tea and coffee pots, and similar articles, to prevent scratching of the table, tray, stand, or other things upon which they may be placed.

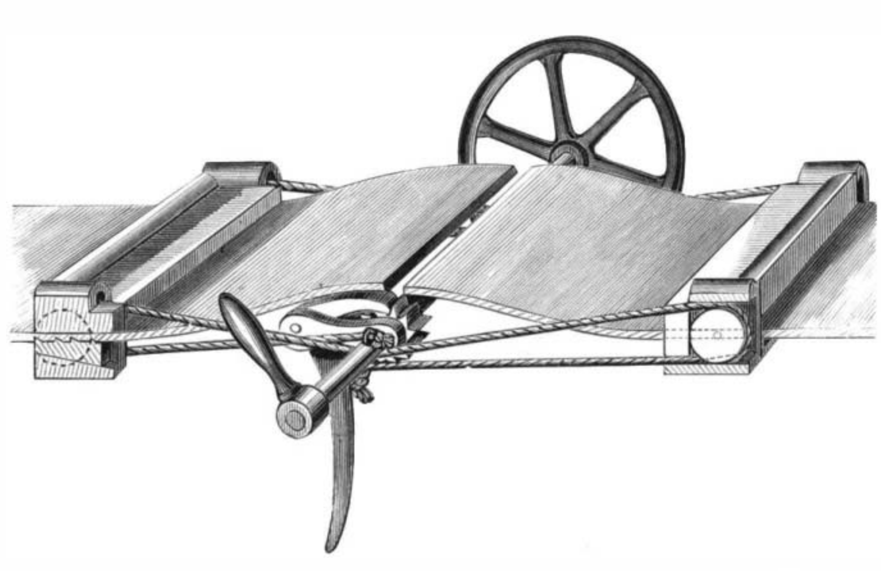
An improvement in grain-meters has been patented by Mr. Alexander Kaiser, of Munich, Bavaria, Germany. The object of this invention is to provide an improved apparatus for weighing and measuring cereals or other granulated or pulverized substances.

An attachment for ladders, patented by Messrs. Joseph D. Norton and Leonard M. Norton, of Loudville, Mass., consists in a central arm clamped on to the upper rounds to act as a pivot to permit the bottom of the ladder to stand square upon the ground when the ladder is placed against any oblique or irregular object, like the limb or crotch of a tree

IMPROVED BELT STRETCHER.

The engraving shows an improved belt stretcher recently patented by Mr. P. H. Kum, of Dixon, Ill. It consists of two clamps capable of grasping the belt tightly, and provided on opposite ends with pulleys, around which ropes pass, one rope being upon each edge of the belt. The ends of the ropes are attached to a windlass located between the clamps and operated by levers at opposite ends of the windlass, or by a lever and pawl acting on a ratchet wheel in the center of the windlass.

The clamps are made with a wedge-shaped serrated piece that clamps the belt in a wedge-shaped mortise, an increase in strain on the belt increasing the pressure of the clamp.



KUM'S BELT STRETCHER.

A Boss Miner.

A fire broke out in a shaft of a deep coal mine at Canton, Ill., and the miners made a wild rush for the elevator, crowding the cage and fighting for places. Five trips of the cage would carry them all up, but it looked as though the flames would quickly close the exit, and in the fright and confusion all struggled to be first. Tom Lukey, the coal and muscular boss of the gang, drove them all aside, and then called out the names of as many as could be hoisted out at once. In making the selections he chose those who had large dependent families. When the cage came down he filled it with those who had fewer relatives, and next time with husbands who had no children. It was not until the fourth lift that unmarried men were given a chance. The fifth carried some almost worthless bummers and Lukey himself, with the fire scorching their clothes. When praised for his act he carelessly replied: "Oh, that wasn't anything. If I hadn't got those fellows out of the way I would have been burned up, don't you see."

Canadian Industries.

