Mitchell Vs. Tilghman

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Appellant : Mitchell

Respondent : Tilghman

Judgement :

Mitchell v. Tilghman - 86 U.S. 287 (1873)
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Mitchell v. Tilghman

86 U.S. (19 Wall.) 287

APPEALS FROM THE CIRCUIT COURT FOR

THE SOUTHERN DISTRICT OF NEW YORK

SYLLABUS

What R. A. Tilghman, of Philadelphia, claimed as his invention under the letters patent granted to him of January 9, 1854, was the process of manufacturing fat acids and glycerin from fatty or oily substances by the action of water at a high

temperature and pressure.

Two conditions, *viz.,* that the heating vessel must be kept entirely full of the mixture of fat and water and that no steam or air must be allowed to accumulate in the vessel employed to impart the heat, were material and indispensable conditions of Tilghman's patented method.

The claim of the patentee must be limited to the specific method or means of applying highly heated water under pressure pointed out in the specification; and although the claim is on its face broader than this, yet it is to be construed by reference to the specification.

In this point of view, it is unimportant whether the claim contained any direct reference to the specification or not. Such reference, where not expressed, will be implied.

The precise apparatus described in Tilghman's specification does not appear to have gone into practical use in this country or in Europe, and the apparatus worked by Tilghman's licensees differs in many material respects from the apparatus described in his patent, and, taken as a whole, therefore, it was considered by this Court that Tilghman did not succeed in introducing his invention into practical use by the means and mode of operation described in his specification.

Accordingly, where a defendant had used highly heated water in a close vessel, but used a much more moderate degree of heat than specified by Tilghman, and used an entirely different apparatus from Tilghman's, and one which permitted the existence of steam as well as water -- construing Tilghman's claim of invention as limited by the specific means and mode of operation described in his specification -- such defendant was held not to have infringed.

Appeals from the Circuit Court for the Southern District of New York in which court R. A. Tilghman filed two bills in equity against R. G. Mitchell, under a patent granted to him the said Tilghman for a process for making fat acid and glycerin from natural fat, one bill having been filed during the first term of the patent and

the other under the extended term of the same patent.

In both cases, final decrees were given in favor of Tilghman, and the defendant, Mitchell, took these appeals.

The bill set forth the grant of letters patent to Tilghman,

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October 3, 1854, for fourteen years from January 9, 1854, the reduction of the patented improvement to use, and the infringement by Mitchell.

The invention claimed by Tilghman may be stated in general terms to be based upon the discovery that if water be heated to a high degree, and at the same time retained in a close vessel so that it cannot pass into the state of steam, but must remain in the liquid state, it will, while in such highly heated liquid state, possess a peculiar property of separating natural fat into its chemical constituents, glycerin and fat acids. He undertook to claim the employment of water *in the liquid state, heated and under the pressure* necessary to retain it in the liquid state as *the decomposing agent.* He asserted that prior to his discovery and invention, no one had ever known, used, or described the employment of *highly heated water retained in the liquid state* by *pressure* as such decomposing agent, and that under the law if he set forth this newly discovered decomposing power of *liquid water heated and under pressure,* and exhibited in his specification one mode of practically applying it, he was entitled to the exclusive use of this decomposing agent in treating facts for the purpose of separating them into fat acids and glycerin.

To understand the questions at issue in this case, and passed upon by the court, there is first to be considered the phenomenon of heating water &c.;, its behavior and properties when heated.

Water when heated in an open vessel at the surface of the earth passes into a state of vapor, at a temperature of 212 of Fahrenheit's thermometer; the waters expanding over eighteen hundred times in passing into steam. It is impossible to

retain water in a liquid state, in an open vessel, after it has reached that temperature. If the vessel in which the water is heated, however, be covered, and the cover be fastened down, the water can be heated to any temperature whatever, and will still remain in the liquid state. The tendency of the water to pass into vapor increases with the

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degree of heat applied to it, and there must therefore be a proportionate pressure or restraint by the enclosing vessel on the heated water to overcome this expansive tendency, or tendency to pass into a state of a vapor.

Vessels in which water could be heated to any desired temperature, and the water still retained in the liquid state, were known in the arts and called "digesters."

To understand matters further a brief statement of the art of treating fat is necessary.

Fats obtained from various sources differed much in hardness and fusibility, and each variety was formerly supposed to be an entirely different article. About 1816, Braconnot, a French chemist, discovered that all natural fats were merely *mechanical* mixtures, in various proportions of fats entirely solid and hard, now called stearin, with a more fluid fat or oil, called olein. He found that simple pressure very slowly applied, squeezed out the more fluid part, and that the remainder made harder candles. But the process of separation by pressure was difficult and imperfect.

Chevreul, in 1825, discovered that all fats were chemical compounds of a substance called glycerin, with fatty bodies having slight acid characters called fatty acids; that fatty acids were of different degrees of fusibility, and that when the glycerin was separated from fats, the fatty acids could be more rapidly and perfectly pressed so as to get out the hardest fatty acids for candles; and he patented a chemical process of separating these fatty acids from glycerin.

His process consisted of two distinct stages:

1. The manufacture of natural fat into *soap,* by boiling lime or other alkali with the fat, in which case fourteen pounds of lime were used to one hundred pounds of fat.

2. The decomposition of the soap so produced into fat acid by the use of two pounds of sulphuric acid to each pound of lime.

Soap had always previously been made by boiling the fat and solution of alkali together, and Chevreul suggested that this production of *soap* could be expedited by boiling the

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fat and the solution of alkali together *under pressure.* He did not, however, suggest that *water alone,* heated and under pressure, would of itself decompose neutral fat into a fat acid and glycerin, but expressly mentioned alkali and sulphuric acid as the decomposing agents.

Another mode of separating free fat acids was devised, which was called *decomposition by sulphuric acid distillation.*

This process was invented and used for producing *fat acid only,* and not glycerin, the glycerin being *destroyed* by the process. It was asserted by Tilghman that this process differed from his:

1. In that the result produced was different, *viz.,* fat acid only, while his, Tilghman's, produced simultaneously both fat acid and glycerin;

2. In that it required sulphuric acid to decompose the fat into fat acid;

3. In that it did not depend for its efficiency on the use of *highly heated water* in the liquid state, retained in such state by pressure;

4. In that it was a process of distillation.

We must view here also the *attempted decomposition by steam.*

It was from time to time attempted, prior to Tilghman's alleged invention, to decompose neutral fat into fat acid by *distillation* in a current of steam, but it was asserted by Tilghman that it was an unsuccessful and abandoned experiment, and had never come into use; and that even if it had been successful it differed in every way from his process. Among other ways,

In not producing glycerin as a result;

In not depending upon or even allowing of the presence of highly heated *water* under pressure;

In that it was a process depending on vaporization and subsequent condensation of the fat acids;

In that the apparatus absolutely *necessary* for the distillation process was such as to render the execution of the hot water process of him, Tilghman, in the same utterly impossible.

Tilghman asserted that he had made the discovery not

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that *heat alone* would decompose fats into fat acid and glycerin, nor that the presence of water was necessary when chemicals are used to decompose fats into fat acid and glycerin -- but merely that *water* in a *liquid state* heated to a high degree of temperature while enclosed in a strong vessel, so as to prevent its passing into steam, would of itself and without the aid of chemicals separate natural fat into its constituent elements, fat acids and glycerin. Having made, as he alleged, this discovery of a new chemical decomposing property of *water highly heated and retained in the liquid state* by pressure, Tilghman, in his patent, announced it, and, as will be seen directly, also described two modes of carrying out his process based thereon.

In the alkaline saponification processes, which were in use prior to Tilghman's invention, various forms of closed boilers, provided with safety valves, were known. It was also known that fat and water would tend to remain unmixed in a

boiler, and therefore agitators or circulators, for preserving a mixture or intimate contact between the fat and lime and water during the process of alkaline saponification, under pressure, were also in use. [Footnote 1]

The specification, in the patent, ran thus:

"Be it known that I, Richard Albert Tilghman, of Philadelphia, have invented a new and improved *mode of treating fatty and oily bodies,* and I hereby declare that the following is a full and exact description thereof."

"My invention consists of a process for producing free fat acids and solution of glycerin from those fatty and oil bodies of animal and vegetable origin which contain glycerin as their base. For this purpose, I *subject these fatty or oily bodies to the*

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action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerin. I mix the fatty body to be operated upon with from a third to a half of its bulk of water."

"And the mixture may be placed *in any convenient vessel in which it can be heated to the melting point of lead,* until the operation is complete. The vessel must be closed and *of great strength,* so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam."

" *The process* may be performed more rapidly and also *continuously* by causing the mixture of fatty matter and water to pass through a tube or continuous channel, *heated to the temperature already mentioned;* the requisite pressure for preventing the conversion of water into steam being applied during the process, and this, *I believe,* is the *best* mode of carrying my invention into effect."

"In the drawing hereunto annexed are shown figures of AN apparatus for performing this process *speedily and continuously,* but which apparatus *I do not intend to claim as any part of my invention.* "

"Figure 1 of the said drawing is a vertical section of this apparatus, and Figure 2 shows the various parts of the apparatus in horizontal section: similar parts in these figures being marked with similar letters of reference."

"I place the fat or oil in a fluid state in the vessel, A, with from one-third to one-half its bulk of warm water; the disk or piston, B, perforated with numerous small holes, being kept in rapid motion, up and down, in the vessel, A, causes the fat, or oil and water, to form an emulsion, or intimate mechanical mixture. A force pump, C, like those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube, D, D, D, D, which, being placed in the furnace, E, E, E, E, is heated by a fire, F, to about the temperature of melting lead. From the exit end, G, of the heating tubes, D, D, D, D, the mixture, which has then become converted into free fat acids and solution of glycerin, passes on through another coiled iron tube, H, H, H, immersed in water, by which it is cooled down from its high temperature to below 212 Fahrenheit, after which it makes its escape through the exit valve I into the receiving vessel. "

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"The iron tubes I have employed and found to be convenient for this purpose, are about one inch external diameter, and about half an inch internal diameter, being such as are in common use for Perkins's hot water apparatus. The ends of the tubes are joined together by welding to make the requisite length, but where welding is not practicable, I employ the kind of joints used for Perkins's hot water apparatus, which are now"

image:a

"well known. The heating tube, D, D, D, D, is coiled several times backwards and forwards so as to arrange a considerable length of tube in a moderate space. The different coils of the tube are kept about a quarter of an inch apart from each other, and the interval between them is filled up solid with cast iron, which

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also covers the outer coils or rows of tubes to the thickness of half or three-quarters of an inch, as shown in Figure 2. This casing of metal insures a considerable uniformity of temperature in the different parts of the coil, adding also to its strength, and protecting it from injury by the fire."

"The exit valve, I, is so loaded that when the heating tubes, D, D, D, D, are at the desired working temperature, and the pump, C, is not in action, it will not be opened by the internal pressure produced by the application of heat to the mixture; and therefore, when the pump, C, is not in action, nothing escapes from the value, I, if the temperature be not too high. But when the pump forces fresh mixture into one end, J, of the heating tubes, D, D, D, D, the exit valve, I, is thereby forced open to allow an equal amount of the mixture, which has been operated upon, to escape out of the cooling tubes, H, H, at the other end of the apparatus. No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased, so that the current through the tubes may be made sufficiently rapid to carry out with it any air remaining in them."

"Although the decomposition of the neutral facts by water takes place with *great quickness at the proper heat,* yet I *prefer* that the pump, C, should be worked at such a rate in proportion to the length or capacity of the heating tubes, D, D, D, D, that the mixture, while flowing through them, should be maintained at the desired temperature for *ten* minutes before it passes into the refrigerator or cooling parts, H, H, of the apparatus."

"The melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matters into fat acid and glycerin takes place with some materials (such as palm oil) at, or below, the melting point of bismuth, yet the heat has been carried considerably above the melting point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. *By starting the apparatus at a low heat, and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed, can easily be determined.* "

"To indicate the temperature of the tubes D, D, D, D, I have found the successive melting of metals and other substances of

different and known degrees of fusibility to be convenient in practice; several holes, half an inch in diameter, and two or three inches deep, are bored into the solid parts of the castings surrounding the tubes, each hole being charged with a different substance. The series I have used consist of tin, melting about 440 F.; bismuth at about 510 F.; lead at about 612 F.; and nitrate of potash at about 660 F. A straight piece of iron wire, passing through the side of the furnace to the bottom of each of the holes, enables the workmen to feel which of the substances are melted and to regulate the fire accordingly. It is important for the quickness and perfection of the decomposition that the oil and water, during their entire passage through the heating tubes, should remain in the same state of intimate mixture in which they enter them. I therefore prefer to place the series of heating tubes in a vertical position, so that any partial separation which may take place, while the liquids pass up one tube, may be counteracted as they pass down the next. I believe that it will be found useful to fix at intervals, in the heating tubes, diaphragms pierced with numerous small holes, so that liquids, being forced through these obstructions with great velocity, may be thoroughly mixed together."

"I deem it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch, before taking it into use; but I believe that the working pressure necessary in using the heat I have mentioned will not be found to exceed two thousand pounds to the square inch."

"When it is desired to diminish the contact of the liquids with iron, the tubes or channels of the apparatus may be lined with copper. The hot mixture of fat acids and solution of glycerin which escapes from the exit valve of the apparatus separates by subsidence. The fat acids may then be washed with water, and the solution of glycerin concentrated and purified by the usual means."

"The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soaps, and applied to various purposes, according to their quality; and, when desired, they may also be first bleached by chemical agents, or purified by distillation, in a current of steam or in a vacuum, as is now well understood. I prefer that the fatty bodies should be previously deprived, as far as practicable, of such impurities as would cause the discoloration of the fat acids

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produced; but when the fat acids are to be finally purified by distillation this preliminary purification is of less importance."

"When the sulphuric acid, nitrous fumes, or other corrosive agent shall have been used for purifying, hardening, or otherwise preparing the fatty body to be operated upon, I take care that all traces of it shall be washed out, or neutralized, before passing it through the apparatus."

"Some fatty bodies (particularly when impure) generate, during the process, a portion of acetic or other soluble acid, which might tend to injure the iron tubes; in such cases, I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes."

"Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that"

" *I claim as of my invention, the manufacturing of fat acids and glycerin from fatty bodies by the action of water at a high temperature and pressure.* "

"R. A. TILGHMAN"

The answers to the bill of Tilghman, which set forth his patent, denied that Tilghman had applied his improvement to practical use;

Alleged that the manufacturing of fat acids and glycerin from fatty bodies by the action of water at a high temperature and pressure, cannot be accomplished so as

to be practically useful, if it can at all, by the method and apparatus described in said letters patent;

Alleged that all attempts to carry on the manufacture of fatty acids by means of the apparatus and method described in said letters patent had failed;

Denied that the defendant had been using the improvement of Tilghman, or "any method in construction or *operation* substantially the same, *otherwise than was thereinafter alleged,* " but admitted that he

"used *water at a high temperature,* and steam, and *such pressure* as arises from the expansive force of *hot water* or steam in a *close* vessel, under and in pursuance of a patent of Wright & Fouche, January 25, 1859;"

Alleged that "the action of *water highly heated in a close*

vessel upon very many substances to decompose them, and upon fats and oils," was, prior to Tilghman's invention, well known to chemists &c.;, and was described in printed publications;

Alleged that before the invention of Tilghman

"the use of a close vessel of such strength as to resist the pressure of the water when heated, or *any needed pressure* when using water to decompose *other* substances, was known to and practiced by men of science and manufacturers in the United States and elsewhere;"

Alleged that the said quality of highly heated water thus used is an elementary principle, and *not patentable;*

Alleged that the mode and means described in the specification as the best means of carrying the invention into effect was dangerous, owing to the degree of heat required.

It also referred to numerous prior patents, and contained extracts from publications to show that Tilghman's invention had been anticipated. Among the extracts were:

1st. Extracts showing use of digesters, for heating water to high temperature and still retaining it in a *liquid* state;

2d. Extracts showing use of digesters for *rendering* raw fat or removing the membranous and cellular matter, and thus purifying it;

3d. Extracts from text books and writers, stating generally that neutral fats can be decomposed into fat acids and glycerin, and that in the act of decomposition the elements of the water are taken up by the fat acids and glycerin;

4th. Extracts to show that alkaline saponification decomposes neutral fat into soap and glycerin, which soap can afterwards be decomposed into fat acid, and also to show that the *alkaline saponification* can be better effected in a close vessel under pressure;

5th. Extracts stating that fats can be distilled in the presence of steam into fat acids, which are passed over as vapors and condensed in the still.

The patent of *Wright & Fouche,* dated January 25, 1859, under which the defendant, Mitchell, in his answer as above condensed, asserted that he was working, was thus:

"TO ALL TO WHOM IT MAY CONCERN:"

"Be it known that we, Robert Alfred Wright civil engineer, and Louis Jules Fouche, steam boiler maker, of Paris, in the Empire of France, have invented 'a new apparatus, destined to produce chemical decompositions by means of superheated steam and water,' and we do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the annexed sheet of drawings, making a part of the same."

"The apparatus, which is the object of the present patent to secure, is susceptible of several industrial applications; but as it is chiefly intended for the *decomposition of fatty substances into fatty acids and glycerin,* we will describe it as applied to that purpose."

"This invention is represented in the annexed drawing, which shows the elevation of the apparatus complete. [Footnote 2]"

"The dimensions of the apparatus may vary with the various purposes to which it may be applied."

" *a* is a metal (iron or copper) boiler of any form whatever, placed in a furnace in order to be heated by a naked fire; this boiler has sides *sufficiently strong to resist a pressure of from ten to twenty atmospheres;* [Footnote 3] it is of a variable capacity, according to the requirements of the manufacture, and it may have its interior lined with lead or by any other metal which will not be attacked by the fatty bodies which are to be introduced and produced therein; *b* , hearth; *c* , ashpit; *d* , dipping pipe, furnished with a cock to empty the apparatus by pressure; *e, e,* manhole, serving for cleaning the cylindrical vessel *a* , and for the introduction of substances, if required; *f* , metal tube (of iron or copper) connecting the bottom of the boiler a with the bottom of the cylinder *h; g,* metal tube of ascension, conducting the superheated water from the boiler *a* to the upper part of cylinder *h* . This tube is terminated in the interior of the cylinder *h* by a rose jet, or, more simply, holes are made in the extremity so as to distribute the water uniformly in the cylinder *h* and to ensure a molecular or finely subdivided contact between the superheated water and the substance submitted to

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the operation; *h* , iron or copper upper cylinder, which should, like boiler *a* , be able to resist a pressure of from ten to twenty atmospheres. The cylinder *h* receives the substances to be treated; *i* , funnel, furnished with a tube and with a cock, serving for the introduction of the substances to be treated into the cylinder *h* -- that is, when this substance is of such a nature"

image:b

"as to be introduced through a small aperture; *k* , manhole, serving for cleaning the cylinder *h* , and for the introduction of substances to be treated which cannot pass through the funnel *i* ; *l* , safety valve; *m* , manometer or pressure gauge, indicating the pressure

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in the whole of the apparatus; *n, n,* cocks serving to indicate the height and level of the substance and of the water in cylinder *h; o,* cock serving to empty the cylinder when the operation is completed."

`ACTION OF THE APPARATUS

"Supposing everything arranged as shown in the drawing, then, in order to decompose fatty substances into fatty acids and into glycerin, the boiler *a* is completely filled with water. The cylinder *h* is filled with water up to one third of its height, and it is then filled up to the level of the upper cock with the fatty bodies to be decomposed. The introduction of the fatty bodies takes place, as we have said, either through the funnel *i* or by the manhole *k* . The boiler *a* is then gradually heated till the pressure gauge indicates a pressure of from *ten to twenty atmospheres,* according to the nature of the substances submitted to the operation, when the following takes place:"

"The *superheated water* in the boiler a acquires an ascending motion on account of the difference in the temperature of the two capacities *a* and *h* ; a current is thus created, whence it results that the *heated water* in boiler *a* ascends through the tube *g* into the cylinder *h* , and being forcibly driven out through the holes in the rose jet, passes through the fatty bodies and descends again through the tube *f* to the bottom of the boiler *a* , where it is again warmed, in order to recommence its ascending motion, and so on."

"When this operation has been thus continued during a length of time which may vary from five to eight hours, according to the nature of the fatty bodies operated

on and also according to the variation of pressure (varying from ten to twenty atmospheres), the fatty bodies are decomposed into glycerin, which remains dissolved in the water, and into fatty acids, which float in the cylinder *h* . The contents are now emptied out and separated from each other at the same time."

"In conclusion, we would remark that we are aware that firstly, the decomposition of fatty bodies by *water under the influence of heat and of pressure* is a well known scientific fact. Water is substituted for the organic basis. It forms a perfect and fixed combination with the fatty acids, while the glycerin is dissolved in the excess of water. Secondly, that as this chemical action takes place under the influence of a weak

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affinity, it is necessary, in addition to the above-named physical and chemical conditions, to ensure a *perfect molecular agitation* of the whole mass, and that we wish it to be understood that what we wish to claim and establish as of our invention consists of an apparatus wherein the water and the fatty matters are heated separately in two different boilers. The first boiler is heated by the source of heat, while the second boiler is heated by the first boiler."

"In these boilers, the agitation necessary for the *chemical action and combination is produced* by the pressure of the *heated water in the first boiler. This water* circulates continuously from this first boiler to the second boiler and from the *second boiler to the first* in a continuous and self-acting or automatic manner, without interruption. The characteristics of our apparatus are that it produces *agitation* by *circulation alone,* a continuous and automatic circulation produced by the pressure of water."

"Lastly, our apparatus effects its chemical action in a continuous manner, without the aid of any manual or other assistance."

"CLAIMS. Having described the nature of our invention and the manner in which the same is to be performed, we do not claim the application of *superheated water* for decomposing fatty bodies, nor the form of the apparatus above

described, which may vary somewhat according to conditions and circumstances; but what we *claim* as our invention is producing a continuous automatic circulation of *highly heated water* in a very finely divided state through the bodies under treatment by means of an apparatus constructed and employed substantially as herein shown and described."

Tilghman insisted that the use of highly heated water under pressure to decompose neutral fats into fat acids and glycerin was an infringement of his patent, no matter what particular form of apparatus might be used or what particular temperature adopted, and no matter what particular device might be adopted to maintain the intimate mechanical mixture of the fat and water during the decomposing operation, these last being obvious matters of detail, susceptible of infinite variety.

He contended that Mitchell's infringement consisted in

using highly *heated water* with neutral fat in a close vessel, and restraining or confining it there under pressure so as to preserve the water while heated in a *liquid state,* and by means of this highly *heated liquid water* to produce fat acid and a solution of glycerin.

Mitchell, on the contrary, asserted that heat alone will decompose fats into their elements; that the decomposition is effected by temperatures varying from about 510 F., the melting point of bismuth, to 610 F., the melting point of lead; *that these were the very temperatures named by Tilghman as required* in his process; but that in the very act of separation, they will be destroyed unless some base be present to unite with these elements; that this destruction so produced was the *burning up,* in fact, of the fat by heat; that this effect was known to Tilghman; and that his invention consisted merely in using heat to decompose the fat by sheer heat, and to supply, at the instant of decomposition, water to prevent the burning up or destruction of the elements produced; that the single idea of Tilghman's patent was the use of great heat to decompose and a contrivance for immediately

presenting particles of the aqueous agent to fix and reunite into the new forms the decomposed elements; that he did this by making an emulsion or mechanical mixture of fat and water; that he called for a vessel of great strength, and proposed to work under a pressure of 2,000 pounds to the square inch; and that he loaded the safety valve to prevent the conversion of water into steam.

