

Christians as the symbol of purity and chastity and it was used to decorate the statues of the Virgin Mary, whence the name "Marien glass," or isinglass, applied to the well-known glass-like foliæ of this substance. The use of alabaster for artistic purposes, for sculptural figures and various vessels, is certainly quite as old, and large slabs of selenite were used in the olden times in place of glass, for lighting the interior of dwellings. Later, the art of working in gypsum—we speak of gypsum or plaster in its artistic application—was lost, to be taken up again at a much later date in Italy by Margaritone. At the time of Raphael, it is said to have been brought to perfection by the painter Nani and the many fine specimens of stucco work in the Vatican bear testimony to the skill of the individual artists who used it.

In Germany, especially in neighborhoods where gypsum is plentiful, remains of old buildings exist, which the records have proven to have been demolished in the fourteenth and fifteenth centuries; they were built with gypsum mortar and to-day display a solidity unattainable with lime mortar. That plaster casting was practised in Germany in the sixteenth century, is demonstrated by the appearance of a number of different treatises on the subject, in a book published in Nuremberg in 1696; on the other hand, the stucco work here and in France dates only from the eighteenth century, where, especially during the Rococo period, it played a very important part.

In the last (nineteenth) century, the use of plaster has increased very materially. As a building material it has attained considerable importance, being not only used as mortar for flooring, for plastering ceilings, also as a finish for ceilings, for running moldings, etc., but also for the production of artificial building materials, such as plaster blocks, plaster boards, and tiles, etc., while in combinations with a wire network and iron rods it is used for the erection of complete structures, which display considerable durability and have also the important advantage of rapidity of erection, the plaster hardening quickly and drying out just as rapidly. Buildings intended for exhibition purposes are built, nowadays, almost wholly of plaster; plastered with gypsum mortar, all the plastic ornamentation, mostly in bas-relief, is of plaster; in fact, it would doubtless be impossible to erect such buildings in so short a time but for the use of plaster. Here, then, we have one of the chief uses of gypsum, which the low price of the material and its other advantages fully justifies. There are, of course, opponents of the practice, who, without further consideration, urge that plaster is not weatherproof, because the so-called plaster figures are very fragile objects; but apart from the fact that a very thin plaster mixture is used in their production, they are usually hollow, and it is also not impossible that in making them, plaster that has been "killed" in the burning or that has lost its setting properties by transportation or prolonged storage, has been used. Just as ordinary lime paste, if used thick, makes a very unsatisfactory mortar, that remains soft but is rendered useful by the admixture of a proper quantity of sand, so gypsum in proper proportions and used in the right manner, becomes a useful building material. As a matter of fact, it has been so used for centuries in certain localities, where it occurs as gypsum rock and is quarried. The old castle at Osterode, in the Harz, which was demolished in the middle of the fourteenth century, was built entirely with gypsum mortar, and in the still existent ruins the mortar is so hard that it yields reluctantly to the hammer. At Luneburg, Goslar, etc., other structural remains exist that are more than five hundred years old, in which plaster casts, plaster coating, etc., are still completely preserved, although they have been exposed, for all the centuries past, to the elements. "Luneburger lime"—coarsely ground, impure gypsum—is still used extensively, near the place of its origin, for large structures and for hydraulic work. The solidity of gypsum mortar is conditional on its being used as soon as possible after it has been prepared, before it has begun to set. Made in small quantities and used quickly, like cement, it is just as durable as lime and cement. As a matter of course, where, as in some neighborhoods in which gypsum is the most readily available material for building, so much plaster is made up in the trough at the beginning of the working day that it is still being used in the late afternoon, or where, to crown all, what is left over when work stops one day is mixed up the next, with some fresh plaster and a few buckets of water, there is small reason for surprise that such gypsum mortar proves unsatisfactory and is good for neither mason work nor finishing.