A marked improvement in the industrial condition of our northern neighbor has taken place during the past year or two. The Minister of Finance, Sir S. L. Tilley, in presenting his annual budget the other day, said that at no period in the history of the country had government met parliament with the finances in as good a position, credit so high, and the people more prosperous, and he claimed that this state of affairs was greatly dependent on the protective policy of the government. The revenue year by year had been increasing until, from having a deficiency of $200,000 in 1879, the treasury had a surplus of over $400,000 for the twelve months ending last July. In 1879, government had proposed and parliament had agreed to remodel the tariff so as to protect native industries, and to-day, as a consequence, the factories were running full time and extending their premises and machinery; people were fully and remuneratively employed, money was plentiful, the ability of the people to buy was greatly increased, and, as a consequence, the volume of imports kept the revenue flourishing. He proved from statistics that the result of the tariff was largely to increase imports from Great Britain, and that the trade in breadstuffs between Canada and the United States had increased from 8,500,000 bushels in 1877–78 to 12,143,000 bushels in 1880–81, proving the groundlessness of the predictions of the opposition as to the results of the operation of the tariff.

Electric Lights in Philadelphia Post Office.

A Philadelphia paper says that there are seventy-five small incandescent lamps at present in use in the City Post Office, supplied by the Maxim Electric Light Company. Each lamp is run to twenty-four candle power, though the power can be more than doubled. When the lamps were first placed some trouble arose in the machinery, in breaking globes, and in the carbons burning out; but the two latter difficulties have been overcome. The carbons are supposed to burn from six hundred to seven hundred hours. Theoretically there is no reason why they should ever burn out, but experience demonstrates, in the Post Office at least, that the carbons rarely last over three hundred or four hundred hours of actual service. The base of the Maxim lamp is of vulcanite rubber and metal, and the work of removing the exhausted carbon and substituting a new one requires but a few minutes. Postmaster Huidekoper expresses himself very much pleased with the lamps. When they were first introduced some of the employes thought the light hurt their eyes and they wore shades, but, with two or three exceptions, these protectors have been discarded.

EFFECTS OF HEAT UPON STEEL.

The illustration shows the effect of heat upon steel. To produce these effects take a bar of steel of ordinary size, say about an inch by a half, and heat six or eight inches of one end to a low red heat, and nick the heated part all around the bar at intervals of half to three-quarters of an inch, until eight or nine notches are cut. This nicking is done at red heat, to determine the fracture at the nicks. Next place the end of the bar in a very hot fire and heat it white-hot until it scintillates at the extreme end, leaving the other parts enough out of the fire to heat them only by conduction. Let the end remain in the fire until the last piece nicked is not quite red red-hot, and the next to the last barely red hot.

Now, if the pieces be numbered from one to eight, commencing at the outer end, No. 1 will be white or scintillating hot, No. 2 will be white hot, No. 3 will be high yellow hot, No. 4 will be yellow or orange hot, No. 5 will be high red hot, No. 6 will be red hot, No. 7 will be low red hot, No. 8 will be black hot.

As soon as heated, let the bar be quenched in cold water and kept there until quite cold. After cooling, the bar should be carefully wiped dry, especially in the notches. An examination by the file will reveal the following, if high steel has been used:

No. 1 will scratch glass; Nos. 2, 3, and 4, excessively hard; Nos. 5 and 6 well hardened; No. 7 about hard enough for tap steel; No. 8 not hardened. In breaking off the pieces over the corner of the anvil they should be caught in a clean keg or box, to keep the fractures clean and bright.

No. 1 will be as brittle as glass; Nos. 2 will be nearly as brittle as glass; Nos. 3, 4, and 5 will break off easily, each a little stronger than the other; Nos. 6 and 7 will be very strong, and much stronger than No. 8, or the bar unhardened.

Place the pieces in the order of their numbers fitting the fractures, then upend each one, beginning with No. 1, and following with each in the order in which they lie, and the result will be fractures as shown so beautifully in our illustration, each differing from the other.

