

[For the Scientific American.]

## SILK CULTURE.

BY W. V. ANDREWS.

A vague notion that silk culture ought to form one of the industrial pursuits of the American people seems to be prevalent enough; but it does not take practical hold upon anybody. The nearest approach to anything practical which we have seen, in late years—excepting, of course, what has been done in California—occurred in New York in July last, when a number of gentlemen pledged themselves, according to a report given in the *Tribune* of July 30, “to promote the native silk trade.”

The gentlemen present at the meeting represented the most prominent silk manufacturing and importing houses in this country. What these gentlemen have since done towards promoting the native silk trade, I do not know, but, having pledged themselves, it is presumed they have done something.

At the meeting, of which the *Tribune* article is a report, flags, and other things, manufactured from California silk, were exhibited; and the report goes on to say that “Mr. Warren also exhibited samples of native and foreign cocoons, and of raw and thrown silk, together with the common *Cecropia* and *Bombyx Cynthia*, species of silkworms which feed upon oak leaves. \* \* \* Also the *Bombyx Yamamai* which feeds upon mulberry leaves; also the *Bombyx Pernyi*, of which the cocoons are early as good as the cocoons of worms fed upon mulberry leaves.”

I have given this extract, word for word, as it stands in the columns of the *Tribune*, because it contains more blunders of one kind or another than I remember ever to have seen in so many words. *Cecropia* is certainly not very particular as to its food, but it is not an oak feeder. *Cynthia* will thrive on nothing except ailanthus, though it will eat one or two other things, but not oak. The *Yamamai*, on the other hand, will eat oak, indeed it is its natural food; but Mr. Warren errs greatly when he says that it will feed on mulberry. The last clause of the sentence, which says that cocoons of *Pernyi* are nearly as good as those of worms fed on mulberry leaves, must be a sort of entomological joke, of which the point is not discoverable by me, so I pass it over.

I do not, however, notice this report on account of its grammatical and entomological mistakes. It is because of the evil effects it may, and probably will, have on amateur silk culturists, that I notice it; for most assuredly, failure will be the result of all attempts to produce silk cocoons by feeding the caterpillars of the different moths on the food prescribed by Mr. Warren. Any patriotic, money-making farmer, who believes in the *Tribune*, purchasing *Yamamai* eggs and setting his worms to feed upon mulberry, which they refuse to eat, and consequently, all die, will probably give up silk culture as being nothing more or less than a humbug. And thus the cause is injured.

For several years past, I have made some experiments in the rearing of the silkworms, giving the result of my experience in the first year in Vol. II., page 311, of the *American Naturalist*; and of a subsequent year in the *Entomologist*, for November, 1869.

The paper in the *Naturalist* is devoted to my experiments with the ailanthus silkworm, *Samia Cynthia* (G. & R.), a naturalized species from the East. In that paper, I have said all that is necessary to say at present, on that species, except perhaps that I am further convinced, from the inspection of samples of sewing and other silks, made from the cocoons of *Cynthia*, that one day it will be reared very extensively in the United States. It is perfectly hardy, is double brooded, and may be reared by any one possessed of a few acres of land, which may be good enough for growing ailanthus trees, but not good enough to grow any thing else. The labor of a few old men, or women, or even children, is sufficient for the purpose. The cost is therefore trifling.

The objection to the cultivation of *Cynthia* is that the cocoon cannot be reeled. But it can be carded, and of the Chinese can make excellent silk goods from it, why cannot we? I suspect, too, that *Cynthia* silk can be worked in with cotton, or, perhaps, woolen goods, adding to their beauty and durability (for it is indestructible in wear), and thus open up branches of manufacture hitherto unknown.

For manufacturers of coarse goods, I have no doubt that the silk from our native silk moths, *Cecropia* and *Polyphemus*, may be used. Indeed, I believe that M. Trouvelot is of opinion that *Polyphemus* may fairly enter into competition with *Bombyx mori*, the ordinary mulberry silkworm. The worm, however, is rather difficult to rear.

