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A THREE SIDED QUESTION.

Since there are three measurably distinct, and in some respects opposing, interests involved in the question of patent rights, there are naturally not less than three independent ways of regarding them. And it is equally natural that these opposing interests should now and then meet in open conflict.

There is first to be considered the interest of the community at large. Next in influence, though not in right, must be ranked the manufacturers and special users of inventions, such as railway companies and other great commercial or industrial corporations. Last in power, though first in beneficence, are the men of fertile brains and skillful hands to whom the world owes so much of its wealth, comfort, and civilization—the inventors.

The practical wisdom of the Fathers of our Republic was in no way more strikingly manifested than in their appreciation of the value of inventions. A new land gave rise to new necessities, and the prosperity of the country largely hinged upon the promptness and skill with which those necessities should be met. Accordingly they set a premium upon invention, and took pains to secure to inventors, at little cost, a property-right in the fruits of their creative genius.

The history of industrial and social progress in this country amply demonstrates the wisdom of the course adopted. Under a hundred years of encouragement, the inventors of the United States have added more to the power and prosperity of mankind than all the rest of the world during unnumbered antecedent ages. And that no peculiarity of race, or situation, or needs is to be credited with this rapid advancement in wealth and power is evident from the single circumstance that the same race, and other races of like development, have been colonizing new lands and creating new nationalities ever since history began. Other nations have been free; other nations have conquered wildernesses; other nations have built up great empires under new conditions. But no other nation ever offered such encouragement to invention, and in no other has invention progressed with such marvelous rapidity. Very naturally therefore the sound common sense of our people, notwithstanding the specious special pleading of doctrinaires and corporation lawyers, thoroughly approves of our patent system, and would rather increase than diminish the advantages it offers to inventors, confident that the evils attending the mild and self-limiting monopolies which patent rights create are insignificant compared with the enormous benefits the country has reaped and daily reaps from the privileges so conferred. Inasmuch as the normal and practical tendency of invention is to benefit the community—by improving and cheapening manufactures, by multiplying and bringing within easy reach of all a greater number and variety of articles of use and comfort, thus widening the scope and enjoyment of life—the community is necessarily bound to favor inventors and encourage their activity.

Not so the second class we have named. To them new inventions are not altogether beneficial. They have an enormous property interest in old inventions. Their profit comes from making and selling articles already in use, or from using processes already profitably applied. Every new device or improved process, particularly if of a high order of merit, is an immediate injury to them, unless they are free to appropriate it. It is a new and winning rival. To compete with it in open market is to invite defeat. They must either better the improvement, or pay for the use of it; and either alternative subjects them to trouble or expense or both together. What wonder, then, that not a few of this class are disposed to treat the inventor as a poacher upon their preserves; an interloper, not content to let well enough alone; a restless, troublesome fellow, who might be useful enough provided he would be controlled by them, but otherwise a very costly nuisance. What wonder, either, that they have a horror of *new* patent rights (they have less fault to find with those upon which their own wealth and prosperity have been founded), and are eager that the patent laws shall be so changed as to make it impossible for an inventor to keep them from enjoying the fruits of his genius and labor!

As for the last mentioned class, there can be no question that their interests lie, not less than those of the community at large, with those measures which secure to them the utmost freedom and encouragement consistent with the common rights of all: this as a right, not as a gratuity. More than any other class the inventors are the mainspring of modern material civilization. Unlike other producers, their contributions to the public wealth are actual creations. But in its first and essential condition the creation of the inventor is intangible. Not until it is translated into material form, and so brought to bear upon the physical and commercial realities of life, can it bring wealth to him; and then only in case he has the right to control it. To insure this translation and the consequent benefit to the community, the theory of our patent system has been that it is necessary to offer the inventor some assurance of property-right in the fruits of his invention: and the practical working of the system has amply demonstrated the correctness of the theory. The temporary monopoly which the patent right grants to the inventor has unquestionably secured the practical application of myriads of useful ideas which would otherwise have died with the minds which harbored them, or still more speedily have passed into the oblivion of forgetfulness; while the temporary restraints which such monopolies have imposed upon others, and the public disadvantages incident thereto, have been infinitely outweighed by the preponderance of the system's good effects.

