Mistakes in the construction of refrigerators have been recently brought to our notice, caused by the supposition that a space filled with air between two metallic cases would be more effective than any other filling, while superior lightness would thereby be secured.

Mistakes in the construction of steam boilers are also common results of want of knowledge of the laws of transmission of heat.

But the most absurd errors occur and abound in the construction and erection of heating and ventilating apparatus. We scarcely ever see anything of this kind in public or private buildings which is not open to criticism in some important particular. It would almost seem that intentional violation of natural laws was the object in some of these arrangements. The old saying that heat *rises* seems to be generally accepted as truth by constructors of heating apparatus. Thus we know of a case where it is expected that heat will rise through a long, narrow, vertical passage, the bottom of which surrounds a fire-box, and has no communication with the external air.

In the case cited, which is a fair sample of blunders to be met with in school-houses, churches, etc., throughout the country, a very little heat escapes from the open mouth of the tube above; the amount thus imparted to the room it is intended to warm being only that due to a little radiation, and the circulation of the air in the tube, which latter, under the circumstances, is very slight. The consequence is that the upper room is never warm while the lower one is continually overheated in a vain attempt to warm the upper one. A good sized hole in the bottom of the tube, and another in the bottom of the upper floor, with a tube leading from it down nearly to the floor below, would enable the heat to be equally distributed thoughout the building, and necessitate much less expenditure of fuel.

Heat does not always rise any more than it always falls or moves laterally. It goes just as it is conducted, conveyed, or radiated, and it is only by understanding this truth and acting in accordance with it that any apparatus intended to transmit heat, or to prevent its transmission can be made efficient.

ARE TIN FRUIT CANS A SOURCE OF METALLIC POISONING?

Our attention has been called to this subject by a note of inquiry from a lady in Brooklyn, Miss Julia Colman, who has achieved considerable popularity as a temperance lecturer, and has made the subjects of food and nutrition a favorite study.

The queries she propounds are, we think, of sufficient importance to merit public attention, which, once aroused to the subject, will not, we trust, be content until a positive answer is obtained to the query which forms the heading of the present article.

Tin has long been justly regarded as one of the metals from the ordinary uses of which mankind have nothing to fear. But the present age is characterized by its factitious imitations. That which goes by the name of tinfoil is mostly an alloy of tin and lead, and it is charged that many of the caps used for glass fruit jars are made of zinc instead of tin. It is well known also that lead is used in soldering cans, and that this metal is attacked by certain organic acids, which are contained in fruits. The tin of commerce is also by no means pure, and housekeepers will vouch that the tin cans are often attacked by these acids, and eaten through so as to leak their fluid contents. In the case of impurities in the tin used to coat the iron of the tin plates of commerce, when the cans are thus attacked, it may well be doubted whether the cumulated effects of metallic poisoning do not sometimes result from this cause.

Our correspondent writes as follows:

"So far as the evidence of the senses goes, housekeepers know that cooking tomatoes in tin 'ruins the basins' as one good woman said; and another admitted that she commonly used up at least one 'basin' in a season for this purpose. How much injury the partaker receives we do not know, but so much has been said of the sad effects of metallic poisoning, even in small though long continued doses, that we would like to be assured of safety. Professor Youmans thinks it a small matter, but I find that many medical authorities disagree with him. One of the latter says: 'It ought to be known to housekeepers that acid, fatty, saline, and even albuminous substances may occasion colic, vomiting, etc., after having remained some time in tin vessels.'

"We see that the inner surface of the tin can is discolored after having been used for fruit, and we find that the flavors of the more delicate fruits are injured when they have been kept in tin cans, but whether the acid acts after the expulsion of the free oxygen, or only during the canning process, we do not know.

"Zinc is more readily oxidized than tin, and yet the caps of some of our glass cans are made of that substance.

"Many if not all the tin cans are freely soldered with lead, and it *seems* inevitable that the usual galvanic action must result when they are filled with an acid.