Mitchell therefore contended that from the very purpose of his patent, Tilghman was to be confined to the very ranges of heat above described; that it was an essential condition of the patent that there should be heat not below 510 Fahr.; [Footnote 4] that the manipulation should be rapid, not exceeding ten minutes; that the vessel should be entirely filled with the mixture of fatty matter and water, and that no steam whatever should be permitted in it.

He contended, in addition, as the Reporter understood it,

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that this construction of the patent was the right one on the face of the instrument and on principles of patent law, independently of the alleged special design of the patentee in framing his specification.

The evidence as to the range of heat by which fats are destructively decomposed seemed, as the Reporter read it, to show perhaps that it was one of conditions.

Renwick (*see infra,* 86 U. S. 357) and Rand, experts of Mitchell, fixed the working range of Tilghman's patent at from 440 F. to 660 F.; and Rand and Wayne, also his experts, testified that the chemical action is the same with water heated and under pressure from 300F. to 600F.

From what has been said the reader will have perceived that the first question in the case was:

The construction of the patent. Tilghman had "claimed" as his "invention" "the manufacturing of fat acids and glycerin from fatty bodies by the action of water at a high temperature and pressure," and he claimed as his invention nothing besides. And in the opening of his specification he declared that "for the purpose of

executing his invention, he subjected these bodies to the action of water at a high temperature and pressure," and declared nothing more.

But he had said in his specification that he "mixed the fatty body to be operated on with from a third to a half of its bulk of water," and that "the mixture may be placed in *any* convenient vessel in which it can be heated to the *melting point of lead,* until the operation is complete," adding that "the vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam," saying nothing, however, about keeping the vessel entirely full of the mixture.

And he had described more specially *"an"* apparatus by which "the process may be performed more *rapidly,* and also continuously, by causing the mixture of fatty matter and water to pass through a tube *heated to the temperature already mentioned,* " &c.;, which he said he *believed* to be the *best* mode

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of carrying his invention into effect, but which apparatus he stated that he "did not intend to claim as any part of his invention."

He had stated also that

"the melting point of lead had been mentioned as the proper heat to be used in this operation, because it had been found to give good results; but that the change desired took place with some materials at or *below* the melting point of bismuth,"

and "that no steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture," and that although decomposition took place "with great quickness at the proper heat," he " *preferred* that the mixture, while flowing through them, should be maintained at the desired temperature for *ten minutes.* "

And he had said, when speaking of the matter of heat:

"By starting the apparatus at a low heat and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed can be determined."

Was, then, the invention claimed (a process) so inseparably connected with certain means, that is to say, with certain and *specific* degrees of high temperature, or fullness of vessels or tubes, or rapidity of manipulation, as that, unless it was effected through those same specific degrees of high temperature, or fullness of vessels or tubes, or shortness of time, it could not be effected under the patent at all?

If this question was to be answered affirmatively, there was no necessity to make a single inquiry further -- there was an end of the complainant's case, though it might be admitted that the defendant was doing exactly that which in the claim to his patent Tilghman claimed as *his* invention, to-wit the "manufacturing of fat acids and glycerin from fatty bodies by the action of water at a high temperature and pressure." For however practical Tilghman's exact methods and exact means might be -- that is to say, however much and well reduced into use -- the defendant confessedly was not using exactly the same methods, or exactly

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the same means, in the particulars just mentioned, but was using methods and means different, confessedly, in some details of both. Plainly he did not infringe.

But if this first question was not to be answered affirmatively -- if the patent was to be construed broadly rather than closely -- if Tilghman's invention was the manufacturing of fat acids and glycerin from fatty bodies by the action of water at a [any] high temperature, by "any convenient" vessel, and irrespective of manipulation in a limited time, and of tubes or vessels kept constantly and entirely full of the mixture, then, of course, arose,

2d. *A question whether he was an original inventor.* And if he was, then would arise,

3d. *A question whether he had given anywhere such "a full, clear, and exact" description of his invention, and of the manner of making and using the same, as would enable anyone skilled in the art most nearly allied to make and use the invention,* a matter required by the Patent Acts [Footnote 5] as a condition to the validity of any patent granted.

And if he had given such a description, then would arise, as one not so immediately to be answered as before,

4th. *A question whether the defendant infringed the patent of Tilghman.*

It will be seen [Footnote 6] that this Court, in giving its judgment, took the first view of the case -- that is to say, construed the patent closely -- so that the other questions possible to have arisen in the case did not perhaps arise, nor indeed any question but the great one of the construction of the patent.

Nevertheless, a great body of evidence was given on the assumption that the other view -- that which gave to the patent the broad construction claimed for it by the patentee -- was the true one, or might be taken by the court. The case was argued largely on that assumption, and the questions which would necessarily arise in that view are discussed very fully in the opinion given in the case. [Footnote 7]

Some of the evidence is therefore perhaps proper to be

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mentioned, in mentioning which the Reporter begs leave to say that the evidence was in some parts conflicting; that in his limited space he can present it much less perfectly than he could desire, and as with larger space he would not fail to endeavor to do. [Footnote 8] He has also to say that in some of its parts, the case presented recondite matters of chemical science; matters which he confesses that he understands but little, and is perhaps unable to understand much more. If in any points, therefore, he has fallen into error, he asks for excuse from anyone whom he may either mislead or fail to lead at all.

It is requisite to state that Richard Albert Tilghman, the patentee, was a citizen of Philadelphia, and brought up a practical chemist; that having, as he conceived, made the discovery that he could *by the action of water at a high temperature and pressure* produce free fat acids and solution of glycerin from fatty and oily bodies which contained glycerin as their base, he went in 1853 to England, and there, March 25, 1854, obtained a patent from the British government for his invention. In the same year, he got patents for the same invention from the governments of the United States, of France, and of Belgium; that granted by the United States being given at *supra,* p. 86 U. S. 291 . He was in Europe and America alternately, from 1853 to 1859, and returned to the United States in August or September of the year last named.

I

ORIGINALITY OF INVENTION

THE COMPLAINANT'S SIDE OF THE QUESTION

The fact that Tilghman was the person who first distinctly observed and publicly announced that water, in a liquid state, at a high temperature and under pressure, would of itself and without the aid of chemical substances separate natural fat into its constituents of fat acids and glycerin, did

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not, as the Reporter read the proofs, seem to be open to well founded question.

Tilghman relied on the following evidence:

I. SCIENTIFIC TREATISES.

Among these the following were specially quoted:

1. *Richardson & Watts' Chemistry Applied to the Arts,* London, 1863, [Footnote 9] where it is thus said:

"The only perfectly unobjectionable mode of obtaining glycerin, inasmuch as it alone insures the entire absence of mineral impurities, is the decomposition of the fats by the vapor of water at a high temperature. This mode of decomposition was first adopted as a means of obtaining fatty acids and glycerin by Mr. Tilghman in 1854."

2. *Musprat's Chemistry,* London, 1856-1858, article "Glycerin," [Footnote 10] where it is thus said:

"A much more economical method is that introduced by Mr. Tilghman in 1854. By this process, the fatty bodies are broken up into acid and basic substances, through the agency of heat, pressure, and steam."

3. *Watts' Dictionary of Chemistry, London,* 1864, [Footnote 11] article "Glycerin," where it is thus said:

"By heating fats with water or with steam. This is the only unobjectionable method of obtaining glycerin, inasmuch as it alone insures the entire absence of mineral impurities. It was first carried out by Mr. Tilghman in the following manner."

Tilghman's mode of working with the coil apparatus is then described.

II. MEN OF SCIENCE.

1. *The Paris jury of savants,* at the Exposition of 1855, when speaking of Chevreul, the eminent French chemist, say:

"We can affirm without fear of contradiction *that with the exception of the undertaking of the saponification of the fatty bodies by water, which remained unknown to him,* he has indicated in a

clear and precise manner all the scientific bases upon which depend the different methods of practical manufacture of the fat acids employed for making candles."

And speaking of Tilghman, under the head of "Aqueous saponification in a close vessel," the same jury said:

" *It was Mr. Richard Albert Tilghman, chemist, of Philadelphia, who was the first who had the idea of applying this reaction on a large scale.* In his patent taken in London, the 25th of March, 1854, he thus sets forth his discovery, and his manner of operating:"

" My invention consists in a new method of obtaining free fat acids and solution of glycerin from animal and vegetable fatty and oily bodies which have glycerin as their base."

" My invention consists in exposing the aforesaid fats and oils to the action of water at a high temperature and pressure, the effect of which is to cause the combination of the water with the elements of the neutral fats, so as to produce at the same time free fat acids and solution of glycerin."

2. *Professor J. C. Booth,* analytical chemist, of Philadelphia, called and recalled, was thus in substance interrogated, and thus in substance answered:

"Q. With whom did you study chemistry, and where? How long have you been engaged in the profession of analytical chemist? What posts, if any, in public institutions have you held, and what works or papers have you written on chemistry?"

"A. I studied chemistry with Wohler, in Cassel, Germany, and with Professor Magnus, in Berlin, during 1833, 1834, and 1835. From 1835 to the present time, I have been engaged as professional analytical chemist. I was professor of Chemistry applied to the Arts in the Franklin Institute, Philadelphia, for ten years, and Professor of Chemistry and Physics in the Central High School, Philadelphia; I have been for the last eighteen years in the United States Mint, and I still continue, independent of the mint, my profession of analytical chemist. I am the author of the greater part of the Encyclopedia of Chemistry; of a report upon the progress of chemical manufactures made to the Smithsonian Institute, at the request of the perpetual secretary of that institute, Professor Henry; I also edited the translation

of Regnault's Chemistry, translating much of it myself, and annotating it."

"Q. From your knowledge of chemistry, who would you say

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was the discover of the chemical power of water in a liquid state, at a high temperature and pressure, on fats, to produce fat acids and glycerin?"

"A. Mr. R. A. Tilghman."

"Q. Do you know of any other person who has claimed the merit of this discovery?"

"A. I know of no other."

"Q. Is this discovery regarded as a new and important fact in chemistry?"

"A. It is so regarded."

" * * * *"

3. The answer of the defendant having set up that it was shown by a paper published in the year 1823 (Journal of Science, London, vol. xvi, p. 172), entitled, "Change of Fat in Perkins's Engine by Water, Heat, and Pressure," that Tilghman had been anticipated in his discovery, and, as will be hereafter seen, some reliance having been placed on that paper, the examination of the witness thus proceeded:

"Q. Give a list of chemical treatises that you have examined on the subject of this discovery and its date, and particularly with a view of showing whether it was known between 1823 and 1854, and whether it has been known since 1854."

"A. I annex a list of standard chemical treatises, of the highest authority, of dates between 1823 and 1854, which I have examined. They all contain descriptions of the properties of fat and fat acids, and the known methods of producing fat acids and glycerin. None of them mentions the fact that fat acid and glycerin can be produced by the action of water on fats at a high temperature and pressure."

"I annex another list of standard chemical treatises of dates subsequent to April 3, 1854, all of which contain mention of that chemical fact."

"I therefore infer and conclude that that chemical fact was first made known subsequent to 1852, an prior to April 3, 1854."

" *List of treatises published between 1823 and 1854* "

" *which do not mention the chemical fact* "

Dumas's Chemistry, vol. 5. Paris, 1835.

Berzelius's Chemistry, vol. 2. Brussels, 1838.

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Ure's Dictionary of Chemistry. London, 1831.

Brande's Chemistry. London, 1841.

Graham's Chemistry. London and Philadelphia, 1843.

Booth's Encyclopedia of Chemistry. Philadelphia, 1850.

Regnault's Chemistry. Paris and Philadelphia, 1852.

Gerhardt's Chemistry. Paris, 1854.

Gmelin's Chemistry, vol. 7. London, 1852.

Pelouze & Fremy. Chemistry. Paris, 1850.

" *List of chemical treatises published after April 3, 1854,* "

" *which do mention that chemical fact* "

Comtes Rendues. Paris, April 3, 1854.

Liebig & Kopp's Year book. Giessen, 1855.

Miller's Chemistry. London, 1862.

Watts's Dictionary of Chemistry. London, 1864.

Gmelin's Chemistry, vol. 16. London, 1864.

Musprat's Dictionary of Chemistry, vol. 2. London, about 1856-1858.

Chemical Gazette. London, 1856.

"Q. State what technical works on the subject of the manufacture of fat acid, published between 1823 and 1854, you have examined, and whether any of them contains any description or notice of the process of manufacturing fat acid and glycerin from fats by the action of water at a high temperature and pressure."

"A. I have examined the following technical works, all of which contain descriptions of the various processes for the manufacture of fat acids. None of them mentions or refers to the process for the manufacture of fat acid and glycerin by the action of water on fats at a high temperature and pressure."

Chevreul & Gay Lussac's Patent. Paris, 1825.

Hibert's Encyclopedia. London, 1838.

Dumas's Chemistry, vol. 6. Paris, 1863.

Parnell's Applied Chemistry, vol. 2. London, 1844.

Knapp's Technology. London and Philadelphia, 1848.

Roret's Encyclopedia. Fat Acids. Paris, 1849.

Morfit's Chemistry of Soap and Candles, 1st edition. Philadelphia.

Payen's Chemistry. Paris, 1851.

Official Report of London Exhibition. London, 1851.

Tomlinson's Cyclopedia of Arts. London, 1852.

Appleton's Dictionary. New York, 1852.

Ure's Dictionary of Arts. Boston, 1853.

"Q. state what technical works on the subject, published since 1854, you have examined, and whether they mention the

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process of manufacturing fat acids and glycerin by the action of water on fat at a high temperature and pressure, and to whom they refer as the inventory of that process."

"A. I have examined the following technical works. They all mention the water process, and refer to Tilghman as its inventor:"

Bulletin de la Societe d'Encouragement. Paris, 1855.

Morfit's Chemistry of Soap and Candles, 2d edition. London and Philadelphia, 1856.

Official Report of London Exhibition. London, 1863.

Richardson & Watts' Technology, vol. 1, part 3. London, 1863.

Repertory of Patent Inventions, 3d series, vol. 24, page 408. London, 1854.

Mechanics' Magazine, vol. 61, page 111. London, 1854.

Newton's Journal of the Arts and Sciences, vol. 45. London, 1854.

Franklin Institute Journal, 3d series, vol. 29, page 36. Philadelphia, 1855.

"Q. Please state in general terms the result of your examination of the standard chemical and technical publications."

"A. No one of the technical treatises or chemical works, published prior to 1854, contains any mention either of the chemical fact of the decomposition of fat by water at a high temperature and pressure, or of the manufacturing process founded upon it. After 1854, both the chemical fact and the manufacturing process are mentioned in numerous technical and chemical publications."

The testimony of:

4. *Professor R. E. Rogers,* Professor of Chemistry for ten years in the University of Virginia; Professor of the same science for eighteen years in the University of Pennsylvania; editor of the last American edition of Turner's Chemistry,

5. *Professor Wolcott Gibbs,* who had studied with Professor Hare of Philadelphia; with Dr. Torrey, of New York; with Professors Ramelsberg and Rose in Berlin, Prussia, and with Liebig in Giessen; for ten years Professor of Chemistry and Physics in the Free Academy in New York, and now Rumford Professor in Harvard University,

6. *Professor F. A. Genth,* student for two years with Professor Gmelin; for two with Liebig and others; for three

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years assistant to Bunsen; for two years Professor in the University of Marburg,

7. *Professor Robert Bridges,* Professor of Chemistry in the Philadelphia College of Pharmacy; editor of Graham's Chemistry, and of several editions of Fowne's Chemistry -- all sustained the assertion of Professor Booth as to the originality of Tilghman with the invention.

Professor Gibbs thus testified:

"Q. state when and by whom your attention was first called to the question of the novelty of the plaintiff's patented invention, as affected by defendant's exhibits. State whether you then made a full investigation of the subject, and a report, and state the substance of any such report."

"A. My attention thereto was first called by Mr. Mitchell, the defendant, in the early part of the year 1863. I then made a full investigation of the subject at his request, and gave him a written opinion, the substance of which was *that the plaintiff's invention was new.* "

8. *The testimony of the Patent Office.* In 1858, Mr. Werk, a manufacturer of candles in Cincinnati and afterwards sued by Tilghman as an infringer of his patent, applied to the Patent Office for an improved treatment of fatty acids through the aqueous process. He was thus replied to by the Honorable Joseph Holt, then Commissioner of Patents:

"UNITED STATES PATENT OFFICE"

"June 26th, 1858"

"SIR: Your application for a patent for an improved treatment of fatty acids has been examined. You are referred to Reganault's Chemistry, vol. ii, p. 1594; to Payen's Chemie Industrielle, p. 771, and to the patents of R. A. Tilghman, January, 1855, and October, 1854. Mr. T. is the acknowledged discoverer of this process. The application is refused for want of novelty."

"Respectfully yours &c.;,"

"J. HOLT, Commissioner"

"M. WERK, ESQ."

9. *The London International Exhibition of 1862.* At this exhibition, one of the juries, reporting on the subject of oils, fats, wax, and their products, and referring to the efforts

made "as early as 1855," by M. De Milly, to modify the process of saponification by means of lime, said:

"Instead of effecting this decomposition at a temperature of 212, and employing 14 percent of lime, he raised the temperature by working under pressure and employing only 4 percent of lime."

"At the present time, M. De Milly has indeed reduced the proportion of lime to 21 1/2 percent. This process has been imitated in Austria. Undoubtedly it constitutes a real improvement upon the ordinary method of saponification by lime, *but in spite of this considerable improvement, which is in fact but a combination of Mr. Tilghman's mode of saponification by water at a high temperature* [Footnote 12] combined with the lime process, we cannot believe that these two methods of saponification, under any modification at present attempted, can, in an *economical* point of view, successfully compete with the sulphuric saponification."

10. *Medal of Honor.* The report of the same exhibition [Footnote 13] contains this:

" *MEDALS"*

"UNITED STATES: TILGHMAN, *for fatty acids obtained by aqueous saponification.* "

III. MANUFACTURERS OF CANDLES.

1. Mr. G. F. Wilson, managing agent of Price & Co.'s Patent Candle Company, at Battersea, London -- the largest candle factory in the world -- who, it appeared, was besides a man of education and had made the general and particular matters now under consideration the subject of learned research, and was in the habit of writing and lecturing upon them, affirmed that Tilghman was the discoverer of the invention claimed by him. In a public lecture delivered by him in January, 1856, before the Society of Arts, in London, he said:

"In January, 1854, Mr. Tilghman, an American chemist, who has studied all that has been published here and in France on the subject of acidification and distillation of fatty bodies, obtained

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a patent for exposing fats and oils to the action of water at a high temperature and under great pressure in order to cause the combination of the water with the elements of the neutral fats so as to produce at the same time free fat acids and solution of glycerin. He proposed to effect this by pumping a mixture of fat and water, by means of a force pump, through a coil of pipe heated to about 612 Fahr., kept under a pressure of about 2,000 pounds to the square inch; and he states that the vessel must be closed so that the requisite amount of pressure may be applied by prevent the conversion of water into steam. This is, all must admit, *a beautiful, original* chemical idea, *well carried out.* "

The defendant, Mr. R. G. Mitchell, who was a witness, testified that the process by water, heat, and pressure alone had not been known to him *before* the date of Tilghman's patent, nor indeed known to him until four years afterwards. He said:

"I have known for more than forty, years that fats were acidified by moisture. I never knew that fat acids and glycerin could be obtained from fats by heat, water, and pressure until I heard of it in connection with the patent of Wright & Fouche, in 1859."

ORIGINALITY OF INVENTION

THE DEFENDANT'S SIDE OF THE QUESTION

I. SCIENTIFIC TREATISES.

No scientific treatise was produced which denied, with mention of Tilghman's name, or by specific reference to what he asserted to be his, that he had discovered what in the claim to his patent he claimed as his invention. An extract from a paper in the *Journal of Sciences,* vol. xvi, p. 172, published in London in 1823, entitled, "Change of Fat in Perkins's Engine by Water, Heat, and Pressure,"

and made by the defendant an Exhibit (E) in the case, and somewhat relied on by him, mentioned that

"Mr. Perkins used in his steam cylinder a mixture of about equal parts of Russia tallow and olive oil to lubricate the piston and diminish friction; that the mixture was consequently

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exposed to the action of steam at considerable pressure and temperature, and, being carried on by steam, it was found in the water, giving rise to peculiar appearances."

A particular account, too long to be here inserted, was annexed.

II. MEN OF SCIENCE.

1. *Professor P. H. Vanderweyde,* a native of Holland, educated in chemistry at the Royal University of Delft, M.D., Professor of Chemistry in the New York Medical College, and in the Cooper Institute, and fifteen years in America, was at different times asked and answered thus:

"Q. From your knowledge of chemistry, would you say that complainant was the discoverer of the power of water under heat *and pressure* to dissolve fats into acids and glycerin?"

"A. The more my information about the matter has increased the more I am convinced that the power of *water* to decompose fats into the fatty acids and glycerin was known a long time before the date of Mr. Tilghman's patent."

"Q. Do you know, or did you ever hear of any standard chemical treatise or book which states that complainant made any chemical discovery as to the decomposition of fats into fat acids and glycerin?"

"A. I do not know, nor did I ever hear of such a statement, and, in those standard works, when Mr. Tilghman's process is mentioned at all, it is stated simply that he

took out a patent for a certain apparatus."

" *Cross-examined* "

"Q. state who was the first person, within your knowledge, who made the explicit statement that fat acids and solution of glycerin could be obtained for manufacturing purposes by the action of liquid water on neutral fatty bodies at temperatures above 350 Fahrenheit, and state when and where such statement was made."

"A. I am not aware that any other man made that precise statement, with all the special conditions mentioned in the question, before Mr. Tilghman."

" * * * *"

"Q. Who was the first person who got so far as to use 'water

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alone' in the practical manufacture of stearic and margaric acid, and oleic acid, and glycerin, from neutral fat?"

"A. I know not who the first person was who practically manufactured stearic and the other fatty acids besides glycerin, from the fats by means of water alone; but I know that Mr. Tilghman took a patent for that purpose. I doubt, however, if it was ever put in practical operation. Surely not to make glycerin."

2. The defendant having put in evidence an extract from the *Journal of Science,* London, 1823, vol. xvi, p. 172, entitled "Change of Fat in Perkins's Engine by Water, Heat, and Pressure," which paper was marked "Exhibit E" (quoted *supra,* p. 86 U. S. 314),

Florence Verdin, partner of the defendant, under the firm name of Mitchell & Co., and who testified that he had an interest against the patent, and if in the present suit a sum of money was decreed to be paid to the complainant, he would be, he supposed, responsible for one-half, had testified, in 1868 in another case (all the

testimony in which was received by consent), as follows:

"Q. Would not any manufacturer of ordinary skill and information in his art, as current prior to 1854, have known from Exhibit E that fat acids and glycerin were produced by the action of water at a high temperature and pressure, and does not the presence of acrolein involve the production of glycerin?"

"A. *I* should have known it, and I cannot doubt others would, as a person had only to subject the fat to the action of water at a temperature and pressure named to have acidified fats; acrolein cannot be formed without glycerin's being formed first."

"Q. Do you know of any standard chemical treatise or book which states that the complainant has made any chemical discovery in reference to the decomposition of fats into fat acids and glycerin?"

"A. I do not know of any such works which give Tilghman the credit of being a chemical discoverer."

"Q. Did you ever hear of any standard chemical treatise or book which ascribes to the complainant any such discovery?"

"A. I have never heard of any."

