lished rule that such publications must contain in themselves such a full, clear, and exact description of the invention as, without anything more, will enable one skilled in the art to practice the invention."

In Celluloid Manuf'g Co. v. Chrolithion Collar & Cuff Co., 31 O. G. 519, 23 Fed. Rep. 398, Judge Coxe says:

"The novelty of the invention is not negatived by any of the patents, American or foreign, introduced by the defendants. * * * No one describes, with anything like the accuracy required, the fabric of the complainants. The burden is upon the defendants to satisfy the court that the prior descriptions contain such a clear, full, and exact statement that a person skilled in the art, with the statement before him, could produce the fabric in question. * * * The law requires something more, beyond the mere suggestion, to defeat a patent. Prophecy will not do it. Facts, not theories, are needed."

In Seymour v. Osborne, 11 Wall. 516, it was held that—

"Patent inventions cannot be superseded by the mere introduction of a foreign publication of the kind, unless the description and drawings contain and exhibit a substantial representation of the patented improvement in such full, clear, and exact terms as to enable any person skilled in the art or science to which it appertains to make, instruct, and practice the invention to the same practicable extent as they would be enabled to do if the information was derived from a prior patent."

It is true that the expert witnesses for the defendants insist that the Khotinsky arrangement of circuits is wholly similar to that described and explained by Mr. Edison in the patent in this suit; but the evidence given upon the same point by the experts for the complainant, Sir William Thomson, Mr. Jenks, and Mr. Brevoort, is directly contradictory, and seems to be more weighty and conclusive. In speaking of the Khotinsky patent, Sir William Thomson says:

"Khotinsky does not suggest anything towards the illumination of towns, or the carrying of the electric energy to considerable distances. He does not contemplate any difference of pressure in the different parts of his circuit. He makes arrangements to provide for one lamp of his system being extinguished without disturbing the others, while the output of the engine remains constant. * * * The difficulties connected with supplying the current, and maintaining approximate enough quality of brilliance among all the lamps, through all the variations of numbers of lamps used in actual practice, * * * were not at all felt by Khotinsky, who in fact gives no indication of applying his system to working at a distance, or of there being any practical difference in the tension in the different parts of his conductors. There is certainly nothing in any part of his patent which gives any indication towards the solution of the problem discovered by Edison."

Prof. Chandler says:

"The Khotinsky patent does not deal with the problem of conveying electricity to a distance, for supplying a large number of lamps, scattered over a considerable area. * * * There is nothing in the language of the Khotinsky patent, when properly translated, to indicate that Khotinsky had considered the question of distance, or that he thought of locating his dynamo at any distance from his lamps. * * * Khotinsky evidently intends to do precisely what Werdermann does,—that is, to maintain a constant current in his system, and to offer to this a constant load,—for he has provided an equivalent resistance, which is to take the place of any lamp which goes out. * * * There is no suggestion of any attempt to overcome the inevitable drop due to distance by a system of feeders, devoid of lamps, upon which this drop is located where it could do no harm. There is no suggestion in the Khotinsky patent of dividing his system of conductors into two parts,—one of which is

to be the consumption circuit, the wires of which are so proportioned with regard to the number and location of the lamps that no drop in tension will occur upon them greater in amount than a negligible percentage; the other, a feeding system, devoid of lamps, upon which all of the inevitable drop due to distance should be located."

Mr. Jenks says Khotinsky does not show or describe—

"Any idea of dividing the conductors, and assigning to each division separate and peculiar functions,—among these functions being that of the intentional loss of a predetermined proportion of the total energy upon the supply conductors,—nor any method for distributing current over comprehensive areas by simply proportioning the conductors."

Mr. Brevoort says:

"There is nothing in the Khotinsky patent that shows that he contemplated supplying any large area, and there is certainly no division of the circuit into two substantial and material portions, distinct from each other,—one, free from translating devices, and adapted to act as a feeder and overcome the distance between the dynamo and the consumption circuit, which latter was to be so proportioned as to insure that the lamps in it would not suffer a loss of pressure of more than five per cent."

