by the Rev L. Jenyns, in his "Observations in Natural History." He mentions that bees which visit these flowers are soon seized with a sort of torpor, and often die unless speedily removed. He quotes also a writer in the *Gardener's Chronicle*, who pronounces the cultivation of the dahlia in compatible with the success of the beekeeper. I find it also recorded that the passion flower stupefies humble bees; that bees of all kinds avoid the crown imperial and the oleander, and that the honey of the latter is fatal to flies. I cannot call to mind that I ever saw a butterfly or a moth settled upon the flowers of this shrub in Hungary and Dalmatia, where it is very abundant. It seems not unimportant to ascertain whether the above mentioned phenomena have been verified by other observers; whether any other insects in such cases undertake the functions generally exercised by bees, and whether other flowers have a similarly noxious or deadly action upon insects.

Propagation of Oysters.—Prof. Brooks, of the Johns Hopkins University, has, according to the *Science News*, been recently engaged in experiments with the object of securing the artificial propagation of oysters, and on the 20th of May his efforts culminated in success. Before these experiments naturalists were not fully conversant with the early history of this mollusk's development. A correspondent of the Baltimore *Sun*, who witnessed the process of making embryonic oysters, says in his account of it: Half a dozen on the half shell served on a plate, a few watch crystals, a small glass jar, a little water, and the microscope, constituted the laboratory. The oysters had been taken fresh from their beds and opened carefully. In this way they will live for a day or two if kept in a cool place, and all the while the heart may be seen to pulsate in its cleft next to the muscles. Close to the heart lay what is usually called the "fat," but which is really the reproductive organs. These are wrapped all around the stomach, liver, and digestive organs, the latter being the "belly" or dark part of the oyster. The flaps extending around the whole of one side of the shell are its gills, through which it breathes and separates its food. The mouth is at the butt end of the shells where the hinge connects them. Male and female oysters on the half shell cannot be told apart, and indeed one in fifty is believed to be hermaphrodite. It is claimed that oysters are females when young, and males when they become older and larger. But the facts have not been established with certainty, nor is it of importance. To produce free swimming ciliated embryos the operator pinched away with tweezers a particle of the generative part, put it into a watch crystal, and stirred it until the eggs were well shaken out. The water was now milky from the great number of eggs. The microscope determined the sex, which in the present experiment proved to be male. Under the microscope these male cells appeared to be minute dots perpetually in active motion, and each one of them being sufficient for impregnation when properly lodged. The female eggs are 100,000 larger than the male cells, but are invisible to the naked eye.

Having been washed out into separate watch crystals, the eggs are mixed with the male cells. Then viewed under the microscope the male cells are seen to attach themselves vigorously to the egg in eager crowds, but only one of the many is supposed to impregnate. The first change apparent is the disappearance of the germinal vesicle, and this is accomplished in a very few minutes. The egg then becomes spherical and remains quiet for one or two hours, when a kneading process becomes visible. A globule appears on its surface, and this is the beginning of segmentation. Then by degrees the egg becomes divided into smaller and smaller granules. This process of subdivision occupies two hours, and at the end of this time a small, transparent swimming embryo is found, which is the oyster in its infantile state. The whole process occupies from four to six hours, according to the temperature, although in the present instance it was brought to a successful issue in four hours. Prof. Brooks in his previous experiments had raised oysters till they possessed the cilia which serve to propel the microscopic animal, but they died without further revelation of the mystery of life. In the present experiment he had the satisfaction of developing the embryos until he could clearly trace their digestive organs, and he is inspired with the hope that continued watchfulness will enable him soon to see the infants begin to assume their armor of shells. It is believed that there is no specific time for the spawning season of the oyster, and that it continues throughout the summer months, though this is a point not yet definitely settled.

Correspondence.

How to Hear Lightning in Advance of the Thunder.

