

The writer, some time since, made a comparison of the light of the sun with that given from the molten steel in the Bessemer converter. This was chosen as an example of the greatest temperature attained on the large scale in the arts, and it is one which is known to equal that at which platina melts. Looking down the mouth of the converter we see at one stage of the process a stream of molten iron poured into the vessel in which the melted steel is already glowing in the background. Every one knows how bright white hot (and still more melting) iron appears, but in this case the steel is so much brighter, that the fluid iron in front seems like thick chocolate poured into a white cup. The steel, just before it is itself poured, seems of sun-like brilliancy, until we come to compare it with the sun itself, which was done by means of a photometer, so arranged that the steel light shone in at one side and the sunlight on the other. When the angle subtended by each source of light was equal, the image of the molten steel was put out by the presence even of much enfeebled sunshine, and ceased to be visible as the dull flame of an alcohol lamp would be if it were set beside an electric light. The area of glowing metal exposed was considerably over one square foot, and measures made with every precaution showed that any single square foot of the solar surface must be giving out much more, at any rate, than one thousand times the light that the melted steel did.

We are not, it is true, entitled to conclude from this that the heat is in exactly the same proportion, but we are justified by inference from this, and by other experiments not here given, in saying not only that the temperature on the sun's surface is far higher than that reached in our furnaces, but that the heat is in fact so enormously greater than any furnace heat here that they can scarcely be made the subjects of comparison. Other considerations, on which we cannot now enter, give the best grounds for belief that this heat is likely to be kept up sensibly at its present rate of emission for a period which, with reference to the brief history of the human race, may be called almost infinite. These are important conclusions, whose practical bearing will be more fully developed in a concluding chapter.

AMATEUR MECHANICS.

GEAR CUTTING APPARATUS.

The index plate, A,* is attached to the larger of the pulleys on the mandrel of the lathe by means of three or four screws, and the stop, C, provided with a point well fitted to the holes in the plate, is held in position on the bed plate, B, by a screw passing through a slot in the foot into the bed piece. The stop, C, is capable of springing sufficiently to admit of

withdrawing the pin from the hole in the plate, and it is strong enough to hold the plate without vibration. Two standards, G, mounted on the plate, B, support pulleys over which the driving belt runs. The gear cutter head consists of a casting, D, fitted to the tool post of the slide rest, and the mandrel, E, provided with a pulley and mounted on carefully fitted centers in the casting. The casting, D, has upon opposite sides, near the upper end, ears (as shown in Fig. 3) for receiving the pulleys, *a b*, which guide the driving belt, so that the cutter may be moved across the face of the wheel, being cut without changing the tension of the belt. The extreme end of the loop formed by the belt is supported by the pulley, H, mounted on a standard rising

presents the side, the lower view the edge of the cutter. It has but a single tooth and is adapted to brass and similar alloys only. It may be sharpened by grinding. When iron or steel is to be cut the cutter should have several cutting edges, and the mandrel, E, should have a larger pulley, as more power will be required and the speed must be slower. By setting the slide rest at an angle bevel gears may be cut.