"Q. Are technical works of any value to the manufacturers

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of fat acids and candles, so far as you have examined them, and if so, what?"

"A. They have never been to me; my knowledge was always superior to theirs; they are generally more likely to mislead the manufacturers than to benefit them."

"Q. Is the information communicated in Tilghman's patent of 1854 of any more value to a manufacturer of fat acids and candles than that which is found in defendant's Exhibit E?"

"A. I think there is no difference between the two, and I have always thought, and think so yet, that the patent of Mr. Tilghman had been copied from Exhibit E."

" *Cross-examined* "

"Q. When did you first see it stated in a book or document that highly heated water under pressure would, without the aid of chemicals, decompose neutral fat into fat acid and a solution of glycerin?"

"A. I don't know when."

"Q. Can you swear you ever saw that statement prior to the date of Mr. Tilghman's patent, January, 1854?"

"A. I cannot."

3. See also testimony of Drs. Rand and Wayne, *infra,* pp. 86 U. S. 355 -357.

II

CAPACITY FOR PRACTICAL USE

THE COMPLAINANT'S SIDE OF THE QUESTION

How far Tilghman's discovery or invention had been or could be carried on so as to be practically, that is to say, commercially, of value by the rapid manipulation described by him, or with the *very* high degrees of heat which he mentioned, or with the vessels filled with the mixture alone -- assuming that either rapidity, or specific degrees of high heat, or entire absence of steam from the vessel in which his mixture was to be put were an essential part of his invention as patented -- seemed, as the Reporter read the evidence, to be a matter less clear than that he was the true and first discoverer of what in the claim to his patent he claimed as his invention.

As on the first point, the evidence relied on by him was that of books of science, and more particularly of men of science and manufacturers of candles.

I. SCIENTIFIC TREATISES.

1. *Richardson & Watts's Chemistry* (quoted *supra,* p. 86 U. S. 307): "The only perfectly unobjectionable mode of obtaining glycerin."

2. *Musprat's Chemistry;* article, "Glycerin" (quoted *ut supra*): "A much more economical method is that introduced by Mr. Tilghman."

3. *Watts's Dictionary;* article, "Glycerin" (quoted *ut supra*): "This is the only unobjectionable mode."

II. MEN OF SCIENCE.

1. *Professor J. C. Booth,* already described, thus testified:

"I tried the second apparatus indicated in the patent, with an apparatus quite similar to the drawing accompanying the specification to Mr. Tilghman's patent, except that the coil was circular, rising in a continuous spiral coil from below upwards, so that the exit pipe came from the upper part instead of the lower, as indicated in said drawing."

"As we obtained at the rate of four hundred to four hundred and fifty pounds in twenty four hours, in so small an apparatus, and as the product consisted of fat acid and glycerin, I regard the process as a most perfect manufacturing process -- that is, making fat acid and glycerin in an economical manner, and adapted to commercial uses."

"By comparing the solid fat acids obtained by the coil apparatus, and subsequent clarification and pressure, with the solid fat acids obtained in Grant's candle factory, in Philadelphia, by the sulphuric saponification, I believe that the product of the coil apparatus is fit for making candles. By comparing the glycerin which I obtained by the coil apparatus with several kinds of glycerin of commerce, I believe that the coil apparatus will make a glycerin, suitable for commercial

purposes, equal to that produced by any other process, after resorting to the usual method of purification."

2. *Professor Rogers,* already described:

"I was present at the trial of the process of the complainant,

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in the coil apparatus, in company with Professors Booth and Bridges, and Mr. R. A. Tilghman. It is my opinion, and not only my opinion, but my thorough conviction, that it is a process altogether adapted to carrying out the method of Mr. Tilghman."

"The odor of the products evinced nothing offensive which would indicate the presence of acrolein as a hurtful substance, the small amount of oxide of iron being an accidental and not necessarily present substance, and was readily removable."

3. *Professor Bridges,* already described, stated that he had been present at the trial of the apparatus referred to; that the trial was made at "about the temperature of the melting of lead." He exhibited specimens of the lard stearin used, and some of the results of the operation, describing particularly how they were obtained. He concluded by saying:

"From the amount of the material used during the operation, and from the character of the results, I consider the apparatus of Tilghman as one capable of carrying on, in a practical manner, his process."

III. MANUFACTURERS OF CANDLES.

1. In June, 1854, Tilghman exhibited his patent and his coil apparatus to Mr. G. F. Wilson, above named as the managing director of Price & Co.'s large candle company in England, and made experiments with it before him. On the 13th of December, 1855, after having thus seen it, that company agreed to pay Tilghman 1000 sterling a year for the use of that patent, and some minor ones of less importance that expired prior to 1859, they, Price & Co., being free to terminate

the arrangement at any time by giving Tilghman two years' notice. They had not terminated it in May, 1864, when the testimony to prove facts just stated was taken, but had, since 1859, paid in each year, and in 1864 were still paying to Tilghman the 1000 sterling for the use of his patent of 9th January, 1854, alone.

2. So a certain Monier, of Paris, one of the managing agents of the *Societe Generale de Stearinerie,* at Villette, near Paris, having seen Tilghman's apparatus at Tilghman's laboratory in London, in June, 1854, and samples of fat acid and

glycerin said to have been produced by it, made a preliminary agreement with Tilghman that "after experiments had been made to enable Monier to judge of the efficacy and reality of the invention," a contract by which they were "to buy the absolute, general, and exclusive license for the new processes of Mr. R. A. Tilghman, giving him a royalty in money," should be made before a notary. The coil apparatus was brought to Paris and worked at Monier's factory, many experiments being made with it. It was worked both by hand and by steam power. A contract in form was then made between Tilghman and Monier, and 15,000 francs were paid to Tilghman. Tilghman and his brother then attempted to make a large apparatus at Monier's factory at Paris. This occupied nearly six months, a good deal of what was done having been superintended by Tilghman's brother, and not by him, he having been ill a short part of the time, and for much the greatest absent in America. The experiments, owing to causes about which Tilghman and Monier disagreed, were unsuccessful, and the contract was annulled by consent of both parties. Tilghman having returned to France, a new contract was made with him, and 12,000 or 15,000 francs paid to him, and more experiments made in Paris. They too were unsuccessful, Tilghman and Monier disagreeing as before about the cause. Tilghman being now in Philadelphia, Monier, representing that the agreement between them was verbal, and not producing the written contract, sued him in one of the inferior courts of Paris, claiming damages in 25,000 francs. Judgment by default for want of an appearance was got by Monier, and damages given in 2,000 francs. Tilghman, in America, hearing of this, ordered an appeal to be taken, and one was taken. The

appeal, however, was not prosecuted. A compromise was made between the parties by which 1,000 francs were paid to Tilghman, the lawsuit discontinued, all previous engagements made "null and of no effect," and Tilghman left free to "reenter into the free use and enjoyment of his patents."

3. *The testimony of Charles Taylor Jones,* of Cincinnati, since

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1849 a member of the firm of Gross & Dietrich, manufacturers of candles.

"Q. State the process first employed by you for decomposing fats into fat acids and solution of glycerin."

"A. The first process used by me was that of saponification with about fourteen percent of lime, in open vessels, and decomposing the lime soap thus obtained with sulphuric acid; the quantity of sulphuric acid requisite being about two and a half pounds to each pound of lime."

"Q. What was the next process, and what advantages had it over the first? And why did you abandon it?"

"A. The next process was saponification under pressure of about 130 lbs. to the square inch, with six to seven percent of lime, and a corresponding diminution of sulphuric acid. It had the advantage over the first process of diminishing the cost of the operation just as much as the lime and sulphuric acid was diminished. This process was abandoned for another, which enabled me to dispense entirely with the use of lime and sulphuric acid."

"Q. State what process you now use and what are its advantages, and also whether you practice the said process by a license from the complainant, and have paid and are to continue to pay him for its use."

"A. I use the process patented to Tilghman, the advantages of which, over all other processes known to me, are that it enables me to produce fat acids without the use of lime or sulphuric acid. I practice this process by a license from the

complainant, and have paid and am to continue to pay him for its use."

"Q. State how much fat has been decomposed at your factory by the action of water only at a high temperature and corresponding steam pressure of 300 lbs. to the square inch."

"A. About 90,000 lbs."

"Q. How much fat is treated at each charge of the apparatus? And how much fat could you decompose per week, if working night and day, at 300 lbs. pressure, at the same rate you have obtained in working by daylight only?"

"A. From 6,000 lbs. to 7,000 lbs. of fat is treated at each charge of the apparatus, and I could decompose about 150,000 lbs. per week by continuous work. "

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"Q. State how long it takes, in your apparatus, after the charge has been heated up, to decompose it into fat acid and glycerin by the action of water alone at 300 lbs. steam pressure."

"A. About five hours."

"Q. Would you have any difficulty in continuing to work by water only if you desired to do so?"

"A. I think not."

"Q. Have you any specimens of stearic acid and of candles made from fat decomposed at your factory by water only? If so, produce them, and mark them."

"A. I have such specimens. Here they are, marked as directed."

"Q. How much fat have you worked, in all, under the complainant's patent when using one-half percent of lime in addition to the action of the heated water? And how long has your factory been working Tilghman's process?"

"A. I have treated 738,000 lbs. of fat in which a half percent of lime was used, and I have been using Tilghman's process since the first of November last."

"Q. Examine the first described process in the complainant's patent, and state whether or not you would infer therefrom that the strong vessel mentioned was to be entirely filled up with oil and water, so as to leave no steam room whatever in the vessel."

"A. I have examined this part of the patent, and I can see nothing in it requiring the vessel named to be completely filled with oil and water."

"Q. State whether there are reasons, obvious to anyone accustomed to steam boilers, why said vessels should or should not be entirely full, and state such reasons."

"A. There are reasons which I should think would be entirely obvious to one accustomed to steam boilers why said vessels should not be perfectly filled with oil and water, the prominent one of which, to my mind, would be the danger of applying even a moderate heat to the vessel, under such circumstances, inasmuch as the expansion of the contents under only a moderate heat might rend the vessel asunder."

"Q. Examine the second described process in the complainant's patent, and state whether or not you can see reasons for the direction there given, to keep the tubes entirely full of liquid, and not to allow steam to accumulate in them; if yea, state such reasons in detail. "

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"A. I see no reasons given therefor in that second part of the patent. Obvious reasons for that direction occur to my mind as a manufacturer, which are the avoidance of irregular working of the machinery indicated, and consequently increased strain and wear of the machinery."

"Q. Do you know the rules for calculating the strength of cylindrical iron boilers? If yea, calculate thereby the strength of perfectly welded iron tubes of the

dimensions directed to be used in the second described apparatus in plaintiff's patent."

"A. I know the rules which I believe to be generally adopted for calculating the strength of boilers. By that rule, I compute the strength of the tubes alluded to in the second part of the plaintiff's patent at 60,000 lbs. -- that is, it would take 60,000 lbs. to burst them."

" *Cross-examined* "

"Q. In the first process used by you, was not water used, and were fats ever decomposed into fat acids and a solution of glycerin without the intervention of water, which was always necessarily present when glycerin was obtained, and generally used in connection with steam?"

"A. Water was used in the first process described, but in quantity only slightly in excess of that requisite for preparing the milk of lime. I do not know of the decomposition of neutral fats into fat acids and a solution of glycerin ever having been attained without the intervention of water. Within the limits of my experience or knowledge, steam has always been an agent in the process."

"Q. When was the second process, described by you, first used by yourself?"

"A. In the fall of 1859."

"Q. You state you use the process patented to Mr. Tilghman. Describe in detail that process as used in your factory."

"A. I place the melted fat to be treated in a large vessel with water, equal to one half the bulk or weight of the fat, or in excess of that proportion, and subject the charge to a pressure of steam, 300 lbs. to the square inch, for a period of about five hours, keeping the water and fat in intimate contact by pumping the water from the bottom to the top, and discharging it on the surface of the fat to make its way to the bottom. I prefer, however, to use half of one percent of lime, inasmuch

as that quantity of alkali enables me to perfect the decomposition in four hours' working at a pressure of 250 lbs. per square inch, with material economy of fuel, and of wear and tear of machinery. Since ascertaining the advantages of this mode I have adhered to it."

"Q. Describe particularly when your apparatus was first put in operation, under whose superintendence, where made, the size, construction, shape, materials that compose it, its capacity and cost, the quantity of fat and water put into the apparatus at one time, how full at each charge, and the disposition made of the products after it was decomposed."

"A. My apparatus was first put in operation in September, 1863, under the superintendence of R. A. Tilghman. The vessel in which the fat is treated was made in Philadelphia. This vessel comprises a tube of about thirty eight feet in length and thirty eight inches in internal diameter, made of iron plates of half-inch thickness and a copper tube of nearly the same length, and about thirty five inches diameter, placed inside the iron tube so as to leave an annular space of about one and a half inches between the copper and iron vessel. The estimated capacity of the vessel is about 10,000 lbs. of oil and water, and the quantity usually put into the vessel at one time is 6,000 lbs. of fat, and about 4,000 lbs. of water, which is held by the copper vessel mentioned above, and serves to fill it within about three feet of the head or top. When the decomposition is perfected, the water holding the glycerin in solution is discharged into its proper receptacle, and the fat acids into their place."

"Q. Explain why two tubes are used instead of one, and why they are of different metals."

"A. Because the cheapness of iron, and its greater strength as compared with copper, suggested its use to resist the great requisite pressure, and the inner vessel was introduced to save the iron from contact with the fat acids, which would rapidly corrode the iron and soon render such iron vessel unfit for use."

"Q. In the description of the operation now used by you, you mention oil and water as the contents of the boiler. When no lime is used, are the products satisfactory?"

"A. The products are satisfactory when no lime is used. I have treated fourteen or fifteen charges of 6,000 lbs. to 7,000 lbs. of fat, each with water alone. The reasons for adding lime in subsequent treatments was the desire to diminish the pressure,

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and this course has been persevered in not only because that object was attained, but because an economy was effected in fuel, labor, and time."

"Q. Do you now state that in order to make the process with the greatest economy in practice, the aid of the pump to circulate the water and oil freely, and the presence of lime in the proportion described by you, are necessary?"

"A. I do not know that a less quantity of lime would not suffice, but I do regard the use of the pump and of some lime essential to the use of my apparatus with the greatest economy."

"Q. By whose direction do you use the pump and the percentage of lime now employed by you?"

"A. The pump was an original part of the apparatus named, and its use directed by the complainant. I use the lime solely for my own convenience and advantage, at my own instance, without direction."

"Q. Who was present when you first employed lime in the process, and who first suggested its use?"

"A. Some of my employees were the only ones present when lime was first used. The suggestion of its use, I think, was made by my foreman at the factory."

"Q. Is not lime used in the process produced by the apparatus of Mr. Tilghman, in every instance, so far as your knowledge extends, when said apparatus is used?"

"A. I believe it is."

"Q. Why?"

"A. I believe it is used for the same reasons that I use it -- namely to economize time and cost."

"Q. State whether anyone in your manufactory ever mixed a fatty body with from a third to a half of its bulk of water and placed the mixture in any convenient vessel in which it could be heated to the melting point of lead; that is, to 600 Fahrenheit, until the operation was completed, the product being free fat acid and a solution of glycerin?"

"A. No."

"Q. Have you always used the pump in your apparatus?"

"A. I have invariably used the pump."

"Q. State how long it takes to heat up the charge in your apparatus."

"A. I have not noted the time. The water is heated up to a temperature indicated by a pressure of 250 lbs. to the square

inch before its introduction to the vessel in which the fat is decomposed, and the pump is set to work immediately after the water has been introduced. This water is heated in the boilers which supply the steam pressure, and is blown up from them into the vessel containing the fat."

"Q. In your examination in chief, you state that you have examined the first described process in the complainant's patent and could see nothing in it requiring the vessel named to be completely filled with oil and water; please quote from the said specification any part which states that the convenient vessel therein mentioned should not be completely filled with fat and water, or any passage implying the same."

"A. There is no part of the said specification which requires explicitly or implicitly that the said vessel should not be completely filled."

"Q. Do you now say that, by a plain interpretation of said specification, as a manufacturer, you would not infer that said vessel was to be completely filled with oil and water?"

"A. I do now say that, as a manufacturer, I would not infer that a plain interpretation thereof would require the vessel to be completely filled with fat and water."

"Q. Have you ever used, for the manufacture of fat acids and glycerin, such an apparatus as is described in the second part of the complainant's patent?"

"A. I have not."

"Q. Please quote from the complainant's patent the words explicitly or implicitly requiring or authorizing the use of a pump and one half percent of lime as used in complainant's apparatus, now employed in your factory."

"A. I find no such words."

"Q. Is there anything to that effect in the patent as reduced to practice in your factory?"

"A. I believe not, sir."

"Q. State how the steam pressure of your apparatus is produced, and how it is applied."

"A. It is produced by cylindrical boilers, which are twenty four inches in diameter and about thirty four feet long, of which there are two. The steam generated in them is introduced into the upper part of the digester, and into an angular space between the iron and copper vessels composing the digester, the iron vessel being closed steam tight, and the upper part of the

copper vessel sufficiently open to admit the steam directly into contact with the charge."

" *Reexamined* "

"Q. You have stated the use of the pump in the apparatus erected by the plaintiff at your factory, to be the circulation of the water through the oil under treatment; now state, from an examination of the second described apparatus in Tilghman's patent, whether or not provision has been made for producing this thorough mixture of the fat and water before it went into the apparatus, as well as for renewing the state of mixture, should it be necessary, within the apparatus itself."

"A. It seems to me that provision has been made for effecting and renewing that intimate mixture; not having used the apparatus described in the second part of the plaintiff's patent, I cannot speak from experience."

"Q. Has the pump employed in your apparatus ever failed to act? Of what material is it composed?"

"A. It has not. It is composed of bronze."

IV. OTHER PROOFS.

1. *Tilghman offered to show to the defendant his coil apparatus practically at work, and the offer was declined.*

Just before the testimony had been closed, Mitchell asked for the inspection of Tilghman's apparatus. The examiner's minutes proceed:

"March 24, 1864. Tilghman replied:"

"That the coil apparatus is very weighty and bulky, and was dismantled at the request of Professors Booth and Bridges the day after the experiments therewith were tried by them in order to enable them to examine its interior construction and dimensions; that to get the coil apparatus again in working order and try new experiments would require considerable time and delay the hearing; that the

defendant neglected to make his request until the moment of adjournment on the day originally fixed for closing the testimony; that the complainant has, however, caused the same experiments to be repeated in a more portable apparatus, which he produces and now formally offers to experiment with it, and try and pertinent experiment in the presence of defendant, on Friday, March 25, at any suitable

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place and hour which defendant will now indicate, it being understood also that such experiments tried for defendant are not to be permitted to delay the hearing."

To this offer the defendant made no reply.

Tilghman subsequently thus addressed his counsel:

"April 5, 1864"

"SIR: The only objection which the complainant had to the repeating of his experiments on the coil apparatus was the risk of delaying the hearing to the next term."

"As the court has ordered that the case shall still be heard this term, though at a later day, the complainant now offers to repeat the experiment tried by Professors Booth, Rogers, and Bridges, in the presence of the defendant; and requests the defendant to signify his acquiescence or refusal of this proposition within five days. If accepted, the complainant will at once have his apparatus put in order, and then appoint the earliest day which may be convenient to both parties for the defendant to visit complainant's laboratory in Philadelphia, and see the process in action."

"Very truly yours,"

"R. A. TILGHMAN"

"G. C. GODDARD, ESQ.,"

"Solicitor for defendant, 17 William Street, New York"

And thus subsequently (enclosing a copy of the letter) again:

"PHILADELPHIA, April 13, 1864"

"SIR: On the 5th instant I mailed to you the notice of which the following is a copy, requesting the favor of an answer within five days."

"For fear that you did not receive it, I now send this copy of my former note, requesting the favor of an answer accepting or declining my proposition within the five days after your receipt of this present notice, inasmuch as I have other engagements to which I wish to attend. I would also thank you to acknowledge the receipt of my former notice, if it was received by you."

"Very respectfully yours,"

"R. A. TILGHMAN"

"G. C. GODDARD, ESQ.,"

"Solicitor for defendant, 17 William Street, New York "

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Mr. Goddard, the counsel, thus replied:

"NEW YORK, April 15, 1864"

"DEAR SIR: Yours of the 13th is received, as was yours of the 4th or 5th, to which I think I made answer."

"After the use of your coil apparatus by us was declined by you, we made arrangements which we hope will supersede the necessity of making experiments on yours. Should we change our minds, and desire to experiment on yours, we will advise you; but at present we do not."

"GEORGE C. GODDARD"

"MR. A. TILGHMAN"

The minutes of testimony taken before the examiner next contained the following:

"May 6, 1864"

"Counsel for the defendant offers to repeat the experiments in the coil apparatus, and on the Scharling apparatus, in the presence of complainant, and make alterations therein to make it conform to complainant's patent, if any are necessary, it being understood that such experiments are to be made at a time which will give opportunity to give evidence in this cause in respect thereto. Also to repeat the experiments on the Scharling apparatus, in complainant's presence."

"Mr. Harding, in behalf of Mr. Tilghman, replies by giving in evidence the offers contained in Mr. Tilghman's letter of April 13, 1864, to G. C. Goddard, Esq., the defendant's counsel, together with the reply, April 15, 1864, of the said counsel, and further refers to his offer to repeat the complainant's experiments on the digester, contained in the record of the date of March 24, 1864. And adds that, as the complainant has a complete apparatus, constructed in accordance with his patent, the successful operation of which he has proved by disinterested experts, and has repeated the offer to exhibit to the defendants, he cannot see any reason why he should occupy time in altering the apparatus now at the defendant's works, especially since the time for closing testimony and the day of hearing will not leave time to reopen this matter. "

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CAPACITY FOR PRACTICAL USE

THE DEFENDANT'S SIDE OF THE QUESTION

I. SCIENTIFIC TREATISES.

Nothing as to the incapacity for practical use of the invention patented to Tilghman was derived from this source.

II. MEN OF SCIENCE.

1. *Professor Vanderweyde* -- already described, *supra,* p. 86 U. S. 315 -- on examination in chief, stated that he had made experiments -- Professor Doremus being present -- for testing the effects of water on fat at a high temperature and pressure. They were careful to follow the directions given in the specifications of Tilghman's patent, except that they did not use the apparatus specified in it. The experiments were not for the purpose of testing the apparatus described. The witness said:

"The first experiment was: fat and water were placed in an iron vessel, hermetically closed. This vessel was provided with a few holes to place in the different substances mentioned in the patent, by the melting of which the temperature was to be determined. The experiment was made by raising the temperature to the melting point of lead, keeping at that temperature for ten minutes, removing the vessel from the fire, cooling it in water and opening it. The result was that the fat was changed into a black substance, which possessed the well known and very characteristic strong smell of acrolaic acid. [Sample exhibited.] Dr. Doremus kept detailed notes. Chemically speaking, I would declare the sample a mixture of acrolaic, stearic, margaric, and oleic acids with water. Heat was obtained from charcoal."