To the Editor of the Scientific American:

During a recent thunderstorm at this place I tried, with much success, the interesting telephone experiment suggested in your last week's paper by Mr. G. M. Hopkins. I connected one pole of the telephone with the water faucet in my room, and the other pole with the gas pipe. On applying the telephone to my ear I heard, at every flash of the lightning, a crackling or bubbling sound in the instrument, the intensity of the sound varying with that of the flash. There were also, throughout the storm, frequent minor sounds, indicating lesser electrical action in the telephone; but these minor sounds were unaccompanied by a visible flash.

The thunder sounds were heard from 5 to 30 seconds after the flashes were seen; showing that the center of electrical action was at a distance of one to six miles from my instrument. The water pipe simply connected with a cistern in the ground near my house. The gas pipe connected with the street main, ramifying through the village over perhaps a square mile, but not in the direction of the storm I have mentioned.

A. E. B.

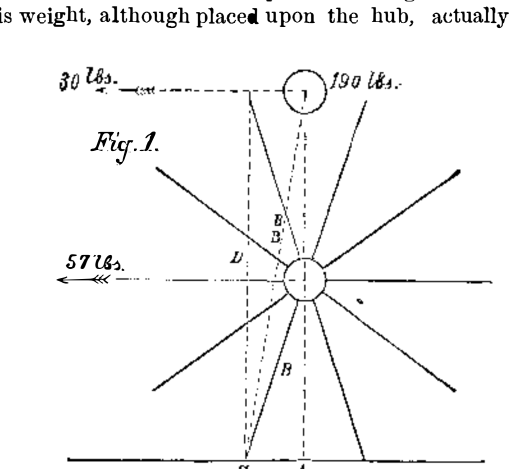
Mont Clair, N. J., July 11, 1879.

Large vs. Small Vehicle Wheels.

To the Editor of the Scientific American:

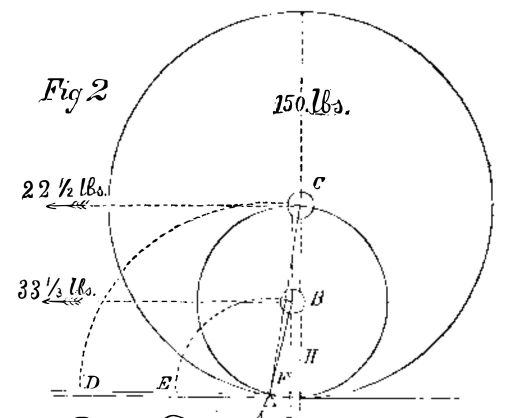
In a late number of the SCIENTIFIC AMERICAN appeared the question whether a large or small wheel ran the easier. The answer was given in favor of the larger wheel. The principle involved is well known to the carriage builder as being based upon the law in mechanics that regulates the workings of the lever. A wheel is a perpetual lever, the weight, although it is placed upon the hub or axle, is carried to the ground by the law of gravitation in a perpendicular line with the suspension. The obstacles to be over come in propelling a vehicle create a continuous fulcrum, being a greater or less distance from the weight in accordance with the obstacle surmounted.

To illustrate this principle we have prepared two illustrations. In Fig. 1 is shown an incomplete wheel, the spokes have been driven into the hub, but the fellies have not yet been placed in position. The wheel stands upon two of its spokes. From the hub is suspended a weight of 190 lb; this weight, although placed upon the hub, actually rests



upon the ground at A; the end of the spoke, B, forms a fulcrum at C. We wish to raise the spoke, B, to a perpendicular position, shown by the dotted line, D, and in order to do so a force of sufficient amount is applied at E, or the hub, pulling in the direction of the arrow. Now as the distance, A C, is to the distance from the center of the wheel to the fulcrum, C, so is the force applied at E, or the hub, to the weight, 190 lb. We, therefore, find that a force of 57 lb. will move the 190 lb. Now, suppose that the wheel is just twice as large, and that the dotted line, B B, represents the spoke of the larger wheel corresponding with B in the smaller wheel. Applying the force at F in the direction of the arrow, we find that 30 lb. will move the weight of 190 lb.