If these criticisms upon the patent of Khotinsky are well founded,—and I think they are,—it is very apparent that the scheme devised by him for improvements in electric lighting cannot be taken to suggest in any way the device of Mr. Edison to secure the same result. It does not appear that the difficulty in electric lighting arising from the necessary drop in tension presents itself in this invention at all. Undoubtedly the inventor does speak about the action of one lamp in no wise affecting the action of others; but this he regards as provided for either by the multiple arc arrangement, itself, or by his special contrivance of an automatic resistance equal to the resistance afforded by the lamp previous to any lamp being extinguished. I do not see that the defendants are aided by this invention.

The defendants next rely upon two British patents granted to Lane-Fox in the year 1878, and upon a letter from Lane-Fox to the editor of the London Times, and published in the London Times on December 26, 1878; and they insist that these patents, in connection with the letter, described a system involving the use of a large number of high-resistance incandescent lamps connected in multiple arc, and operated from a central station. They insist that in this system Lane-Fox professedly followed the general methods of distributing gas, and that he describes a system of conductors arranged like gas mains, supplied from a gasworks located at some central point in the system.

The invention in this case is for improvements in obtaining light by electricity, and conveying, distributing, measuring, and regulating the electric current from the same, and in the means or apparatus employed therein.

A careful reading, however, of the description of the invention, as declared in the letters patent, differentiates it, I think, entirely from the inventive device of Mr. Edison. Undoubtedly, Lane-Fox had in mind the difficulties of electric lighting due to drop in tension, but his plan for obviating those difficulties was to enlarge the

system of conductors as they approach nearer to the central station, forming what is generally known as the "Tree System." This may be described as a system of distribution in which the electrical energy starts from the central station on the largest of all the conductors in the system, then divides itself into so many branches as may be necessary to accommodate the groups of lamps to be operated, and which branches diminish in sectional area as the distance from the station increases. He does not depend entirely upon his system of conductors to obviate the difficulty of drop in tension, for which, "as a remedy," he proposes to annex or attach to his system, at various points, Plante batteries, which might act as storage batteries for storing up electricity, and distributing it through his system. Carefully reading the patent, I cannot see that there is any attempt on the part of Lane-Fox to localize or separate the circuit in such a way that a considerable drop of potential is admissible upon part of it, and no perceptible drop is admissible on the other part; that is, there seems to be nothing analogous to Mr. Edison's feeding or consumption circuits. For this opinion I find confirmation in the very clear statement made by Prof. Chandler. In criticising these patents of Lane-Fox, he used this language:

"In conclusion, I would say that I find none of the essential features of the Edison invention in the Lane-Fox patents. The only points of resemblance are the central station, and the large number of incandescent lamps. There is no division of the circuit into two distinct parts. The circuit is all consumption circuit. Lamps are shown upon all parts of it. There is no portion of the Lane-Fox distributing circuit which corresponds to the feeders of the Edison system; no portion upon which the inevitable drop in tension due to distance could be intentionally localized, where it would have no influence upon the lamp, and no means are adopted for maintaining equality of pressure at the terminals of the lamp, except by enlarging the conductors systematically as they approach the central station, which is the very plan which Edison practically disclaims in the patent in suit. * * * He has no system of feeders, and he does not anywhere in his system intentionally incur the inevitable drop due to distance, and there render it harmless."

It must be borne in mind that Mr. Edison's invention was to localize the drop in tension, which was inevitable, where it would be perfectly harmless, so far as the operation of the lamps upon the system was concerned. The effect which he produced by his invention was to strip the consumption circuit of all harmful drop in tension, so far as that circuit was concerned. The result is as if no such thing as drop in tension, perceptible in its effect, existed at all. Clearly, the main and chief thing accomplished by Mr. Edison was this division of the circuit. Now, in the Lane-Fox system of electric lighting, the whole circuit is a consumption circuit, from beginning to end. The diagram which he annexes to his patent, and which he refers to in his specifications, clearly shows that all of the circuit was to be used as affording stations for lamps; and his means of overcoming drop in tension, other than the enlargement of his conductors, was the use of supplementary batteries, which were placed throughout the system. It would require the assistance of a vivid imagination to draw an analogy, suggestive and educational in its character, between such a system, so planned

and devised, and to be so operated, and that of Mr. Edison. Save that in both systems conductors and electric energy and incandescent lamps and central stations are used, there is no patent similarity. The intent may have been identical. The means of realization are diverse. If it needs the close and acute examination of skilled experts to discover any similarity between inventions, such necessity would seem to deny the existence of suggestive character in either.