"The second experiment was in all respects similar to the first except that the temperature was only carried up to the melting point of tin. The result was that the fat was not so black-looking as in the first instance; but the smell of the acrolaic acid was not less offensive. [Sample of this result exhibited.] This sample is the same as the former. There is a difference in color, produced by the difference in temperature, almost 200. "

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"Doubts were entertained by both Dr. Doremus and myself if the experiments were fair, as perhaps some parts of the iron vessel might be exposed to a temperature somewhere above the melting point of lead and tin; therefore it was suggested by

us to procure a bath of melted lead and place the vessel in it in order to have an equal temperature throughout. This was done. The same experiments were repeated as in the first instance, with the vessel immersed in the melted lead, taking care that the lead was not heated above its melting point, keeping a hose ready to bring in a water jet into the fire when supposed necessary. In the first experiment in the bath, the vessel was full; in the second, it was filled about two-thirds, as doubts were expressed if the patent requires the vessel to be full or not. Of the results I have the samples here. [Samples exhibited.] In both instances, the smell of the acrolaic acid was as strong as the results of the first experiments."

"Q. What caused or produced the acrolein in these experiments?"

"A. As the temperature of melted lead corresponds with the boiling point of fat, and as the boiling of fat is in fact a chemical decomposition of the base of the fat, the glycerin, into acrolein or acrolaic acid, it was anticipated that exposing fat to so high a temperature would have the effect of destroying the glycerin and to contaminate the fatty acids with so much acrolein as to make them comparatively worthless. The result fully answered our expectations. Acrolein is produced in no other way than by the decomposition or destruction of glycerin. In the first two experiments, there was a little agitation, as the vessel was standing in the charcoal, and from time to time moved up or down to regulate the heat; in the last two experiments, there was considerable agitation, as the vessel was rolled about in the melted lead in order to secure a uniform temperature."

"Q. Is the method described in said specification for producing fat acids and glycerin, in your opinion, practical, and if not, why?"

"A. That specification bases the treatment of fats on two principles: one, a special, very ingenious apparatus, about the practicability of which I, however, am much in doubt. The other, the action of water and heat combined on fat in a close vessel. The objection, however, is that the temperatures prescribed

in the specification are altogether too high, and that no provision is made to keep the particles of fat and water in a continually varying contact by means of circulation of some kind."

"Q. Why is this contact and circulation necessary?"

"A. It has been ascertained, first by Chevreul and later by other chemists, that fats are composed of one base, glycerin, and three or more acids, stearic, margaric, and oleic, and that the action of water will be sufficient to separate those substances; the water, having a strong affinity for glycerin, has the power to abstract this base from the fats, and Berthollot stated more than ten years ago that water will rapidly, at 360, or slowly at ordinary temperature, resolve all fatty bodies into the acids and glycerin. Circulation is only necessary to hasten the process."

" *Cross-examined* "

"Q. What temperature, in your judgment, would be about as low as it would be proper to use as a practical one for decomposing of fats in the arts for the manufacture of candles?"

"A. When water alone is used under pressure, the most profitable temperature ranges from 350 to 390. When we are below this, the time is too long. When we go beyond this, to above 400, 430, the melting point of tin, 500, the melting point of bismuth, and 615, the melting point of lead, as Mr. Tilghman prescribes in his patent, we decompose the glycerin entirely destroy it and contaminate the fatty acids with acrolein."

"Q. Prior to the experiment with what you call Mr. Tilghman's mode, state precisely what experiments you had tried to enable you to express an opinion as to the temperature at which fat will begin to decompose into acrolein."

"A. I have never tried any experiments expressly for the purpose to verify this temperature, but I have had plenty occasion, during my labors in different laboratories, to observe this change incidentally, and so has, I believe, every cook; but I was ahead of the cook in making an estimate of the temperature, and always

adopting at about 620, the boiling point of fat, or the melting point of lead, and this view is fully confirmed by the experiments stated."

"Q. Who took part in the experiments you have described, to verify what you call Mr. Tilghman's process? Who was present, and where were they tried?

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"

"A. Dr. Doremus, myself, Mr. Verdin, senior (Mr. Mitchell's partner), and two or three men assisting to regulate the fires &c.; The experiments were tried at Mr. Mitchell's factory."

"Q. Was no glycerin left undecomposed in your experiments with what you call the Tilghman process?"

"A. In some of the four experiments there was."

"Q. Why was it left undecomposed in some and not in others?"

"A. I don't know."

"Q. Why did you not mention in your examination in chief that you sometimes obtained glycerin?"

"A. Because I made all my statements by memory. They were quite long, and it is very natural to forget some particular when the attention is not called to it by a direct question, as is done now."

"Q. Did you ever see or try Mr. Tilghman's apparatus as described in his patent?"

"A. I like to see anyone who saw it in successful operation. I never saw it; and it is the impression generally entertained by those who understand those matters that it never has been, nor never will be, except by some important modifications, or rather change."

"Q. Name every person skilled in the art of treating fats practically whom you know entertain and have expressed to you this opinion."

"A. Among the practical men I know is, of course, at the head of the list Mr. Mitchell, Mr. Verdin, and Mr. Verdin, Jr., and all the intelligent employees in their factory. With other practical men I had not occasion to converse on the subject, but no scientific man will doubt that they are right."

"Q. Why do you yourself pronounce Mr. Tilghman's apparatus impracticable?"

"A. In the first place, because it does not provide for a circulation sufficient to bring the particles of oil and water in a continually varying contact. In Mr. Tilghman's apparatus, the fat is only pushed forward with the water by means of a piston, through a long tube coiled up, escaping at one end in proportion as it is pressed in at the other extremity. The first extremity is closed by a safety valve charged to stand a pressure of not less than 130 to 150 atmospheres. Now, it is doubtful that if this safety valve is once opened by the pressure of the force pump, if not by the expansion of the steam necessarily formed

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when some exit presents itself, a great deal more of the contents will escape than is forced in at the other end. This is a view which I cannot help entertaining till seeing it to be erroneous by the practical operation of said apparatus, always supposing the apparatus to be constructed exactly as the patent describes it."

"Q. If fat or water are kept in a perfect state of mechanical mixture while exposed to heat, is any other circulation needed to decompose the fat?"

"A. You cannot possibly keep fat and water in a mechanical mixture when at rest or simply pushed forward, as is the case in Mr. Tilghman's apparatus. To keep them in a mechanical mixture, you have continually either to bring the water from below over the fat above, as is done by the circulation process, or may be done with some pump, or the mixture may be stirred with some kind of wheel, otherwise fat and water will follow the laws of their respective specific gravities; the water

below, the fat above"

"Q. Question repeated."

"A. Mechanical mixture alone will, of course, promote the action; but when this is combined with a continual motion and intermingling of the two substances, the action will be greatly improved, and insofar circulation may be considered necessary."

2. *Professor Ogden Doremus,* resident in New York, who began the study of chemistry with Dr. Draper in the city just named; who had been Professor of Chemistry in the Brooklyn Medical College, in the New York Medical College, in the College of Pharmacy, New York, and was now (1864) professor of the same science in the Bellevue Medical College and the Free Academy in the same city.

"I assisted, in February, 1864, with Professor Vanderweyde, in performing experiments after the method described in the specification to Tilghman's patent of 1854."

"[The witness then described at length the apparatus and the experiments.]"

"The fatty acids produced were not in a pure state. Acrolein was produced at each operation. It was produced by the

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high temperature to which the tallow was heated in the presence of water. The temperature, however, was not higher than that indicated in Mr. Tilghman's specification as proper."

" *Cross-examined* "

"Q. What do you know about the condition of that apparatus at the time you tried that experiment, and of its previous use?"

"A. I know not what use it had been put to prior to the experiment, but believed it to be in a fitting condition for an honest investigation of the subject."

"Q. Who put the fat into it?"

"A. The tallow and water were weighed out by Mr. Verdin, in the presence of Professor Vanderweyde and myself; they were poured into the apparatus by a workman from the story above, Dr. Vanderweyde accompanying him, the other remaining below."

"Q. Were any means tried in your presence to satisfy you whether any remains of fat acids might be adhering to the interior of the vessel in the last operation in it?"

"A. The vessel was simply washed out; I felt satisfied that the vessel was clean; my impression is, it was hot water, but I am not certain."

"Q. Did you test any of the results of that experiment as to the proportion of the fat acids obtained to the whole mass?"

"A. I did not; I made a rough approximation of an analysis, and should judge there was at least five percent of acid."

3. *The Paris jury of savants,* already mentioned, [Footnote 14] at the Exposition of 1855, after stating that Tilghman was the first who had the idea of undertaking, on a large scale, the saponification of fatty bodies by water, and after describing the coil apparatus recommended by him, said:

"Visiting the manufactory of Messrs. Monier & Co., at Villette, near Paris, we had an opportunity of seeing the trial of the continuous process in its application to palm oil."

"We are sorry to say that the fatty matter on coming out of the apparatus was not at all deodorized, and, more besides than that, that it gave out a strong odor of acrolein. From the point

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of view of the quality of the products, this arrangement of apparatus, then, by no means realized the end which the author has proposed. Moreover, in our opinion,

the chances of deterioration of a system of apparatus of any kind which works constantly at a temperature capable of exerting a pressure of ninety to one hundred atmospheres are such that it is hardly possible that industry will utilize it, even if the products which it furnishes were irreproachable."

4. *The jury of the London International Exhibition,* already mentioned [Footnote 15] as having given Tilghman the credit of saponification by water, and declared that De Milly had only much improved it, added that they doubted whether the two methods, "under any modifications up to that time attempted, successfully compete with the sulphuric saponification."

III. MANUFACTURERS OF CANDLES

1. *Nathaniel Ropes,* resident in Cincinnati, Ohio, a manufacturer of star candles, sometimes called adamantine candles, and of lard oil, a witness of the defendant.

"Q. Describe the old process used in your factory by which you obtained the fatty acids and glycerin, and describe the process now used there."

"A. We formerly worked in an open tub with about thirteen percent of lime and about twice that quantity of sulphuric acid; we now operate in close tanks, copper tanks, and use about a half percent of lime and about twice that quantity of sulphuric acid, and have operated under a pressure of about 150 lbs. or 160 lbs. to the square inch. But I feel satisfied in my own mind that lime could be dispensed with altogether under a higher pressure, probably 180 lbs. to 200 lbs., and the same result accomplished in about the same time -- say six or seven hours -- whereas under a pressure of only 150 lbs. it would take from twelve to twenty hours to accomplish a like result, depending upon the quantity of water and the quality of stock used. We have taken twenty hours, but, with a better quality of stock and nearly double the quantity of water, we have accomplished the result in about twelve hours; under a higher

pressure, the time would be very much shortened. In the twelve-hour operation, with 2,000 lbs. of prime stearin and the same quantity of water introduced, 1,000 lbs. each time, a beautiful result was produced. The separation was perfect and the stock well crystallized. We have continued on since using a half percent of lime, as we prefer doing this to adding a greater pressure than 150 lbs. or 160 lbs. to our works, as we incur less risk from explosion. We have not repeated the operation since then without any lime, not because we don't think them practicable, for I fully believe that under pressure -- say of 200 lbs. to the square inch, which would give something like 400 Fahrenheit, I should suppose -- as good a result could be obtained in as short a time as with a half a pound of lime under a pressure of only 150 lbs. to the square inch. This last is, as I say, a matter of opinion, without having tested it."

"Q. Describe your works; also describe the mode of their operation when you first began; under whose superintendence; what changes you made in its operations by experimenting therewith, and how long you experimented therewith before finally adopting your present mode of operation."

"A. We generate steam in an iron boiler, about thirty feet in length and forty inches diameter. Another boiler is connected with our copper tanks by means of iron steam pipes, with stopcocks attached, for letting off or on the steam from the first named boiler; steam is made to operate on the crank inside, that revolves by means of a pulley. The steam agitates the stock inside of these boilers. When sufficiently cooked it is forced off through pipes to an open tub on the second floor. The tank was first brought on in January, 1860; it was introduced under the superintendence of Mr. B. C. Tilghman, brother of the patentee; he operated or experimented for several months; he had never had an opportunity of operating with lard stearin; he was willing, if I would find the stock, to operate without any compensation, and we did so operate for several months; after that, as long as I continued to operate, I was to pay him, and am still to pay him twenty cents a hundred. Mr. Tilghman desired the place and the opportunity where he could exhibit this operation to other manufacturers, and he proposed, if I was not satisfied with the operation and the working of the apparatus, to take it away

without expense to me; but I was so well satisfied with it that I purchased

of him the tank and its connections probably five or six months after its first introduction -- in August, 1860. I have made no particular changes since that time, with the exception of introducing this other tank, and from that time forward we have continued to operate in this and no other way."

"Q. State when you first introduced lime, and the quantity."

"A. We introduced it from the start, a half percent."

"Q. Describe the construction and the operation of the mixer or stirrer, and whether or not the mixer is essential, in mixing together the ingredients in your decomposing tanks, to the decomposition of the fats."

"A. The shaft is constructed with wings, or more properly arms, through its whole length, so that when it revolves it keeps the whole of the stock in agitation. To show the importance of this, the arms upon my shaft on the new tank are not sufficiently extended, and the stock would collect at one end of it, and we would have to take off the main head and clear it out. I am now extending the shaft in my new boiler to its full extent, so that the stock may be well agitated throughout the full extent of the boiler. We have had no trouble with the small boiler, which was constructed under Mr. Tilghman's directions. This fault that I speak of was only with my new tank. Under this mode of operation, which I have adopted, the mixer or stirrer is essential to the decomposition of the fat. At the same time, other apparatus might possibly be constructed in which the mixer or stirrer might be dispensed with."

"Q. In the boiler furnished by Mr. Tilghman, or in your own tanks, state whether or not you have ever produced free fatty acids or glycerin without the use of the stirrer or agitator just described."

"A. No sir, we never have. We have never tested it without the use of the stirrer. We never have attempted it."

"Q. State whether or not, after your process is completed, the glycerin water contains free fatty acids; if yea, how are the free fat acids separated from the glycerin water?"

"A. I don't think there is any free fat acids connected with the glycerin water. They are separated by the process."

"Q. State whether or not water is used in the old process as well as in the new."

"A. It could not be used to the same advantage as under the new. If I understand Mr. Tilghman's process, it is to produce

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a free fat acid with one operation, under pressure, either with or without lime; but if so much lime is used as to produce a lime soap, it goes without his process, right or wrong. Of course water is used in the old process, but in diminished quantities. We dilute our sulphuric acid with water, and a sufficiency is used, of course, to boil up the lime soap."

"Q. In the practical operation of your process, as introduced by Mr. Tilghman, state whether or not you use any other agents than those employed formerly in the old process."

"A. No, sir; none other. No other agents, and these (with the exception of water, which we use largely) in very small quantities."

"Q. State where, if at any place within your personal knowledge, soap or candles are manufactured from free fat acids produced by the use of water alone, at a high temperature and pressure, without the use of any alkali."

"A. I can't say that I know of any place. I don't know about other establishments, of my own personal knowledge."

"Q. State where, if at any place, the manufacture of free fat acids by water alone, at a high temperature and pressure, has been tried under the direction of B. H.

Tilghman or B. C. Tilghman, and desisted or discontinued in whole or in part, and afterward some alkali used in the process."

"A. I don't know of any place where it has been tried and been discontinued -- that is, voluntarily discontinued."

"Q. State whether or not, in your own factory, in the two operations you have mentioned, of twelve and twenty hours respectively, such was the case."

"A. No, sir; we did not. We never, in our factory, adopted the use of water alone except with a view of testing the practicability of it. We preferred in our factory to use a half percent of lime, with a pressure of 150 lbs. to the square inch, rather than to subject our works to the higher pressure which would be necessary to produce the result without lime. It is only with reference to safety that we have not discontinued the use of lime altogether, and subjected our works, boiler and tanks, to a higher pressure."

"Q. State whether or not anyone in your factory has ever mixed a fatty body with from a third to a half of its bulk of water, and placed the mixture in any convenient vessel in which it can be heated to the melting point of lead, until the operation

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was completed, the products being free fat acids and a solution of glycerin."

"A. No, sir."

" *Cross examined* "

"Q. State as nearly as you can how many pounds of stock you have worked into good stearic acid with the Tilghman process, and without the use of any lime."

"A. About 8,000 lbs. altogether. About 6,000 lbs. successfully; a very good result from 8,000 lbs."

"Q. Are you or not satisfied that the Tilghman process, without the aid of any lime, is a practical process?"

"A. I think it is, sir."

"Q. Could you have continued to work that process without any lime regularly and daily?"

"A. I think so, sir; yes, I think so."

"Q. Was not this 6,000 lbs. of stearic acid made into merchantable candles? What was their character?"

"A. They were made into candles; they were first rate candles -- no better; they were unexceptionable. All were made into candles, with the exception of about 150 lbs., which quantity of the stearic acid was retained for Mr. Tilghman, and a portion of it to be retained at home as a sample of what could be accomplished without the use of lime."

"Q. Can you produce a specimen of that stearic acid?"

"A. I have a specimen here. [Marked by the commissioner.]"

"Q. How many pounds of stock have you worked with the apparatus and process of Tilghman since you first commenced?"

"A. I took it off from my books last night, as you requested. From February 1, 1860, to April 1, 1863, 1,127,000 lbs. under that process."

"Q. How many pounds of lime and how many of sulphuric acid did you save by the Tilghman process on each 100 lbs. of stock worked by you, as compared with the old process used prior to the introduction of Mr. Tilghman's process?"

"A. Well, we saved about twelve and a half pounds of lime and twenty five pounds of sulphuric acid on the hundred pounds of stock."

"Q. In your opinion, is it or not owing to the decomposing power of highly heated water under pressure that this saving is due?

"

"A. Yes, sir; I think so."

"Q. Have you paid Mr. Tilghman twenty cents on every 100 lbs. of fat you have worked since April, 1860? Do you continue to pay him that amount?"

"A. I have paid him since August 1, 1860, twenty cents on every 100 lbs. I think it was from August 1, 1860, that I contracted to pay him. I have not paid him all, but I am ready to pay him the balance when called on. The arrangement still continues."

2. *Nathaniel Ropes, Jr.,* a witness of the defendant, was also examined, and confirmed, so far as he was examined on the same topics, the testimony of N. Ropes, his father. He stated among other things that in using Tilghman's process, the firm generally employed one-half percent of lime; that a saving of lime and acid was effected by this process, as compared with the old process used prior to the introduction of Tilghman's process, of ten and a half to twelve and a half pounds of lime to a hundred pounds of fat; twice that quantity of vitriol; and that this saving was due to the chemical action of highly heated water under pressure on the fat; and that this chemical agent of highly heated water, under pressure, was not, so far as the witness knew, used prior to the introduction of Tilghman's process.

3. *Florence Verdin,* a partner of the defendant, already described, manufacturer of stearic acid and candles:

"I have tried several experiments in which I followed the specification of Tilghman's patent. There was very little glycerin, and it was very poor. The acrolein had injured it so much that it would not have been salable. The fatty acids also were very poor, affected by the acrolein. Candles made from these fatty acids might be freed from the smell of the acrolein with additional expense. The value of the fatty acids as they come out of the vessel would be impaired in value at least one cent per pound."

"The process described in the specification would not in my opinion be of any value to a manufacturer of candles or of stearic acid. The use of the apparatus as

there described would not be safe to the operatives in charge of it. There would be danger of explosion from the heat and pressure specified. I think I

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should make my will before I would operate with them. With the heat and pressure mentioned in the specification, the valves therein mentioned will not keep tight. The process described in that specification is not anywhere adopted that I know of."

" *Cross-examined* "

"Q. What heat are said valves exposed to in the apparatus described in complainant's patent?"

"A. The melting point of lead."

"Q. Examine the drawing now shown you of the complainant's patent, and state what valves in said apparatus are exposed to any heat above 212."

"A. There are none. I was mistaken. I had seen the drawing before, but was under the impression that the valves were nearer to the boiler."

" *Reexamined* "

"Q. From your present knowledge of the position of the valves in the complainant's drawing and the mode of operation, is or is not the complainant's apparatus a practical mode of accomplishing his object?"

"A. I think not."

4. *C. H. Grant,* resident in Philadelphia, of the firm of C. H. Grant & Co., manufacturers of adamantine candles, a witness of the defendant, testified, in substance, among other things, thus:

"We now use the distillation process, with the use of sulphuric acid. From the fall of 1859 to nearly the beginning of 1862, we used the Tilghman process, under a

license from him, but not continuously. Our interests are in his favor. We did not employ the coil apparatus, but a cylindrical digester with spherical ends, procured from Mr. Tilghman. We used it in connection with high pressure, 160 lbs. to the square inch. We used the process a portion of the time without lime. The fat during its treatment was agitated by paddles on a shaft running through the digesters from end to end. We voluntarily abandoned the use of the Tilghman process because we found it was costing us too much. The process was unprofitable -- that is to say the profits were not equal to what they would have been by the sulphuric acid process. Mr. Tilghman was at our manufactory frequently, and suggested all the modes of treatment. We expected,

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as well as I can recollect, to produce decomposition by water alone in about six hours, but I think we were about twice that time. Except possibly by double hot pressure, which we never tried, we could not by the use of water with heat and pressure alone produce such a decomposition as would make merchantable candles. It is my opinion that a person of ordinary skill in the branch of manufacture to which this patent relates, with the patent as his guide and without experiment, could not decompose fat by water, heat, and pressure so as to produce a valuable result."

" *Cross-examined* "

"There was a difference of opinion between myself and my partner as to the policy of abandoning Tilghman's process. I always advocated the process, and was unwilling to abandon it so long as there was the least hope of success. Since we abandoned the process, it has not been generally abandoned by other manufacturers. I know of no manufacturers in the United States who are now working by the old lime saponification process, though there may be some. I cannot name any manufacturer in the United States besides ourselves who has abandoned the use of Tilghman's process after having once adopted it. I do at this moment believe that fat can be decomposed by the action of water, at a high temperature and pressure, into fat acids and solution of glycerin. I believe that the

intimate mixture of the fat with the water is an important circumstance in producing this decomposition. I believe that the higher the temperature and pressure employed, the more quickly the decomposition will be produced. I believe that the pressure should be made to correspond with the temperature employed, so as to prevent the water escaping as steam. Except agitation, which is of use only to produce mixture of the fat and water, I do not believe that any conditions besides intimate mixture of fat and water, a high temperature, and a pressure sufficient to prevent the water from escaping as steam, are necessary to produce the decomposition of fat into fat acid and glycerin. Which of these three conditions we were unable to produce in the apparatus we used I don't know. If we had used twice as much water, or continued the operation twice as long, or taken a second charge of water, I believe that we would have made better decomposition. "

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5. *Mr. E. S. Wayne,* manufacturer of candles in Cincinnati, a witness of the defendant, testified that Tilghman's process with the coil apparatus was practical but not economical.

6. Soon after the issue of his patent, Tilghman began to modify the apparatus described in his specification. Of this it did not appear that he made any secret. One of his letters to Messrs. Thomas Emry & Son, manufacturers of candles in Cincinnati, produced by the defendant, was thus:

"LONDON, June 25, 1856"

"GENTLEMEN: I have received from Mr. Davenport your favor of 30th May last. Our experiments in the factories here and in Paris have shown that, on the large scale, the decomposition of fats by water is more conveniently effected by modifying the apparatus originally proposed so that the fat and water are exposed to a comparatively lower heat and pressure for a longer time, instead of a very high pressure for a few minutes; and a considerable quantity of material is *treated at one charge, in an ordinary steam boiler* lined with lead or copper and provided *with an agitator* in place of using the continuously working pumps and coil of

pipes. At a pressure of 225 lbs. per inch, tallow, or palm oil, or lard stearin is completely decomposed in five hours. In the course of a few months we shall probably have going on at Price & Co.'s works an apparatus on the above plan capable of treating *several tons* per day. Until my process is in actual use in England, I have decided not to begin its introduction into the United States, and therefore cannot at present reply to your request as to terms of sale. As soon as *it is well established here,* I intend returning home, and will immediately communicate with you. . . ."