In Fig. 2, two wheels are represented, the smaller two



feet, the larger four feet in diameter We will suppose an obstacle is placed upon the track at A; a weight of 150 lb. is placed upon the axle of the smaller wheel, and a force applied at B in the direction of the arrow. This force will be equivalent to 33⅓ lb., while a force of 22½ lb., applied at C, the center of the large wheel, under the same conditions, would accomplish the same object. In order to illustrate the principle more fully, let D A represent the long arm of a lever, corresponding with the spoke of the larger wheel, and A H the short arm. Suspend a weight of 150 lb. at H, and another of 22½ lb. at D, and the lesser weight will balance the heavier. The same with E A F; here, however, a larger weight is required to balance the 150 lb. than with the longer arm, thus fully demonstrating the advantage of a large wheel over a smaller.

GEORGE A. HUBBARD.

New Haven, Conn.

The Old Telegraph Mine.

To the Editor of the Scientific American:

About twenty-five miles by rail, south of Salt Lake City, in the Bingham Cañon, one of the most reliable mines of Utah is located. I refer to the Old Telegraph, which has for many years been well and favorably known in this country as a producer of lead bullion. The mine is reached via the Utah Southern and the Bingham Cañon Railways, the latter road connecting with the former at Junction, a distance of twelve miles from Salt Lake City, and thence it runs to Bingham, thirteen miles distant, up a grade 200 feet to the mile. From Bingham there is a tramway running up the sides of the mountains to the mouth of the mine, more than two miles away. The ore is run down this tramway in small cars, and dumped from their elevated track into the larger cars of the railroad. The accessibility of the Old Telegraph is all that could be reasonably desired. Bingham Cañon is more in the nature of a valley than of an abrupt cañon. The slope is admirably utilized by the tramway and railroad already described, so that the attraction of gravity performs without cost what otherwise would require expensive machinery to accomplish. This Bingham Cañon Railroad was built to meet the necessities of ore shipments from the Old Telegraph, and it has paid for itself more than three times over.

Bingham City is also an outgrowth of this mine, and it is one of the most considerable mining towns in the Salt Lake valley. The property of the mine is about 3,500 feet in length, and the strike of the vein is nearly east and west. The average altitude of the whole mountain in which the mine is located is 6,800 feet. This is divided by deep gulches which offer convenient egress in various places for the ore.

The vein is tapped horizontally by five different levels. The first is the 460 foot level; the second is the 420 foot level, the third, the 360 foot level; the fourth, the 310 foot level, and fifth the 60 foot level. The width of the seam at the 460 foot level is 72 feet, and at the 60 foot level 60 feet. The entire length already opened is 1,710 feet, and about 1,790 feet more is virgin ground yet unopened.

The geology of the whole Bingham Cañon is of the Devonian formation, consisting of quartzite, marble, clay, and limestone. These have been rifted and twisted, by the volcanic action which reared these mountains, into multitudinous forms. The vein of ore is a true vein, of great strength, and practically inexhaustible. The upper part contains less lead than the lower, but is rich in silver. The whole vein averages from 25 to 50 oz. in silver, though in some places the yield is upwards of 200 oz. The average yield of lead is from 40 to 60 per cent. The lead ore consists of carbonate, which, when pure, contains 77 per cent. of lead, and galena, which contains 87 per cent.