"I have no desire to raise a false alarm, indeed I should be much gratified to learn that such a use of tin cans is perfectly safe, since many depend on them for all their canned fruit.

"If the amount of tin that may enter the system, as a result of its domestic use, is not likely to prove injurious, the questions are narrowed down to the purity of the article used and the actual results of using the various cans prepared for our market.

"I had an opportunity recently to make some inquiries of Profesor Edwards of the 'Woman's Medical College of the N. Y. Infirmary,' and he said that the tin cans, *as prepared*, are very unsafe, that the acids dissolve the lead solder and sometimes eat through the entire plate, making the cans leak (a new fact to me), and also that serious cases of poisoning had occurred from using their contents. If facts like these could be called out from scientific men they would arrest public attention, and they might suggest to manufacturers of glass cans the desirability of protecting the inner surfaces of their metallic caps in some way. Those with metallic caps work so much more easily than others, that they will long be more or less in demand. (Professor Edwards, however, said that the metal used in them is lead). I line mine with stiff white paper, a small protection of course."

We believe the subject thus broached by our correspondent is one of importance. If manufacturers are presuming upon popular ignorance, and palming off upon the public zinc and lead for tin in vessels intended to contain food, the fact ought to be known. Acetic acid acts slowly upon lead, but its action is hastened by exposure of the metal to air. Acid fluids act with more violence upon zinc.

According to Miller commercial tin may and usually does contain (except the Banca tin, which is not used for tin plates) small quantities of copper, arsenic, iron, and lead. Of these adulterations all but the iron are poisonous. The copper as well as the lead is acted upon by vegetable acids. In the gradual destruction of vessels made of tin plates by culinary use, it would seem that more or less of the poisonous salts of the metals named must enter the food prepared in them. Whether this amount is sufficient to affect health is a question that ought to be decided.

THE MYSTERY OF SLEEP.

What are the differences between sleeping and waking? What is the peculiar nature of that mysterious condition which we call sleep? These are questions long and earnestly asked but never answered. There is something about this phenomenon that seems to defy investigation. The distinctions between the sleeping and waking state are, save a few external differences, as entirely unrecognized to-day as they were ages ago.

Sit by the cradle of a child and watch it as it sinks into quiet slumber. The muscles gradually relax; the eyelids fall; and voluntary motion ceases. The breathing is slower, as is also the action of the heart. The temperature of the body is slightly depressed; and a state of apparent unconsciousness accompanies the physical changes specified. That is all we can see, and yet it seems hard to believe these things are all that constitute sleep. If so, sleep might be accurately defined as a simple cessation of volition, or the action of the will, so that thought and motion of all muscles except those of the vital organs is impossible. But a little thought will show that cessation of will is only one of the manifestations of sleep, and that the will may and frequently does only partially cease to act, retaining command of the voluntary muscles, and giving rise to the phenomenon of somnambulism. At times also the mind becomes active in sleep, and often reasons with surprising coherence, and dreams, more or less approximating to realities of waking hours, are produced.

But the mystery of mysteries pertaining to sleep, is the fact that it renovates the system from fatigue. And after all, this is no greater mystery than fatigue itself. What is fatigue? In what state of mind or body, or of both, does it consist are questions the answers to which still puzzle the profoundest physiologists.

The periodicity of the desire for sleep is another peculiarity which is still involved in mystery. Why is it that darkness, monotonous noises, the fixing of the eyes upon some stationary object, all favor the approach of sleep? On all these points there is still no certain light. Upon respiration, digestion, circulation, reproduction, and assimilation, some accurate knowledge exists, but of sleep almost nothing. This function which influences more or less every other, and which has been aptly described as "a partial death from which springs a fresher life," is apparently no less remote from present means of scientific investigation than the greatest mystery of all, life itself.

PRIMARY SCHOOL EDUCATION.