"I remain, very respectfully yours,"

"R. A. TILGHMAN"

7. *Mr. G. F. Wilson,* already mentioned as the managing agent of Price & Co.'s candle works in London (which company, as has been mentioned, paid to Tilghman 1000 sterling a year), and whose statement in a public lecture delivered by him in January, 1856, that Tilghman's discovery, as carried out by his coil process, would draw from all the admission that it was a beautiful, original chemical idea,

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well carried out; in that same lecture, and in immediate sequence to this statement, added:

"It has yet to be proved how far it can compete successfully with distillation."

Adding further:

"We have made an arrangement with Mr. Tilghman which will give us the means of testing its commercial merits."

Mr. Wilson, in a public lecture delivered previously (of September, 1855), after referring to the fact that until of late times no practical modes of obtaining glycerin other than in an impure state had existed, said:

"A new process for decomposing neutral fats *by water under great pressure coming under our notice,* led us to look again more closely into our old distilling processes, and the doing this showed, what we had often been on the brink of discovering, that glycerin might be distilled."

"In *our* new process the only chemical agents employed for decomposing the neutral fat, and separating its glycerin, *are steam and heat;* and the only agents used in purifying the glycerin thus obtained are heat and steam; thus all trouble from earthy salts or lead is escaped. Distillation, however, purifies the impure glycerin of the old sources."

8. *Mr. Tilghman,* who was examined as a witness and who stated the fact of the agreement to pay him 1000 sterling a year, stated further that though he had been in some of the factories of Price & Co., he had not been in *all,* nor had he been in all the parts of all the factories which he did visit, and being requested to speak "of his personal knowledge" of what processes &c.;, Price & Co. used, stated that he had no personal knowledge whatever as to what process they employed for decomposing fats, what form of apparatus was used by them, or what degree of heat.

9. *Monsieur Monier,* whose *stearinerie* had now apparently failed or otherwise come to an end, thus testified:

"We made numerous experiments immediately after signing the contract. Mr. R. A. Tilghman was present and worked with

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his brother during ten or fifteen days. Mr. R. A. Tilghman, on leaving the factory, left his brother to represent him with my firm and to continue and direct alone the experiments described in the patents. The results of these first experiments, as well as of those which followed, were entirely useless and productive of no good. They took place in our factory at Villette, near Paris, by means of a little apparatus brought from London by Mr. Tilghman. [Described by the witness, and obviously the coil apparatus.] It was placed in a furnace of fireproof brick and received all the

heat of the furnace, the flame of which completely enveloped it, and which brought it to an excessive heat, of which it was impossible to ascertain the degree of intensity, as there was no instrument which would indicate the degree of heat. A suction and force pump was firmly established and fixed at some distance from the apparatus. This pump was worked by hand, and being connected with one end of the coil in the cast iron block, threw into the said coil a mixture of water and fatty matter contained in a vessel from which it drew it, and forced it to traverse all the turns of the coil, and forced it out of the other end of the said coil encased in the block of iron, which was, as I have already said, heated to an excessive degree. Although the mixture of water and fatty matter was, during its passage in the coil, subjected to a temperature which I estimate to have been above five hundred degrees (500) and a pressure of more than twenty atmospheres, the decomposition of the fatty matter was never complete, and never produced fat acids and glycerin, but only an altered fatty matter which, when washed, produced acrolein to such a point as to fatigue the workmen who assisted at the experiments. The experiments, in conformity to the indications of Mr. Tilghman, possessor of the patent for making fat acids and glycerin, lasted about six months. The first fifteen experiments were made by the Messrs. Tilghman, aided by two workmen, in my presence, and they alone directed the work; and after the departure of Mr. R. A. Tilghman, the patentee, they were all directed by his brother. None of the numerous experiments succeeded. After the failures with the little apparatus brought from London by Mr. Tilghman, his brother caused to be constructed successively three apparatus. The first was composed of a hollow iron tube, and was made by Perkins, in London, and put in a bath of melted lead in order to always have at least three hundred degrees

of heat. The second, which was also composed of a hollow iron pipe, was constructed in Paris, and put in a bath of melted zinc in order to always have at least five hundred degrees of heat. The third and last was constructed with the Perkins pipe divided into three equal parts, of which each part was placed in a block of cast iron, by Davidson, iron founder at La Villette, and under the

superintendence of Mr. Tilghman's brother. This last apparatus was placed in a furnace of fireproof brick, constructed upon the plan of Mr. Tilghman's brother and under his direction, and at a temperature the elevation of which I never determined, but which certainly much surpassed that of melted zinc. It is easy to see that Messrs. Tilghman paid no attention to the process patented, but made at our factory and at our expense not serious experiments, but trials to find the means of overcoming the difficulties which arrested them. This is shown by the fact that all which Mr. Tilghman demanded was instantly given him, and that he often used two kilograms of fatty matter in one day, and always without any results. I have no plans or drawings of the apparatus which Mr. Tilghman had made. The experiments made at our factory by Messrs. Tilghman cost the firm of Monier & Co. more than forty thousand francs, counting the money given to the brother, which was, I think, between 12,000 and 15,000 francs. The contract made between Mr. Tilghman and our firm was annulled by common consent because the process never produced fat acids and glycerin. I affirm that it is impossible to decompose fatty matter and obtain fat acids and glycerin by the method indicated in Mr. Tilghman's patent."

"Sometime after the first experiments were discontinued and the first contract annulled with Mr. Tilghman, Mr. De Fontaine Moreau, in whom we had great confidence, announced to us the return to Europe of Mr. Tilghman with a new process, based upon the principles of the method already patented, and urged us earnestly and decided the firm, much to my regret, I assure you, to join the firm of Charles Leroy & Durand, candle manufacturers at Paris, to whom he had already spoken, for the trial of the new process, the success of which he said was certain, as Mr. Tilghman had already obtained admirable results in the United States. A new contract was made between Mr. Tilghman and my firm, representing also Messrs. Charles Leroy & Durand, upon the same basis as the first, Mr. De Fontaine Moreau

again representing Mr. Tilghman, the patentee. New experiments were made at La Villette by Mr. Tilghman's brother during two or three months, and, like the first,

produced neither fat acids nor glycerin."

"In my opinion, a mixture of fatty bodies and water, exposed in a close vessel at a high temperature, and under a strong pressure, cannot decompose the fatty bodies to the point of producing fat acids and glycerin."

10. *Mitchell offered to show to the complainant operations with an apparatus* alleged by Mitchell to have been made in accordance with the specification in the complainant's patent. Which offer, for certain reasons stated, the complainant declined. [The history of this matter appears *supra,* pp. 86 U. S. 327 -329.]

REDUCTION TO PRACTICAL USE

REBUTTAL BY THE COMPLAINANT

1. To rebut the testimony of Monier given in 1867, Tilghman proved that suspecting that a certain De Milly, a large manufacturer of candles in France, was using his patent, he had requested his agent, Mr. Fontaine Moreau, to inquire how this was; that Mr. Fontaine Moreau had inquired of Monier, and that Monier had thus answered him:

"SOCIETE GENERALE DE STEARINERIE"

"LA VILLETTE (near Paris), July 17, 1857"

"MY DEAR FRIEND: I received your letter of yesterday. Not only does De Milly work by the Tilghman process, but also he has sold to many candle manufacturers, amongst others to MM. Petit & Lemoult, the right to work his patent in France in their factory at Grenelle. Mr. De Milly has also sold in Belgium and in Austria, so that while the Messrs. Tilghman are in London and suspect nothing, Mr. De Milly reaps a harvest in selling that which he has stolen from them. But what can anyone here say of all this so long as the Messrs. Tilghman are content to suffer themselves to be robbed? You know De Milly. He does not lose his time. So he is more and more eager to offer his processes. He has offered them to us many times. If the Messrs. Tilghman wish to draw any profit from their patent, they ought to prosecute him for infringement as soon as possible.

Let them think of it seriously. I am too much interested in the question to admit of my giving them advice which might perhaps be misinterpreted. I must be content with wishing that Mr. Tilghman should have the courage to defend his intellectual property -- that is to say, his honor."

"Your very devoted"

"MONYER"

2. In regard to Tilghman's inability, when requested by the defendant's counsel, cross-examining him as a witness, to state on his "personal knowledge" what processes, forms of apparatus, and what degrees of heat were used at Price & Co.'s factory, it appeared by the testimony of the defendant Mitchell that he, Mitchell, before July, 1865, which was before this suit arose, had asked Tilghman why he had not personally inspected their mode of working, and why he did not know how they worked.

"He stated in reply that Mr. Wilson, who was the managing director of that company, was trying to invent a process of his own, and would not allow him to inspect it."

3. One of the defenses set up in the answer, it will be remembered, was that the apparatus described by Tilghman as the one which he believed was the best to carry his invention into effect was dangerous from the degree of heat required. On that point this testimony was given:

Joseph Nason, mechanical engineer and constructor of steam apparatus for warming buildings, for heating evaporators &c.;

"I have had two years' experience as an assistant to Mr. Perkins, during which I have applied the apparatus to many purposes requiring very high pressures and temperatures, among which I will mention the generators of steam for Perkins' steam gun, heating ovens for baking bread, and for heating various processes requiring temperatures as high as 600 Fahrenheit and upwards. I cannot state

precisely the maximum of temperature at which such an apparatus could be used without injurious or dangerous results, but I can say positively not less than 650 or 700. I have known the apparatus, working at the temperature of 600 and upwards, to be in daily use for many years

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without injurious or dangerous results, without inconvenience, and without any considerable depreciation. With ordinary care, I should consider an apparatus constructed in accordance with the descriptions and drawing of the coil apparatus in the patent of Tilghman, a perfectly safe practical apparatus for heating the materials to a lead melting heat. I do not see that any practical difficulty would be incurred in its operation. So long as the temperature be limited to the melting point of lead, an apparatus as strongly constructed as those with which I have been familiar would be almost absolutely secure against explosion. I should consider such an apparatus used at lead melting heat much safer than an ordinary form of steam boiler at a pressure say of 180 lbs."

REDUCTION TO PRACTICAL USE

EVIDENCE CLAIMED BY BOTH PARTIES

In addition to the evidence which has been grouped, as on the preceding pages, [Footnote 16] as tending apparently to sustain either the complainant's case or the defendant's, there was some evidence which perhaps it was not quite easy to say, until the construction of the patent was settled, which side it sustained. It was claimed by each side. Such was,

1. *A statement by Mr. Wilson,* already more than once mentioned. In the public lecture referred to on page 86 U. S. 313 , as given in January, 1856, he said:

" *I went with my chemist assistant, Mr. Payne, to see Mr. Tilghman's little apparatus at work, and in the course of some experiments which it led us to try, or rather to try over again,* it struck me that steam passed into the fat at a high temperature should effect by a gentle process what Mr. Tilghman aimed at

effecting by a violent process -- the resolving of the neutral fat into glycerin and fat acids. We proved that this was so, and that the glycerin distilled over in company with the fat acids, but no longer combined with them."

"In July, 1854, we took out a patent for this process, by which many hundred tons of palm oil and other fats have now been worked, and which has given to the arts and medicine a body never before known, either in France or here, even in the chemist's

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laboratory -- glycerin which had passed over in the form of vapor without a trace of decomposition."

2. In July, 1857, Tilghman introduced into Price's candle factory in London, an *ordinary long boiler with a revolving stirrer,* working at a temperature of about 400 Fahr. (225 pounds pressure), and having a capacity of treating two and a half tons of fat daily. This appeared by a letter of his own, given in evidence, like the one just above by the defendant.

"LONDON, July 20, 1857"

"TO M. DE FONTAINE MOREAU."

"DEAR SIR: In compliance with your request, I proceed to describe the present state of the apparatus for decomposing fats, as it is now being worked at Messrs. Price & Co.'s."

"As I have before mentioned to you, it consists of a boiler thirty-two inches diameter and thirty feet long, made of iron nine-sixteenths thick and lined with copper."

"It is heated by an interior copper serpentine, *'a retour d'eau,'* which is supplied with steam from a smaller tubular boiler (thirty two inches diameter by ten feet long, with eighteen flues, three inches diameter). It also has a tube pierced with holes to inject free steam. The apparatus is worked at a pressure of from 200 lbs.

to 225 lbs. per square inch (fourteen to fifteen atmospheres); it is charged with two and a half tons palm oil and three quarter tons water, and the oil is perfectly decomposed in four and a half hours after the above pressure is attained. *The decomposition would be effected in shorter time if a larger proportion of water was employed and if agitation and mixture of the materials was produced by the injection of free steam from the pierced tube,* but as one object is to get the glycerin in a strong state (the demand for glycerin being just now greater than they can supply), they prefer for the present to work it as described."

"Price & Co. are now thinking of putting up another apparatus, which will probably be constructed to work at a pressure considerably higher than above mentioned, so as to shorten the time of decomposition, and also will *be made to work continuously, so as to avoid loss of time* in filling and emptying."

"Very truly yours,"

"R. A. TILGHMAN "

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This apparatus continued at work at Price's factory down as late as 1865, as appeared by a letter of Tilghman admitted in evidence.

"PRICE'S PATENT CANDLE COMPANY"

"LONDON, July 13, 1865"

"R. A. TILGHMAN, ESQ."

"Philadelphia"

"DEAR SIR: I thank you for your letter of 19th of June, which I have laid before the directors today, and they will be much obliged if you will, as you kindly offer, procure for us tracings of the working drawings of the apparatus now in use for your process in America, and most approved of by you."

"You are right in supposing that the apparatus we have now at Battersea is just what you saw or heard about when you were here. There is a stirrer in each vessel, but plainly insufficient for the proper contact of the water with the fatty body. I should think we may very probably use our present digesters for the outer iron vessels of your apparatus, putting them, of course, upon their ends. They are very much the shape of the vessels you describe. You do not mention what quantity of water you put to the fat. I should think it might be well to put it in at two doses, drawing off the first where it has taken up the bulk of the glycerin and then finishing off with fresh water, to take the last part of it away, using this water again as the first water for a fresh charge of fat; but very likely you already do this. The whole of your letter now being replied to, as well as of the previous one, was of much interest to us. If any further matters occur to you as worth mentioning in connection with the working of the process on your side, we shall be much obliged by your stating them when you write again."

"I am, dear sir, yours, faithfully,"

"J. P. WILSON"

On the 15th of May, 1860, Tilghman took out another patent. The specification and claims in that patent were thus:

"Be it known that I, Richard Albert Tilghman, of Philadelphia, Pennsylvania, have invented a certain *new and improved method* of decomposing fatty and oily substances, and I do hereby declare that the following is a full and exact description thereof: "

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"My invention *relates* to the process of obtaining free fat acids and solution of glycerin from fatty substances by the action of water at high temperatures and pressures, and it is applicable either when water alone is used or when, in addition to the water, a portion of alkali is used to aid the chemical action."

"I have observed in working this process that though the action of the water in extracting the glycerin from the fat is rapid at first when the water is fresh and the fat contains all its glycerin, yet as the decomposition advances and the fat gradually loses and the water takes up the glycerin, that the decomposition becomes slower and slower, so that to extract the last portion of glycerin from the fat with a moderate quantity of water requires a considerable time when the lower range of pressures are used."

"Now if we use a large proportion of water to a given quantity of fat, the decomposition may be made sufficiently complete in a moderate time; but this has the inconvenience of occupying a considerable portion of the vessel or apparatus used, and thereby diminishes the quantity of fat that can be treated therein."

"Now my invention consists in *applying* the water to the fat in *several successive portions.* I remove the first portion as soon as it becomes partly saturated with glycerin, and I add successive portions of fresh water to the partly decomposed fat, which fresh water is more active in taking up the last remaining glycerin of the fat, and *thereby I render the decomposition more rapid and complete, and can treat a larger quantity of fat in a given apparatus.* "

"My invention can be applied to any of the different forms of boilers or tanks used for the decomposition of fats by water at a high temperature or pressure, either with or without lime, which are now well known and need no detailed description. Instead of putting nearly an equal or more than an equal bulk of water to the fat, I put in say only one-third of the bulk of the fat, and after this has been stirred up with the fat, and exposed to a high temperature and pressure during some time (say from two to three hours, if working at from 120 lbs. to 150 lbs. per square inch), I allow the water to settle, and blow it out of the tank. A similar quantity of water, which has been previously heated up to the working temperature of the apparatus

in a separate close iron vessel, is then forced into the tank by steam pressure, and is stirred up with the fat, and after two or three hours' mixture is settled and blown out as before; and this is repeated until sample show that all the glycerin has been extracted and that the fat is well decomposed."

"I will now describe another method of applying my invention to practice whereby the operation is made continuous -- that is, the raw or neutral fat, either by itself or previously mixed with a small quantity of alkali, is introduced in a continuous stream, or nearly so, at one end of the apparatus, and the decomposed fat or fatty acids issue continuously, or nearly so, from the other end of the apparatus, while at the same time the water enters where the fat acids issue, and following the opposite route to that taken by the fat issues as a solution of glycerin from that part of the apparatus where the raw fat enters. By this method, the fat which has lost nearly all its glycerin is brought in contact with fresh water containing no glycerin, and the water partly charged with glycerin comes in contact with raw fat containing all its natural glycerin."

"In the arrangement of this form of apparatus, there are two features which form distinct parts of my invention. As fat and water dissolve each other to a very slight extent, their action upon each other is much accelerated by large surface of contact. This large surface of contact has generally been produced by a mechanical agitation and mixture of the two liquids, but as this mixture is almost incompatible with a perfectly continuous form of apparatus, I have devised plans whereby these advantages of large contact and renewal of the water may be obtained by other means, either in continuous or intermittent forms of apparatus."

"1. I arrange the fat and water in numerous shallow layers, so as to obtain large surface of contact."

"2. I cause the fat and water, arranged in shallow layers, to flow in opposite directions, so as to bring fresh water in contact with partly decomposed fat."

"The following is a description of the *apparatus,* it being understood that if any alkali is used (which is generally in but small proportions, say one-half to one

percent of the fat), it should previously be combined with the fat."

"[Here follows a description of the apparatus, and the schedule proceeds:] "

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"What I claim as my invention and desire to secure by letters patent is:"

" *In* the process of decomposing fats into fat acids and glycerin by means of water at a high temperature or pressure, either with or without the presence of an alkali,"

"1st. *Applying* the water in several successive portions, and removing those portions when partly saturated with glycerin."

"2d. *Arranging* the fat and water in shallow layers, so as to give an increased surface of permanent contact between them."

"3d. *Causing* the fat and water arranged in shallow layers to *flow in opposite directions,* so as to bring fresh water in contact with the partly decomposed fat."

"R. A. TILGHMAN"

In 1867, ten factories in the United States were working the water process under license from Tilghman, but none of them probably with heat so high as 440 Fahr., or without the aid of certain amounts of alkali, as described by C. T. Jones, *supra,* p. 86 U. S. 325 .

III

AS TO THE MATTER OF INFRINGEMENT

THE COMPLAINANT'S SIDE OF THE QUESTION

On this matter, Professors Booth, Rogers, Genth, Bridges, and Gibbs, all testified that the defendant's process was identical with Tilghman's.

"It is the same,"

said Professor Booth.

"I consider it to be identical,"

said Professor Rogers, an expression iterated by Professors Bridges, Genth, and Wolcott Gibbs.

THE DEFENDANT'S SIDE OF THE QUESTION

Professor B. H. Rand, lecturer on chemistry at the Franklin Institute from 1853 to 1862; Professor of Chemistry in Philadelphia College of Medicine, 1853 to 1858; in the Medical Department of Pennsylvania College, 1859 to 1861, in the Central High School, 1859 to 1864; and since 1864 in the Jefferson Medical College:

"There is, in my opinion, a great difference in the mechanical surroundings and conditions forming part of the processes of

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the complainant and defendant, respectively. The process of the complainant requires a very high temperature. It also requires vessels of very great strength, 'the working pressure' being stated as not likely to exceed '2,000 lbs. to the square inch.' The conditions of complainant's process could not possibly be realized in the defendant's apparatus. The complainant's patent speaks of subjecting the mixture, in the continuous apparatus, at the desired temperature, for ten minutes; the defendant's requires as many hours. Again, the requirements of the patent that"

"the vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam,"

and "no steam or air should be allowed to accumulate in the tube, which should be kept entirely full of the mixture," do not exist in defendant's processes, because the vessels employed by him are not full, or nearly so, and steam, the source of the heat used, is constantly present during the continuance of the processes. In my opinion, therefore, the mode of working in the two processes is essentially different.

"Again, it is may understanding of the patent of the complainant, that it describes and claims a process in which the decomposition of fats is effected by the sole action of water in the liquid form, highly heated in close vessels."

" *With this understanding of it,* it is my belief that defendant's processes are substantially different in a chemical sense."

It is obvious that on this matter of infringement, Professor Rand assumes the close construction of Tilghman's patent to be the true one. Doubtless experts of the other side assumed the broad one to be. So that here, as in a large degree in the question of practicalness, the construction of the patent was the fundamental question.

In this view of Professor Rand concurred:

Mr. E. S. Renwick, residing at Milburn, New Jersey, and occupied principally as expert in the trial of patent causes and in soliciting patents, and

Mr. E. S. Wayne, of Cincinnati, chemist and druggist, engaged practically and theoretically for the last thirty years in chemistry, formerly Professor of Chemistry in the Ohio Medical College, Cincinnati, and of pharmacy and chemistry

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in the Cincinnati College of Pharmacy. Mr. Wayne, after stating that he was fully satisfied that the patent of Tilghman described a different process from that of Mitchell, because, among other reasons, *"it describes a different apparatus,"* added on a different topic:

"I am of the opinion that the liquid water in Tilghman's process is of itself of no value beyond furnishing the elements of water for the decomposition, and that heat alone is the agent causing the decomposition of the fats by water; and the pressure he claims and uses is the only way to obtain the heat necessary for this decomposition. The water is only necessary so far as it furnishes the elements of water in chemical equivalent to the fact to form respectively fat acids and glycerin. Steam in its chemical relations in this decomposition is equivalent and identical

with water. All that steam requires is the same temperature. This is given to it by superheating [Footnote 17] it to the point necessary for the decomposition. Fat acids and glycerin is the result. Could water be heated without pressure to the temperature necessary for the decomposition of fatty bodies, the same result would follow as with the use of pressure, namely, fat acids and glycerin."

"Hence, I can perceive that there is no new discovery of the decomposition of fatty matters by the agency of water alone, and conceive the facts in relation to it have been known, mentioned, and experimented with prior to the complainant's patent. Water and steam for the decomposition of fats require a high temperature, and the higher the temperature, the more rapid the decomposition; but the introduction of another agent in the decomposition, such as an alkali, or water containing a small percentage of sulphuric or sulfurous acid, or neutral lime soap, the decomposition of fats into fat acid and glycerin will take place at a much lower temperature than can be effected by steam or water alone."

In regard to the range of heat allowed by Tilghman's patent, Renwick said:

" *The temperature relied upon is one exceeding the melting point of tin (440F.),* and not exceeding the melting point of nitrate of potash (660F.), the temperature of the melting point of lead (612F.) being the temperature for general practice."

Mr. Justice Nelson, in giving the opinion of the court below, held:

"1. That Tilghman's invention consisted of a *process* for producing free fat acids and solution of glycerin from fats and oils."

"2. That"

"for this purpose he subjects the fatty or oily bodies to the action of *water* at a high temperature and pressure, so as to cause the elements of these bodies to combine with water, and thereby obtain at the same time free fat acids and glycerin."

"3. That Tilghman proposes to do this in any convenient vessel of the requisite strength, and that although under the law he describes two vessels or apparatus for doing it, there is no claim for any special vessel or machine."