In reference, however, to *Bombyx mori*, it is well known that the silk crop in France and Italy has been reduced greatly, and the price of silk goods consequently enhanced, by prevalence of disease among the worms. So much is this the case, that silk breeders have been obliged to look around for some silk-producing moths whose products may, at any rate, supplement the deficient crop. *Cynthia*, as already mentioned as one of these, and two others mentioned by Warren in the *Tribune* reports above adverted to, are at present the subjects of experiment.

My article mentioned before as appearing in the *American Entomologist* is mainly devoted to my experiments, and those of my correspondents, with *Yamamai*, which, as I said before, is an oak feeder. In Japan, which is its native country, it feeds, in its wild state, on *Quercus serrata*. Whether that oak be found in America, I do not know, but it is of little importance, as the worm will feed on almost any species of oak, although I think that it prefers white oak. The importance of acclimatizing new species of silk moths is of so much prospective importance, that I shall devote the remainder of this article to the consideration of whether *Yamamai* and *Pernyi* may not be naturalized here

Any one, who happens to have the number of the *Entomologist* containing the article above alluded to, may find it worth while to read it, but as many persons may not be able to obtain that number, I will here repeat the substance of my remarks, adding as much new matter as subsequent experience has afforded.

The silk from the *Yamamai* being considered being considered superior to that produced by any other of the substitute silk moths, great efforts have been made in Europe to acclimatize it; but, it must be confessed, hitherto with but slight success. There are exceptions, however, particularly among amateurs in Germany, sufficient to show that success is possible. The Baron de Bretton raises about 27,000 cocoons annually.

In this country but little has been done, or attempted, and that little has not been very successful.

The fact is, that *Yamamai* is a difficult moth to rear in a country like this, where in early spring the temperature varies so much; but that success is possible, I am convinced.

The moth emerges from the cocoon in the latter part of the summer, copulates, lays its eggs, and of course dies. And now the trouble commences; that is, with eggs laid, say in Japan, from whence we mainly get our supplies.

As soon as the egg is laid, the young larva commences its formation, which in a short time (about one month) is perfected. It lies in the egg in a quiescent state till early spring. If the egg remain in the country where it is laid, and is kept at a pretty even temperature, and free from damp, the caterpillar emerges in a healthy condition. But if it be removed some thousands of miles, passing in the transit from heat to cold, and back to heat again; and if, in addition, it be closely confined in a damp place, with little or no circulation of air, the egg is attacked by a fungus which sometimes prevents the worm from emerging at all; or, if it emerge, it is in a sickly condition. That these conditions obtain in the transit of eggs, from Japan to Europe, and thence to America, is evident enough; and it may, therefore, require the efforts of many persons, continued for a long time, to enable us to acclimatize the *Yamamai*. But this is all that is required, and I feel confident that ultimate success is certain.

On hatching out, the worm is of a brimstone yellow, and thinly covered with strong hairs; after the second month it is greenish, with black, longitudinal streaks, and the thread a dull coral red color. After the third month it becomes of a fine apple green, with yellow tubercles on each segment, from which issue a few black hairs. The head and legs are chocolate brown, the prolegs reddish, and the first segment edged with pinkish color. The greatest care is necessary, as the spring advances, to prevent the eggs from hatching before the oak buds are ready for them, and the temperature must be regulated with the greatest nicety. If the eggs can be kept somewhere about 50 deg. Fah., it would be quite safe; higher than that the mercury should not be allowed to rise, till you are quite ready for the worms, and, on the other hand, the eggs should not be allowed to freeze.

On emerging from the eggs, the worms should be allowed either to crawl to the oak branches, or rather to sprigs obtained for that purpose, the end of which should be placed in a jar, or bottle, of water, or the worms may be placed on gently with a camel-hair brush. The leaves should be well sprinkled with clean water that the caterpillars may drink.