If we analyze the working of the mind in performing a train of reasoning, we shall find that comparison or contrast is the principal part of the operation. Thus, in classification we first compare the object or idea to be classed with similar ideas or objects, and place it in the category with which it corresponds. In ascertaining the differences between objects or ideas we compare them. Says Max Muller, "all higher knowledge is gained by comparison, and rests on comparison. If it is said that the character of scientific research in our age is pre-eminently comparative; this really means that our researches are now based on the widest evidence that can be obtained, on the broadest inductions that can be grasped by the human mind. What can be gained by comparison?—Why, look at the study of languages.—If you go back but a hundred years and examine the folios of the most learned writers on questions connected with language, and then open a book written by the merest tyro in Comparative Philology, you will see what can be gained, what has been gained, by the comparative method."

It is thus that we form judgment upon relative size, weight and color of bodies, as also texture, form, and all other physical properties which our senses are able to detect in masses of matter.

And even when we pass beyond the realm of physics and indulge in metaphysical speculation—which it is to be hoped few are often tempted to do—we shall find that we cannot even speculate without comparison.

If then we learn so much and reason so much through this operation, it is of the first importance that we should be able to do it correctly. We venture to affirm that in the want of ability to make just comparisons is found the explanation of the inferior judgment of the masses upon all great questions, and their willingness to accept opinions ready made, from the, so to speak, "slop shops" of pseudo philosophers and political economists, and quacks who live upon public credulity and grow rich upon the sale of manufactured opinion to those too indolent or too weak to think for themselves.

We recently read a leading article in a daily cotemporary lauding the immense benefits of trial by jury, because—as it maintained—by this means, whatever the law may be, a decision in accordance with the public opinion of average men is certain to be obtained. Something might be said in regard to a doubt whether in the present system of impanneling juries we really get average men. For our own part we feel that if this is the case, the average intellect is humiliatingly, if not dangerously, small in this country. But admitting that average intellect and average integrity are secured in the jury-box, we have still graver doubts as to whether questions of law and medical jurisprudence are subjects with which the average intellect is competent to deal. When a man begins to think independently, and to accept his conclusions without reference to popular prejudice, his intellect may be set down as above the average.

It will be seen from what we have said that we believe the power of making just comparisons, of contrasting things and ideas to detect their specific points of similarity or difference, is small in the majority of minds, and as we further believe that this is a fault rather of education than of natural endowment, we should not have done much good in pointing out the defect without we could suggest a remedy.

There has latterly been developing in this country a system of primary training known as object teaching. This system makes the first and principle end in the instruction of youth to the development of the power of comparing things and ideas. To this end it brings skilled minds into contact with untrained mind, the skilled directing the unskilled, and correcting its errors, and by practice teaching the infant mind to use judiciously the avenues by which knowledge enters the mind. Thus the sense of touch, of sight, of smell, of taste, and of hearing, are each educated as they should be, for it is our firm belief that the basis of a sound system of instruction is education of these senses. Let a child be first trained to gain correct impressions of external objects, and there is little fear that when he comes to finally apply his intellect to abstract ideas, that he will be satisfied with imperfect and crude notions.

This system of instruction has however met with serious obstacles from the prejudices of people, who imagine that a book is the only medium through which knowledge can be gained, and who are content to measure progress by pages, and problems traversed, rather than by growth of mind and strength to grapple with facts.

It is one of the most encouraging signs of the times that the progress of science is remodeling systems of instruction, sweeping away old barriers and disseminating new views on the subject of education, and we believe the time will come when it will be generally seen and conceded, that primary instruction may be better accomplished by the oral system, and by directing the young mind to think and observe for itself, than in the method of compulsory cramming so long in vogue, and soon we hope to become obsolete.

A NEW ALKALOID IN OPIUM.