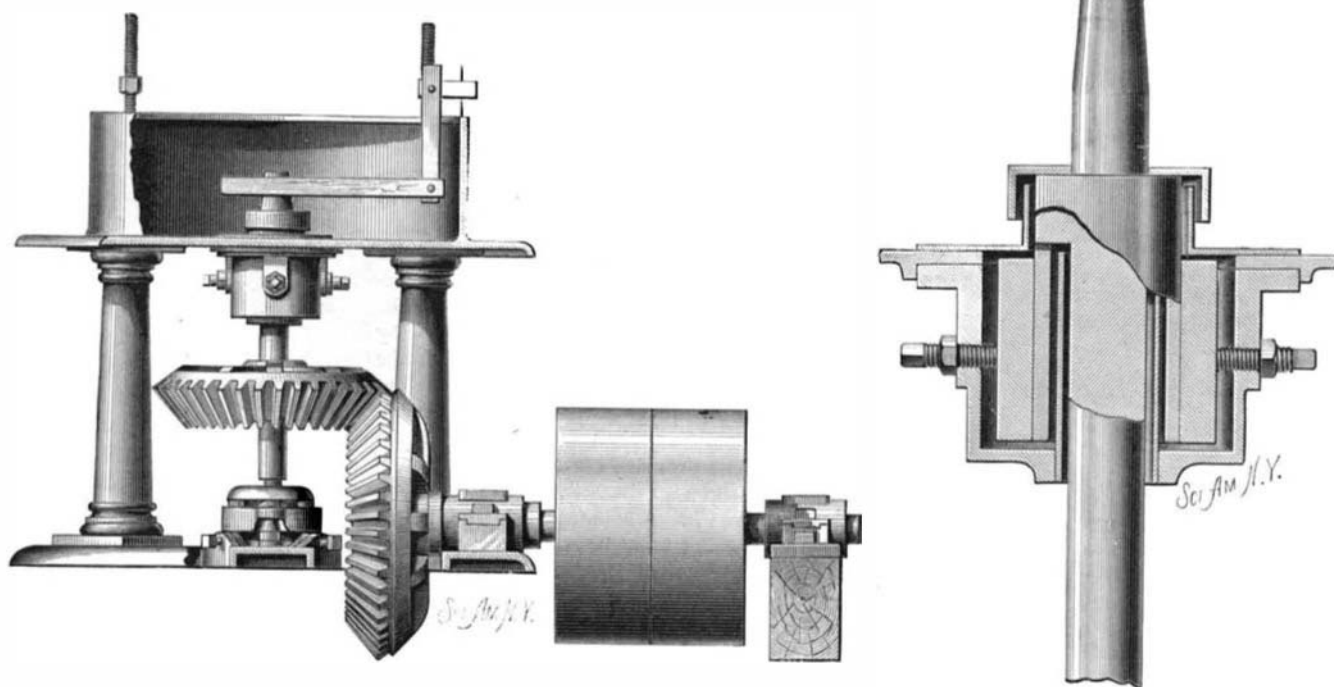
In a subsequent article the subject of sizing and cutting small gears will be treated. M.

AN IMPROVED MILL.

We give herewith engravings representing some recent improvements on the Munson mill, which was described in these columns some time since. The late improvements relate to the trammings of the spindle, to a novel device for lubrication, and to other points of merit.

The manufacturers of this mill say that the so-called portable mills now being sold in the market answer very well on coarse grains and coarse grinding, but for fine work they do not meet the demands of the trade; they are constructed without regard to the trammings of the spindles or the importance of keeping them in their true working positions. The metal boxes, which are held up against the collar or the neck of spindles, are continually wearing out, and unless some provision is made whereby the spindles may be perfectly and accurately adjusted, the work performed is of an inferior quality, and the loss of power by friction greatly increased. The Munson mill is made on mechanical principles, and special pains have been taken in their construction to obviate these defects. The curb of the mill, being cast in one piece, has its inside rim turned perfectly true, and by means of a tram stick or index, as shown in our illustration, any deviation or any perceptible change in the position of the spindle, no matter how slight, can be easily detected and easily adjusted.

The spindles are made of solid wrought iron or hammered iron and are provided with inserted solid steel points ground in on a taper fit with emery and oil, making an absolutely perfect bearing, which may be easily removed when injured. The neck or collar is forged solid on the spindle and reamed out to fit within the bush; inside the bush Babbitt metal boxes are placed, which are held up against the collar by setscrews. The bush is provided with a central vertical tube around which the collar works, the tube passing up between the collar and the bottom of the spindle, the collar in the bush forming the bearing surface of the spindle. The bush is covered by a cap having a circular central opening through which the spindle passes. The bush once filled with oil will keep the bearing of the spindle perfectly