It is well to remark that in passing judgment upon these various inventions, in order that impartiality and exactness may be exercised, it is to be remembered that 10 years ago the science of electric lighting of large areas was in its infancy, and that the application of the knowledge which to-day is common possession, in forming our conclusion of the nature and character of operation of electric energy when chained down to the performance of labor, was then wholly impossible. What those inventions of those days were capable of performing was limited by the knowledge of those days. Some of those inventions may seem to be suggestive now, when we use our present knowledge touching electricity and its characteristics; but 10 years ago they were unsuggestive, simply because, as the fact shows, they failed utterly to suggest. This is the unanimous testimony of all scientists touching the matter.

The defendants, as an essential part of their defense in this case, further insist that the claims of the letters patent involved in this suit were clearly anticipated by prior publication and uses relating to electro-metallurgy, including therein, especially, electroplating and electrotyping. They depend upon Napier's work on Electro-Metallurgy, published in 1867, and upon the testimony of Mr. Weston, and perhaps one or two other witnesses, who were connected in the erection of a plant for electroplating and electrotyping in Newark, and upon a copy of the Scientific American, a newspaper published in New York City, of the date of September 1, 1877, which latter the defendants' claim shows clearly, in a cut of an electroplating plant, the same arrangement and proportioning of wires and conductors, and the division of the circuit into feeder and consumption circuits, to obtain equality of pressure, as Mr. Edison claims in his patent. Their contention, briefly stated, is that in electrotyping and electroplating, and similar applications of electricity, the electric current is distributed by multiple arc; that the necessity for equalizing pressure is fully as great as in electric lighting; and that long prior to the date of Mr. Edison's invention the method employed for equalizing pressure in these operations was the same as that described by him. That we may weigh this claim properly, and arrive at a just estimate of its worth, it will be necessary to consider for a moment just what electrotyping and electroplating are.

"Electro-metallurgy" is a term characterizing all processes in which electricity is applied to the working of metals. Electrotyping was in vogue as a popular amusement as early as 1840, and it was quite the fashionable thing at that date to copy, by the new process which had just been described in the scientific pa-

pers of the day, coins, seals, and medals. The apparatus employed was very simple, and practically is the same to-day. It consisted of a glazed earthenware jar containing a solution of sulphate of copper, and a small porous cylinder containing diluted sulphuric acid, in which a rod or plate of zinc was placed, and which was suspended in the jar. The object to be copied by electricity was attached by a copper wire to the zinc, and immersed in the solution. It thus formed the negative element of a galvanic battery, and a current of electricity passed from the zinc through the liquid in the jar and cylinder to the immersed object, and thence back to the zinc through the copper wire, thus forming a complete circuit. The effect of this electrical action was to deposit upon the object to be coated a thin film of copper, obtained by the decomposition of the copper solution. When the film or incrustation of copper had become sufficiently thick, it was readily removed from the object, and presented a complete fac-simile of it in reverse. A repetition of this operation, with this reversed object as a matrix, resulted in presenting the object itself in natural relief.