In 1803 Derosene discovered a crystalline body in opium, and, in 1817, Serturner described its properties. This was the first discovery of a new class of bodies called vegetable alkaloids, and, consequently, points an era in the history of chemistry. Since then, more than one hundred analogous bodies have been discovered, and we count among them some of our most prized medicines. We need only mention quinine, narcotine, strychnine, brucine, theine, nicotine, conine, morphine, codeine, etc. Since attention was directed to opium by the labors of Serturner, chemists have discovered in that gum a large number of different alkaloids, representing the peculiar properties of the medicine, and it was supposed that this field of research was exhausted. It appears, however, that still another base has been discovered. The new body has the same chemical composition as morphine, minus the elements of water. Its special therapeutical property is, that it is deprived of the narcotic effects of morphine, and acts as a powerful emetic. Injected sub-cutaneously in minute quantities, it produces violent vomiting in the course of five minutes. This property is so strong that the chemists who prepared it had great difficulty to overcome the constant feeling of nausea superinduced by it. The new body was discovered by Messrs. Matthiessen & Wright, of Saint Bartholomew's Hospital, London; and if all that has been said of it be confirmed by subsequent experiments, it is destined to play an important part in medicine.

Skilled Industry in America.

The position given in this country to skilled industry is awakening general attention. Now that measures are taken to place permanently a National Exhibition in this city, public men of other countries are calling attention to the matter. It is generally overlooked that a large proportion of the population of the Atlantic States are classed as artisans, who comprise no less than two-thirds of the workingmen in Maine, one-third in Massachusetts, one-fourth in this State, three-fifths in Maryland, and five-sixths in the city of Philadelphia.

Lord Clarendon, Secretary of the British Legation, in his report to Parliament, makes the following statement:

"There are few countries in which the workingman is held

in such repute as in the United States of America. The laboring classes may be said to embrace the entire American nation. The American prefers the occupations in which the exercise of the brain is in greater demand than that of the elbow. His chief ambition is to attain to the position of a master workman."

THIRTY-NINTH INDUSTRIAL EXHIBITION OF THE AMERICAN INSTITUTE.

The Board of Managers of this association have issued circulars announcing their thirty-ninth exhibition, which will be held at the Empire Skating Rink, on the Third avenue, between Sixty-third and Sixty-fourth streets. The premises, lately enlarged and improved, will be opened for the reception of goods on Monday, August 29th, 1870, and on Wednesday, September 7th, the Grand Exhibition will be formally opened to the public by an address at 12 o'clock, M. It will remain open every secular day from 9 A. M. to 10 P. M., until Wednesday evening, November 2, 1870, when the closing address will be delivered, and awards to successful competitors announced.

Circulars containing full information may be had on application to the "Corresponding Secretary of the American Institute, New York," who will also send blanks and give any desired information to parties desiring to become exhibitors, and will receive and file all applications for space.

CINCINNATI INDUSTRIAL EXHIBITION.

This exposition will be held under the joint auspices of the Chamber of Commerce and the Board of Trade of the city of Cincinnati, and the Ohio Mechanics' Institute, commencing Wednesday, September 21, 1870.

It is the expressed desire of the managers to make this exposition of art and industry superior in point of attraction and practical benefit to all concerned, to any display of a similar nature which has ever been held in that city.

They hope to see art and mechanism fully represented. Steam power for driving machinery will be furnished. Any desired information will be obtained by addressing the "Secretary of the Cincinnati Industrial Exposition," who will furnish rules and blank applications for space.

NEW MECHANICAL MOVEMENTS.

On page 192, present volume, we gave the following problems for solution:

"PROBLEM 1.—Required to convert the rotary motion of a pulley into a horizontal intermittent rectilinear motion, first in one direction and then in the opposite direction, without the use of a pitman, pulley, toothed wheel, cam, cam groove in a pulley, or a flexible band, the first rotary motion to be constant and uniform. In other words, let it be required to move a piece of metal, wood, or other material, to a certain point where it shall pause, and then again move on a certain distance and again pause, and so on successively as far as desired, when it shall return to the point from which it originally started in the same intermittent manner and under the conditions above specified.

"PROBLEM 2.—Required to produce a variable rotary motion in a shaft driven directly by a belt from a pulley having a uniform constant rotary motion, without the use of anything but the one belt and the two pulleys; no cone pulleys or their equivalent to be allowed. All the motions to be continuous and in the same direction.