Plaster finds a further extensive use in the production of molded objects, an art, which like the making of plaster casts, has come to us from Italy, proof of which is furnished in the predominance of Italians, or people of Italian origin, in the industry. Plaster casting, originally confined to the simplest forms, has developed, in the course of years, into an art, the plaster casts being turned out in a more advanced stage of completion and ornamented in the most diversified manner. Plaster casts in the natural color, i.e., white, are somewhat rare, at least it is usually sought to impart to the cold white color a somewhat warmer tint, yellowish and resembling ivory, if they are not bronzed, made to resemble real bronze, or painted with gay colors, given a polychromatic treatment, which imparts to them, as colors always do to cold, stark objects, a more lifelike appearance. Naturally, the sculptor, the real creative artist, is opposed to this multiplication of gypsum plastics. But we must not forget that comparatively few people are in a position to acquire the original productions of the sculptor, and yet have a taste and liking for their works, which in

the form of plaster casts are accessible to them in great variety. As a matter of fact, the sculptor could not do without the plaster cast and the use of gypsum in the exercise of his art. Moreover, the plaster cast has been of the greatest importance to antique sculptural art, which, in excellent reproduction, it has brought within reach of the whole world.

As a fertilizer, gypsum has been long in use. It ranks in this respect with the mineral substances which promote the solution of the nutritive substances in the soil, enhance the effects of mechanical tilling, and by this means exercise a beneficial effect on the increase of soluble nutriment. In a productive soil, mechanical tilling and fertilization stand in a definite relation toward each other—in a certain sense, they complete each the other. Gypsum fertilization has proved itself specially advantageous in the cultivation of clover crops.

By treating wine with gypsum, so-called "plastering," we aim to make it earlier bottle ripe and more fiery in color. It is chiefly in France, Spain, Portugal, and Greece, and more particularly in the case of red wines, that this process is resorted to, and it consists in adding to the wine, usually, however, to the must, and sometimes even to the grapes prior to the pressing process, a certain quantity of burned and ground gypsum. The addition of the gypsum to the must and wine is followed by a chemical transformation in the tartar or argol, whereby tartrate of lime is separated in insoluble form and sulphate of potassium goes into solution. At the same time the phosphates of the must or wine are caused to release phosphoric acid. The latter enhances the intensity of the coloring substance of the wine (particularly of the red varieties); the settlement of the insoluble tartrate of lime causes a mechanical clarification of the wine and thereby makes it earlier ripe for bottling. The addition of gypsum to wine is not injurious, but the increase in sulphate of potassium in the wine, caused by the gypsum, is not to be regarded with equal indifference, as sulphate of potassium is an active laxative. Owing to this, the "plastering" of wines is prohibited in some countries; in others it is permitted under prescription of the maintenance of the minimal amount of sulphate of potassium (2 grammes per liter).

Gypstereotyping is the designation of a process for the production, from movable types, of a solid printing plate of type metal. The printing form to be "cast" is secured in a metal frame, or "chase," the type matter oiled and the space above it filled with plaster paste, struck off even with the upper edge of the frame. The plaster cast sets in a quarter of an hour, and being lifted off the form, constitutes a matrix or mold in which the letters appear depressed, the justification in high relief, and in the plaster mold thus obtained, molten type metal is poured.

In galvanoplastic work, plaster molds, saturated with stearine or wax and coated with graphite, are extensively used, and in the manufacture of rubber stamps, as in stereotyping, an impression is taken from type in plaster and in this the rubber substance is pressed and vulcanized.

With broken bones or otherwise injured limbs a rigid bandage, the so-called plaster bandage, is employed, where it is desired to keep the affected part for a considerable period absolutely motionless; in battlefield surgery, especially, the plaster bandage is of the greatest value. The plaster bandage, the virtue of which is based on the rapidity with which the plaster sets, is applied according to various methods. A roll of gauze, flannel, or other bandage material is thoroughly impregnated with finely-ground plaster, dipped in water, and before the plaster has had time to set, the affected part is enveloped in several thicknesses of it; or burned, ground gypsum is mixed with water in a dish to a paste, which is spread in an even layer on the bandage to be applied to the part under treatment; over this is laid another bandage, to which a layer of plaster paste has also been applied. We can likewise proceed by dipping the bandages of the proper form into a mixture of plaster and water and wrapping several thicknesses about the affected part. Any of these processes results in inclosing the part in a capsule which in a few minutes is hard and rigid. Sometimes it is advisable to supplement the plaster by the introduction of wooden or steel splints, which may be provided with joints. As the bandage, if it does not fit accurately, may easily cause injury by too severe pressure, it is customary, before applying it, to wrap the part in flannel or cotton wadding. If it is necessary that places inclosed in the bandage shall be accessible for inspection and treatment, they are exposed by cutting apertures in the bandage. The bandage is removed by means of special scissors (plaster scissors) or knives (plaster knives).