Electroplating, another branch of electro-metallurgy, was simply the coating of one metal by another, the deposited metal becoming inseparably a part of the object plated. The process was very similar in its operation to electrotyping. In both processes, now, separate batteries or dynamos are used as the generators of the electrical current, and the current is carried by wires to the tanks or vats or baths in which the object to be plated or copied is immersed. As in the electrotype bath, so in the electroplating bath, there is a liquid containing in solution a metal which it is desired to deposit upon an object temporarily immersed therein. The current of electricity is carried to the bath by means of a plate of metal, called the "anode," which is the same as that in solution. The object to be plated is immersed in the bath, opposite to the anode plate, and the electrical current passes through the liquid intervening between the two. This operation decomposes the liquid, separating the metal held in solution, and depositing it as a thin film upon the face of the object to be plated. The operation is continued until the resultant plating has become of the required thickness, when the plated object is removed from the bath. Looking at these operations generally, and without further explanation, it is exceedingly difficult to draw any analogy between them and the lighting by electricity of large areas, in which the necessary drop of tension is necessarily overcome. It is certainly very obvious that whatever may now be thought of the suggestiveness of the electroplating process or the electrotyping process, in view of what Mr. Edison has accomplished toward the solution of the problem of electric lighting, none of the scientists who in 1879 and 1880 were searching for the solution of that problem ever gathered from them any suggestion or hint towards the solution so ardently sought. It is difficult indeed to see the least possible analogy between a bath or a vat or a tank containing metal in solution, through which an electric current is to be passed—First, for the purposes of decomposition; and, secondly, for a fixing of the decomposed mole-

cules of the metal upon an object temporarily placed in the bath,—with a system of electric conductors, feeding and consumption, running for miles, perhaps, through thickly-settled territories, having upon the consumption circuit incandescent lamps permanently fixed, and in large numbers, usable at pleasure, and wholly beyond the influence of "drop in tension." Certainly, a nonexpert, though never so alert, would scarcely discover resemblance between two things so utterly dissimilar, nor would he be any the more happy in searching for analogy to assist in the solution of a problem touching the distribution of the electrical current. Electroplating and electrotyping, even when the electric current was conveyed from dynamos or batteries exterior to the vat or bath, were, as a rule, carried on within a space of limited dimension. In the plant spoken of by Mr. Weston, in Newark, the feeder wires were but 16 feet in length, and the support upon which articles to be plated were suspended across the bath still less. Here, certainly, was no opportunity for a harmful drop in tension of the current in passing from dynamo to bath. And, besides, in these operations the current sent through the wires is of so low a tension that it would be utterly futile to consider it as a possible factor in electric lighting. It is true Mr. Weston says that in the construction of the Newark plant, illustrated in the Scientific American, the feeder wires and the supply wires, if they may be so called, were of different sectional area, and were purposely so made that there should be an equality of pressure at the baths. But he is the only one sufficiently bold to make such statement; and, without harshly criticizing it, surely it is remarkable that if he thus solved a problem which was exciting the whole scientific world with its difficulties, and its apparent impossibilities, he should not have made known his success in reaching the true solution, and that he should not have patented that invention, so pregnant with result, for his own peculiar benefit. He applied for, and was granted, other patents, about that same time, all having reference to the use of electricity; but he nowhere and at no time intimates or claims or suggests that he has accomplished the equalizing of electrical pressure by a due and proper proportioning of feeder and consumption conductors. It seems that Prof. Chandler's explanation of the difference of sectional area of the wires in the Newark plant, or as suggested in Napier's essay, is the more credible, as it is much more reasonable. Speaking of the fact that the bars or copper rods upon which are suspended the objects to be plated are larger in sectional area than the wires connecting them with the batteries or dynamos, he says:

"There can be no appreciable drop in tension upon them, in so short a distance, which would need the difference in sectional area to overcome; and the difference in size is a mere incident, and due to the necessity of selecting rods large and strong enough to support the weights hung upon them, and short, on account of the limited dimensions of the tank."

All the experts examined by the complainant have answered very fully and completely in reference to the system of electroplating and electrotyping, and as to the information given by Napier in his essay; and they are unanimous that there was nothing, either in the