The primitive vein material was galena, which was changed into sulphate, carbonate, and chloride by the action of concentrated sea water. Silver is found in the form of sulphate and chloride of silver. Ores containing much chloride of silver are seldom rich in lead, and are, therefore, not smelted, but leached out. The Old Telegraph has a leaching establishment immediately adjacent to the mine, and another one on a larger scale at West Jordan. This leaching process produces sulphate of silver, by the way of solution of hyposulphate of sodium, and precipitation by sulphite of calcium. Under the administration of Mr. L. A. Haldin, the former superintendent and manager of the Old Telegraph, the mine produced in one year $700,000. The average daily output was about 100 tons, or something over $20 per ton net profit. In the year 1876, the mine produced the sixth part of all the lead in the United States, or 10,000 tons in bullion. In 1877 it produced the eighth part, or 11,000 tons in bullion, the general yield being greater throughout the country in 1877. In 1876, 1,000 tons of the ore were analyzed at Pittsburg, by Othon Wuth, with the following result:

Carbonate of lead	50·43
Galena	15·02
Oxide of iron	3·78
Sulphate of copper	0·69
Sulphate of iron	7·37
Quartz	12·47
Clay	3·01
Carbonate of lime	3·64
Sulphate of lime	3·04
Carbonate of manganese	0·26
Water	0·19
	99·88

More recent analyses have been made with practically the same result. The Old Telegraph bullion is esteemed highly throughout the East, and is worth $5 more per ton than any other Utah bullion, because it does not contain antimony, arsenic, or zinc metals, which are noxious to the refining process; and consequently the bullion and ore of the Old Telegraph is sought by refineries and all smelting works in the neighborhood.

About the first of the present year a wealthy French company purchased this valuable mine, and since the 8th of May have been in possession of the property. The management is now taking out over 100 tons of rich ore per day. This operates the tramway to its full capacity and keeps four out of the five furnaces of the smelting works in blast. One hundred men are constantly employed, and preparations are making to increase this number, with additional facilities for a much larger output of ore. It is proposed, at no distant day, to put up three new furnaces, and when this is done the owners of the Old Telegraph will be able largely to command the whole silver smelting of Utah; for there is no good lead in the territory to smelt the silver with except that of the Old Telegraph; consequently, rather than sell their ore to smelt that of other neighboring mines with, they will buy all other ores and smelt them in their own furnaces. This is the true policy of the present company, which they undoubtedly appreciate. The company being one of large resources, the shareholders will not press the management for immediate large dividends, but will be content to wait for more permanent and equally beneficial results.

Being in Salt Lake City for a few days, I was invited to join a party of ladies and gentlemen who intended looking through the mines of Bingham Cañon. This gave me the opportunity of examining the Old Telegraph, with the foregoing results. At the present time the quantity of ore in sight is something over 2,000,000 tons in the open space.

I saw a body of ore with a face 300 feet long, 56 feet high, and over 100 feet thick. This was in the 310 foot level, in one spot only; and was nearly virgin ground. The temporary agent and manager who represents the Frenchcompany has introduced many good reforms, such as putting in the waste and saving the timber, while his energy and zeal find indorsement on all hands. He proposes soon to introduce the system of contracts with the workmen which prevails in Europe. He has expressed himself as favoring high wages to good workmen, and this new system of paying by the piece will guarantee this result.

It may be said generally of the Old Telegraph Mine that the temperature is agreeable, the metal easy of access, and readily worked. There is no water in the mine; blasting is not necessary, nor hoisting. But the metal is run down shoots in the inside of the mine from the higher to the lowest level; and outside of the mine down the tramway and railway to the furnaces and concentrating works, being a continuous falling until the ore is changed into bullion.

H. S. W.

Salt Lake City, Utah, June 26, 1879.

CURIOUS DISCOVERIES IN REGARD TO THE MANNER OF MAKING FLINT IMPLEMENTS BY THE ABORIGINES AND PREHISTORIC INHABITANTS OF AMERICA.

At the last meeting of the Anthropological Society at the Smithsonian Institution, Mr. F. H. Cushing, who has made an original and experimental study of aboriginal processes in the manufacture of pottery, stone axes, and flint arrow heads, using only the tools which were within the reach of the aboriginal manufacturers, gave an interesting description of the manner in which flint implements, especially arrow and spear heads, were made by the prehistoric inhabitants of this country and Europe, previous to the discovery or introduction of iron.

