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Contents:

(Illustrated articles are marked with an asterisk.)

OBSTACLES IN THE WAY OF THE SUCCESS OF INVENTORS.

The difficulties which want of means and influence places in the way of inventors, the compulsory exactions of poverty and the discouragements of those who should stand ready to aid with their influence any attempt to relieve the *onus* of labor and increase the return of capital employed, seem to be enough to dishearten those who hope by their improvements to benefit themselves while adding greatly to the advantage of their fellows. But these difficulties overcome, there are others still greater in the path to pecuniary success, which must be removed before the benefit intended can be realized by the mass. We allude more particularly to the jealousy with which any improvement, deserving the name, is viewed by those whom it will most directly and certainly benefit.

Possessors of capital, whether it is invested in mechanical enterprises or not, view with more than a critical eye any device which proposes to aid them in the increase of their capital or its advantageous investment. To them the inventor appears as a harmless visionary, annoying and verbose, impractical and troublesome, well got rid of by a few words of milk-and-water encouragement, or perhaps by a bluff notice that their time is too valuable to waste on him. In consequence of these rebuffs, perhaps often repeated, the disappointed and disheartened inventor ceases effort, sees afterward his invention reproduced by another, made one of the grand inventions of the age, and spends the remainder of his life in legal squabbles, out of which he will consider himself fortunate to secure the crumbs of the feast at which the capitalist and the plagiarist fare sumptuously.

Singularly enough it is that those whose experience has driven them through a similar course, and who by a lucky stroke have achieved pecuniary independence are among the last to recognize the value of an invention or the claims of the inventor. And those whose fame, if not fortune, has been attained by their persistence seem ashamed to make their virtue of perseverance glorious by encouraging followers in the same path. It is almost as difficult for an inventor to procure even an interview with the men whose inventions and discoveries have made their names famous as to achieve a presentation to Queen Victoria or the Emperor Louis Napoleon. But these notable men are not ignorant or forgetful of the means that gave them fame; for at dinners given in their honor and in sketches or biographies of their lives they are not ashamed to rehearse the circumstances of annoyance, the obstacles, the difficulties that faced them and troubled them before success was assured. But they seem to suppose that their inventions and their value to the world absolve them from any further concern about the welfare of the race or the well-doing of individuals. The old British doctrine, "Once a subject always a subject," is entirely applicable to the realm of invention. No man who has worried through the annoyance, and trouble, and travail, and agony of discovery, and come out successful against great odds, has any right to repudiate his allegiance to the great republic of improvers and refuse his aid to those who strive to reach his eminence.

But these are not the worst obstacles in the way of the inventor. His patent secured, the favorable opinion of experts and influential persons obtained, and even a fair trial having proved the superiority of his device over others used for a similar purpose, he must meet the unreasonable objections of unreasoning or captious men. He may have considered his path easy after having demonstrated by fair experiment the absolute valve of his invention, but the road is still rough. Introducing his device and procuring the assent of the party to whom he wishes to dispose of a machine, or right, he is not certain that he has made a success, even in a single instance. Although no direct objection can be urged against the facts adduced or the demonstration shown by experiment, not unfrequently the purchaser and user will bring forward some objection not really tenable, and without logical argument to support it, but which, to him, is all-sufficient. It is difficult to manage such cases. It is hard to combat prejudice. Attachment to old forms of tools, to machinery perfectly understood, to familiar methods, is hard to overcome. With all their faults the mechanic loves his own tools and own methods the best. Only the all-powerful influence of interest can avail to overcome this sentiment.

This conservatism—vulgarly called old-fogyism—among mechanics, is the hardest difficulty met by the inventor and introducer of new tools, appliances, and methods. Is there not too much of it; too much of a disposition to give the cold shoulder to all projected, or even perfected improvements; too much of the old time sneer of "visionary" directed to the inventor, too much of an adherence to the old and not enough attention to the new, by our mechanics and manufacturers? Would it not be better, not only for the inventor or discoverer, but for the mechanic and the manufacturer to look fairly, try impartially, test honestly, and judge rightly, than to allow prejudice to work injury to themselves and produce disappointment to the inventor?

DOES AMERICAN INDUSTRY NEED PROTECTION?