No. 1 will be coarse, yellowish cast, and very lustrous; No. 2 will be coarse and not quite so yellow as No. 1; No. 3 will be finer than 1 or 2, and coarser than No. 8, and will have fiery luster; No. 4, like No. 3, not quite so coarse, yet coarser than No. 8; No. 5 will be about the same size grain as No. 8, but will have fiery luster; No. 6 will be much finer than No. 8, will have no fiery luster, will be hard through and very strong. This is what is called REFINING by hardening. No. 7 will be refined and hard on the corners and edges, and rather coarser, and not quite so hard in the middle. This is about the right heat for hardening taps, milling tools, etc., the teeth of which will be amply hard, while there will be no danger of cracking the tool. No. 8 illustrates the original grain of the bar.

In nine cases out of ten the bar will crack along the middle to the refined piece. In the illustration the crack shows very plainly in No. 4, but we have never known this crack to extend into the refined piece, although we have repeated the experiment many times. We learn from this experiment the following:

FIRST, "*a*" Any difference in temperature sufficiently great to be seen by the color will cause a corresponding difference in the grain. "*b*" This variation in grain will produce internal strains and cracks.

SECOND, Any temperature so high as to open the grain so that the hardened piece will be coarser than the original bar will cause the hardened piece to be brittle, liable to crack, and to crumble on the edges in use.

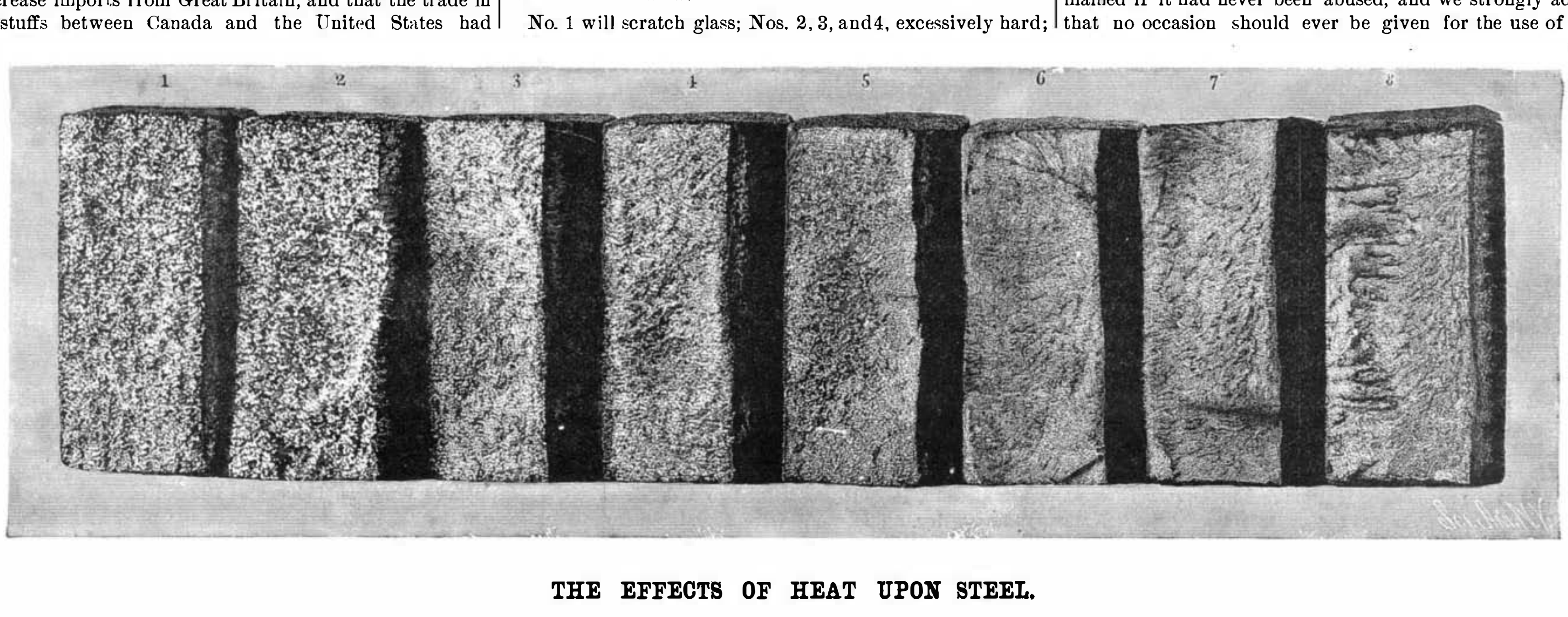
THIRD, A temperature high enough to cause a piece to harden through, but not high enough to open the grain, will cause the piece to REFINE, to be stronger than the untempered bar, and to carry a tough, keen cutting edge.