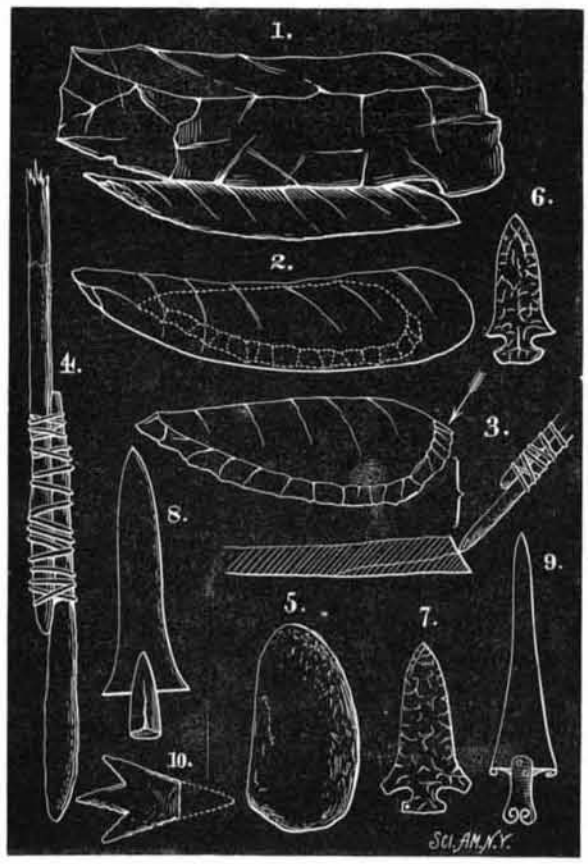
It is the popular impression that flint arrow heads were all chipped into shape by striking off fragments with a rude stone hammer, and this was the method first tried by Mr. Cushing. He found, however, that it was impossible to imitate in this way any of the finer and more delicate specimens of Indian arrows, and that three out of four even of the coarser forms were broken in the process of manufacture. It was evident, therefore, that the Indians had other and more delicate processes. After many unsuccessful experiments, he accidentally discovered that small fragments could be broken off from a piece of flint with much greater certainty and precision, by pressure with a pointed rod of bone or horn, than by blows with a hammer stone. The sharp edge of the flint would cut slightly into the bone, and when the latter was twisted suddenly upward a flake would fly off from the point where the pressure was applied in a direction which could be foreseen and controlled.

To this process Mr. Cushing gives the name of flaking to distinguish it from chipping produced by percussion. And its discovery removes most of the difficulties which previous experimenters had met with in trying to work flint without the use of iron. Spear and arrow heads could, in this way, be flaked even into the most delicate and apparently fragile shapes with a certainty attainable in no other way, and with a greatly lessened probability of breakage. Mr. Cushing then described with the aid of blackboard illustrations all the steps in the manufacture of an arrow, beginning with the striking off of a suitable flake from the mass of material selected, trimming it roughly with a pebble into a leaf shape with a beveled edge, Fig. 2, scaling off surface flakes by repeated blows with a hammer stone upon this edge at right angles to its plane, Fig. 3, and finally finishing, pointing, and notching the arrow head with the bone flaking instrument previously referred to.