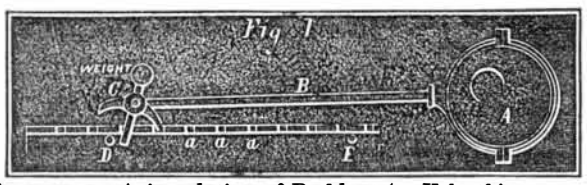
"PROBLEM 3.—From a reciprocating body to communicate reciprocation to another body, so that the second shall make four reciprocating movements for every reciprocation of the first; the motions of these bodies to be in lines parallel to each other, and the pieces to be connected by only three moving parts, which parts shall be neither wheels nor pulleys of any kind, and no inclined planes, cams, belts, or flexible cords, cranks or bell cranks to be allowed, and no radial motion from a fixed center in any piece employed."

We are happy to announce that each of these problems has received a correct solution, and we have engraved some which could hardly be understood by a mere verbal description.

Problem 1 seems to have received the greatest share of attention, and we have received a number of solutions which do not comply with the enunciation of the problem. One of these is, however, sufficiently ingenious to be noticed, notwithstanding it is an

IMPERFECT SOLUTION.

"An eccentric pulley is allowed in the solution of Problem 2, page 287, Vol. XXII., SCIENTIFIC AMERICAN, and I there-



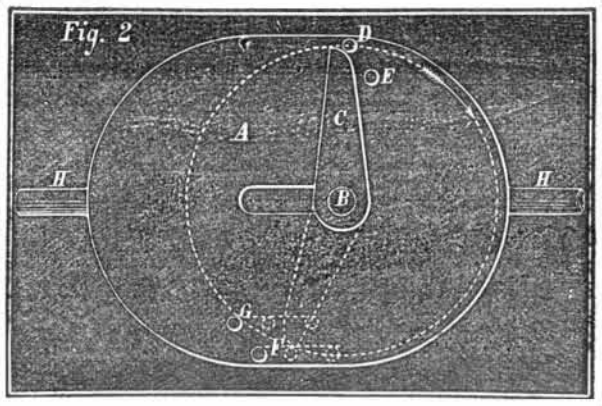
fore use one, A, in solution of Problem 1. Yoke this eccentric pulley to a rod, B, in the usual manner; on this rod is the simple double pawl, C, which engages in the notches, a, a, a, a, etc., and gives horizontal, intermittent, rectilinear motion in one direction as above. At the next stroke of the eccentric, a pin at D may trip the pawl, and we will then have horizontal intermittent motion in the other direction, until another pin, say at E, again reverses the motion.

Salem, N. C. J. W. FRIES."

We consider this solution faulty because the eccentric may be regarded as the equivalent of a crank in this instance, and if so regarded, the rod, B, is the equivalent of a pitman. The latter is not allowed by the conditions of the problem.

TRUE SOLUTION OF PROBLEM 1.

"A, Fig. 2, represents the piece that has the intermittent, rectilinear motion, sliding with the rod, H. B is the shaft having the constant uniform rotary motion, and carries with

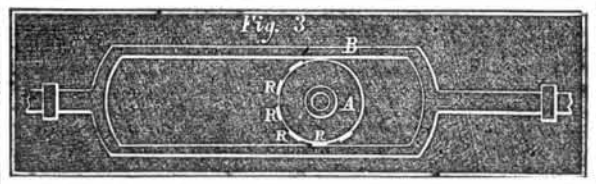


it the wiper, C; this successively engaging with the pins, D, E, F, G, imparts the motion required, the number of intermissions being varied with the number of pins. I have made a model of this movement, and it works in all respects as described. WM. M. MOORE."

Niles, Mich.

SECOND SOLUTION OF PROBLEM 1.