"4. That Tilghman's patent does not require that the vessel should be absolutely *full of water* and fat. [Footnote 18]"

"5. That Tilghman's patent does *not require the use of a heat* so

high as melting lead, but merely prescribes it as a maximum, and announces that no fixed degree of heat can be given, as the different fatty or oily substances that may be used will require different degrees, and that by starting the vessel at a low heat and gradually increasing it, the best temperature may be ascertained for the particular substance used."

"6. That upon a proper interpretation of the patent, the process could be and had been proved to have been carried into successful operation by both the means pointed out by the patentee."

"7. That"

"prior to the date of Tilghman's invention there were but two modes known or in practical use for decomposing fatty substances and obtaining from them fatty acids and glycerin. One called the lime saponification, and the other known as the distillation process,"

and that they were different from patentee's, more expensive and tedious, and have generally gone out of use in this country and England since appellee's invention.

"8. That Tilghman was the first person that discovered the chemical fact that fatty or oily substances could be decompose, and that the fatty acids and glycerin separated by the action of water at a high temperature and under pressure."

"9. That it is immaterial to inquire whether defendant's vessel or machinery is similar to that described in Tilghman's patent; they constitute no part of his invention."

"10. That the defendant has manufactured fat acids and glycerin from fatty bodies by the action of water at a high temperature and pressure, according to the process explained by appellee in his specification, and hence had infringed his patent."

Mr. Justice Nelson accordingly decreed for the complainant.

The case afterwards came up before Judge Blatchford on exceptions to the master's report or otherwise. That learned justice on different occasions said:

"It is manifest, that the defendant decomposes fatty bodies into fat acids and glycerin by the action of water at a high temperature and pressure, and thus uses the plaintiff's process."

As to Mr. Justice Nelson's views

"that the plaintiff's specification did not require either that the vessel containing the mixture of water and fatty matter should be entirely

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filled therewith, or that no steam was to be permitted in it,"

he said:

"On full consideration, I concur in his views, and have no doubt that his interpretation of the specification in regard to them was correct."

To the defense of want of practicalness, he said:

"The defendant has entirely failed to show that the plaintiff's process, carried out as described in his patent, is not practicable or practical. It was put in practical operation in London in 1857, a patent having been taken out for it in England by

the plaintiff, January 9, 1854. It was put in operation in Cincinnati, Ohio, in 1869, and has been in use, under license from the plaintiff, in the United States ever since, there being ten factories in the United States working under such license."

On the other points he agreed with Mr. Justice Nelson, and in conclusion said:

"The great merit and value of the plaintiff's invention, not only in the manufacture of candles but as a process for obtaining pure glycerin for use in the arts, are shown by evidence. The case is a clear one on all points."

Decrees were finally entered for Tilghman for $335,661 as the amount of the profits, with interest, which the defendant had made by infringement.

The merits of Tilghman's patent had also been before Justices McLean and Leavitt, in Ohio, in *Tilghman v. Werk,* October, 1860. There was a concurrence of opinion between those judges about the case, and Mr. Justice McLean was to deliver the opinion of the court in it. His death having supervened, it was delivered in February, 1862, by Leavitt, J. That learned justice said that he had "no hesitation in concluding that the attempt to invalidate the plaintiff's patent for want of originality had wholly failed," and that it was shown by "actual and successful experiments," made alike by experts and by the practical manufacturers, Ropes and Grant, who made no mention of any difficulty from a want of exactness in the specification as to the degree

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of heat required, that free fat acids and solution of glycerin could be produced by Tilghman's process. Referring to the language of the specification in reference to the temperature of the heated water, he said:

"The specification seems to be sufficiently explicit. There is a precise degree of heat, the melting point of lead, 612 Fahr., recommended and prescribed as sure to produce a good result in changing common fatty bodies to acid and glycerin; and a lower temperature, the melting point of bismuth, 510, when palm oil or similar substances are to be operated upon. And it clearly does not render the

specification liable to objection for want of certainty and clearness, that the patentee states that the degree of heat may be carried above these figures without injury. Nor is the sufficiency of the description impeached by the fact that the desired result has been produced at a lower temperature of water. There is a fixed rule given which may be safely followed, while it is made known that the manufacturer may safely depart to some extent, from this rule, if from experiment and a just exercise of discretion it should be expedient to do so."

"DECREE ACCORDINGLY"

The matter came up also subsequently to all these decisions before Mr. Justice Emmons, in the Ohio Circuit Court, in the cases of *Tilghman v. Werk,* and of *Tilghman v. Shillito.* That learned justice there said that

"were he to consider this matter uninfluenced by precedent, he feared that he should be compelled to give the patent a more limited construction than it had received,"

and to hold "that the claim included only those higher degrees of heat at which lead and other substances mentioned in the patent will melt."

He added, however, that without a violation of judicial propriety, he could not disregard the judgments of his own court and of the coordinate one in New York, adding:

"Especially is this so where the judge delivering the opinion has taken so leading a part in all the discussions on the subject in the court of last resort.

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MR. JUSTICE CLIFFORD delivered the opinion of the Court.

Exclusive jurisdiction, in all actions at law and suits in equity arising under any act of Congress granting or confirming to inventors the right to their inventions or

discoveries, is conferred upon the circuit court, subject to the condition that the final judgment or decree in such a controversy may be removed here for reexamination.

On the third of October, 1854, letters patent were granted to the complainant for a new and useful improvement in processes for purifying fatty and oily substances of animal and vegetable origin and which contain glycerin (glyceryl) as their base. His invention, as the patentee states, consists of a new and improved mode of treating such substances in order to produce fat acids and solution of glycerin which, as he says, was not known or used before his application, and the recital of the patent is that it shall take effect from the ninth day of January preceding the date of the instrument. By virtue of the said letters patent, as the complainant alleges in his bill of complaint, he acquired the exclusive right to make and use the described improvement and to vend the same to others to be used, and he also alleges that the respondent, prior to the time when the bill of complaint was filed, without his license and in violation of his rights, engaged in making and using his patented process, and that he, the respondent, intends to continue to make and use the same, as set forth in the bill of complaint. Service was made and the respondent appeared and filed an answer setting up several defenses, as follows:

1. That the complainant, on the ninth of January, 1854, was not the original and first inventor of the improvement described in the said letters patent.

2. That the result described in the specification and claims of the patent cannot be accomplished, so as to be practically useful, by the method and apparatus described in the specification.

3. That the respondent never practiced or used the patented process of the complainant as charged in the bill of complaint, or in any other manner. He admits that he is

engaged in manufacturing candles, and that in manufacturing such articles he uses water and steam at high temperature, and that he also uses such pressure

as arises from the expansive force of hot water or steam in a close vessel, but he denies that he uses any such method, process, or apparatus as those described in the letters patent of the complainant.

4. That the patented processes described in the specification were well known to chemists and men of science and to manufacturers long before the alleged invention of the complainant, and were also used and practiced by them and were descried in printed publications before the complainant filed his application for a patent.

5. That the use of a close vessel of sufficient strength to resist the pressure of water when heated, or any pressure needed when using water to decompose other substances, was known to, and practiced by, men of science and manufacturers in this country and elsewhere long before the alleged invention; that highly heated water when used as described is an elementary principle open and free to all, and that such a principle is not one that is subject to a patent; that a prior knowledge of the alleged invention was possessed by many other persons, and that the same was described in many printed publications, as fully set forth in the answer.

Issues of the kind cannot be intelligently determined without a clear understanding of the nature and scope of the invention secured by the letters patent, as it is the patented invention which it is alleged the respondent has infringed, and in order to such an understanding it becomes necessary, as a preliminary step in the investigation, to construe and define the claims of the patent, as the most efficient means of ascertaining the precise nature and extent of the inquiry involved in the respective issues presented in the pleadings.

What the patentee claims as his invention is the process of manufacturing fat acids and glycerin from fatty or oily substances by the action of water at a high temperature and

pressure, which, beyond doubt, is the true object of the invention described in the specification, as plainly appears from the description of the means employed by the patentee to decompose the described substances and to produce the described result. His invention, as the patentee states, consists of a process to produce fat acids and glycerin from the described fatty and oily substances by subjecting the substances to the action of water at a temperature and pressure, so high as to decompose those substances and cause the elements of the same to combine with water, and by such means to produce fat acids and solution of glycerin, which is the described result. Specific description is also given as to the relative quantity of water to be used, and of the character of the vessel to be employed, as means to create the high temperature and pressure and to decompose the original substances, and cause the elements of the same to combine with the water to produce the result described in the patent. Such substances, the specification states, must be mixed with a quantity of water, equal in bulk to one third or one half of the fatty or oily substance to be subjected to the patented process, and that the mixture of the substance and the water must be placed in some convenient vessel in which it can be heated to the melting point of lead and be kept at that temperature until the operation is complete. Undoubtedly the mixture may be placed in any convenient vessel of sufficient strength to resist the internal pressure when the solution is heated to the point described in the specification, but it is equally clear that any vessel not strong enough to resist such a pressure would not be a convenient one for such a purpose, nor is anyone of less strength within the contemplation of the patentee, as he states with emphasis that the vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam, and he might have added, to prevent the vessel from bursting. High temperature, in the view of the patentee, is indispensable, and inasmuch as the vessel must be closed it follows that the vessel must be one of great strength, as the high temperature

will necessarily produce very great internal pressure. Hence the requirement is that the vessel must be one of great strength, and the patentee suggests, as the

best mode of carrying his invention into effect, that the mixture, prepared as described, be passed through a tube or continuous channel, heated to the before mentioned temperature, that is, to the melting point of lead.

Figures of the several parts of the described apparatus for performing the operation are given in the drawings, and the inventor proceeds to state, that in applying his process and carrying it into effect he places the fat or oil to be subjected to the process in the receiving vessel shown in the drawings, with from one third to one half its bulk of warm water, and to effect the described result he employs a piston with a perforated disk, arranged to work up and down, in the receiving vessel, which being kept in rapid motion will cause the fat or oil and the water to form an emulsion or intimate mechanical mixture, which is the mixture to be subjected to the high temperature and pressure. But the heat is to be applied in another vessel, as shown in the drawings, and for the purpose of removing the mixture to such other vessel the inventor employs a force pump, like those in use for hydraulic presses, by means of which he drives the mixture into and through a long coil of very strong iron tube, which being placed in a furnace is continued there until the mixture is heated to the temperature of melting lead. Attached to the opposite end of the coil is a refrigerator or cooling apparatus, but the inventor states that he prefers that the high temperature of the mixture should be maintained for ten minutes before the product passes through that part of the coil immersed in water, by which it is cooled down from its high temperature to 210 Fahr., after which it escapes through the exit valve to the vessel prepared to receive the product of the patented process. High heat applied in the manner and by the means described is unquestionably the agent employed by the patentee to decompose the fatty and oily substances to be subjected to the patented process, and it is equally certain that he contemplates that the temperature

shall be so high that the fatty and oily substances, as mixed with the water, in the manner before explained, will be decomposed and converted into fat acids and solution of glycerin in a brief space of time, not exceeding ten minutes, as he gives no intimation that it will ever be necessary to continue the mixture in the heated

coil beyond that length of time.

Rapid manipulation and high heat are therefore the leading characteristics of the described process, as the great pressure mentioned is only the consequence of the high heat, but as the high heat is indispensable to produce the described result, and as the vessel containing the mixture to be heated must be closed, it is quite obvious that the vessel must be one of very great strength, else it would prove to be a very inconvenient one, as it would be likely to burst. Support to that conclusion is found in the description which the inventor gives of the character of the tubes which he employs as the vessel for heating the mixture. He employs coils of tube for the purpose, arranged in such a manner that a considerable length of the same will occupy but a moderate space, the coils being kept about a quarter of an inch apart from each other. Tubes of the kind are made of iron, and the inventor states that they are one inch in the external diameter with a half inch bore, encases with solid cast iron, which also covers the outer coils or rows of tubes to the thickness of half or three quarters of an inch, to ensure uniformity of temperature in the different parts of the coil and to give strength to the apparatus and to protect it from injury by fire. Much additional confirmation to the conclusion that the process of the patentee contemplates high heat and rapid manipulation is also found in the other parts of the specification. Evidently the inventor is of the opinion that the operator must be exposed to imminent danger unless the vessel is one of very great strength, as he states that he deems it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch before taking it into use. Such a test he deems prudent before using the vessel, but he expresses the opinion that the working

pressure necessary in using the degree of heat required will not be found to exceed two thousand pounds to the square inch, which admission of itself is sufficient to maintain the conclusion that high heat is the agent which the inventor in his process employs to decompose the substances subjected to the patented process. Certain substances, such as palm oil, the inventor represents, may be decomposed and converted into fat acid and glycerin under his process when the

temperature is at or below the melting point a substance but he states that the heat in decomposing such a substance may be raised considerably above the melting point of lead without any apparent injury, and he adds that the decomposing action of the water becomes more powerful as the heat is increased.

Considered as a whole, these several considerations show to a demonstration, in the judgment of the court, that the invention described in the specification and embodied and claimed in the patent is the use of great heat in the manner described to decompose the described substances when properly prepared, by being pulverized or broken into small particles and mixed with water, and cause the elements of the decomposed substances to unite with the particles of the heated water by which the mixture is converted into fat acids and solution of glycerin. Manifestly great heat, applied in the method described, is the principal agent, but water is an essential ingredient, as without it the product of decomposition would be destroyed in the operation.

Evidence that the inventor contemplates that the change in the substance shall be accomplished in a brief space of time abounds in the specification. Ten minutes is the maximum time suggested that the high temperature should be maintained while the mixture is flowing through the heated tubes before it passes into the refrigerator, but the patentee also states that it is important for the quickness and perfection of the decomposition that the oil and water should continue, during the passage of the emulsion through the heating tubes, in the same state of intimate mixture as they were when the mixture was driven into the heated coil, and to that

end the inventor states that he prefers to place the series of heating tubes in a vertical position, so that if any partial separation takes place while the liquid passes up one tube, the change may be corrected as the liquid passes down the next.

Suitable means are pointed out to indicate to the operator the state of the heat in the tubes, and for that purpose the inventor suggests the making of certain

indicators or gauges showing the melting point of certain metals and other substances, of different and known degrees of fusibility, and he gives the series which he has used, which consist of tin, melting at 440 Fahr.; bismuth, 510 Fahr.; lead, 610 or 612 Fahr.; nitrate of potash, 660 Fahr.; and he describes the mode in which such gauges may be constructed. Palm oil will be decomposed by heat at 510 Fahr., and the inventor mentions that as the lowest gauge for the treatment of any known fatty or oily substance to be subjected to the patented process under consideration.

Ordinary fats, such as beef tallow, or the tallow of sheep, require the heat to be raised to 612 Fahr., which is the melting point of lead. Mention is made in the series set forth in the specification of the melting point of tin, which is 440 Fahr., but the mention of that chemical fact was doubtless made as a guide to the operator in carrying up the heat to the point necessary to decompose the respective substances, such as palm oil or the ordinary tallows, all of which require the heat to be raised to a point higher than the melting point of tin.

No different conclusion can be reached, as there is nothing in the record which gives any countenance to the theory that the melting point of tin, 440 Fahr., was given as a gauge of heat which, under the process of the patentee, would decompose any known fatty or oily substance in such a manner as would enable the operator to manufacture the product described in the patent.

Substances are mentioned in the specification which, under the described process, would require the heat to be raised to the melting point of bismuth and to the melting point of

lead, but the specification does not make mention of any substance of the kind which can be decomposed as required at the melting point of tin, nor does it mention anyone which for the same purpose would require the heat to be raised to the melting point of the nitrate of potash. Probably the former was mentioned for the guidance of the operator, as before explained, and it may be that the latter was

given for a corresponding purpose as the maximum limit for the operator in raising the heat to decompose such fatty and oily substances as the ordinary beef tallow or the tallow of sheep, which require the heat to be raised to the melting point of lead in order to produce a good result under the patented process.

Two other requirements of the specification support the theory that high heat is the principal agent of the patented process, and that the vessel to be used for heating the mixture must be kept closed during the process of decomposition, and be one of sufficient strength to sustain, without bursting, an internal pressure of at least two thousand pounds to the square inch. One is that the exit valve is required to be so loaded that when the heating tubes are at the desired working temperature the valve will not be opened by the internal pressure produced by the application of the heat to the mixture, so that when the pump is not in motion none of the mixture will escape at the other end of the apparatus; and the other requirement is that "no steam or air shall be allowed to accumulate in the tubes, and that the tubes shall be kept entirely full of the mixture."

Argument to show that the vessel used for heating the mixture must be kept closed is unnecessary, as the terms of the specification expressly require it, and the patentee to that end directs that if practicable the ends of the tubes should be welded, and if not, that they be connected by certain described joints to accomplish the same purpose, evidently regarding a compliance with the requirement that "the vessel must be closed" as an indispensable condition.

Half or one third of the mixture to be subjected to the patented process is water, and the condition set forth in the

specification is imperative that the vessel used for heating the mixture must be closed, that the requisite amount of pressure may be applied to prevent the water from being converted into steam; and it is also an express condition that no steam or air should be allowed to accumulate in the tubes, for reasons which will be obvious to any who will carefully examine the described method of producing the

described result.

Means of a mechanical character are prescribed in the specification for intermingling the fat and the water into what is called an emulsion, which is the mixture to be subjected to the patented process, but the difference between such an intermingling of one substance with another, which may be accomplished by a stirrer or by the churning process, and the actual union produced by chemical affinity between two or more substances, is as wide as one thing well can be from another. Such an intermingling of fat with water does not work any chemical change in either substance, as it creates at best but a temporary affinity. Consequently the water, if the mixture is left for a sufficient length of time undisturbed by the stirrer or piston, will separate from the particles of fat and settle at the bottom. Widely different results flow from chemical affinity, as such an affinity will produce a new and distinct substance, uniting, it may be, the constituents or properties in whole or in part of substances as different as fat and water.

Fats consist of several constituents closely united in indefinite proportions, of which olein, margarin, and stearin are the only ones usually recognized and defined by chemists; the former constituting the oily and the two latter the solid principle of the united substance. [Footnote 19]

These constituents or elements are held together by chemical affinity, the consistency of the united substance depending upon the respective proportions of the constituent parts. High heat will overcome the affinity by which the constituents are united and decompose the substance. Different

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kinds of fat, however, require different degrees of heat to effect the decomposition of the united substance, varying in intensity from 510 Fahr., the melting point of bismuth, to 610 or 612 Fahr., the melting point of lead, which are the very temperatures mentioned as required in the specification of the complainant's patent. But it should be remarked in this connection that the decomposition of such

a substance by heat alone will not produce fat acids or solution of glycerin. [Footnote 20]

Free fat acids and solution of glycerin are what the patentee promises as the result of a proper application of the patented process. Those acids, it is conceded, are oleate, margarate, and stearate, which, it is claimed, the process will produce, together with the solution of glycerin, but it is clear that heat alone will not produce either of those fat acids or the solution of glycerin, as the three acids and the glycerin are chemically combined in the original substance with the oxide of glyceryl as an acidifying base. Temperatures such as described will decompose the fat, but unless some chemical agent, such as water, lime, soda or potash, is present to take the place of the oxide of glyceryl to acidify the olein, the margarin, and the stearin, or to oxidize the said several constituents and to convert the same into oxide of olein, margarin, and stearin, neither of the fat acids required, to-wit, oleate, margarate, or stearate, can be obtained from the decomposition of fats by heat, as the oxide of glyceryl, which was their base in the original substance, is separated by the Act of decomposition; nor is it possible, unless water or its equivalent be present when decomposition takes place, to obtain solution of glycerin, for reasons equally conclusive through somewhat dissimilar in the chemical sense, as the presence of water or its equivalent is required in the latter case to hydrate the glyceryl and convert the same into the solution of glycerin. Without the presence of water or its equivalent constituents neither the fat acids mentioned nor solution of glycerin will be obtained

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by heat, but with it the three fat acids mentioned and solution of glycerin will be produced if the operator complies with all the other conditions described in the specification. [Footnote 21]

Viewed in the light of these suggestions, as the question should be, it is quite clear that the two conditions last named, to-wit, that the heating vessel must be kept entirely full of the mixture and that no steam or air must be allowed to accumulate in the vessel employed to impart the heat, are material and indispensable

conditions of the patented method of producing fat acids and solution of glycerin from the described substances, as without a compliance with those requirements there might not, and probably would not, be present when decomposition takes place any equivalent of a base to take the place of the oxide of glyceryl and to unite with the olein, margarin, and stearin to convert the same into the three fat acids known as oleate, margarate, and stearate. These three constituents in the fat, to-wit, olein, margarin, and stearin, are combined with the oxide of glyceryl as a base, and when decomposition is effected under the influence of heat, some chemical agent, such as water or its equivalent must be present, which can take the place of the oxide of glyceryl to change the three constituents of fat just named into the oxides of olein, of margarin, and of stearin. [Footnote 22]

Some chemical agent must also be present to take the place of the constituent which was combined with the glyceryl to produce the solution of glycerin, as represented in the specification; and it does not appear to be controverted that in all methods heretofore practiced water or its equivalent has always been present for such purpose, and it is manifest that the requirement that water or its equivalent shall be present to accomplish that purpose, in the specification, is an indispensable condition, as the new substance would otherwise be destroyed by the operation, which requirement cannot be fulfilled unless the vessel is kept

entirely full of the mixture, as otherwise steam and air will accumulate and fill the vacuum.

Water must be present in the mixture to furnish the requisite constituent to unite with the olein, margarin, and stearin, and to oxidize the same, else it will be impossible to obtain the described fat acids; and the presence of water in the mixture when the decomposition takes place is also equally indispensable to furnish the requisite constituent to take the place of the oxide evolved by the operation from the glyceryl and to unite with the other constituents of the same to produce solution of glycerin, which the specification alleges is one of the results to be obtained from the decomposition in the method therein described. Unless water

or its equivalent be present to furnish such constituent to take the place of the oxide evolved from the glyceryl, the same heat that separates the glyceryl from the other constituents of the fat in the mixture will convert the same into acrolein, which is an offensive substance destitute of any useful quality, or, in other words, the glyceryl will be converted into a substance which is neither new nor useful, and of course the process to obtain it would not be the proper subject of a patent. [Footnote 23]

Nothing provided in the patent or suggested by the patentee will secure the presence of water when decomposition takes place, unless the vessel be closed and be kept entirely takes place, unless the vessel be closed and be kept entirely full of the mixture, as otherwise the water will be converted into steam, and steam and air will accumulate in the heating vessel. No means are described or suggested to add water to the mixture after the mixture is forced into the heating vessel, and it is plain that nothing of the kind can be successfully accomplished without some material change in the apparatus.

Beyond all doubt the conditions mentioned appertain to the described method patented by the complainant for producing fat acids and solution of glycerin from fatty and oily substances of animal and vegetable origin, which contain

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glyceryl as their base, but it is equally clear that the patentee does not claim the described apparatus as any part of his invention, and that he is not the original and first inventor or discoverer of the scientific truth that such fats as beef tallow and palm oil may be decomposed by heat or by heat and water combined, nor of the scientific truth that fat acids of commercial value may be obtained from such substances as tallow and palm oil by means of heat or by heat and water.