In the manufacture of paper, gypsum is used as a filling for the pulp, to give it greater body and density, so that the paper appears to be made from good pulp, but is hard and brittle and in spite of the most careful glazing, is never very well adapted for writing. The gypsum is employed in the form in which it is obtained, by wetting it with an excess of water by which it is deprived of its setting properties. The mineral substance is plainly evident in the ash, if the paper is burned, and the notable strength of the ash of burned sheets of paper in the manufacture of which it has been used is due to its presence.

In the production of dry colors, gypsum also finds quite extensive employment, usually in copiously diluted form, either as a base on which the color solutions can be precipitated, or as a means of cheapening and adulterating the colors. That such colors are of little value will be self-evident. The plaster used is

either killed by heat or slaked by an excess of water. We find, therefore, this substance, which, in anhydrous form (carstenite), might be used as building material, but with unsatisfactory results, owing to its transformation gradually into the hydrous gypsum, serving useful human purposes as vulpinite (at Vulpino, Northern Italy), or otherwise, artistically colored, as alabaster, transformed into sculptural works, as well as in quite a number of other forms (for instance, in the adulteration of cereal flour) in which it is either employed in a subordinate capacity or its use is not generally acknowledged.—Translated from Marco Pedrotti's "Der Gips und seine Verwendung."

A FUTURE FOR THE ICE-MANUFACTURING INDUSTRY.*

By W. E. PARSONS, M.E.

THERE is usually a very considerable difference between making ice theoretically and conducting an ice-manufacturing business for profit.

It is not my intention, however, to pause here to rehearse the causes of failures and disappointments that may have occurred in the past.

I would rather seek a place beside those who have already discovered the road to success and those who are looking forward to still brighter achievements for the future.

In the first place, an ice-manufacturing business, in order to attain the degree of success, should be managed from its inception by a man who is not only conversant with the management of the ice business in general, but who also understands every detail of the manufacturing process—a man who is capable of choosing the best location—who is capable of planning, at least in outline, the entire lay-out of the plant—who is competent to choose the very best machinery, apparatus, etc.—not only as a whole, but in every detail, so as to secure the best possible results in every feature of the plant, and who knows how to develop a system by which he can keep informed at all times as to whether every individual part of the plant is performing its functions up to the maximum efficiency.

So far there are few such men to be found ready-made. They must be made to order. But men will train for such positions just as soon as it is realized that they will be suitably compensated according to the results which they are able to produce. As in any other business, the man who can deliver his ice to customers at a less cost than any one else, is master of the situation from every point of view.

The business must be studied in detail. The site or location of an ice plant affects various items of expense of conducting the business, such as interest on the investment for ground, taxes, assessments, insurance, etc., cost of water supply, cost of delivering fuel to the plant, and of delivering ice to consumers.

I will, at this time, consider only the use of steam power for operating the ice machines. The steam-producing feature of an ice plant cannot receive too much careful attention. The cost of fuel is generally looked upon as a most important item in the cost of making ice. Advocates and builders of different types of machinery and different systems of ice-making offer, as their most attractive claim, a certain number of tons of ice which they are supposed to make per ton of coal. But how many of these ice-machine manufacturers are willing to guarantee the heat value of the coal, or the efficiency of the boilers and its accessories or the efficiency of the firemen, etc.? Of course, these things can be covered by various assumptions by the ice-machine builders; but that does not help the man who manages an ice plant if he is not able to realize the results which these assumptions call for.

It is better to consider the cost of production of steam as the most important item, and not simply the cost of fuel. Then it becomes a matter of determining the minimum cost of producing a given quantity of steam from and at 212 deg. F., with different kinds and types of boiler-room installations, different kinds and prices of fuel, and different kinds and types of firemen, etc. The cost of production of steam should include every item of expense connected with the boiler-room, such as fuel, disposal of ashes, wages of firemen, coal passers, cleaners, etc., cost of water, interest on investment, depreciation, cost of maintenance, taxes, insurance, etc.

Let the costs of operating the different types and makes of ice machines and apparatus be compared in a similar manner to the boiler plant. Charge to the ice machine not coal, but the heat units it requires from the boiler through the medium of live steam and credit it with the heat units which it is able to return to the boiler through the medium of exhaust or condensed steam; all per ton of refrigeration, under a given set of conditions.