Surface flaking, which is the thinning of the unfinished arrow by the detachment of flakes running from the edge to the center, is the most difficult part of the whole process. Arrows upon which no signs of it appear were always the work of beginners. It may be produced either by direct blows with a hammer stone, by pressure with a flaker, or by a combination of the two methods, the hammer being used with the flaker as if the latter were a stone chisel. Each of these methods leaves its unmistakable mark upon the finished implement, so that it is easy to determine by simple inspection of the chipped article to what degree of perfection the art had come at the time when it was made. Thus it can be proven that the marvelously chipped axes of the Danish shell heaps were produced by using a horn flaker as if it were a stone chisel, by striking it with a hammer stone, while the beautifully finished daggers, arrows, and spear heads from the same region had been flaked by a combination of the latter process and pressure, and that when the paleolithic flint implements found in the drift were made, the art of using the flaker in either of these methods had not yet been discovered. Hammer stones, however, which bear marks of having been used for chipping, are found everywhere where arrow or spear heads occur, showing that savages universally pursued the method followed by Mr. Cushing, of first blocking out the implement with a hammer stone, whether they afterward used a flaker to finish it more perfectly or not. Since, therefore, all the specimens found in the great "deposits," or *cachés*, throughout this country bear marks of the hammer stone, but not of any other instrument, they may be definitely regarded as unfinished articles laid by for future completion.

The various processes and implements used in chipping and flaking had grown out of the difference of material to be worked. Where the latter was tough, as was the case with the hornstone of Western Arctic America, it could not be flaked by pressure in the hand, but must be rested against some solid substance, and flaked by means of an instrument the handle of which fitted the palm like that of an umbrella, enabling the operator to exert a pressure against the substance to be chipped nearly equal to the weight of the body. Thus the T-shaped wooden-knife flaker of the Aztecs was the outgrowth of the easily worked obsidian; and the slender horn flakers of California and the Southwest, of the fragile chalcedony and jasper of that region.

Material often contained small masses of harder or tougher substance. Where these occurred the ordinary flaking was likely not to remove them, in which case they formed objectionable protuberances on the unfinished arrow point. When nearer one edge than the other, their removal was attempted by chipping into that edge, thus making the arrow head onesided. The almost invariable occurrence of traces of such protuberances on the edge most chipped of these unequal specimens was evidence that this, the so-called "knife type," was of accidental origin.



THE MAKING OF FLINT IMPLEMENTS.

1. Mass and flake; 2. Leaf form; 3. Surface flaking; 4. Flaker, upper end wood, lower end horn; 5 Chipper (pebble); 6. Bell-shaped Stone age spear; 7. Bell-shaped spear; 8. Bronze age spear; 9. Modified bell-shaped dagger, bronze; 10. Example of accidental chipping.

Most if not all of the so called "turtleback" implements which had been regarded by archæologists as designed for special purposes, were really articles never finished because of the presence of such prominences on the center of one side or the other.

Where these irregularities appeared on the middle of the side of a specimen of choice material, or on which much labor had been expended, its removal was undertaken by the chipping down of both edges, thus resulting in the bell-shaped outline of spear head, Fig. 6, so much admired by archæologists, which being recognized by savage manufacturers as ornamental, was afterward purposely produced, and even survived in the weapons of the bronze age, Fig. 8, or that period immediately following the age of Stone.

The difficulty of making long narrow surface flakes made it much easier to form narrow and delicate points than the larger, though even ruder forms on which much surface flaking was necessary, and the slender fragile perforators which had been regarded as inimitable by any existing race were really the most readily and rapidly made of all.

In flaking a large arrow or spear head in the hand it was necessary to hold it alternately by the point and by the base. As the grasp by the base was much firmer, the pressure was greater, and hence the flakes scaled off further toward or over the center, and as this unavoidably happened on opposite edges of the specimen, a twisted and even at times distinctly beveled point was the result when hard material was flaked. This not only accounted for the beveled type of spear head so common in Tennessee, but also indicated that wherever this type occurred the method of flaking was by pressure in the hand and not as among the Esquimau and Kjockkenmoedding people.

Mr. Cushing added that since all specimens of this kind were found to be twisted one way—from right to left—the inference was unavoidable that the aborigines who made them were, like ourselves, a right-handed people, and that wherever this form occurred the method of flaking by pressure in the hand must have prevailed.

Prof. Mason here mentioned that he had seen two examples beveled from left to right, indicating, of course, an occasional left-handed individual.

Mr. Cushing then explained how it could be known on examination whether an imperfect arrow had been broken during the process of manufacture or by use.