FOURTH, A temperature which will harden and refine the corners and edges of a bar, but which will not harden the bar through, is just the right heat at which to harden taps, rose-bits, and complicated cutters of any shape, as it will harden the teeth sufficiently without risk of cracking, and will leave the mass of the tool soft and tough, so that it can yield a little to pressure to prevent the teeth tearing out. These four rules are general, and apply equally well to any quality of steel or to any temper of steel.

Steel which is so mild that it will not harden in the ordinary acceptance of the term will show differences of grain corresponding to variations in temperature.

To restore any of the first seven pieces shown to the original structure, as shown in No. 8, it is only necessary to heat it through to a good red heat, not to a high red, allow it to stay at this temperature for ten minutes to thirty minutes, according to the size of the piece, and then to cool slowly. If upon the first trial the restoration should be found incomplete, and the piece upon being fractured should still show some fiery grains, a second heating continued a little longer than the first would cause a restoration of fracture. This property of restoration is not peculiar to any steel, and its performance requires no mysterious agencies beyond those given above.

It should be distinctly borne in mind that a piece restored from overheating is never *quite* as good as it would have remained if it had never been abused, and we strongly advise that no occasion should ever be given for the use of this



THE EFFECTS OF HEAT UPON STEEL.

process of restoration except as an interesting experiment. The original and proper strength of fine steel can never be FULLY RESTORED after it has once been destroyed by overheating.—*Treatment of Steel.*

Geology of the Panama Canal Route.

Discussing the geology of the Isthmus along the route of the proposed canal, the Panama correspondent of the *Herald* says:

The nearest signs of comparatively recent volcanic action are to be found in the neighboring Department of Veragua, in this State; and the conical hills between here and the Atlantic are not, as one might suppose, of surface volcanic origin. But it is admitted that the signs of submarine igneous action are to be found in considerable variety. Granite, syenite, and crystalline schist are not plentiful. Trachytes, blendes, dolomites, and basalts are, however, to be frequently met with. Columnar basalt composes a goodly portion of the Culebra Mountain, and it is very hard. The trachytes line much of the Chagres banks on both sides, forming hills that range away back into the country. In the bed of the Rio Grande dolomites and trachytes predominate, while on its bottoms the sedimentary earths are formed of vegetable mould and submarine tuffs. On the Atlantic side, near Mindi, these formations are of rocks which have little cohesiveness. The corresponding formations on the Pacific slope belong to a more ancient period. A variety of conglomerates, containing porphyry, granite, and syenite, is discoverable in the vicinity of Panama; but neither dolomites nor basalts appear here. The rocks receive their characteristic color from the presence of peroxide of iron. The stratified ledges in the center of the isthmus are acknowledged to have originated in submarine volcanic action of the tertiary period.