The recent history of the civilized world has shown the greatest progress to be coincident with the greatest encouragement of invention. To withdraw the direct results of such encouragement, in the past, would be to take away four fifths of our power as a people, four fifths of all that we specially prize and delight in, four fifths of all that goes to make modern civilization higher, more enjoyable, more secure, and more promising for future good, than any that has gone before it: and what has proved so beneficial in the past is not likely to prove less so in the future.

It is a serious question, therefore, whether our legislators shall be allowed to withdraw, at the instance of the short-sighted selfishness of special classes, any portion of the protection and encouragement which our inventors have hitherto enjoyed. To recur to a figure already used, the country cannot afford to break, or even weaken, the mainspring of its material progress.

THE LIQUEFACTION OF AIR AND ALL THE PERMANENT GASES.

Matter exists in the three forms, solid, liquid, and gaseous, and is in all these states supposed to consist of molecules which are never at rest but which always possess a movement or vibration of their own. In the solid state the molecules vibrate about fixed positions from which they are prevented by the force of cohesion from departing, and which movement does not interfere with the shape of the body. In liquids the fixed positions are absent, and the molecules while still affected by the force of cohesion are free to move and rotate about themselves. In gases the molecules are altogether freed from their mutual attraction and follow the ordinary laws of motion. When they meet they repel each other, and thus a gas will expand indefinitely unless inclosed in an envelope.

Under certain conditions of heat all substances in nature are capable of assuming these states. When heat is imparted to a solid the motion of the molecules is accelerated until the limit of such motion is reached, which allows the body to remain in solid form. Further elevation of temperature determines the passage of the substance to the liquid form, and ultimately to the gaseous state. Still further application of heat after this last condition has been assumed increases the velocity of molecular motion, and causes the molecules, if in a closed vessel, to resist greater pressure, or under the same pressure to resist that pressure over a greater area; hence follows the phenomenon of the expansion of gases. Now, if the temperature be indefinitely raised or the volume of space indefinitely increased under a constant temperature, the vapor or gas will finally approach a state corresponding to that of a perfect gas, that is, one which possesses the condition of perfect fluid elasticity and presenting under a constant pressure a uniform rate of expansion for equal increments of heat. The conditions, however, of an absolutely perfect gas cannot be attained, because all gases change their physical state when the molecular movement of their particles is modified. And this modification may be effected in two ways. First we may reverse the operation above detailed and abstract heat, producing just the reverse result to that noted, or, second, we may overcome the motion of the molecules by actual compression. That by these means presumably permanent gases could be liquefied was demonstrated by Faraday in 1823, but he is said to have been anticipated by Monge and Clouet in the condensation of sulphurous acid in 1800, and by Northmore, who liquefied chlorine in 1805. The simple apparatus used by Faraday consisted of a bent glass tube having a long and a short leg at right angles. In the open end of the longer portion was placed a substance from which gas could be obtained by heat, after which the tube was hermetically sealed. The shorter leg was then plunged into a freezing mixture and by the application of heat to the long leg large quantities of gas were produced which through being confined in very small compass was subjected to its own pressure and to the reduction of temperature by the freezing mixture until finally the liquid form was assumed. Faraday in this manner liquefied chlorine and several other gases supposed to be permanent, and demonstrated the truth that between vapor and gas, the one being transformable into liquid, the other not, no difference exists, or, more broadly, that the three states of matter, liquid, solid, and gaseous, are not specific to any form of matter, but solely depend upon the mode of motion of the molecules of the substance.

A few weeks ago, to have stated this law thus broadly would have been to neglect an apparently very important exception, namely, that six gases had persistently refused to be governed by it; and although, theoretically, it was impossible to except them, still, practically, the ingenuity of chemists and physicists had failed in all attempts to reduce them to actual conformity to the law. Six gases—hydrogen, oxygen, nitrogen, nitric oxide, marsh gas, and carbonic oxide—had resisted all efforts to liquefy them. Records of tests of this kind are not wanting; and among the most elaborate experiments are those made by Dr. Andrews, and described by him before the British Association in 1861. He used the elastic force of the gases evolved in the electrolysis of water as the compressing agent, and subsequently mechanical means. The gases were compressed in capillary tubes and then subjected to the cold produced by the carbonic acid and ether bath. Atmospheric air was compressed by pressure alone to $\frac{1}{311}$ of its original volume, and by the united action of pressure and a temperature of —106° Fah. to $\frac{1}{575}$, in which state its density was little inferior to that of water. Oxygen