Power to issue letters patent is conferred upon the Commissioner of Patents, and inasmuch as such grants are executed by public authority and in pursuance of an act of Congress, the rule is that the patent, when introduced in evidence by the complaining party in a suit for infringement, affords a *prima facie* presumption

that the patentee is the original and first inventor of what is therein described and claimed as his invention. Application for a patent is required to be made to the commissioner appointed under authority of law, and inasmuch as that officer is empowered to decide upon the merits of the application, his decision in granting the patent is presumed to be correct. [Footnote 24]

Sufficient has already been remarked to show what the alleged invention is as construed and defined by the court. Having ascertained that matter, the next inquiry is, whether the complainant is the original and first inventor of the improvement?

1. Persons seeking redress for the unlawful use of patented inventions must allege and prove that they are the original and first inventors of the same, and that the party defendant is guilty of the alleged infringement. In the first place, the burden to establish both of those allegations is upon the party instituting the suit, but the rule, as before explained, is that where the complainant or plaintiff introduces the patent in evidence, if it is in due form, it affords a *prima facie* presumption of its correctness, which, in the absence

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of opposing proof, will entitle the complaining party to relief. Availing himself of that rule the complainant introduced his patent in evidence, which is sufficient to show that he is the original and first inventor of his improvement, as construed and defined by the court, unless sufficient evidence to overcome that presumption and to establish the contrary allegation of the answer is exhibited in the record. [Footnote 25]

Whether tested by the language of the claim or by that of the patent, or by the language embodied in the two introductory sentences of the specification, it is equally clear that the patentee, at the time the patent was granted, did not pretend that he was the original and first inventor or discoverer of the scientific truth that high heat or water heated to a high temperature would decompose such fatty and oily substances as those mentioned in the specification of his patent, and the

evidence in the record shows that such a pretense, if it had been made, could not have been supported for a moment.

Opposed to that proposition it is suggested that the patentee claims "the manufacturing of fat acids and glycerin from fatty substances by the action of water at a high temperature and pressure," which must be admitted subject to the universal qualification that the legal construction of every such claim is that the patentee means to limit the same to his described method or process; or, if it be a machine, to his described means of obtaining or of accomplishing the described result. Usually the claim contains the words as described or substantially as described, or words of like import, which are everywhere understood as referring back to the descriptive parts of the specification. Words of such import, if not expressed in the claim, must be implied, else the patent in many cases would be invalid as covering a mere function, principle, or result, which is obviously forbidden by the patent law, as it would close the door to all subsequent improvements. [Footnote 26]

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Doubtless, an invention may be good though the subject of it consists in the discovery of some principle of science or property of matter, never before known or used, by which some new and useful result is obtained, and such an invention or discovery may be the subject of a valid patent without including in the claim any new arrangement of machinery to accomplish the object, provided the inventor describes, as required in the patent law, the method, process, or means of applying the invention to practical use and of obtaining the described new and useful result. [Footnote 27]

Limited, as explained by reference back to the descriptive parts of the specification, the claim may well be regarded as in due form, but it is quite clear that it would be invalid if it is not so limited, as it has always been held that a patent embraces nothing more than the improvement described and claimed as new, and that anyone who afterwards discovers a method of accomplishing the

same object, substantially and essentially differing from the one described, has a right to use it and to vend it to others to be used. [Footnote 28]

Apply that rule and it is clear that the invention must be limited to the described method of producing free fat acids and solution of glycerin from the fatty and oily substances therein mentioned, as the patent states that the patentee alleges that he has invented a new and useful improvement in processes for purifying such fatty and oily substances, and the opening sentence of the specification describes the invention as a new and improved mode of treating fatty and oily substances, and the patentee, in describing his invention, states that it consists of a process for producing free fat acids and solution of glycerin from such fatty and oily substances as are therein particularly described, and there is not a word either in the specification or claim of the patent to warrant the conclusion that the patentee or the Commissioner of Patents, at the time the patent was granted, regarded the patentee as the original and first inventor or discoverer of

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the scientific truth that such fatty and oily substances may be decomposed by high heat or water heated to a high temperature.

Unquestionably the method or process embodied in the patent includes high heat and rapid manipulation, but the patentee is not the original and first inventor of the scientific truth that heat or water at high temperature will decompose such fatty and oily substances as those mentioned in the specification. Different gauges of heat to be employed in applying his process are certainly given in the specification, as before explained, but it is a great mistake to suppose that the gauge for decomposing such fats as beef tallow or the tallow of sheep admits of any variation except what is authorized by the word "about," or that the gauge given for decomposing palm oil may be varied from the melting point of bismuth, except so far as the authority to diminish the temperature may be inferred from the words "at or below," which words, when properly construed, mean substantially the same thing as the word about, when the latter is used to qualify the temperature designated as the melting point of lead.

Attempt is made in argument to show that the respective gauges given in the specification to specify the required degree of heat are subject to a much wider variation, and that the patentee did not intend to require that the mixture should be exposed to any higher temperature than that which should prove to be requisite to accomplish the described result. Suppose that could be admitted, still it is not probable that the admission would much vary the case if the apparatus employed should not be changed, and all the conditions for applying the process should remain in full force, as rapid manipulation is an express condition in applying the process of decomposition, which, it is believed, cannot be accomplished in the time allowed unless the high temperature is maintained.

Support to the theory that the gauges given admit of a wider variation than is here supposed is attempted to be drawn from the sentence in the specification which immediately

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follows the statement that the decomposition of the water becomes more powerful as the heat is increased. Fatty matters such as palm oil, says the patentee, may be changed into fat acids and glycerin at or below the melting point of bismuth, but he states in the same connection that the heat in such a case has been carried considerably above the melting point of lead without any apparent injury; and he adds that the decomposing action of water becomes more powerful as the heat is increased. Then follows the sentence which is invoked as supporting the theory that the gauges of heat given in the specification, to-wit, the melting point of bismuth and the melting point of lead, are subject to indefinite variation.

By starting the apparatus at a low heat, says the patentee, and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty substance employed, can easily be determined. Evidently the sentence should be examined in the light of the context, and when so examined it is quite clear that the patentee never intended to employ the language in any such sense as that which the complainant ascribes to it, as he was speaking of palm oil, which is decomposed at the melting point of bismuth, and

had just remarked that the heat, in applying the process to that substance, had been carried considerably above the melting point of lead without any apparent injury.

Water, said the patentee, becomes more powerful to decompose such substances as the heat is increased, and then adds, as a precaution to the operator, not to carry it too high above the gauges given. You can easily determine what is best in any given case by starting the apparatus at a low heat and gradually increasing it to the gauge given or above, as may appear to be best from the particular substance subjected to the process and the quality of the product obtained by the operation. Not an intimation is given in the sentence that any less heat will accomplish the purpose than that that indicated by the gauges mentioned in the specification. On the contrary, the language employed, if it

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warrants any substantial variation from the prescribed gauges, justifies the inference that the heat may be increased above the temperatures mentioned rather than diminished.

High temperature and pressure are among the leading characteristics of the invention, as appears from the claim and every part of the specification. Doubtful expressions may be subject to construction, but where the language employed is clear and unambiguous it must speak its own construction in the specification of a patent as well as in any other grant issued by public authority. Intention in every case, it may be admitted, is the primary rule of construction, but language invoked to support a particular theory must be such as is fit, when it is compared with the whole instrument, to express the imputed intention, else the theory in question cannot be supported, as courts of justice cannot legislate nor can they add to a grant or contract any stipulation or condition which it does not contain. Consequently, the theory of the complainant that the sentence under consideration warrants the conclusion that the claim of the patent includes low as well as high heat must be overruled. [Footnote 29]

Additional observations respecting the apparatus employed by the patentee are unnecessary, as he expressly states that he does not intend to claim it as any part of his invention. Enough has already been remarked also to show what is the nature and scope of the invention and to point out what the question is which is involved in the first issue presented in the pleadings. Construed and defined as explained, the first issue respecting the patent must be found for the complainant, as the proofs in the record bearing upon the question of novelty are not sufficient to overcome the *prima facie* presumption that the patentee is the original and first inventor of what is described in the patent as his invention. [Footnote 30]

2. Grant all that, still it is insisted by the respondent that

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the result described in the specification and claim of the patent cannot be accomplished so as to be practically useful by the method and apparatus described in the specification.

Whoever discovers that a certain useful result will be produced in any art, machine, manufacture, or composition of matter by the use of certain means is entitled to a patent for his invention, provided he specifies the means he uses in a manner so full and exact that anyone skilled in the science to which it appertains can, by using the means he specifies, without any addition to or subtraction from the described means, produce precisely the result he describes. Such description must be correct, as it is settled law that the patent is void if the described result cannot be obtained by the described means. [Footnote 31]

Nor does it make any difference whether the effect is produced by mechanical principles or by chemical agency or by the application of discoveries in natural science, as in either case the requirement of the Act of Congress is imperative that the patentee must describe the method, process, or means he employs in full, clear, and exact terms, and the end which the invention accomplishes.

Inventions, in order that they may be the proper subjects of letters patent, must be new and useful. Utility in most cases is a question of fact, as it usually depends

upon the evidence resulting from actual experiment. There are two modes, says Mr. Curtis, in which the utility of an invention may be impeached, the second of which is where it appears that it is not capable of being used to effect the object proposed, which is the question presented in the second defense set up by the respondent. [Footnote 32]

Cases arise also, even where the means described will accomplish the described result, when it cannot be held that the invention is useful if it appears that the operator, in using the described means, is constantly exposed to imminent danger, either from the explosive tendency of the substance

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to be used or from the liability of the vessel to burst which is required to be employed as means of accomplishing the patented result. Where the patentee finds it necessary to employ any such dangerous means to accomplish the described end it cannot be held that his invention is useful, within the meaning of the patent law, even though it appears that the operator, when no such disaster happens, may be able to work out the described result by the described means, as it is quite clear that Congress, in making provision to secure to inventors the exclusive right to their discoveries, never intended to promote any such as were in their nature constantly dangerous to the operator in employing the described means to accomplish the described result. [Footnote 33]

Apply these rules and it follows that neither an invention which will not enable the operator to accomplish the described result nor one which constantly exposes the operator to the loss of his life or to great bodily harm can be regarded as useful within the meaning of the patent law.

Patents were granted to the supposed inventor by the proper public authorities in England, France, and Belgium, as well as by the proper public authorities in the United States, but the respondent insists that the described result cannot be obtained by the means and in the mode of operation described in the specification, and that the invention has never been reduced to practice by the use of those

means or in that mode of operation, either in the United States or in anyone of the foreign countries where the same has been patented.

Both branches of the proposition are controverted by the complainant and many depositions and other proofs upon the subject were introduced at the hearing. Witnesses were examined by the complainant to prove the affirmative of the issue, but none of them appear to sustain his views in that behalf unless the scope of the invention is extended beyond the means and mode of operation described in the specification as construed and defined by the court. Proofs

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of the kind, if they exist, could easily have been procured, as both the complainant and his brother, who acted as his agent in efforts to introduce the invention in the United States, were examined as witnesses in the case.

Licenses were given by the complainant in some instances, and he called Charles T. Jones, one of his licensees, to prove the affirmative of the issue under consideration. It appears by his deposition [Footnote 34] that he became a member of a certain firm in 1849, and that the firm were engaged in the manufacture of candles; that they first used the process of saponification with about fourteen percent of lime in an open vessel; that they decomposed the lime soap thus obtained by sulphuric acid, using for the purpose two and a half pounds of sulphuric acid to each pound of lime; that they continued to use that process until the fall of 1859, when they introduced the process of saponification under pressure of about one hundred and thirty pounds to the square inch, with only six or seven percent of lime and with a corresponding diminution of sulphuric acid. Subsequently they abandoned the second process used by them and introduced another, which the witness calls the process of the complainant.

On cross-examination he was asked whether water was not used in their first process and whether he ever knew any process by which fats were decomposed into fat acids and a solution of glycerin without the intervention of water; to which he answered, water was used in the first process described, but in quantities only

slightly in excess of that requisite for preparing the milk of lime; and he added that he did not know that the decomposition of neutral fats into fat acids and a solution of glycerin had ever been accomplished without the intervention of water.

Counsel for the respondent also requested the witness to describe the process used by his firm which he calls the complainant's process. His answer is, in substance and effect, as follows: he places the melted fat to be treated in a large vessel with a quantity of water equal at least to

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one-half the bulk or weight of the fat, and subjects the melted fat and water to a steam pressure of three hundred pounds to the square inch for a period of about five hours, keeping the water and fat in intimate contact by pumping the water from the bottom to the top of the vessel and discharging it on the upper surface of the fat in order that the water may make its way to the bottom of the same, to which he added that he preferred to use half of one percent of lime, for the reason, as he states, that that quantity of alkali enables him to perfect the decomposition in four hours at a pressure of two hundred and fifty pounds to the square inch with material economy of fuel and of wear and tear of machinery; and he states that since ascertaining the advantages of the lime, he has adhered to that mode of operation.

Responsive to another question, he states that the apparatus was first put in operation, under the superintendence of the complainant, in September, 1863; that the vessel used was manufactured in Philadelphia; that it comprises a tube thirty eight feet in length and thirty eight inches in the internal diameter; that it is made of iron plates of the thickness of a half inch, and a copper tube of nearly the same length, thirty five inches in diameter, which is placed inside of the iron tube so as to leave an annular space of about one and a half inches between the copper and the iron vessel, whose estimated capacity is about ten thousand pounds of oil and water, but the quantity of fat usually put into the vessel at one time is about six thousand pounds, with about four thousand pounds of water, all of which is placed in the copper vessel, which serves to fill the vessel within three feet of the head or

top; and he states that when the decomposition is perfected the water holding the glycerin in solution and the fat acids are discharged into their respective receptacles.

Two vessels are used instead of one, as directed in the specification, because iron is cheaper than copper, and to secure greater strength to resist the requisite pressure and to save the iron from contact with the fat acids, which discolors

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the product and rapidly corrodes the iron to such an extent that it will soon render the vessel unfit for use.

Satisfactory products, as the witness states, may be obtained by the process without lime, though he adheres to the statement that he prefers to use it in order to diminish the pressure which would otherwise be required, and for the economy which it effects in fuel, labor, and time, but he states without any qualification that no one in their manufactory ever mixed any fatty or oily substance with water, in the proportions given in the complainant's specification, and placed the mixture in any vessel in which it could be heated to the melting point of lead until the operation was completed and thereby obtain free fat acids and solution of glycerin.

Even without any discussion, it is obvious that the means and mode of operation practiced by the witness are widely different from the method or process described in the specification of the complainant's patent. Instead of working in a vessel entirely full of the fat and water and under a pressure sufficient to prevent the presence of steam, the operation under the process of the witness is performed in a vessel only partly filled, which is open at the upper end and enclosed in another vessel, and the heat is applied by the introduction of steam from boilers outside. Other differences also exist, as for example, instead of being worked at a temperature of 510 or 612 Fahr., and in a vessel capable of sustaining an internal pressure of two thousand pounds to the square inch, the process of the witness is worked at a temperature represented by a pressure of only three hundred pounds to the square inch, which is a latitude of deviation not warranted by any language

to be found in the complainant's specification.

Two other differences may also be mentioned which are equally persuasive to show that the method or process practiced by the witness is substantially different from that embodied in the patent of the complainant. Instead of the fat and the water being maintained during the entire operation in a state of intimate mechanical mixture, as required

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in the specification, a pump is provided, not to force the mixture into the heating vessel, but to be kept constantly at work to draw the water from the bottom of the vessel and to discharge it on top of the charge of fat, in order that it may percolate down through the fat and supply the deficiency occasioned by the fact that the water is constantly being converted into steam.

Ten minutes is the maximum time allowed for the operation in the complainant's specification, but the method or process employed by the witness, instead of effecting the decomposition in ten minutes, requires at least four or five hours, even when he uses a shall proportion of lime to assist the chemical action of the heated water.

Besides the differences between the two methods already pointed out, there are others which may be suggested, equally striking and of a character equally persuasive, to show that the two methods are substantially different, as, for example, the apparatus employed by the witness consists of two vertical cylinders, one within another, instead of a coil of tubing, with an annular space between the two, as before explained, of an inch and a half.

Fat and water in nearly equal proportions are charged into the inner cylinder, leaving a vacant space at the top of the same of about three feet. Like the coil of tube, the outer cylinder is steam-tight, but the inner one is open at the top. Steam for the operation is generated in two separate boilers, which is introduced through the top of the outer cylinder to the space between the two and through the upper end of the inner one, which is open, to facilitate the circulation of the steam in

order that the fat and water in the inner cylinder may be heated to the temperature represented by a pressure of two hundred and fifty to three hundred pounds to the square inch, and the witness testified that he regarded the use of the pump and the use of some lime as essential to the use of the apparatus with the greatest economy.

Licensees of the complainant were also examined by the

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respondent, to-wit, Nathaniel Ropes and Nathaniel Ropes, Jr. [Footnote 35] These witnesses have had great experience in manufacturing candles, and they testify that they know of no place in this country where candles or soap are manufactured from free fat acids produced by water alone at high temperature and pressure without the use of alkali. They both describe the old saponifying process as consisting in the treatment of fact by water heated in an open vessel, lime being mixed with the water, by which the glycerin was separated from the other constituents of the fat, leaving what some manufactures call lime soap, or fat acids and lime, which latter ingredient was afterwards removed by sulphuric acid, the residuum being free fat acids.

Changes were made in their mode of operation early in the year 1860, which alterations were introduced to them by the brother of the complainant, who experimented in their manufactory several months before he put the apparatus adopted in operation. By that plan, they use water in equal proportions with the fat, with a half percent of lime and double that quantity of sulphuric acid, the whole being heated to a temperature representing a pressure of about one hundred and fifty pounds to the square inch in a closed vessel for twelve hours. Formerly they conducted the operation in open tubs, using thirteen percent of lime with double that quantity of sulphuric acid, but since the new method was introduced by the agent of the complainant, they have substituted closed copper tanks in the place of the open tubs, using, however, the same agents to effect the decomposition of the fatty substances, though in different proportions.

Copper tanks are used as receptacles for the fat and the water, but the steam to communicate the heat is generated in a large iron boiler thirty feet in length and forty inches in diameter, with which the copper tank is connected by means of steam pipes furnished with stop cocks as regulators in the use of the steam. There is also a shaft in the

tank having radial arms, which shaft is kept in rotation to cause and preserve an intimate mechanical mixture of the fat and the water during the whole operation.

Instead of having the tank constantly filled with the fat and water, the fact is that it is never filled, nor is the mixture kept under a pressure sufficient to prevent the accumulation of steam and air, as directed in the specification of the patent described in the bill of complaint. Empty space is left in the tank above the fat and water at the outset sufficient to allow boiling, which space of course would be filled with steam and air. Heat is communicated to the mixture by introducing steam from the large iron boiler into the copper tank, creating a temperature causing a pressure of one hundred and fifty pounds to the square inch.

Several months were employed in making the experiments before the method now in use was finally put in practice by the complainant's agent. He tried it without lime at a pressure of two hundred pounds, allowing twenty-four hours for the operation, but the result was not satisfactory. Dismissing that method, he next tried the experiment with fat and water in the proportion of two to one, allowing twenty hours; still the result was unsatisfactory. Next he tried the compound of fat and water in equal proportions, using only half of the water during the first part of the operation, then discharging that and putting into the charge the other half of the water, and he found that the operation produced a good result in twelve hours. Some of the experiments were without lime, but the witnesses state that inasmuch as they found that by the addition of lime they could accomplish the work at a pressure of one hundred and fifty pounds to the square inch and in less time, they have ever since continued the use of lime in their business.

Much discussion of the process introduced on that occasion is unnecessary, as it appears that instead of working at a heat equal to the melting point of lead in a vessel capable of sustaining an internal pressure of two thousand pounds, these licensees of the complainant use a certain percent of lime at a pressure not much above one hundred and fifty

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pounds, and it appears that they decompose the fat in a vessel not filled with the mixture, nor provided with a mechanical stirrer, and leave a vacant space in the vessel sufficient for circulation, in which steam is not only generated but is introduced from a separate boiler. Differences such as these require no comment except to say that the method is entirely different from that described in the patent in question and to add that it corresponds much more nearly to the method described in a patent dated May 15, 1860, subsequently obtained by the complainant, and which was introduced in evidence by the respondent.

Reasons exist besides those disclosed in the testimony of those witnesses to support the conclusion that the complainant never supposed that his patent conferred the exclusive right to use temperatures and pressure to decompose fats with water alone much below the gauges given in his specification, and that he had come to doubt, several years before those experiments were made, whether the patented method or process could be accomplished so as to be practically useful by the means and in the mode of operation pointed out in the patent.

His letter, dated London, June 25, 1856, addressed to a certain firm in Cincinnati, [Footnote 36] affords strong support to that conclusion, in which he states that our experiments in the factories here and in Paris have shown that on the large scale, the decomposition of fats by water is more conveniently effected by modifying the apparatus originally proposed so that the fat and water are exposed to a comparatively lower heat and pressure for a longer time, instead of a very high pressure for a few minutes. By which means he suggests in the same letter that a considerable quantity of material may be treated at one charge in an ordinary steam boiler lined with lead or copper, and may be provided with an agitator in the

place of using the continuously working pump and coil of pipe, and the suggestion is that

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at a pressure of two hundred and twenty five pounds to the square inch, tallow, palm oil, or lard stearin may be completely decomposed in five hours.

Nearly two years before the date of that letter, to-wit, on the twenty-fifth of March, 1854, the complainant took out a patent in England for the same invention as that described in the patent in issue in this case, and the proofs show that he made various efforts to introduce it into practice in that country. He remained there, it seems, from 1854 to 1859, and it appears that in June, 1854, he exhibited his process in the old form to George F. Wilson, the managing director of the Price Patent Candle Company, and the company entered into a contract with the complainant respecting the same, by which he assigned the said letters patent and the privileges thereby granted to the said company, and that the said company, in consideration of the assignment, covenanted to pay him an annuity of one thousand pounds sterling from the month of October of the following year during the continuance of the patent, subject to various conditions, and among others to be terminated by giving notice to the complainant as therein provided; the company were also to have the use of several other patents therein described, which have since expired.

Proofs were also exhibited showing that the said company have ever since paid the stipulated annuity, but there is no satisfactory evidence in the case to show that they have ever applied the process to produce fat acids and solution of glycerin by the means and in the mode of operation described in the specification, as construed and defined by this Court. Some use, it may be presumed, has been made of the patent by the assignees, but what that use is does not very satisfactorily appear. It does appear, however, from a paper read before the British Association in September, 1855, by the general director of the company, to whom the complainant testifies that he exhibited his process the year previous, that he stated that in our new process the only chemical agents employed for

decomposing the neutral fat and for separating its glycerin are steam and heat, and that

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the only agents used in purifying the glycerin thus obtained are hear and steam. [Footnote 37]

Strong confirmation of that is also derived from a paper read by the same person at a session of the Society of Arts, held in that country January 25, 1856, also put in evidence by the complainant, [Footnote 38] in which the author says, in speaking of the patented process, "It has yet to be proved how far it can compete successfully with distillation," adding that they had made an arrangement with the inventor which, as he expresses himself, will give them the means of testing its commercial merits, and then he proceeds to state that on witnessing a trial of the process in the small tube apparatus, it struck him that steam passed into the fat at a high temperature should effect by a gentle process what the patentee aimed at effecting by a violent process, to-wit, the resolving of the neutral fat into glycerin and fat acids, finally stating that they had proved that the fact was so and that the glycerin distilled over with the fat acids though it was no longer combined with those products, evidently showing that the process employed by them was at that time widely different from that claimed by the complainant.