From some cause, not well understood, the young caterpillars have a tendency to wander; and if care be not taken many may be lost. To prevent this, it is well to cover the branches with a gauze bag, tied tightly around the stems, and close to the bottle. Care must also be taken that the caterpillars do not find their way into the water, which they assuredly will if they have the opportunity, committing suicide in the most reckless manner. If the number of caterpillars be few, it is a good plan to place them at the outset with their food, in a wide-mouthed bottle, covering the mouth with gauze. The branches, particularly if the weather be warm, must still be occasionally sprinkled, so that the caterpillars may have the opportunity of drinking. It must be remembered that experiment is necessary in rearing *Yamamai*, but one thing is ascertained, and that is, that the worms must not be exposed to direct sunshine, at least not after seven or eight in the morning. If the spring be warm, I am inclined to think that a northeastern exposure is the best, and we may sum up by saying, that comparatively cool and moist seasons are more favorable to success than hot, dry weather. In America the worms suffer in the early spring, from the rapid changes of temperature, 40° at 9 A.M. increasing to 70° in the afternoon and falling off to freezing point during the night. The worms cannot stand this. If they become torpid, refuse to eat, and consequently die. To prevent this, if the nights be cold, they must be placed where no such change of temperature can occur.

It is scarcely necessary to say that an ample supply of fresh food must be always supplied, but it may not be amiss to say that it is well, when supplying fresh branches, to remove the worms from the old to the new. The best way of doing this is to clip off the branch, or leaf, on which the worm is resting, and tie, pin, or in some way affix the same to the new branches. If this be not done, they will continue to eat the old leaf, even if it be withered, and this induces disease. If the worm has fastened itself for the purpose of moulting, the best way is to remove the entire branch, clipping off all the dried leaves before so removing it. These remarks apply, in general, to the treatment of all silk worms, except *Bombyx mori*.

The results of numerous experiments with *Yamamai* go to show that it is, as I said before, a difficult worm to rear; but it has been reared near New York to the extent of eight hundred cocoons out of sixteen hundred eggs, and this, although not a remunerative result, is encouraging.

The Chinese silk moth, *Alutera Pernyi*, also an oak feeder, has been successfully raised by me and by others, for several years. Eggs have been sold to persons in States widely separated, and the results show that this worm is perfectly hardy.

The moth winters in the cocoon, emerges early in May, if the weather be warm, pairs readily, and lays from 150 to 200 eggs. These hatch out in about fourteen days, and like *Yamamai*, always about 5 or 6 o'clock in the morning. It is necessary to be on the alert to catch them on hatching only, and to remember that they are vagabonds, even to a greater extent than *Yamamai*. Consequently similar precautions must be taken.

The worm on emerging from the egg is large, and of a chocolate-brown color. After the first month it becomes of a yellowish green; head, pale brown; feet and prolegs of nearly the same color. The body has numerous reddish tubercles, from which issue a few reddish hairs. At the base of some of the tubercles on the anterior segments are silvery patches.

The *Pernyi* worm is much more easily reared than that of *Yamamai*, but still great care is needed; fresh food of course is essential, and a slight sprinkling of the branches and worms in very warm weather is advisable; although it is not so necessary as with *Yamamai*. It is remarkable that *Pernyi* worms, fed in the open air, on oak trees, do not, at present, thrive so well as those fed in-doors, but this, doubtless, is a question of acclimation. I advise white oak (*Quercus alba*) as food, if it can be readily obtained, but failing that, pin oak (*Quercus palustris*) will do; and I have no doubt that they will feed on any kind of oak. They will, indeed, feed on birch, and on sweet gum (*Liquidambar*), but oak is the proper food. It is worthy of remark that *Pernyi* bears a strong resemblance to our *Polyphemus*, but it is more easily reared in confinement, and double brooded; an important fact for the silk culturist. From American reared eggs, I obtained cocoons as early as July 4th, the perfect insect emerging on July 31. Copulation immediately ensued, and the resulting eggs hatched only on August 12, ten days only from the time of laying; and as the worm feeds up in about four or five weeks, this affords plenty of time for rearing the second brood. It must be remembered that on the quantity and quality of food, much depends, not only with *Pernyi* but with all caterpillars. By furnishing food sparingly the time of feeding would be much prolonged.

I have already said that both *Yamamai* and *Pernyi* should be fed under shelter for the reasons given, but there is another reason of less importance. The young worms are liable to be attacked by spiders and wasps, and even after the second month, they are not safe from these enemies. I have seen a wasp bite a large caterpillar in two, carry off the anterior section and return for the posterior, which had held on by its prolegs. Did the wasp anticipate this fact, and therefore carry off the anterior part first? As to the spiders, they form a series of pulleys and hoist the caterpillar off its legs, sucking its juices at leisure.