"The wheel, A, Fig. 3, is the given pulley, having a uniform rotary motion. R, R, represent rubber pieces fastened upon

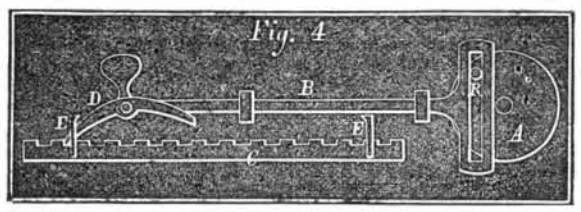


one half of its perimeter, the action of which upon the yoke, B, will produce the intermittent reciprocating motion required.

Toledo, Ohio. COURTNEY HEATH."

THIRD SOLUTION OF PROBLEM 1.

"The following is another form of movement, which I believe to be a true solution of problem 1. The given pulley, A, Fig. 4, carries a wrist, R, which works in the slotted yoke,



B. The end of the arm, B, carries a double pawl, D, which works in the rack, C. E, E, are stops for removing the pawl, D. IBID."

PROBLEM 2.

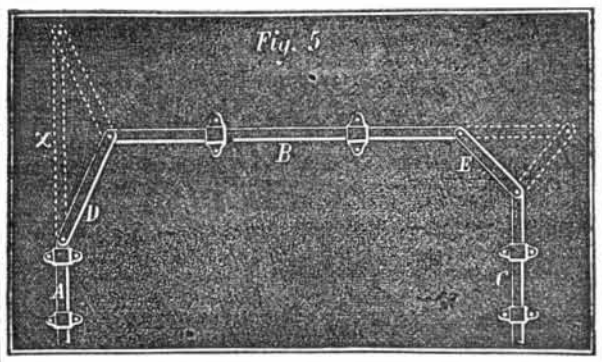
Several solutions have already been published for this problem, see page 287. E.A. T. of Philadelphia, Pa., sends still another, which we are inclined to think is not new, but will nevertheless give it. It is simply two eccentric pulleys of equal throws, connected by an inelastic belt.

PROBLEM 3.

But one solution for this problem has been received that can be accepted as new, and also as correct. The author of the movement, shown in Fig. 1, favored us with one, but it has a radial movement from a fixed center in one of the pieces, which is not allowed in the specified conditions.

TRUE SOLUTION OF PROBLEM 3.

The bar, C, Fig. 5. is the body required to make four reciprocations, while the bar, A, makes one. Move the bar, A,



up to the point x, and the bars, B and E, will take the position shown by the broken lines on the right. The bar, C, will have made one whole reciprocation. Continue the motion of A to the position shown by the broken lines on the left; C will then have made two reciprocations. Move A back to its original position, and C will have made four reciprocations, while A has made but one. This beautiful link motion is the invention of the author of the movement shown in Figs. 3 and 4.

Sweet Potato Experiments.

The *Western Rural* states that Colonel Baylor, of Georgia, aided by some scientific gentlemen in Boston, has been for some time conducting a series of experiments upon the sweet potato. The articles produced are starch, dextrine sugar powder, a sweet kind of vegetable flour. It is said that there is a variety of sweet potato cultivated in the Southern States which will yield ten per cent of cane sugar.

It is estimated that the sweet potato crop of Georgia, properly manufactured for commercial purposes, would add from $10,000,000 to $15,000,000 to the wealth of that State. The value of the manufactured crop in North Carolina would exceed this sum.

PATENT OFFICE AFFAIRS.

The business of the Patent Office is now in a flourishing condition, and the present is a favorable time to enter applications. Inventors will find the SCIENTIFIC AMERICAN PATENT AGENCY ready to attend to the prosecution of claims with the greatest dispatch. By reference to our register, we find that we have made upwards of twenty-four thousand preliminary examinations into the novelty of alleged new inventions. This great experience, together with the fact that a large proportion of all the business with the Patent Office, for the past twenty years, has been conducted through this Agency, suggests to inventors the surest and best means to secure their rights.

We give opinions free, and all we require is a rough sketch and description of the invention.

Inventions patented through this Agency receive notice in the SCIENTIFIC AMERICAN.