Application for a patent was also made by the complainant to the proper authorities of France during the same year, and it appears that the application was successful, as he immediately commenced negotiations through his patent agent with the firm of Monier & Co., doing business near Paris in that empire, for the sale of the patent, which negotiations resulted in a contract of sale. Pursuant to that contract, he transferred the patent to that firm subject to the condition that the process would effect the results promised by the grantor.

Numerous experiments were subsequently made under the superintendence of the patentee or his brother, for a period of six months, all of which produced results which the evidence shows were entirely useless. They were made in the

first place, as the senior partner of the firm states, [Footnote 39]

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by means of a small apparatus brought from London by the patentee, which consisted of a hollow iron tube of serpentine form, incased in a cast iron block from which the two ends of the tube projected -- one for receiving the fatty substance used in the experiments for decomposing the same, and the other for discharging the product.

High heat was required for the purpose, and with that view, the apparatus was so placed in a furnace constructed of fireproof bricks that it received all the heat, the flames of which completely enveloped it, and which brought it to an excessive heat, but the witness cannot give the degree of heat, as the apparatus did not contain any gauge to indicate its intensity.

Fatty matter and water were put in a vessel prepared for the purpose, which was provided with a bronze suction and force pump worked by hand and connected with one end of the iron coil projecting from the cast iron block, by which the mixture of fatty matter and water was drawn from the receptacle and was forced into and through the iron coil of tube, as the same was encased in the iron block, and out at the opposite end of the same, where it was discharged into another receptacle prepared for the purpose. By means of the furnace, the iron tube and the block in which the coil was incased were "heated to an excessive degree," estimated by the witness to exceed 500 Fahr. with an estimated pressure of more than twenty atmospheres. Both the patentee and his brother worked at the experiments ten or fifteen days, but the decomposition of the fatty matter, as the witness states, was never complete, and that they never produced fat acids and glycerin, the product being only an altered fatty matter, which, when washed, showed acrolein to such an extent as to fatigue the workmen who assisted at the experiments. Fifteen of the experiments were made by the patentee aided by two workmen, in the presence of the witness, and he states without qualification that none of the experiments succeeded.

Three new apparatuses were subsequently constructed by the brother of the patentee, acting as his agent. Two were

constructed in Paris and one in London. Experiments were subsequently made by the brother of the patentee, and in some instances without any regard to the patented process, the aim being to find out if possible the means of overcoming the difficulties manifested in the prior attempts to produce the promised results.

None of his efforts, however, succeeded, though the experiments were continued until the expenditure exceeded forty thousand francs, and it appearing that fat acids and glycerin could not be produced by the process, the contract was annulled, and the witness affirms that it is impossible to decompose fatty matter and obtain fat acids and glycerin by the method indicated in the complainant's patent. He admits, however, that his firm were subsequently induced, on the return of the patentee to that country, to join with another firm engaged in manufacturing candles to make a new contract with the same party upon the same basis as the first contract, it being represented that the patentee would introduce a new process, based upon the principles of the patented method, which promised certain success and admirable results. Such a contract was accordingly made, and new experiments were prosecuted for a period of two or three months, but, like the first efforts in that direction, the experiments failed to produce either fat acids or glycerin. How much these last experiments cost the witness does not state, but he does state that the experiments were productive of no good, as they produced neither fat acids nor glycerin.

Remarks respecting the Belgium patent are unnecessary, as no proof was offered to show that the process was ever introduced into practice in that country.

Having failed to accomplish such results in those countries as would show that his process would be practically useful if applied by the means and in the mode of operation described in the specification, and probably having become convinced that the decomposition of fats by water could be more conveniently effected by

modifying the described apparatus so that the fat and water would be exposed to a lower

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heat and pressure for a longer time, as expressed in his letter of the twenty-fifth of June, 1856, the patentee left England in August or September, 1859, and returned to the United States.

Conclusive proof that the patentee did not accomplish results in France which would show that the patented process, applied by the means and in the mode of operation set forth in the specification, is exhibited in the record of the other case between the same parties, which was heard at the same time. Reference is made to the report of the jury upon organic chemistry made the third of December, 1855, to the international exhibition held in Paris, which is made an exhibit in that case.

Chemists, say the jury, liken neutral fats to compound ether, which was the hypothesis put forth by Chevreul in his investigations of such matters. Ether, it was known, may be decomposed by being heated to a high temperature in close vessels with water, and from that persons were led quite naturally to attempt to effect in the same way the decomposition of neutral fats, and they state that experience has confirmed the assumed theory, which, as the jury say, is the origin of the new processes of saponification to which they refer, and they add that it was the patentee in this case who first had the idea of applying such reaction on a large scale, which they verify by an extract from the specification of the patent; [Footnote 40] but, as they report, they visited the manufactory of Monier & Co., where they had the opportunity of seeing the trial of the process in its application to palm oil, and they conclude their report upon the subject as follows: [Footnote 41]

"We are sorry to say that the fatty matter, on coming out of the apparatus, was not at all deodorized and, more besides than that, that it gave out a strong odor of acrolein. From the point of view of the quality of the products, this arrangement of apparatus, then, by no means realized the end which the author has proposed.

Moreover, in our opinion, the

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chances of deterioration of a system of apparatus of any kind which works constantly at a temperature capable of exerting a pressure of ninety to one hundred atmospheres are such that it is hardly possible that industry will utilize it, even if the products which it furnishes were irreproachable."

Made public, as the report was, more than two years before the patentee returned to the United States, it may be presumed that it came to his knowledge before his return.

On the fifteenth of May, 1860, the new patent referred to was granted to him in this country, [Footnote 42] which affords the most conclusive proof that the alleged invention is one of a very different character from that described in the specification of the patent in issue in this case, and yet he states under oath that he verily believes that he is the original and first inventor of the improvement, and that to the best of his knowledge and belief it had not been known or used before his application for the patent, which is utterly repugnant to the pretense that anything which is embodied in that patent was included in the one granted to him more than five years before the latter application was filed.

Experience seems to have greatly modified the views of the patentee, as he now characterizes the improvement as a new and improved method of decomposing fatty and oily substances, and alleges that it is applicable either when water alone is used, or when, in addition to water, a portion of alkali is used to aid the chemical action; and he also alleges that to extract the whole of the glycerin from the fat with a moderate quantity of water, when the lower range of pressure is used, requires considerable time, and he actually states that his invention consists in applying the water to the fat in several successive portions.

High temperature and pressure are represented as the agents of decomposition, but in the view of the complainant as expressed in that specification, the high temperature required may be only that which is represented by a pressure of one

hundred and twenty to one hundred and fifty pounds to the

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square inch. Gauges to indicate the required temperature are dropped, and all idea of rapid manipulation seems to be discarded as the terms "a considerable time" or "from two to three hours" are substituted in the place of "ten minutes."

Vessels of very great strength are no longer required, as the patentee states that his invention may be applied to any of the different forms of boilers or tanks used for the decomposition of fats by water at a high temperature or pressure, meaning doubtless that the terms high temperature and pressure shall be understood in the same sense in which he employs them in a subsequent part of the same paragraph. Water may be supplied when wanted, and of course it is of no moment even if some of it is converted into steam; nor does the specification contain any requirement that the heating apparatus shall be kept entirely full of the mixture or that neither steam nor air shall accumulate therein during the time required for decomposition, or, in other words, the old specification is divested of everyone of its extreme conditions, and the inventor, under his new patent, is left free to claim every means and every mode of operation which the ingenuity of man ever did or ever can invent or discover. Further remarks respecting it, however, may be omitted as it is not the subject of litigation in this case.

Chemical and mechanical experts were examined as witnesses on both sides in about equal numbers. Those called by the complainant express the opinion that the patented process may be applied by the means and in the mode of operation described in the specification so as to accomplish useful results and of a character to give commercial value to the new product. On the other hand, those examined by the respondent express opinions widely different, and most or all of them are of the opinion not only that the means and mode of operation described in the patent cannot be so applied that the invention will be practically useful, but several of them state that the attempt to apply it without the exercise of extraordinary precautions must be attended with danger to the operator.

Most of the expert witnesses made experiments in applying the process, and in the course of their examination were required to state the results of the same as supporting their opinions, but experiments made, as most of these were, with small apparatuses admitting only a small charge of the fatty substance or mixture to be treated are not entitled to much weight in determining such an issue, however satisfactory the analysis may have been to the chemist who conducted it, as the issue necessarily involves very difficult questions of mechanics as well as of chemistry.

Taken as a whole, the evidence convinces the Court that the patentee never did succeed in introducing his invention into practical use by the means and in the mode of operation described in the specification to such an extent as would warrant he court in finding that issue in his favor.

Doubts of a very serious character are also entertained by the Court whether the patented process, unless divested of its extreme and unparalleled conditions, can ever be reduced to practice by the means and in the mode of operation described in the specification, so as to practically useful or safe to the operator, but the proofs are very conflicting upon the point, and inasmuch as it is impossible to foresee what future experiments may do in the way of overcoming the existing doubts and difficulties, the Court is not inclined to rest their decision entirely upon that ground.

3. Passing from that, the next question is whether the proofs show that the respondent practiced and used the patented process of the complainant, when properly construed and defined, as charged in the bill of complaint.

Such an inquiry cannot be intelligently considered without first ascertaining what the respondent's process is, as it is obvious that the two processes must be compared in order to determine whether they are substantially the same in principle and mode of operation, or substantially different, which is the criterion by which to determine every such issue as the one under consideration.

Factories have been erected by the respondent for manufacturing

candles, and he is largely engaged in that business, but he denies that he uses the alleged improvement of the complainant or any method of decomposing neutral fats embracing the means and mode of operation described in the specification of the complainant's patent. He admits that in his process of manufacture he uses water at high temperature, and steam, and that he also uses such pressure as arises from the expansive force of hot water or steam in a close vessel; that he is engaged in manufacturing candles under and in pursuance of letters patent granted by the United States of the twenty-fifth of January, 1859, to Wright and Fouche, as subsequently amended, but he denies that he employs either the method, process, or apparatus described in the complainant's specification.

Appropriate means are at hand to enable the court to make the comparison, as the patent under which the respondent works was given in evidence at the hearing. [Footnote 43] On the face of the patent, it purports to be a new and useful improvement in process for decomposing fats, and it appears that the inventors obtained a patent for the improvement in France two years before the complainant left England to return to the United States and more than three years before the complainant obtained his new patent in this country, in which he left out all of the extreme and unexampled conditions of the old patent and in which he stated under oath that he verily believed he was the original and first inventor of the improvement, and that it had never been known or used before his then application was filed.

Wright and Fouche describe their invention in their specification as a new apparatus destined to produce chemical decomposition by means of superheated steam and water, and that it is chiefly intended for the decomposition of fatty substances into fat acids and glycerin, and they particularly describe the means to be employed and the mode of operation when the patented method is applied to that purpose. Drawings are annexed to the specification, which

contain figures of the apparatus to be employed in applying the patented process in the decomposition of fatty substances to obtain fat acids and glycerin.

Two vessels constructed of iron or copper are required for the purpose -- one is called the boiler in the specification, which it is said may be of any form, and the other is called the cylinder, and is placed on a base and elevated higher than the boiler. Both are required to be sufficiently strong to resist a pressure of from ten to twenty atmospheres, and of a capacity varying according to the requirements of the manufacture, and they are connected by a tube extending from the bottom of the boiler to the bottom of the cylinder, and also by another tube, called in the specification the tube for ascension to conduct the superheated water from the boiler to the upper part of the cylinder, which terminates in the interior of the cylinder by a rose jet, or holes may be made in the end of it so as to distribute the water uniformly in the cylinder and to insure the intimate contact between the superheated water and the fatty substance subjected to the process. Fatty substances to be subjected to the process are placed in the cylinder, which, with other things, is furnished with a pressure gauge to indicate the pressure in the apparatus used with devices to indicate the height and level of the substance and of the water in the cylinder.

Everything being arranged as described for applying the process, the boiler is completely filled with water and the cylinder is filled with water to one-third of its height, and then it is filled to the level of the upper cock, shown in the drawings, with the fatty substances to be decomposed, the latter substance or substances being above the water in the cylinder, which is still not filled, there being a vacant space in the cylinder above the fatty substance. Heat is then applied to the boiler, which is placed in a furnace where it may be exposed to fire. By the direction, the heat is to be gradually applied until the pressure gauge indicates a pressure of ten to twenty atmospheres, according to the nature of the fatty substance to be decomposed.

Minute description is then given of what it is claimed

takes place in the apparatus. Superheated water, it is said, acquires an ascending motion, whence it results that the heated water in the boiler ascends through the described tube into the cylinder, and being forcibly drawn out through the holes in the described rose jet, passes through the fatty substance to the vacant space above, where the temperature being reduced, it descends through the other described tube to the bottom of the boiler, where it is again heated, and then recommences its ascending motion as in the first instance, and so on during the operation.

Suggestion is made that the operation may be continued from five to eight hours, according to the nature of the fatty substance composing the charge and the degree of heat and pressure applied, and it is claimed that the result will be that the fatty substance will be decomposed and that the product will be fat acids and glycerin.

In their specification, they admit that it is a well known scientific fact that fatty substances may be decomposed by water under the influence of heat and pressure, which could not well be denied in view of the fact that water or its equivalent was used in all the prior processes of saponification, and of the great mass of other evidence to support that proposition which is embodied in this record. Consequently, those inventors do not claim to be the discoverers of that scientific truth. All they claim is that their invention consists of an apparatus wherein water and the fatty substances are heated separately in two different boilers, the first boiler being heated in the furnace, called in the specification the source of heat, while the second boiler, called the cylinder, is heated from the first boiler.

Unlike as the two processes are in so many material characteristics, it seems almost a work of supererogation to enter much into details, as the dissimilarity is apparent in the whole description of the respective inventions, except that both contemplate the employment of heat and water in effecting the decomposition of fatty substances, and even in that respect, they are widely different, as the

patentees under whose patent the respondent works employ only

moderate heat, as compared with the other process, never exceeding in practice what is represented by a pressure of one hundred and eighty pounds to the square inch, and they also employ steam as well as water in a vessel which is never filled with the fatty substance or with water or with both combined.

None of the other characteristic conditions of the complainant's invention is found in the specification of the patent under which the respondent works, full proof of which is shown in the enumeration of those conditions, which are as follows:

1. That the fatty substances to be treated must be first mixed with water equal in bulk to one third or one half of the fatty substance.

2. That for that purpose, the fatty substance and the water in the proportions mentioned must be put into the described receiving vessel, where it must be subjected to the action of the piston with the perforated disk until it causes the fat and the water to form an emulsion or intimate mechanical mixture.

3. That the mixture so formed must then be driven by a force pump through the connecting tube into the heating vessel, whether a coil of iron tubing or other convenient vessel and be subjected to a high degree of heat and pressure for ten minutes to effect the decomposition of the fatty substance.

4. That the heating vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

5. That the heating vessel must be filled with the mixture and kept entirely full of it throughout the operation.

6. That the only means suggested to fulfill the condition is the forcing pump, as the provision is that if necessary, the speed of the forcing pump should be increased.

7. That the heating vessel must be kept full of the mixture, so that no steam or air shall accumulate in the heating vessel, and to preserve the intimate mechanical mixture of the fatty substance and the water, as the description does

not suggest any means to supply any deficiency of water in any other way, whether occasioned by evaporation or by its being converted into steam.

8. That the temperature required for the operation, if the fatty substance be such as palm oil, is 510 Fahr., or if such as beef tallow or the tallow of sheep, it must be carried to 610 Fahr., or the melting point of lead.

9. That the heating vessel should be tested before taken into use by a pressure of ten thousand pounds, and should be of sufficient strength to be safe at a working pressure of two thousand pounds to the square inch.

10. That the apparatus must be furnished with gauges to indicate the required heat to be applied in the operation, and with a refrigerator near the exit end of the apparatus to cool down the product from its high temperature below 212 Fahr. before it is discharged into the receiving vessel.

Compare these conditions with the specification of the patent under which the respondent works and it is clear that he does not use any such method, process, or operation as those described in the letters patent of the complainant.

Witnesses have been examined by each party as experts to assist the court in making the comparison, but they differ so widely in their statements as to afford the Court but little aid in the solution of the question. Attention is also drawn to the fact that several circuit judges have decided otherwise, to which the proper reply seems to be that the proofs before the Court are much fuller than on any former occasion, and that the conclusion stated is the best one the Court can form after having given the whole record an attentive examination.

Expert witnesses on both sides have been examined also upon the issue of infringement, but they differ so widely in opinion that their testimony affords the

Court but little aid in deciding the question, which after all must depend chiefly upon the comparison of the descriptive portions of the two specifications. [Footnote 44]

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Two things are not the same under the patent law when one is in practice substantially better than the other in a case where the second improvement is not gained by the use of the same means or known mechanical equivalents. [Footnote 45]

Patent laws have for their leading purpose the encouragement of useful inventions. Practical utility is their object, and it would be strange if with such object in view the law should consider two things substantially the same which practically and in reference to their utility are substantially different. [Footnote 46]

Slight differences in degree cannot be regarded as of weight in determining the question of substantial similarity or substantial difference, but in all cases, the question whether the difference in degree is sufficient or insufficient to prove the alleged infringement is a question of fact to be determined by the jury in an action at law, or by the court in a suit in equity. [Footnote 47]

Differences, however, so great as are exhibited in this record relieve the case, in the judgment of the Court, from all doubt, and warrant the conclusion that the process under which the respondent works is substantially different from that of the complainant.

On the twenty-third of November, 1867, the patent of the complainant was extended for seven years from the expiration of the fourteen years for which the original patent was granted. Subsequently, to-wit, on the sixth of March, 1871, the complainant instituted a second suit against the respondent founded upon the extended patent, which is number 340 on the calendar. Both cases were heard at the same time. Suffice it to say in respect to the latter that the pleadings, issues,

and proofs in the two cases are substantially the same, and that the latter must be disposed of in the same way as the preceding case.

Decrees were entered in these cases respectively in the

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circuit court in favor of the complainant, each of which must be reversed.

Decree in each case reversed with costs, and the cases respectively remanded with direction to dismiss the respective bills of complaint.

JUSTICES SWAYNE, STRONG, and BRADLEY dissented.

MR. JUSTICE DAVIS took no part in the judgment.

[Footnote 1]

Testimony in the case showed a great variety of these things, the common barrel churn being one of the simplest and best known. De Milley's vertical boiler, with an agitator going up and down, used A.D. 1834, was another form. Alliott's vertical boiler, with centrifugal pump to draw water from bottom and to spread it on the top, used A.D. 1851, was another. Radley & Meyers' revolving mechanical agitator, used A.D. 1851, in a closed boiler having a safety value, was yet another. The automatic circulation by the ascending power of a column of heated water, it was testified, was used in an apparatus of Floyd, A.D. 1795.

[Footnote 2]

In the patent itself, there were besides, some descriptions and drawings of parts of the apparatus modified. With neither of these, however, is it necessary to embarrass the reader -- REP.

[Footnote 3]

From 340 to 420 Fahr.

[Footnote 4]

The melting point of bismuth.

[Footnote 5]

5 Stat. at Large 117.

[Footnote 6]

Infra, pp. 379-390.

[Footnote 7]

Infra, pp. 390-418.

[Footnote 8]

The records contained 1048 closely printed 8vo. pages.

[Footnote 9]

Vol. 1, part 3, p. 751.

[Footnote 10]

Vol. 2, p. 252.

[Footnote 11]

Vol. 2, p. 886.

[Footnote 12]

Specimens of which are exhibited in the American Department.

[Footnote 13]

Page 7.

[Footnote 14]

Supra, p. 86 U. S. 307 .

[Footnote 15]

Supra, p. 86 U. S. 313 .

[Footnote 16]

From p. 86 U. S. 306 to p. 350.

[Footnote 17]

By "superheating" steam is meant applying heat directly to steam which has been already generated by the action of heat on water. This latter sort of steam is called "saturated steam," the former "superheated steam." -- REP.

[Footnote 18]

"We cannot agree," said the court, when speaking of this point,

"that a fair construction of the specification tends to the conclusion either that the vessel was to be entirely filled or that no steam was to be permitted in it. No doubt it is true, as urged for the defendant, if thus filled and the vessel closed, and the contents heated to the point of melting lead, or under a pressure that would prevent the existence of steam, the process would be utterly impracticable, and doubtless the patentee knew this would be the result as well as any of the experts. It would require but the commonest knowledge and experience in the business of life to reach such a conclusion. This moderate degree of knowledge, at least, should be kept in view in construing the general terms of the description."

"Besides, the patentee does not direct that the vessel should be entirely filled. This is an inference of the learned counsel from the direction that the vessel must be closed and be of great strength so that the requisite amount of pressure be applied to prevent the conversion of the water into steam."

"All that was intended, as is apparent from the context, by the patentee was that the pressure should be so great as to prevent the body of the water in the vessel from passing into steam, as the heated water was the element that separated the fatty acids and glycerin. That there would necessarily be some steam must have been obvious to the patentee as well as to anyone of common observation."

[Footnote 19]

1 Regnault's Chemistry 1592.

[Footnote 20]

Turner's Chemistry, by Johnston, 8th edition, p. 456.

[Footnote 21]

Silliman's Chemistry, 25th edition, p. 441.

[Footnote 22]

3 Miller's Chemistry, 370, 1141; 2 Ure's Chemical Dictionary, 5th edition, 379.

[Footnote 23]

2 Watts's Chemical Dictionary 894; Attfield's Chemistry 394; Silliman's Chemistry, 25th edition, p. 44, 763.

[Footnote 24]

Agawam Co. v. Jordan, 7 Wall. 597.

[Footnote 25]

Seymour v. Osborn, 11 Wall. 538.

[Footnote 26]

78 U. S. 11 Wall. 547; Curtis on Patents 242.

[Footnote 27]

Household Co. v. Neilson, 1 Webster's Patent Cases, 683; Curtis on Patents, 4th edition 279; *Foote v. Silsby,* 2 Blatchford 260.

[Footnote 28]

O'Reilly v. Morse, 15 How. 119; Curtis on Patents, 4th edition, 163.

[Footnote 29]

Green v. Wood , 7 Q.B. 178; Potter's Dwarris 199-200.

[Footnote 30]

Railroad Co. v. Stimpson, 14 Pet. 458; Curtis on Patents, 4th edition, 472.

[Footnote 31]

O'Reilly v. Morse, 15 How. 119; Curtis on Patents 189.

[Footnote 32]

Curtis on Patents, 4th edition, 449.

[Footnote 33]

Curtis on Patents, 4th edition, 106 and 449.

[Footnote 34]

See supra, p. 86 U. S. 321 -- REP.

[Footnote 35]

Supra, pp. 86 U. S. 336 -341 -- REP.

[Footnote 36]

Supra, p. 86 U. S. 344 -- REP.

[Footnote 37]

Supra, p. <86 U.S. 345|>345 -- REP.

[Footnote 38]

Supra, pp. 86 U. S. 344 -345, 86 U. S. 350 -- REP.

[Footnote 39]

Supra, pp. 86 U. S. 345 -348 -- REP.

[Footnote 40]

Supra, pp. 86 U. S. 307 -308 -- REP.

[Footnote 41]

Supra, pp. 86 U. S. 335 -336 -- REP.

[Footnote 42]

See supra, pp. 86 U. S. 353 -355 -- REP.

[Footnote 43]

See it *supra,* pp. 86 U. S. 298 -304 -- REP.

[Footnote 44]

Hill v. Thompson, 1 Webster's Patent Cases 232; *Turner v. Winter, ib.,* 77.

[Footnote 45]

Curtis on Patents, 4th edition, 330.

[Footnote 46]

Ib, 331.

[Footnote 47]

Caboon v. Ring, 1 Clifford 621.