And now I must devote a few words to the advisability of silk culture from a pecuniary point of view. *Bombyx mori*, or the ordinary mulberry silkworm, is, of course, the best to rear, if you can obtain healthy eggs. But this is the difficulty, and thence arises the necessity of cultivating other silk-producing species. I imagine that silk can be produced in most of the States of the Union, and manufactured from the cocoon at a large profit; but for the present, we will leave the manufacture out of the question, and consider only, whether it will not pay to rear eggs and cocoons for sale? It must be remembered that European manufacturers are at this moment largely dependent on foreign countries for the supply of both eggs and cocoons; and this, because of the general prevalence of disease among all the races of *Bombyx mori*. And now, to what extent does the reader suppose this dependence exists? Of cocoons I have no returns at hand, but, of raw silk, European manufacturers purchase, annually, not less than \$160,000,000 worth; and of eggs (*Bombyx mori*) to the value of \$10,000,000. This, then, is a business of no trifling amount. California seems to be alive to the fact, and, I am informed, raised, this last season, \$3,000,000 cocoons; and, for sale, about 4,000 ounces of eggs, worth at least \$4 per ounce, wholesale. Now, there is no earthly reason why California should monopolize this business. Why are not companies formed in other States for this purpose? or if private individuals lack the enterprise or the means, why do not the legislatures, of those States most favorably located, do something by way of starting the business? A few thousand dollars loaned, or even donated, may prove to be a valuable investment for the people at large, and, even supposing a failure, would not be a very great loss to any body.

So far as farmers are concerned, it may interest them to know that one man in England, Capt. Mason, clears \$50 per acre by rearing silkworms (*Bombyx mori* in this case), and I much doubt whether any crop raised here pays as well.

By way of commencement, then, let everybody that has sufficient leisure set to work, and rear as many silkworms, of the above-named species, as he possibly can; and if the process be not remunerative in a pecuniary sense, it most assuredly will be in the amount of pleasure and knowledge obtained.

One caution I must give to those who cultivate *Bombyx mori*. Although *Yamamai* requires sprinkled branches, *Bombyx mori* does not; nor must the leaves be furnished to them while wet with rain or dew.

EFFECT OF COLD UPON IRON.—The article upon this subject, giving experiments of Fairbairn and others, referred to in our editorial upon the same subject, in our last issue, was crowded out by press of matter. The reader will find it in the present number.

**Universal Boring Machine.**

Our readers will recollect an illustrated description of an universal wood-working machine, published on page 79, Vol. XIII. of the SCIENTIFIC AMERICAN. The machine herewith illustrated is manufactured by the same firm, and is a valuable addition to the many excellent wood-working machines now in use. A boring machine, though one of the simplest, is by no means an unimportant adjunct to a full outfit of wood-working machines. The one shown in our engraving is one of the most complete ever brought to our notice, and the great variety of work it is capable of performing, renders the name chosen for it peculiarly applicable. It is called the "Universal Boring Machine" because the most prominent feature of its construction is its power to bore a hole in any desired angle with the axis of the bit.

Any sized bit required is inserted into the chuck, which is adjustable to fit large and small shanks. The mandrel which carries the chuck is made to traverse by a foot lever, so as to bore any depth up to twelve inches. The mandrel is driven by belt from a cone pulley of three faces, which gives the proper speeds for different sized bits.

Slots and stops upon the table enable the work to be set at any desired angle on the horizontal plane, while the table can be set on an incline to any angle not exceeding forty-five degrees. The table is twenty-one inches wide, with fifteen inches slide, and it can be raised or lowered fifteen inches.