The conglomerates around Barbacoas are exceedingly hard and tenacious. Near San Pablo station the gray conglomerate, whose layers may be seen from the railroad, contains trachyte of a totally different nature from what is found within a radius of twenty-five miles, as it does not show any fossil remains. Some not very distinct traces of fossils are discoverable among the calcareous spars on the banks of the Obispo River. At Gatun the upper strata are mostly made up of brown argillaceous matter and rocky detritus. Here fossils are met with in such small fragments that it is difficult to classify them; nevertheless, they appear to differ but little in character from those of Aspinwall bay. Under some of the recent tertiary formations deposits of conglomerates repose whose upper portions present the aspect of volcanic tuffs. Porphyritic and trap formations make up much of the rocky mountains in the background to the central chain of the Varro Colorado. The Panama sandstone formation belonging to the transition period extends to the slopes of the Cerro Grande, at which latter point it may be considered as almost identical with the rocky layers of Barbacoas. Only at the point called Varnos-Varnos is there a deposit which may be assigned to the secondary strata. The tertiary formation of calcareous and fossil bearing sandstone, and the most considerable after the traplic and porphyritic deposits, comprises all the distance from Trinidad River to the sea. Baila Monos marks the northern limits of the dolomitic, porphyritic, and trachytic deposits. At Mamei, in addition to the formations already named, there must be included several species of phonolites, granite, quartz, and dolomites coming from the rocky ledges above Las Cruces. Matechin, in addition to the rocks already mentioned, has trachii-dolomites, simple dolomites, and several other kinds. It is here where the heavy work of excavation must begin if that sort of labor shall ever commence. Near Emperador the coniform hills are mostly made up of dolomites mixed with tuff of the conglomerate character in the nature of volcanic and marine matter. Coming up from the Pacific basalt is met with at Paraiso, nine miles from Panama. In the valley of the Rio Grande, which begins near there and runs toward the ocean, the pyramidal hills seen on either hand chiefly consist of basalts and dolomites, with conglomerite tuffs in the bottoms, mixed with earthy cements containing fragments of rocks belonging to the various orders. Around Pedro Miguel the formation is about the same in nature, excepting in this locality some beautiful agates have been picked up. Rocks of remote volcanic origin are found along the line to near Panama without showing the presence of either granite or gneiss. At the mouth of the Rio Grande, a little west of this city, there is a stratified horizontal belt of sandstone, holding no fossil remains, which seems to belong to the transition period. Panama is built on a small peninsula of this reddish conglomerate sandstone, and the picturesque Cerro de Ancon, a mile or so distant, is for the most part composed of conglomerate trachytes.

The Cause of Explosion in Kerosene Lamps.

The *Technologische Blätter*, of Vienna, contains a scientific disquisition by P. Knopp upon the causes upon which depend the explosions too frequently noticed in petroleum lamps.

The combustible hydrocarbon gases formed by the evaporation of petroleum burn easily, and when mixed in certain proportions with oxygen gas they burn so rapidly as to produce a violent explosion. This takes place when one part of the vapor is mixed with two parts of air. This gaseous mixture expands at the moment of ignition and in consequence of the heat generated, so that it far exceeds its former volume, and it makes room for its increased bulk by destroying the surrounding bodies. The explosions that occur in petroleum lamps have their origin in the existence of such explosive gas mixtures. What remains to be shown is: first, how such a mixture is formed in the receptacle; and secondly, in what manner it can be ignited.

The oil receiver, which in the greater majority of kerosene lamps consists of glass, has only one opening which is provided with a metallic collar. This is used both for filling the lamp and for receiving and holding the burner. This receptacle and the oil contained in it, when the lamp is burning, acquire a certain temperature, which is different under different circumstances, but in nearly all cases it is high enough to generate these hydrocarbon vapors. The higher the temperature of the oil in the receiver the more rapid, of course, will be the evolution of vapor.

Every burner, consisting of a good conductor, becomes heated by the flame and communicates this heat to the petroleum holder. Since heat and light are very nearly related this development of heat will increase in proportion to the illumination given by the lamp. For example: if a lamp that gives a poor light is burning in a cold room no vapors will be generated at all. On the other hand, if a lamp that gives a good light burns in a well-heated room, at a short distance from the ceiling, where the temperature, owing to the ascending heated air, often exceeds 30° R. (100° Fah.), and in addition to that a shade is suspended above it and thus reflects the heat down upon it, there will be a rapid evolution of gas and vapor. (Yet these hanging lamps very rarely explode, because they are let alone.)