MODELS.—In order to apply for a patent the law requires that a model shall be furnished, not over a foot in any of its dimensions, neatly and substantially made. Send the model by express, prepaid, addressed to Munn & Co., 37 Park Row-New York, together with a description of the operation and merits of the invention.

CAVEATS.—Whenever an inventor is engaged in working out a new improvement, and is fearful that some other party may anticipate him in applying for a patent, it is desirable, uuder such circumstances, to file a caveat, which is good for one year, and, during that time, will operate to prevent the issue of a patent to other parties for the same invention. The nature of a caveat is fully explained in our pamphlet, which we mail free of charge.

EUROPEAN PATENTS.—Probably three-fourths of all the patents taken by American citizens in Europe have been secured through the SCIENTIFIC AMERICAN PATENT AGENCY. Inventors should be careful to put their cases in the hands of responsible agents, as in England, for example, the first introducer can take the patent, and the rightful inventor has no remedy. We have recently issued a new edition of our Synopsis of European Patent Laws.

All communications and inquiries addressed to Munn & Co., respecting patent business, are considered as strictly confidential.

Death of Mr. Dickens.

As we go to press the telegraph brings us news of the death of the great novelist, Charles Dickens, than whom no writer of his time has become more widely known and admired. The writings of Mr. Dickens have all been in the interest of humanity, and no more fitting epitaph could be engraved upon his tomb than

"Write me as one that loved his fellow man."

His death will be lamented by the intellectual and the good of both hemispheres.

AN express train on the Alleghany Valley Railroad, running at the rate of forty miles an hour, was lately brought up all standing against an obstruction on the track, consisting of rocks and dirt, the result ot a land-slide. This train was fitted with Miller's platforms, buffers, and couplers. Notwithstanding the fearful velocity of the train no lives were lost, as the cars did not telescope, as ordinary fastened cars would have done under the same circumstances. Miller's inventions should be adopted on all railroads without delay. On the Missouri Pacific Railroad nineteen passengers were lately killed by the telescoping of the cars.

HARD ON THE M.D.'s.—Dr. Charles Elam has lately written a work in which he undertakes to prove, and asserts he does prove, that the practice of medicine of to-day is less efficient, performs fewer cures, and is less able to check disease than it was thirty years ago.

Inventions Patented in England by Americans.

[Compiled from the "Journal of the Commissioners of Patents."]

PROVISIONAL PROTECTION FOR SIX MONTHS.

1,237.—SUPPORTING AND GUIDING APPARATUS FOR MACHINES FOR SEWING BOOTS AND SHOES.—Daniel Mills, New York city. April 30, 1870.

1,255.—BUCKLES OR BALE TIES.—E. J. Beard, St. Louis, Mo. May 2, 1870.

1,257.—HOISTING MACHINE.—Henry Reedy, Cincinnati, Ohio. May 2 1870.

1,261.—MACHINERY FOR PRINTING UPON SPOOLS FOR THREAD, ETC.—Ira Dimock, Florence, Mass. May 3, 1870.

1,286.—STEAM ENGINES.—Babcock and Wilcox, Providence, R. I. May 5, 1870.

1,324.—MACHINERY FOR KNITTING LOOPED FABRICS.—John Pepper, Lake Village, N. H. May 9, 1870.

1,215.—APPARATUS FOR ABSORBING THE OVERFLOW OF OIL IN HYDRO CARBON AND OTHER LAMPS.—L. E. C. Moore and J. S. Hamilton, Pittston Pa. April 27, 1870.

1,289.—SAFES, ETC.—T. Hyatt, New York city. May 5, 1870.

1,313.—STAMP.—Towle and Harding, New York city. May 7, 1870.

1,323.—NUT LOCK.—R. Rutter, Vallejo, Solano county, Cal. May 9, 1870.

1,335.—ILLUMINATING GAS APPARATUS.—M. H. Strong, T. Barbour, and C C. Conner, New York city. May 10, 1870.

1,336.—BREWING ALE AND OTHER MALT LIQUORS.—James McC Boston, Mass. May 10, 1870.