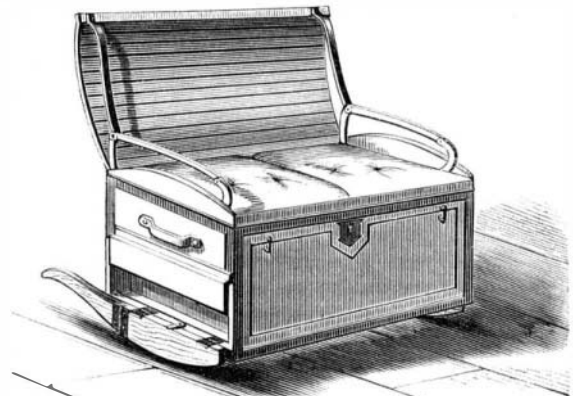
The countershaft rests in self-adjusting boxes, and has a tight and a loose pulley eight inches in diameter. The traversing mandrel is of the best quality of steel, and the machine is otherwise made of iron in a substantial manner.

The several adjustments enable the operator to do all kinds of light and heavy boring, with ease and with great rapidity.

This machine was awarded the first premium at the Cincinnati Industrial Exposition, in October, 1870, and was patented through the Scientific American Patent Agency, Aug. 16, 1870. It is manufactured by McBeth, Bentel and Margedant, of Hamilton, Ohio, whom address for machines rights to manufacture, or other information.

**COMBINED TRUNK AND ROCKING CHAIR.**

A unique invention, calculated to increase the comforts of travellers on steamboats, ships, and in crowded rooms of hotels, is illustrated in the engraving published herewith. It is the invention of T. Nye, of Westbrook, Me., and was