testimony of the witnesses, or in the processes described, or in the publications referred to, that was similar, or substantially similar, to the invention described in the first three claims of the patent in the suit. As was said before, the answer to the contention of the defendants with respect to this part of their case is that while, under the light that we have to-day, these processes and this imparted information may seem as if they ought to have suggested something of value, from which, as starting points, a learned electrician should, by successive and logical steps, reason out the result at which Mr. Edison arrived, yet in point of fact they did not suggest any such thing, and were evidently wholly valueless for any such purpose. And this is evidenced by the fact that the scientists of the day not only did not resort to these alleged processes and these technical works, but absolutely ignored them, as affording any assistance towards the solution of the problem which they were seeking to solve. It is a comparatively easy task to-day to argue that these various processes and arts and methods and publications ought to have revealed the solution of the problem involved in electric lighting of large territories. From each may be selected peculiarities, beneficial and unique, that in more or less degree bear resemblance to Mr. Edison's invention. But the truth is that they did not, conjointly or separately, give birth to suggestion. The logic of argument, then, must fail to compel conviction, when confronted by the more robust logic of fact.

The defendants further contend that there is no patentable novelty displayed, because the prior methods and systems of, and publications relating to, gas and water distribution for public use, constitute a complete anticipation of Mr. Edison's alleged invention. Their insistence is that the pressure in the distribution of gas and water was equalized by precisely the identical means adopted by Mr. Edison in his distribution of electricity.

The publications upon which the defendants rely are the works of Clegg, of 1841; two editions of the works of Giroud, of 1867; of Allavoine, published in 1879; the reports of the Philadelphia Gasworks from 1837, 1841, 1848, 1849, 1859, and 1860; and of the works of Du Moncel, published in 1878, relating to the distribution of gas. A number of witnesses were also examined, whose testimony was with reference to distribution of gas, and the means and process adopted to equalize it, in the cities of Newark, Lowell, and Philadelphia.

So far as the distribution of water was concerned, the defendants claim that the statement made by Mr. Church as to the distribution of the water supply in New York; of Mr. Greenough, as to the distribution of water in Boston; and of Mr. Brown, as to the distribution of water in Pittsburgh,—fully sustain their contentions.

It must be admitted that for certainly 50 years back, and more, perhaps, it has been the custom to have, in the distribution of water and of gas to customers distant from the reservoir or holder, independent mains or lines of pipes, from which originally no service pipes were laid, and which were used simply to carry the water

or gas to a point generally in the center of the general system, for the purpose of overcoming the effect of friction by a new supply of the gas or water to be furnished. The theory of the defendants is this, and at first glance it is extremely plausible: That the analogy between the flow of the liquids, gas and water, and the flow of the current of electricity, is exceedingly strong, and almost identical, and that any reputable engineer would necessarily, upon but little thought, adopt, from his knowledge of the distribution of gas and water, the same method and plan for dealing with the electric current. On the other hand, the complainant insists that the problem to be solved is wholly different with regard to water and gas, on the one hand, and electricity, on the other; that in the one case a retardation of the flow by the action of friction was the sole difficulty to be considered; in the other, how to deal with the absolute loss of the current itself became the vital question. Its thorough destruction lay at the basis of the problem which so tried their ingenuity. And they asserted that differences, radical and unexplainable, existed between the ponderable bodies which are called "gas" and "water," and that imponderable and intangible vibratory action of molecules which is called "electricity." Many differences between them were cited upon the argument, the effect of which was necessarily to weaken very much, if not entirely to destroy, the theory that there was a distinct and positive similarity between gas, water, and electricity, which would justify analogy in their treatment. It would be simply impossible to analyze and state here these different theories.

Evidently the questions thus submitted to the adjudication of the court are questions primarily for learned experts, and they were so dealt with in this case. A battle royal has been fought between those who have presented the theories of the defendants, and those who have explained and illustrated the contentions of the complainants. Weighing the testimony as best I can, and after the most careful consideration, I am of the opinion that neither the distribution of water nor of gas, nor the various publications referring thereto, and suggesting methods therefor, could have formed a basis upon which Mr. Edison could have successfully constructed his system. It would be tiresome, in the extreme, if all the opinions advanced by the experts on either side, touching this point, were quoted. I shall simply say that the evidence given by Sir William Thomson, the leading British scientist, upon this part of the case, is so satisfactory, and, as it seems to me, so logical and convincing, that I give it unqualified assent. He says:

"I do not think the analogies known, prior to 1880, between the action or flow of gas and water and of electricity, were sufficient to teach electricians that electricity could be successfully distributed over considerable areas to incandescent electric lamps in the manner and by the means referred to in the tenth interrogatory, so as to maintain uniform candle power throughout the system. I have myself, for many years,—at least thirty-five years,—been familiar with the analogies between the flow of gas or water in pipes, and electricity in conductors, and have explained and illustrated that analogy in many published works contained in my volume of collected papers mentioned in my answer to interrogatory 2. To make a proper working analogy, the pipe through which gas or water flows must be filled with porous or spongy

material, through which the gas or water would percolate when compelled to do so by difference of pressure at the two ends of the pipe. We should then have flow of the ponderable fluid in simple proportion to the pressure, as is the flow of electricity in a conductor. In reality, the flow of gas or water through a pipe is nearly in proportion to the square root of the difference of pressures, but it is also affected by various other circumstances, for which there is no analogy in the flow of electricity through conductors. Thus, in the defendant's translation of Giroud's treatise, (page 615,) we find: 'Coming from the holder under a pressure which is necessarily constant in Paris, 150 mm., for example, the flow of gas is obstructed first by the outlet valves at the works; then, by the turns or elbows of the pipes, by narrowings of pipes of too small diameter, by differences of level; and, finally, by the stopcock of the burner itself; and this obstacle, the last of all, allows the gas to escape from the orifice of the burner at a pressure of hardly more than two or three mm., and fifteen or twenty on burners constructed on false principles. It is between these two extremes that all the phenomena of circulation take place which we are about to discuss in this work.' This is absolutely unlike the problem of electrical distribution. The object of pressure for gas between the works and the place of consumption is merely to bring the gas to the place. The enormous range of pressure from 150 mm. to two or three for the best burners is utterly different from anything that occurs in the electric problem. The efficiency of the gas is not dependent on its pressure, but on its combustion; and it is remarkable, in contrast to the action of electricity, that it gives better results at the low pressure of two or three mm. than at the higher pressure of fifteen or twenty. In the electric light the efficiency of a certain quantity of electricity depends wholly on its pressure; and lamps adapted to work at a pressure of twenty would give, with the same quantity of electricity, ten times as much light as lamps of the same quality adapted to work at a pressure of two.

"In an electric system, delivering electricity from the source at a pressure of 150, and using it at a pressure of three, only one-fiftieth of the whole energy would be used, forty-nine fiftieths of it being wasted by the generation of heat in the conductors. The comparison of the flow of electricity in a single conductor, and the flow of water or gas in pipes, set forth in the diagram facing page 292 of the defendants' printed record in this case, represents the almost total loss of energy by the electricity in figure 3, in circumstances analogous to those of the outflow of gas at B in figure 2. The difficulty in making out anything of a quantitative comparison between the two cases is illustrated by the fact that the forces illustrated by the spring balances and repelled disks of figure 3 would be, not in simple proportion to the pressure, but would depend, in a very complicated manner, on the squares of the pressures, and the configurations of the lines of electric force between the disks, and round their edges to the earth. Thus, the lower ends of the springs would be nothing nearly in a straight line, as shown in figure 3, while the levels of the water in the pressure gauges of figure 2 would, as correctly shown, be essentially in a straight line. The electric system essentially involves two conductors, with a difference of potentials maintained between them. This difference of potentials is what is technically, and by English board of trade rule, called 'pressure.' To this there is absolutely nothing analogous in pipes for the distribution of water or gas. * * *

"The equalizing of electric pressure within five per cent. in the consumption circuit, in all varying conditions of the lamps used in different parts of the circuit, and the calculation of the conductors required for this purpose, and for the feeding conductors, after having formed the idea of using feeding conductors, is a problem upon which no light whatever is thrown by anything to be found in these treatises. And in fact, prior to 1881, none of the engineers who attacked the problem of the electric lighting of cities, many of whom were thoroughly acquainted with gas distribution, did propose or show any signs of having invented the system of consumption district and feeders until Edison gave it in his patent 264,642. Even as late as 1885 we find Professor George Forbes, in his Cantor lectures, delivered in the month of February of that year, and published in the Journal of the Society of Arts for October, 1885, giving an elaborate and full comparison of electric distribution with gas dis-

tribution, and describing Mr. Edison's feeder system and patent in the following statement: 'It must be acknowledged that the simple tree system, where all the dynamos are connected in parallel with the mains, presents a very serious obstacle in the rapid fall of potential; the maximum distance of a lamp from the station along the line of conductors, consistent with the economical considerations, being 124 yards, if the pressure required for all lamps is the same.' * * *