Treat the auxiliaries in a similar manner and make comparisons of the relative cost of different types and the different methods of operation.

A copious supply of good cold water is of the greatest value to an ice plant and should be secured even at great cost.

The minimum cost of producing a ton of refrigeration with different machines and apparatus and under varying sets of conditions should be determined independently of the systems employed for utilizing this refrigeration for converting water into ice.

The cost of preparing water by different systems and processes for freezing should be determined and considered.

We should know the real cost of converting water

* Read before the annual meeting of the American Society of Refrigerating Engineers in December, 1906.

into merchantable ice by different processes, and, in determining the cost per ton, the weight of ice produced should be determined by means of scales and not left to guesswork.

In every case there is more or less of the ice, which has been produced, converted back into water during the process of harvesting. This loss varies with the different systems of ice making and should be taken into account accordingly.

The storage of artificial ice furnishes several subjects of controversy. It seems to be the opinion of some that the storage house can be more cheaply refrigerated by means of ice than by mechanical refrigeration.

This question should not be difficult to settle. There is an open field for invention in the line of improved methods of machinery and appliances that may be used for handling artificial ice cheaply and quickly into and out of storage houses.

The greatest opportunities for improvement are not to be found in the provinces over which the several manufacturers of refrigerating machinery and refrigerating engineers hold special and undisputed sway. They are to be found principally in the production and utilization of steam and in the handling of ice.

Ice plants—where conditions and circumstances will permit—should be established on as large a scale as is compatible with a fairly economical delivery system and they should be operated and managed under the direct supervision of progressive, technically educated engineers, who are specially trained for the purpose.

[Concluded from SUPPLEMENT No. 1624, page 26015.]

THE ETHICS OF TRADE SECRETS.*

By FREDERICK P. FISH.

In some respects the law of trade secrets does not seem quite complete. There have not been sufficient cases arising under sufficiently varying conditions to enable all aspects of the law to be worked out.

For example, under the decisions of the courts there seems to be practically no limit as to the character of the subject matter which may be treated and protected as trade secrets. They may be of small or large importance; they may or may not involve great novelty or real inventive quality. They may be mere business expedients which have a trade value because of their convenience, or because they record useful information. Unlike a patentable invention, it does not seem necessary that they should be "new" as well as useful.

At first sight it might seem that all that was required was that there should be a secret plan or method or device of any kind to entitle its possessor to the limited protection which the law gives.

I doubt, however, if such is ultimately determined to be the law. When cases arise which require a close analysis of the question, it is probable that the courts will decide that there is something necessary over and above the mere question of secrecy to justify the exercise of the power of the court to prevent the use or disclosure by one who acquired his knowledge in confidence or while under contract.

It is well settled that the alleged secret must be a real secret. I believe, however, that before the courts should intervene to protect an alleged trade secret it should appear that it was not only regarded as secret, but that it was distinctly treated carefully as such and guarded by the possessor of it. It should not be enough that he has had it in mind to call it a trade secret, if he ever needed to invoke the protection of the law. He must have taken all necessary and reasonable precautions to prevent its disclosure. Moreover, it does not seem proper that he should have redress against his employees and associates unless it is made to appear that they knew, while occupying the fiduciary relation which gave them the opportunity to learn the secret, that the specific thing now called a secret was in fact regarded and treated as a secret. It should not be enough that one man has worked for another. The employee has a perfect right to grow with his experience. He has a right to carry away for general use everything that he learns in his place or employment, except trade secrets. The public interest requires this as much as it requires that trade secrets should be respected. The employee or associate should be notified of the exact trade secret, that he may know what results of his experience he can and what he can not take away and use freely.

With these qualifications, some of which are perhaps not fully elaborated in the opinions of the judges, there seems no reason to doubt that the law is thoroughly consistent with sound ethical principles. I can conceive of only few directions in which a change of any moment is possible. One would be to the effect that the possessor of a trade secret should publish it to the world so that all might have the advantage of it. Such a law would be incapable of enforcement, for the man who has a thought or an idea cannot be forced to express it. Surely, this would result in no benefit to the community. Again, the law might be modified so as to remove the present restrictions against the disclosure of a trade secret by one who thereby is guilty of a breach of trust or of contract. So long as we maintain our present standards of right and wrong, so long as we value and insist upon loyalty and good faith, would not such a change in the law seem to us inconsistent with all that is good in human nature and the application of a principle which is most distinctly immoral?