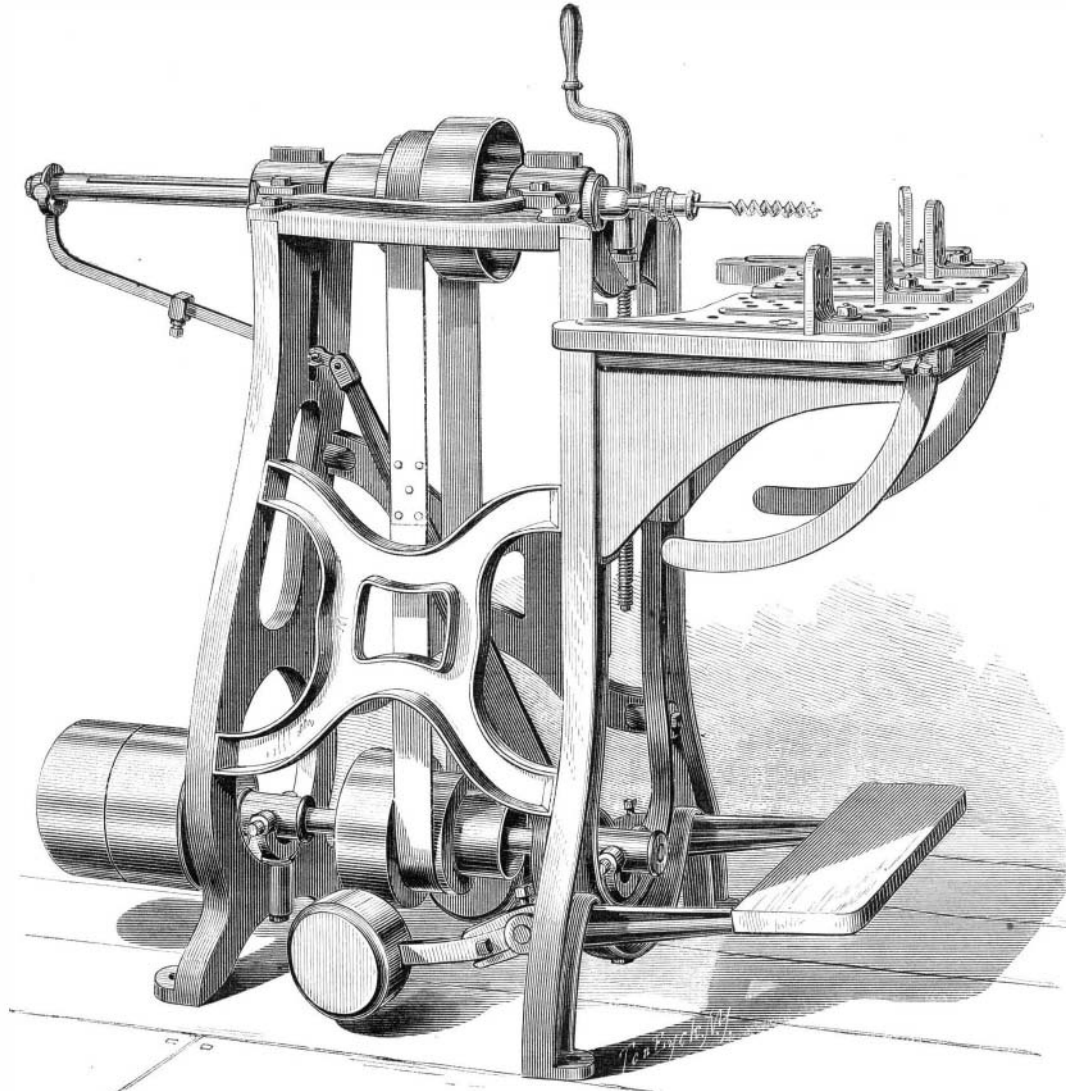


patented by him, June 18, 1867. It is a combined trunk and rocking chair. The rockers are made to fold into recesses, where they are retained by suitable appliances till wanted. The trunk being opened, as shown, forms a back to the seat, which is held by metallic braces. When closed, the whole presents the appearance of an ordinary trunk.

**Cosmetics.**

The extensive use of preparations for hiding nature's bloom on the human countenance, and presenting to our view a sort of metallic plaster, suggests the inquiry, "how are these pigments made?" Without going into an unnecessary analysis of the "Bloom of Youth," the "Rejuvenator," the "Corpse Decorator," or the other inventions for destroying the skin, with which the druggists' stores abound, we may state again the fact, always unheeded, that all the detestable compounds are injurious. They are nearly all metallic poisons, and, if there be any that are innocent of this charge, they are in every instance harmful to the health. The color and surface of the skin cannot be changed by any application which does not close the pores; the pores, which are so exquisitely fine that there are millions of them to the square inch, and which must be kept open if a healthy and cleanly body is to be preserved. There is more breathing

done through the pores of a healthy person than through the lungs; and we need not remind our readers of a ghastly piece of cruelty once enacted in Paris (that of gilding the body of a child, for a triumphal procession, which killed the subject in two hours), to show that the stoppage, in any degree, of the natural functions of so important an organ as the skin, is injurious. The immediate effect of the use of

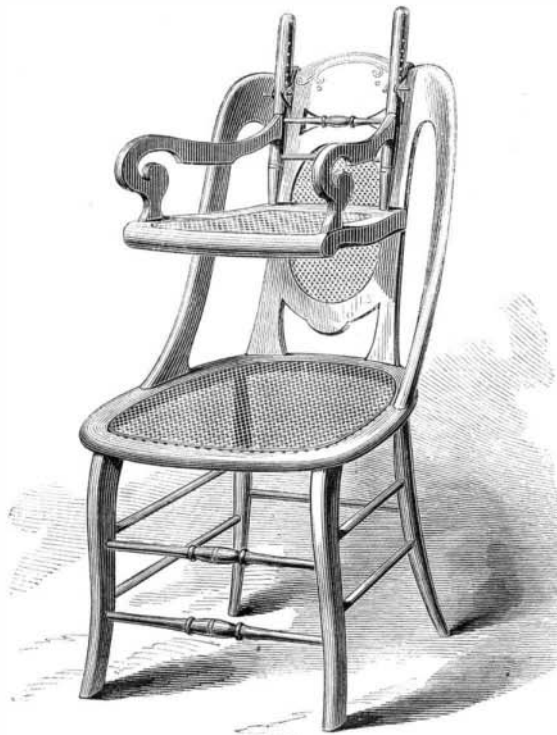


McBETH, BENTEL, & MARGEDANT'S UNIVERSAL BORING MACHINE.

such compounds is to destroy the vitality of the skin, and to render it, in appearance, a piece of shriveled parchment. We must warn our readers that a temporary and meretricious "bloom" can only be attained at the cost of future freshness and lively appearance, so that a year or two of "looking like paint" is followed by a long period of "looking like dilapidation."