"The translating devices used for the electric light are utterly and essentially different from anything used in gas lighting, or in connection with gas distribution. The electric light, of whatever kind, acts entirely by the resistance of an arc, whether of air or of some solid conductor, to the flow of electricity through it. The electric current essentially passes through the lamp from one portion of the system of conductors to another, at a different potential from the first. The difference of potentials of the two is the working pressure of the lamp. In gas lighting the gas simply flows out of the pipe, and burns in the air. The light given depends on the quantity of gas delivered and on the temperature and manner of its burning. It depends on pressure only so far as this influences the manner of the burning. The work done by the pressure on the outflowing gas is infinitesmal in comparison with the work done by the combustion which generates the light. Every time the gas is lighted it is regulated by the user, who lights it and turns the stopcock till he sees the flame to be of the size and brightness which he desires. Doubled or tripled or halved pressure, supervening in the course of a morning or evening, on account of the extinction or the lighting up of other lights fed by the same mains or branches, is controlled by the user, who partially closes the stopcock when he sees the light flaring up too high, and opens it wider when he finds his light too low. This control by the stopcock does not in the slightest degree impair the economy or alter the quality of the light, however great the difference of the supply pressure may be. There is absolutely no analogy in gas to the electric bridge from one main to another main, such as is constituted by the incandescent light. The incandescent light has no regulator in connection with it. It is either off or on. The ordinary user has no means of altering the difference of potential in virtue of which it acts. The regulation of the pressure, or difference of potentials, is required for two purposes: (1) To prevent the lamp from being destroyed by too high pressure; (2) to keep up its brilliance to the proper degree. No such reasons demand equalization of pressure for gas, and the only reason for requiring a rough approximation to uniformity of pressure is to save the user the trouble of regulating by his stopcock, or to save the expense incurred by too much gas passing, or by the breakage of a lamp glass when a light is allowed to flare up without being noticed. With these well-known facts in every one's mind, it is not to be wondered at that electrical engineers did not look to gas distribution for suggestions as to how best to arrange the pairs of conductors required for the electric lighting of a city."

I do not think that the witnesses for the defense have by their statements and arguments in any wise weakened these reasons, or affected these conclusions. Of course, it is exceedingly hazardous for one not an expert to express an opinion on a question so wholly within the domain of scientific exposition; and the hesitation to do so would be unconquerable were it not that even the able and learned witnesses for the defense, when speaking of the problem of the distribution of electricity on a large scale in 1880, and its probable solution, were positive that there was a serious difficulty involved, which was apparently insuperable, and Dr. Morton did not hesitate to challenge as impossible the statement that Mr. Edison had really accomplished what he claims, even after his invention was made public; and yet Dr. Morton and the other most learned witnesses must have been thoroughly aware of the means adopted to equalize the pressure in gas and water distribution.

At that very time it was common knowledge with them. Yet, knowing what that method and those means were, these gentlemen not only failed to derive assistance from those methods, or to apply their knowledge to the distribution of electricity, but absolutely doubted, even after the announcement of Mr. Edison's successful experiment, whether it could possibly be true. At that time they could have had no faith in the educational power of the methods of gas and water distribution in their application to the distribution of the electric current.