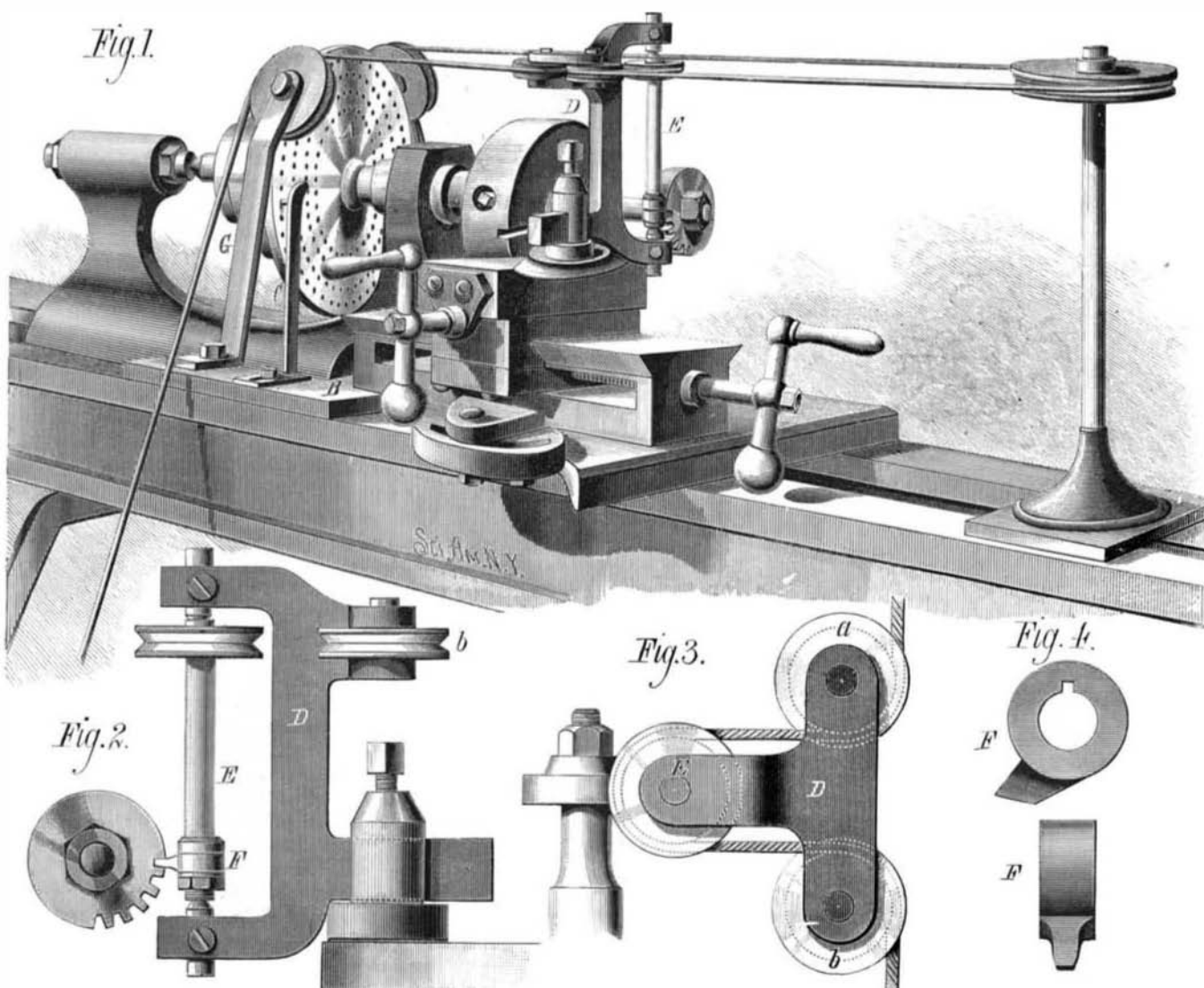
MUNSON BROTHERS' MILL.

from the lathe bed. The standard may be placed far enough from the slide rest to admit of putting the tail stock between it and the slide rest in case it should be necessary to use the tail stock for supporting the work.

The mandrel, E, is provided with a collar and a nut for clamping the cutter, F. It will be noticed that the cutter comes exactly opposite the line of the lathe centers, and that it occupies about the same position, in relation to the tool post, that the point of an ordinary turning tool does. The cutter, F, is shown in Fig. 4, enlarged. The upper view re-

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APPARATUS FOR GEAR CUTTING.

* See "Index Plates for Gear Cutting," page 20, current volume of SCIENTIFIC AMERICAN.

lubricated until the oil is entirely exhausted or worn out, with no delays from over-heating, and with no loss of power by friction. The bearings are always cool and work perfectly. These mills are constructed with the under stone hung on a sensitive point or cockhead spindle, or they can be made with the under stone rigid and stiff on the spindle.