**SMITH'S INFANT DINING CHAIR.**

The accompanying engraving illustrates a convenient and cheap infant dining chair, which can be attached to any of the ordinary chairs in common use.



It consists of a chair without legs, suspended by the posts of the back, as shown, on pins engaging with hooked bars, which are placed upon the back of an ordinary chair. The details of the device will be seen by a glance at the engraving. The chair is adjusted in height by placing the pins in the proper holes in the posts made for this purpose.

For further information, address Smith, Hollenbeck & Co., Toledo, Ohio.

**The Medicines of the Ancients.**

At the recent commencement of the Homeopathic College in this city, Mr. S. H. Wales, of the SCIENTIFIC AMERICAN, addressed the graduating class, and from his remarks, we quote the following:

"Many writers of our time persist in regarding this, above all others, as the best period in the history of our race; and,

doubtless, it is true in many important respects. But I cannot forbear the suggestion at this moment, that there was a time in the history of the world when the science of medicine was unknown, when people lived to the incredible age of many centuries; and, even after the span of life had been reduced to threescore and ten, sickness was comparatively unknown. In ancient times, it was looked upon as a calamity, that had overtaken a tribe or people, when one of its members prematurely sickened and died.

"Other arts and sciences flourished in Rome long before medicine was thought of; and the historian tells us that the first doctor who settled in Rome, some two hundred years before Christ, was banished on account of his poor success and the very severe treatment applied to his patients; and it was a hundred years before the next came. He rose to great popularity, simply because he allowed his patients to drink all the wine they wanted, and to eat their favorite dishes.

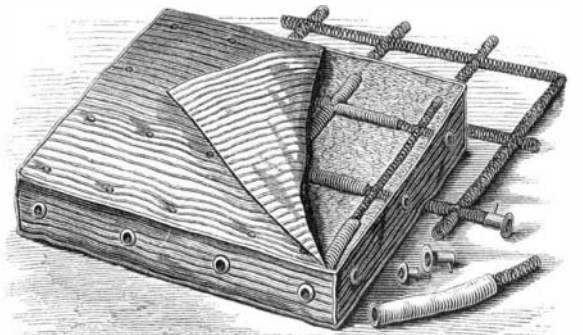
"The whole code of medical ethics presented by Moses consisted simply in bathing, purification, and diet. This simplicity of life was not confined to the wandering tribes who settled in the land of Canaan, but was the universal custom of all nations of which history gives us any account. This simple arrangement for health was considered enough in those primitive times, when the human system had not been worn out and exhausted by depletive medicines. The luxuries of public baths, athletic sports and games, were deemed

ample, both to educate the physical perceptions and to prevent disease.

"All this wisdom, which had its origin in ancient games and sports of the field, led to the erection of extensive bath-houses, and the adoption of other healthful luxuries to which all the people could resort to recreate their wasted powers."

**BARNES' VENTILATOR FOR MATTRESSES, ETC.**

Many diseases are caused by the use of beds not properly aired; and it is difficult, if not impossible, to properly air, or ventilate, a mattress, made in the usual manner. If this could be done more thoroughly than it generally is, much sickness would be avoided.



To secure this object cheaply and efficiently is the design of the invention herewith illustrated. By it a complete circulation of air through the mattress is secured, which carries off all dampness arising from constant use. Thus the mattress becomes more healthy for sleeping purposes, more durable and better fitted for the sick room. The ventilators consist of coiled wire, covered with coarse cloth (to prevent the stuffing closing up the tube), running through the mattress in all directions. The ends of the coils are secured to the ticking by means of metal thimbles, inside of which are pieces of wire gauze, to prevent insects getting in, but which admit air freely. The cost of the ventilators is small, and they will last as long as any mattress. They can be applied to any bed at small expense.

This invention was patented through the Scientific American Patent Agency, January 10, 1871. The right to manufacture will be disposed of in any part of the country. Further information can be obtained by addressing the proprietors, Barnes & Allen, Hoosick Falls, N. Y.

THE third annual exhibition of the National Photographic Association takes place at Horticultural Hall, Philadelphia, June 6, 1871. Prof. Morton is to deliver two lectures on Light.