The man who undertakes to answer the question which stands as the caption of this article, must be one of broad views. A mere superficial observer must necessarily err in his conclusions upon a subject, which has puzzled the minds of careful and thorough thinkers. It is not our intention to definitely answer this question here, but to call attention to a point, which, in all that we see written or hear spoken upon the subject, seems to be in a measure overlooked.

Commissioner Wells has told us in his able report, that a tariff is a tax.—Admitted. He also asserts that a tariff on imports is a tax that, under all circumstances, is paid wholly or in part by the consumer. Granted also

The general argument against protection based upon this well understood and admitted fact, is that the imposition of protective duties on special articles of manufacture raises the price of these articles to the entire mass of consumers, while a few are enriched by their production. The general answer to this argument which is as old as the idea of protection itself, is, that the advantages which accrue to the commonwealth from the protection of special industries, by the wise imposition of duties, compensate for the increased price of the taxed products. We believe this position is sound, but without rehearsing the arguments usually put forth in its support, we will at once state our proposition. The political health of any commonwealth demands a diversity of industries. The cheap lands and the high rates of labor prevalent in the United States, as compared with Europe, naturally tend to unduly develop agriculture, at the expense of many industries of vital importance to the general good. These latter, fostered by a judicious legislation, can be sustained without detriment to the agricultural interest.

It is unwise to be dependent upon foreign sources for any important production. The history of the world teaches us that the relations between nations are liable to frequent and serious disturbance, and that the increase of values upon articles of import consequent upon war is often enough to make the domestic manufacture of such commodities remunerative for a decade, if distributed equally during such a period.

But especially is it dangerous to fail in the protection of such industries as furnish material for national defence. All governments have recognized this fact, and have either taken full control of them or have made it certain that the cutting off of a foreign source of supply would not prove a source of embarrassment. The same principle can and ought to be applied to such productions as are essential to the comfort of the people at large. It is easy to imagine the distress which would be felt in some European states if the importation of breadstuffs should be suddenly stopped. Our own land is so wide and its products so diversified that it would be difficult to name a commodity which, if its importation should at once cease, would now seriously embarrass the Government, or materially detract from the comfort of the people; but it is easy, we think, to see how improper legislation might so dwarf the home production of—say iron for example, and so stimulate its importation, as to render such a contingency as we have named not only possible but probable.

There is another reason why national prosperity is dependent, among other things upon diversified occupations. It is by this means only that the full mental power of the population can be developed. All are not adapted to pursue the same calling, and different pursuits are as necessary to the health of a nation as different articles of diet to bodily health.

The danger of enriching a few at the expense of the many, is, in this country, limited by a free competition; and we are not in sympathy with those who view a proper protective tariff as the parent of monopolies.

CENTRAL LAKE NAVIGATION.

The grand chain of lakes occupying the center of the North American Continent together affords navigation almost oceanic in its proportions. The improvement and development of these great waters have, with the increased settlement of the fruitful regions surrounding them, become a matter of necessity, and the public will be interested to know something of what is now being done in this direction.

General T. J. Cram, of the United States Corps of Engineers, is now directing the improvement of what is known as St. Clair Flats. The improvement consists in the construction of a canal, one and one-half miles in length and three hundred feet wide, and of sufficient depth to permit the passage of vessels drawing thirteen feet at low water, and is built with a view of increasing its depth to eighteen feet in future if required. The bank is flanked by dykes of timber to be filled by the excavated earth. The timbers are to be saturated with creasote to retard decay. Few unacquainted with the subject will realize the great increase of facilities for navigation which this canal will afford. An examination of a map of the lakes will however show at once the importance of the work.

At Chicago, other improvements worthy of notice are progressing under the direction of the Chicago Dock and Canal Improvement Company. These improvements consist of a system of piers and canals having for their object the increase of dock facilities at the above named city and a huge breakwater for increased safety of the harbor. The canals are to extend into the town, twelve hundred feet from the shore line.

The breakwater is to be a very extensive structure. It is to be built in sections three hundred feet in length, to be sunk to to the water line; and it is contemplated to build thereon an immense storehouse covering the entire length, if experiments shall demonstrate the safety of such a structure. The entire area the storehouse will cover, from which also the size of the breakwater can be estimated, is one hundred and fifty-six thousand feet.