For further particulars address the manufacturers, Munson Brothers, Utica, N. Y.

THE ASWAIL.

The aswail, or sloth bear, is found in the mountainous parts of India, and is equally dreaded and admired by the natives of that country. Although a sufficiently harmless creature if permitted to roam unmolested among its congenial scenery of mountain and precipice, it is at the same time an extremely dangerous foe if its slumbering passions are aroused by wounds or bodily pain of any kind. As a general rule the aswail remains within its sheltered den during the hot hours of the day, as its feet seem to be extremely sensitive to heat, and suffer greatly from the bare rocks and stones which have been subjected to the burning rays of the glowing Indian sun. On one or two occasions, however, where the wounded bear had been successfully tracked and killed, the soles of the animal's feet were found to be horribly scorched and blistered by the effects of the heated rocks over which the creature had recklessly passed in its haste to escape from its enemies. On account of this extreme sensitiveness of the aswail's foot, it is very seldom seen by daylight, and is generally captured or killed by hunters who track it to its sleeping place, and then attack their drowsy prey.

The aswail is said never to eat vertebrate animals except on very rare occasions, when it is severely pressed by hunger. Its usual diet consists of various roots, bees' nests, together with their honey and young bees, grubs, snails, slugs, and ants, of which insects it is extremely fond, and which it eats in very great numbers.

Probably on account of its mode of feeding, its flesh is in much favor as an article of diet, and though rather coarse in texture, is said by those who have had practical experience of its qualities to be extremely good.

The hair which covers the body and limbs is of singular length, especially upon the back of the neck, and the head, imparting a strange and grotesque appearance to the animal. The color of the fur is of a deep black, interspersed here and there with hairs of a brownish hue. Upon the breast a forked patch of whitish hairs is distinctly visible. When it walks its fore feet cross over each other, like those of an accomplished skater when accomplishing the "cross roll," but when it remains in a standing attitude its feet are planted at some distance from each other.

These bears seem to be very liable to the loss of their incisor teeth, and even in the skulls of very young animals the teeth have been so long missing that their sockets have been filled up by nature as if no teeth had ever grown there. On account of this curious deficiency, the first specimen which was taken to England was thought to be a gigantic sloth, and was classed among those animals under the name of *Bradypus ursinus*, or ursine sloth. In one work it was candidly described as the "Anonymous Animal." Other names by which it is known are the jungle bear, and the labiated or lipped bear. This last mentioned title has been given to the animal in consequence of the extreme mobility of its long and flexible lips, which it can protrude or retract in a very singular manner, and with which it contorts its countenance into the strangest imaginable grimaces, especially when excited by the exhibition of a piece of bun, an apple, or other similar dainty. It is fond of sitting in a semi-erect position, and of twisting its nose and lips about in a peculiarly rapid manner in order to attract the attention of the bystanders, and ever and anon, when it fails to attract the eyes of its visitors, it slaps the lips smartly together in hopes to strike their sense of hearing.

When captured young it is easily tamed, and can be taught to perform many curious antics at the bid of its

master. For this purpose it is often caught by the native mountebanks, who earn an easy subsistence by leading their shaggy pupil through the country, and demanding small sums of money for the exhibition of its qualities.

Lobsters for the Pacific Coast.

A large quantity of live black and striped bass, eels, and lobsters from the Atlantic coast have lately been distributed along the California coast. This is the first time that lobsters in good condition have reached the Pacific. Their successful transportation is attributed to the unremitting attention of Mr. Livingstone Stone and his assistants, in whose charge they were. The lobsters were taken at once to Point Bonito, and liberated. On the way to the Point they were placed in a fresh supply of water from the incoming tide, which greatly delighted them. They were all females, ripe for spawning, and were estimated to carry 1,000,000 eggs.



ASWAIL, OR SLOTH BEAR.—*Melursus Lybius*.

The cost of the importation was borne by the California State Fish Commission.

Railway Risks from Defective Vision.

Railway risks from color blindness have attracted much attention of late, and a system of railway signals, using bars at different angles, has been proposed as a substitute for color signals. Dr. Garretson, of Philadelphia, calls attention to a new source of danger from such signals, arising from the great frequency of the optical defect known as astigmatism.