Believing as I do that the law of trade secrets is fundamentally right and in accord with sound ethical

and social principles, at least as gaged by our present standards, I have not turned aside to consider the possible objections to the views that have prevailed. It seems to me that those objections are largely upon a consideration of the obvious hardships involved in the situation. It is a burden that one who knows a useful thing should not have full power to utilize it. Is not this true of every legal restriction upon the individual?

It must not be forgotten that no man need place himself under the embarrassment of knowing a trade secret unless he chooses. Each of us is free to refuse the employment or the relationship or the contract from which such knowledge would come. If we do not refuse, we must as in all other relations in life, accept the situation as a whole, with its burdens as well as its advantages. There is nothing special, as to trade secrets, in this regard.

Neither must it be forgotten that the right to protection in the use of a trade secret is a general right. It is sometimes suggested that while the rules of law, as I have defined them, were adapted to a former condition of things, they are not in harmony with our present industrial situation. I do not think that such is the case.

It is true that in the early years of the last century, when the trade secret of to-day, in its legal relations, was formulated by the courts as a logical development of the general principles of law, the units of trade were small. Trade secrets were then in the possession of small manufacturers, for there were no large ones. In so far as trade secrets play any part in our industries of to-day, they are necessarily, to a large extent, features of our modern corporation and factory system. I do not see how these changes in industrial conditions affect the question under discussion. The reasons which led to the original protection of such secrets against breach of contract or breach of faith one hundred years ago, are sound to-day.

The law on the subject is the same whether the secret is of large or small importance, whether it is possessed by any individual or a corporation. We should not forget that any one of us in this room, and any workman in any factory in the land, may light upon such a secret. If he does, it will have the protection of the law.

A consideration of possibly more moment is that there is offered to the originator of certain special forms of industrial secrets, or to his assignee, the protection afforded by the grant of letters-patent. It may be contended that the opportunity to patent an invention is all the encouragement to the promotion of the useful arts that is required in the public interest, and that there should be no other reward for the origination of a new thought or of a new method or device than that given by a patent. Passing for a moment the point that only a small class of useful ideas are capable of receiving the benefit of letters-patent and referring only to things that are patentable, such a view does not seem to me fair or reasonable. Why should a man be forced, against his will, to publish what is in his mind?

The whole law of patents implies the right of a man to keep as a secret that industrial improvement which he has conceived. It is because that right is recognized that patent laws exist. They say in effect: "You, the inventor, have a trade secret which is, among other things, new, useful and the result of invention. You may keep this secret if you can, and so long as it is kept secret you and those claiming under you alone may use it. If your secret is discovered without breach of faith, as may be the case at any moment, you lose it absolutely. Do you not prefer to make a contract under the patent law by the terms of which you are to publish your invention in the best form known to you, and in consideration of that publication secure a right, which you cannot otherwise have, and which shall be enforceable by law, to prevent the use of your new idea by any others without your consent for a limited term, say seventeen years?" You will, to be sure, sacrifice the chance you now have of keeping your invention for an indefinite time a secret and, therefore, in your own control, but in return you get the right to invoke the aid of the law to restrain any use without your consent for a certain period. Which course do you think most for your advantage?

As I understand the decisions, even unfairness or want of faith on the part of one who receives knowledge of the secret in confidence, does not make it impossible for him, before he is enjoined by the courts, to disseminate the information so that those who get it from him may use it freely. A person who has notice of the incapacity of his informant to violate confidence, or one who has given no consideration for the information, would be subject to injunction. On the other hand, a *bona fide* purchaser of the secret who had no notice of any breach of confidence or of contract on the part of the one who sold him the information for value, could, I believe, use the information without interference from the courts. He, as a *bona fide* purchaser for value and without notice would have an equity equal to that of the possessor of the secret. Under such circumstances the courts are not likely to interfere.