The canals are to be divided by cribwork consisting of two rows of piles driven as closely together as they can be set, and capped longitudinally with timbers. The space between is to be filled with stone, and planked. The docks are to connect with every railroad in the city by special tracks and switches, so that goods can be transferred directly from the cars to the vessels. The expense of the work is estimated at two million dollars, and when completed will be as complete and convenient as any system of inland dockage in the world.

IS LABOR-SAVING MACHINERY THE ENEMY OF LABOR?

The old, old fight, almost interminable, and persisted in notwithstanding the recorded verdict of history—and the events now transpiring, shortly to become a portion of history—is still going on. It is between ignorance and enterprise, dull conservatism and wide awake improvement. Will this absurd conflict never be ended? Will our would-be social theorists ever be willing to accept facts as better than their theories? Will ever the Malthus philosophy cease to affect social relations and the opinions of those philosophers whose thoughts intend to "shake mankind" and mold the ideas of the active ones who strive to make these thoughts a reality? Is the advance of the race by means of new scientific discoveries and new mechanical improvements to be checked by the bugbear of a plus of laborers over the work to be done? Have we reached the point where we must either stay the progress of labor-saving, and time-saving, and brain-saving, to allow the muscle as wielded by the puny arm of man to exploiter us and prevent all progress by brain muscle, or allow the serfdom and feudal lordliness of the past ages to return? Must all our boasted improvements in the arts and the sciences be considered only as toys for the intellect, unaffecting the well-being of the race? Shall we return to the laws of Lycurgus, and immolate our progeny upon the altar of national advantage, as understood by the fearful disciples of Malthus?

Such would seem to be the idea of some theorists. A gentleman of culture—æsthetic and literary—called upon us a few days ago to make inquiries relative to the subject of supply and demand as concerning the progress of the race. He seemed to be devoted to the idea that the supply of labor exceeded the demand, and that labor-saving contrivances were only laborer-slaying devices. The information we might give him in relation to this subject as shown by the record of patents, and their aggregate or proportionate usefulness, he supposed might be available to sustain what was his plainly preconceived view, that the laborers were many and the harvest small. He alluded to the destruction of labor (life) in our late war as something like a "providential dispensation," to weed out and lessen the choking growth of laborers in our social garden. We could not give him encouragement.

That some of the centers of manufacture and commerce are overcrowded proves nothing in favor of the idea that the laborers are too many. It proves only that this labor is misdirected, either by its possessors or others. Commerce, or rather the mercantile branch of business has grown to be a fungus on our industries. It was once used and is now calculated to be a support and aid to productive industry, but that it has proved to be either a parasite or a fungus, garroting the growth and sapping the life of industry, alluring by its temporary or periodical luxuriance, does not prove that labor is less in demand, only that other means of living than that of direct labor make seemingly fairer offers. If the cities are crowded, the country is open; if it is hard to procure even indifferent shelter and precarious living in crowded cities, both are easily obtained outside. Take the State of New York, for instance, and go through the nearest one hundred miles from the metropolis, what acres upon acres, miles upon miles of fertile soil which one passes on the line of a railroad, may be seen from the window of the swiftly gliding car, that seemingly have never felt the magnetic and magical touch of the laborer's hand! This State alone has unoccupied and unused land enough to give good homes and profitable or comfortable incomes to all the possessors of muscle and brain, however uneducated, that come to our shores from foreign lands in a twelvemonth.

Do the improvements made by researches in science or experiments in art add to the difficulties of labor in seeking its reward? We cannot see it. On the contrary, every advance,

even if it includes the production of labor-saving devices, opens and clears the way for the pioneer, the laborer, the *avant guard* of civilization. Has the sewing machine been a benefit to the women who before lived by sewing? Let the demands for female seamstresses daily published in our journals answer. Has the introduction of railway trains driven by steam diminished the production or the price of horses? Let the plain facts of to-day reply. Has the adaptation of steam to river and ocean navigation diminished the amount of freight and the number of passengers conveyed, or even the number of men heretofore employed? The condition of this business as compared with itself fifty years ago is a sufficient demonstration of the value of labor-saving machinery in this department.