Now let us imagine that a lamp has been filled to the rim with oil before the wick is lighted. The petroleum is consumed by the flame, and hence the volume of oil in the lamp gradually decreases. The empty space thus formed, so long as little or no vapor is generated, will be filled with atmospheric air sucked in through the burner. It is absolutely impossible to prevent this entrance of air; for if it were technically feasible, a vacuum would be formed in the lamp, and the oil could not be drawn up the wick to the flame, so that the burning of the lamp would be hindered if not entirely prevented. This admission of air, combined with the gases evolved in the lamp, are adapted to the production of the explosive mixture.

We now come to the question of how it is possible for this mixture to be ignited.

In all the burners hitherto in use in Germany the flame is regulated by shoving the wick up or down in the metallic case by means of a ratchet wheel at the lower part of the burner and attached to a projecting wheel and axle. Owing to the softness and flexibility of the wick this movement is possible only when the wick is rather loose and has some play in the tube. This space, which is frequently increased accidentally still more by the wick being too small or thin, would be of no importance so long as it merely permitted the atmospheric air to enter the oil holder, for this access of air, as already remarked, is not to be prevented, but rather aided. Unfortunately this space permits the gases rising from the oil to reach the flame, which is sure to take place as soon as there is the slightest pressure in the receptacle. This pressure, however, is necessarily produced by the development of gases in the holder.

If, now, these gases are pressed upward through the wick space by the side of the wick, they reach the flame and are at once consumed there without any explosive action as long as the gas is not mixed in the requisite proportions with the atmospheric air. Since this intermixing may take place in many different ways, we can explain in this way the many explosions and the greater or less danger with which they are attended.

If no explosive mixture of gases has been formed in the receptacle itself, but only in the tube with the wick, the explosion will be but a slight puff, accompanied by a flickering of the flame and the evolution of some smoke. This little explosion will be more violent and noisy the greater the volume of explosive gases that have collected in this wick tube. If the dangerous mixture almost fills the free space within the wick tube, the burning gases will burst out below because of their expansion at the moment of combustion. In such cases a bluish flame can be distinctly seen to descend into the oil cup or holder. This flame is immediately extinguished without any injury being done, provided there is no explosive mixture present in the oil receptacle itself, because the force generated by the expansion of so small a volume of gas as that burned in this case, does not suffice, as a rule, to break or injure the receptacle. If, however, there is an explosive mixture in the receiver itself, an explosion can not but take place, and its violence again will depend upon whether all the space in the receiver above the surface of the oil is filled with the explosive mixture of air and vapor, or only a part of it.

We may add that the less oil there is in the lamp the larger the space which may or may not be filled with this dangerous mixture. The relative safety of an oil is judged by the temperature at which it gives off combustible vapors, but in a lamp where a certain degree of rarefaction may exist it is quite possible for these vapors to be generated a few degrees lower than in the usual petroleum tester.

A Deep Oil Well.

One of the deepest wells ever drilled for oil purposes is the Tack Bros. well, recently finished in Millstone Township, Elk County, Pa. It was drilled to a depth of 2,600 feet, and was dry. The sands were found regularly, and the second sand looked very encouraging, but all hopes were abandoned when the third sand was passed and no oil found.

AGRICULTURAL INVENTIONS.

Mr. John Bartlett, of Oshawa, Ontario, Canada, has patented an improved root-harvesting machine, which removes the tops while the root is in the ground, and afterward removes the root from the ground.

Mr. John H. Bethune, of Fayetteville, N. C., has patented an improved cotton-chopper of very simple and inexpensive construction. The chopping wheel is rotated by connection with one of the driving wheels, and the forward end of the machine is supported on a shoe or runner of peculiar form.