The answer, I think, which must be given to this part of the defendants' case,—and in this I include, also, the defense which is based upon the alleged anticipatory system of equalizing pressure in electrotyping and electroplating, and upon the publications thereto relating,—is this:

"That while it is admitted by the experts on both sides, in this case, that all the learned electricians of the world, in 1880, were individually engaged, each in his own way, in attempting to solve the problem of the distribution of the electric current over large areas, so as to be successful, not one of them, so far as the testimony in this case goes, and so far as our knowledge extends, ever thought of adopting the means which it is alleged was used to equalize the pressure in water and gas distribution, or to equalize the pressure in electrotyping or electroplating, to overcome the harmful drop in tension, necessarily found in sending the electric current to a large number of incandescent lamps. Surely, if these were anticipations, or if they were so educational in their character and in their effect as is claimed by the defendants to-day, we would have seen the practical result in the operations of the minds of scientific gentlemen scattered all over the world, who were diligently seeking to solve a problem which, notwithstanding all this previous knowledge, seemed to them practically unsolvable."

There were other patents and publications mentioned by the defendants, and some criticism made upon the original proceedings in the patent office, but I do not think it is necessary to consume time in discussing them. I have gone over what seemed to be the strongest points of the defense,—points which were relied upon at the argument,—and my conclusion is that they do not successfully disprove the claim which Mr. Edison has made to be the first inventor of the combination described in these letters patent. I think it is clearly proved that he was the first to conceive of such an arrangement and proportioning of the consumption and conducting wires of a circuit that the inevitable result would be to secure uniformity of pressure throughout the whole system. He was the first to divide a circuit covering a large area into smaller consumption circuits, in which the drop in tension would be negligible, without the expense of a very large sum of money in increasing the copper of his wires. He was the first to obtain the equalization of candle power. He was the first to supply his consumption conductors with feeding conductors set apart for that purpose only. He was the first to localize upon feeding conductors the drop in ten-

sion, so that the loss upon the consumption conductors was always negligible.

It is difficult—impossible, perhaps—to describe what invention is. If invention implies something more than a mere change of form or arrangement or mode of use; if it be the result of inventive, as distinguished from mechanical, skill; if it be the result of the operation of the intellect, not following the beaten track, but striking out into some new direction, and achieving some new triumph; if it be the resultant of the exercise of the creative skill and genius in harmonious combination,—then I think Mr. Edison, so far as the matters involved in this suit are concerned, should be termed an inventor of high order.

The defendants deny infringement. Considerable testimony was taken on both sides with reference to infringement, and, as usual, there is some contrariety of statement; but the weight of evidence shows clearly that the defendants had adopted the system of elec trical distribution which Mr. Edison had described in these letters patent, and in so doing had clearly infringed the claims now in suit. It is not necessary to consume time in discussing the evidence on this point. Some technical questions touching the pleadings in the cause were presented at the opening of the argument; but, as leave was given to make such amendments as might be necessary to present the real merits of the controversy, they may be regarded as out of the case.

There must be a decree as prayed for in the bill.

GREEN v. CITY OF LYNN.

(Circuit Court, D. Massachusetts. April 7, 1893.)

No. 1,824.

1. PATENTS FOR INVENTIONS—ADJUDICATION BY SUPREME COURT ON QUESTIONS OF FACT—HOW AVAILABLE.

   The decisions of the supreme court upon questions of fact in a suit determining the validity of a patent do not operate strictly as res judicata, or as a technical estoppel, in a subsequent suit in the circuit court upon the same patent between different parties, but operate merely upon the conscience of the inferior tribunal; and therefore, in applying conclusions of the supreme court, the circuit court should first inquire what facts are proven in the pending case by independent evidence, given under the ordinary rules of law, and, second, examine the opinions of the supreme court, and the line of reasoning and conclusions which they exhibit, and from these or otherwise, but not by formal evidence, become satisfied whether or not the proofs of which the latter court took cognizance were substantially the same as those in the case at bar; hence there is no reason for burdening the record in the case at bar with the record in the supreme court, and, if offered in evidence, it will be stricken out.

2. SAME—VALIDITY—LIMITATIONS—DRIVEN WELLS.

   Reissued letters patent No. 4,372, granted May 9, 1871, to Nelson W. Green, for an improvement in driven wells, must be limited to the process in which the tube is driven through the earth, without boring, so as to form an air-tight joint by the pressure of the earth around it; but it covers this process whether the tube is so driven for the whole depth of the well or for only a part of such depth.