If a disclosure was wrongfully made in trade journals or otherwise, it would be a difficult, almost an impossible, task for the one whose rights had been violated to secure redress against the entire public who had read of the secret and who were actually innocent of any breach of faith. Moreover, where there is a trade secret, the fact that it exists is likely to be known throughout the trade, and each competitor has the full right to find the secret for himself, using all information as to its nature and the results from it

that he can get from an inspection of the product, from speculation, or in any fair way. I will say nothing as to unfair ways that might be employed and which might be carried out with effect, but so shrewdly as to evade the law. No man would prefer a trade secret to a patent if the only question was one between the chance of keeping his device or method to himself indefinitely without publication, and publication with a reasonable certainty of protection during a limited term. But the issue does not come up in this simple fashion.

In the first place, many trade secrets are not of a patentable character. Many such should surely be capable of protection in some way. There is no other possible way than through the present rules of law to which I have referred.

There are many valid reasons why the discoverer of a new industrial process may well determine not merely that it is for his interest to take his chances of keeping it secret rather than to publish it in a patent, but that the latter course might lead to disaster. While it is generally, but not always, easy to prove an act of infringement of a patent, on a product or a tool or a machine, it is often practically impossible to obtain legal proof of the process employed by one who is believed to infringe a process patent. The infringer is very apt to be able to keep his infringement an undiscoverable secret. I am inclined to the belief that a substantial part of the important and valuable trade secrets now in use, would, if patented, be used without much, if any, chances of redress on the part of the patent owner. At any rate, if the one who controls the secret fears that he could not prove infringement of a patent, is it contrary to public policy that he should be allowed to take his chances of keeping what he has discovered a trade secret rather than run the risk of losing it altogether by publishing it?

Again, nothing can be patented unless it involves invention. Pages have been written by way of defining invention. Many of our greatest judges have given all possible thought to the subject. It is still indefinite, however.

Inasmuch as a trade secret is a man's own, to use or not as he pleases, can it be required that he should absolutely give up his opportunity to utilize his idea for his own benefit, and incidentally for the benefit of the public, in his own factory and under the seal of secrecy, and take a patent which might be declared invalid for want of invention, no matter how useful and meritorious the subject matter might be?

It is to me somewhat significant that the legislatures of England and America, which have many times dealt with the patent law, have never directly touched the subject of trade secrets. They seem to have recognized the fairness and justice of the common law rules on the subject, and that the only course which would commend itself to a sound public sentiment was to make the patent laws so attractive as to induce the owners of patentable trade secrets to publish them in consideration of the patent grant. In this way they have to a large extent succeeded. There are an innumerable number of patents, and a comparatively small number of trade secrets. It is only in a few special classes of subject matter that the patent is not a more attractive reward for the new contribution to industrial progress than is the limited protection given by the law to a trade secret. It is only with processes which are practised in a factory and which are not disclosed by a study of the product that there is any substantial chance of maintaining secrecy.

If a man elects in those few cases not to publish but to take his chances, can there be any real objection to his pursuing that course? It is certainly inconvenient and annoying to some extent. It is a real personal hardship that a workman or engineer who has learned the secret under such conditions that he must respect it, cannot utilize it in his subsequent work. It undoubtedly holds back the progress of the useful arts to some extent that the whole world is not free to practise it and to improve upon it. But this, in theory, is equally true as to things that are patented, during the long term of seventeen years in which no improvement on the thing patented can be rightfully used except by the patentee or those claiming under him.

On the other hand, I believe that sound business generally and the comparatively few arts in which such secrets are of any importance are definitely promoted by the fact that the law aids in preventing disclosures based upon bad faith.

Such are my views as to the ethics of trade secrets. They are those of the courts, and I believe of the public. I recognize that all industrial questions are now under investigation. Much good will come from a fresh study of them in their relations to modern social, political, and economic conditions.

The question we have been considering is only one of many as to which the community has had settled views which were reflected in the unanimous findings of the courts. As to some of those questions, it may be that we are on the verge of marked changes of thought which may result in equally great modifications of what have seemed to be sound and permanent industrial and business principles, and in the applications of those principles. The engineers of the United States will surely be on the right side of the discussions of these subjects, and of any political or judicial action which follows those discussions. It may be well in every case to consider the grounds for the doctrine that has prevailed before condemning it altogether. It will always be necessary to determine whether the criticism should not be directed to the applications of the doctrine, that is, to the special cases, rather than to the doctrine itself. In the matter

* From an address delivered before the American Society of Mechanical Engineers at New York.