This condition exists in irregularities of the refracting media of the eye, and is a defect so common as to be met with very much more frequently than color-blindness, the evils of which are sought to be remedied. The eye affected with astigmatism sees bars or lines with clearness only when these are at certain planes with the horizon; lines or bars at other planes it sees dimly or not at all. An astigmatic pair of eyes, having the bar signals alone for a guide, would certainly wreck the train under their direction.

If the new system be adopted, railway officials will owe it to the community, and for the protection of the companies against damages from accidents, to submit every employé for examination by competent surgeons. Accidents arising out of such neglect would assuredly be without excuse.

NATURAL HISTORY NOTES.

A New Theory in Regard to Galls.—Insect galls, which are usually held to be excrescences, a diseased condition of vegetable tissue, resulting from the injection of some fluid or secretion by certain insects, are regarded by Mr. A. S. Wilson, of Aberdeen, in altogether a different light. He says, in a communication to *Nature*, that "all insect galls are in reality leaf buds, or fruit buds, and not mere amorphous excrescences. The vascular lines which would form leaves can easily be followed up the structure of the oak leaf galls. And in cases where the egg has been deposited in the tissue of a young branch, the cap of the gall is sometimes surmounted by a leaf two or three inches long. But in the large blue Turkish galls many lacunæ occur where the fleshified leaves have not filled up the spaces between them. If a dissection be made of one of the weevil galls on the bulb of the turnip, the second or third slice will show the outer

foliations, exactly similar to those of the root buds. When the center has been reached, where the maggot will be found, there will also be found a vascular pencil running up from a medullary ray in the bulb, and bearing on its top a bud of the same description as that produced by a ray running out from a root. The insertion of the ovipositor brings a medullary ray into action, producing a tuberculated bud, and it is only the bud which the larva feeds upon. The growth of a bud is an intelligible cause of the growth of a gall, but we can infer nothing from the injection of a fluid. The analogy to leaves is further shown by the fact that various microscopic fungi are matured in the interior of imperforate galls.

Red Canary Birds.—Among the varieties of the canary bird that have recently come into fashion among amateurs is one with red plumage. These birds, according to Mr. Vander Suickt, a Belgian fancier, appeared for the first time at the London Exhibition in 1872. They were exhibited by Mr. Bembrose, of Derby. The birds received no prizes, however, as the jury had doubts as to the origin of their color, and believed them to be dyed. The following year, at the Exhibition held at Whitby, the red canaries were recognized as a new variety, and they became all the rage. In numerous controversies Mr. Bembrose had given his word of honor that the color of his bird was not due to any fraudulent processes, but had been really obtained through a special mode of feeding. But as a friend to whom he had communicated his secret abused his confidence and sold it, the author has believed it his duty to make known to the public the process which he used to obtain his results. It appears, according to him, that the birds are fed upon hard boiled eggs crushed up with the crumbs of common white bread and dusted over with

Cayenne pepper. Dr. Dusch, a Belgian amateur, adds the following:

Purchase at the druggist's some of the very best quality of Cayenne pepper, ground very finely; for each meal mix some of it with stale bread macerated in well water, and press it together so that it will crumble, but not form a paste. Instead of bread the white of an egg may be used, if preferred. This kind of food should be given to the bird only before and after moulting. It is well to add that it would be a waste of time to experiment on any other canaries than those of the Norwich breed, or on birds that are not of a very dark yellow strain. This statement is made on the authority of *Les Mondes*.

Insects Destroyed by Flowers.—Mr. J. W. Slater, in a communication to the Entomological Society of London, says: Whilst it is generally admitted that the gay coloration of flowers is mainly subservient to the purpose of attracting bees and other winged insects, whose visits play so important a part in the process of fertilization, it seems to me that one important fact has scarcely received due attention. Certain gayly-colored, or at least conspicuous, flowers are avoided by bees, or if visited have an injurious and even fatal effect upon the insects. Among them are the dahlia, the passion flower, the crown imperial, and especially the oleander. That the flowers of the dahlia have a narcotic action both upon humble bees and hive bees was first pointed out, I believe,