He then referred to an archæological publication recently (1868) printed in Spain, on the covers and title page of which appeared the figure of a three-pointed arrow. This had been regarded as one of the most important archæological discoveries of that year, and its figure adopted as the seal of the book. But had the members of that Spanish society and the author been practically familiar with flint chipping, they probably would not have regarded as so rare the inverted base of a common barbed and stemmed arrow head, from which the point had been removed by accidental chipping (Fig. 10).

Arrow flaking was accompanied by great fatigue and profuse perspiration. It had a prostrating effect upon the nervous system, which showed itself again in the directions of fracture, and it was noteworthy that, on an unimpressible substance like flint, even the moods and passions of centuries ago might be found thus traced and recorded.

Mr. Cushing then closed his remarks by calling attention to the use of the study and practice of the art of arrow making in establishing the groundlessness of all archæological classifications of chipped articles, based on diversity of form alone, or of attributing distinct or definite uses to types of form thus established, which these investigations proved to be the results only of constantly or imitated recurring accident.

Photography by the Electric Light in a French Court of Justice.

The question whether the Vander Weyde system of the application of the electric light to photography is or is not public property, is one which is just now forcibly occupying the attention of the photographic world in France. And there is much reason for this, for the question possesses more than one interesting aspect: There is, in the first place, the point of law as to what rights are attached to a patent taken out in France, and then there is the doubt as to the line of conduct to be pursued by photographers who desire to work the electric light in their own studios.

Naturally there was some excitement at the thought of the advantages which operators by the electric light would be able to possess, once it was completely established that by a new process really practical results could be obtained. It was remembered that the ill success of the first attempts to introduce the electric light into photographic work had caused them to be quickly abandoned, and that since then they had never been renewed. In the English Department of the late International Exhibition at Paris there were shown some photographs taken by the Vander Weyde system, and professional photographers were astonished, for all the artistic conditions which were formerly wanting were now combined in them. Thanks to the special organs of the press, in which the *Photographic News* was one of the most active in bringing before the public the merit of the invention, it was learned that the technical requirements had been satisfactorily complied with by the new process, and that the employment of the electric light in photographic operations would henceforth be feasible; arguments—or, rather, proofs—not to be refuted were forthcoming. Some time ago, it is true, photographs had been taken by the electric light; the fact that this peculiar manifestation of energy could be successfully substituted for daylight was well known. But the apparatus used only allowed a pencil of rays to be emitted in a confined space, and the result was not what in photographic language is called "clean work." The great problem to be solved was that of the diffusion of the light, and this was successfully accomplished by M. Vander Weyde. According to the *Times* of the 25th of December, 1877, in an article containing an account of this valuable invention, M. Vander Weyde took out his patent in England on the 1st of February of the same year.

In France the discovery was only honored from afar. People rejoiced at the idea that photographers would henceforward be independent of the changes of light, and would be able to work at any hour and during any kind of weather. There were, indeed, some who, before the Vander Weyde discovery, had rendered the assertion possible—and, indeed, even before electricity had been thought of at all for the purpose—placarded the startling absurdity, "*Dull weather is the best*," in large brilliant letters illuminated by gas; but it was merely a means of advertisement, and gave occasion for many a laugh among professional photographers. Business men, whose time, during the hours of sunlight which were propitious to the operator, is fully occupied, were prohibited from even going to the photographer, however desirous they might be of having their portraits taken; ladies could not realize their wishes of being represented in evening dress unless they put it on in daylight; actors and actresses, whose costumes are intended to produce an effect by the illumination of the foot-lights only, were compelled, much against the grain, to endure their finery in the full glare of the sun. In France, then, we have been content to stand on our old lines, though we still tried to emulate the photographic feats of the electric light in England.

All the advantages of the process, however, much as the French photographers appreciated them, they could only hope to realize by the employment of an electrical apparatus giving a sufficiently diffused, and at the same time intense,