An improvement in seed-drills has been patented by Mr. John Bartlett, of Oshawa, Ontario, Can. The object of this invention is to facilitate the planting of grain and seeds in drills and promote the convenience of the farmer by enabling him to plant different kinds of grain and seeds with the same distributing apparatus.

An improved harvester-finger has been patented by Mr. Charles Jay Johnson, of Lone Pine, Cal. The object of this invention is to increase the durability of mowing and reaping machine fingers by reducing the wear, and by providing a detachable wearing block at the back of the guide for the sickle-bar.

Sensitiveness of the Retina.

Any photographer who has ever considered the subject of the human eye as a camera and lens must have been struck with the marvelous sensitiveness of the retina, the part of the eye which represents the photographic plate or film; but probably it has never come under his notice that this sensitiveness varies, and to a very great extent. We know that the iris of the eye changes in diameter without our being conscious of it, and that it forms, in fact, a most perfect self-adjusting diaphragm, and we know that by this means a larger proportion of the light reflected by surrounding objects is allowed to enter the eye when these are dimly lighted, than when they are brightly; but it is not generally taken into account that there is a far greater change than this—that besides the change in the amount of light admitted, there is an enormous change in the sensitiveness of the retina. The very change is of such a nature as to prevent us from perceiving how very great is the range of light through which we can see distinctly. We shall take an example.

On a brilliant moonlight night, some hours after sunset, our friend, on looking round, remarks, "Oh, how beautiful, how bright the light; almost as bright as daylight," and really it almost seems to be so; yet we know that the light is in reality vastly less bright than sunlight. Let us look a little into what really is the ratio of the brightness of moonlight and sunlight. We all know, of course, that the light of the moon is but borrowed light—light received from the sun and reflected from its surface. Now, were the surface of the moon a perfect reflecting medium—that is to say, were it to reflect all light which reaches it—the amount which we should receive from a full moon would be only about a one-hundred-and eighty-thousandth part of what we receive from the sun in the daytime. But it is evident that the moon's surface will reflect but a small fraction of the light which reaches it. Probably its average color is about the same as the color of the rocky parts of the earth's surface, and it is likely that we are overstating the amount actually reflected when we say that it may be a fifth or a sixth of the whole received, yet this assumption leads us to the astounding conclusion that the bright moonlight which we have so much wondered at is really about a million times less bright than sunlight. It is quite evident that, besides the alteration in the area of the iris of the eye which has taken place, there must, in the few hours between sunlight and moonlight, have been an enormous increase in the sensitiveness of the retina.

We have stated the ratio of the brightness of the sun and moon as perhaps a million to one; but certain experiments in moonlight photography, which we made some time ago, lead us to the conclusion that the ratio is probably considerably higher—likely about two millions to one.

The limit of sensitiveness which may, so to speak, be excited in the retina, does not, however, stop here. Under certain conditions it may be still more increased, so much so that moonlight may in its turn appear by comparison an almost unbearably strong light. It is not, as might be expected, by remaining in total darkness that the maximum sensitiveness may be reached; it is by working and continually using the eyes in the least possible light for a considerable time. We have experienced such a sensation when experimenting with extremely sensitive emulsions. We have worked for several hours in our dark room at night time by artificial light, and have kept the light just to the lowest point at which it was possible to see at all. On emerging from our room into the open air, the moonlight appeared so powerful that, for some seconds, it was painful to look at any white object lying in it. From this we conclude that the sensitiveness of the retina may become so marvelously great that it can perceive objects, and follow the rapid motion of those objects, in a light which may be white, but so dim that, were the retina replaced by the most sensitive gelatine film, it would take weeks or even months for a developable image to be impressed upon it.

But what is the practical outcome of all this to photographers? Well, we deduce from it a lesson which all of them might take to heart. There is the most extraordinary difference of opinion as to what is and what is not a safe light in which to work in the dark room. Now, we believe that a great deal of this difference of opinion is due to the