heat can be utilized to a very great extent by the use of an easily vaporized fluid seems to be proved by the bisulphide of carbon engine, which has already effected a saving far beyond your estimate of possibilities.

The second point is the large buantity of heat which necessarily (under present conditions) goes up the smoke stack. I have already suggested one remedy for this waste in the use of a second vapor engine. Another plan which may be worth considering would be to burn charcoal, petroleum, or anthracite in an airtight chamber, surrounded by water, under such pressure that the escaping products of combustion would have, when released, the same or nearly the same temperature as the surrounding air, the question being whether the heat which passes up the chimney represents more power than would be consumed in forcing air into the furnace.

Another way to save a portion of this heat would be to apply it, as in Siemens' regenerating furnace, to heat the air which supplies the fire, unless indeed it is all required to produce draft.

Of course all these things present certain difficulties, but, to quote my Hibernian friend again, "if there was no throuble, sure there'd be no work for us."

Benton, Cal. C. H. AARON.

R. A. M. states, from his personal experience, that an application of spirits of turpentine is a certain relief for the pain of a bee sting.