The proudest days of the Roman empire saw a state the wealthiest members of which knew less of the luxuries of life than the ordinary American mechanic of to-day, and the workers were simply slaves whose liberties and lives were held in fee simple by their masters. While their masters shivered in the cold of their unheated marble palaces and gorged themselves on food, barbarously cooked, their slaves courted any sunshiny corner for warmth and greedily devoured the leavings we now think fit only for dogs. Then, the only relief from this state of vassalage was the army. Here, even, the soldier was not always sure of his regular food, but like the savage dogs in Eastern cities in our own time, or the wild beasts of the wilderness, he must fight for, or thieve for, or murder for it, before he could get it. Even the commonalty (*Cives Romani*) were only hired hinds, the tools of warlike generals, the victims of licentious civilians, or the protegés of a wolfish government, that raised her cubs to imitate the fabulous dam of the empire's founder. There were laborers enough then, but their labor was enforced and their pay stripes, imprisonment, or death. They had brains as we, but they did not invent; they had necessities but they could not supply them. Would they have been worse, would the empire have been poorer if a patent office had existed and an invention could have been protected? The remedy, then, for too great a population was that of Malthus propounded in later times, and his admirers in our day.

Now, it is hardly necessary that we should allude to times nearer our own, but it may be well to direct our readers—those at least who delve into the musty soil of history—to the condition of our mechanics less than one hundred years ago. These readers will see the wonderful difference between the condition pecuniarily and the position socially of the mechanics of that time and those of the present.

In 1769 a carpet on the floor was unknown, except in the houses of the magnates of the church or state, and at that time they were one. In the Plymouth Colony, in that year, one of the deacons (then like our present ministers, ordained to baptize and conduct religious services) was brought before a committee of his church in a town in Eastern Massachusetts and roundly reprimanded by his pastor for "presenting before ye congregation of ye w^ch he was an honoured officer ylch an yxample of luxury as best befitts yee times of ye ungodly of England" and was suspended for his daring, although the carpet, which was the head and front of his offending, was the handiwork of his dame and daughter.

Have we progressed since that? And is the progression, if made, to be attributed more to religious tolerance than to mechanical invention? Here is a nut for our Malthusian philosophers to crack. The world of eighteen hundred years ago contained all the means for man's comforts it does now—possibly more. We have found out not only what the earth contains, but we have found out the means of getting at it and using it. We with our Briarean arms of labor-saving utilities can afford to sneer at the Roman patrician of eighteen hundred years ago, and offer to his despairing slave not only freedom from his bonds of iron and steel that bound his limbs or prevented his freedom, but an equal right with his patron, or master, in the present possibilities, and in the magnificent future, for himself and his. And why? Because science and mechanical skill has made the impossible possible; because labor-saving machinery has not only opened new fields for the exercise of his faculties, but has provided with its iron fingers what he never could hope to provide for himself.

KEROSENE OIL.--REPORT OF PROF. CHANDLER TO THE METROPOLITAN BOARD OF HEALTH.

We reproduce the salient points of a report lately made by Prof. C. F. Chandler to the Metropolitan Board of Health, of New York, not particularly because it presents any new facts or suggestions, but because it deals with a subject to which we have repeatedly called attention in these columns, and recognizes the importance of a matter to which we have devoted much thought and given much space in our paper, as we deemed it of great and general importance. Prof. Chandler says:

The burning fluid sold so extensively throughout the United States under the name of kerosene oil, is refined petroleum from the oil wells of Pennsylvania, Ohio, Virginia, Kentucky, and Canada. As it comes from the wells petroleum is generally of a dark yellowish or greenish brown color, and possesses an odor more or less offensive. To render it salable it is subjected to a process of refining by which it is rendered almost colorless and freed as much as possible from its disagreeable odor. One of the most important objects of the purification is, however, the separation of the more volatile constituents, the benzine, keroseline gasoline, or naphtha, as they are variously called. These liquids, being very volatile, and, at the same time, very combustible, are the substances which give rise to the explosions which render the use of kerosene so dangerous. Benzine being the cheaper article, the cupidity of the refiner leads him to leave as much benzine in the kerosene as possible, regardless of the frightful consequences. Native petroleum is a mixture of a great number of hydrocarbons, compounds of hydrogen and carbon. These differ from each other in volatility. Some are so volatile as to evaporate rapidly at ordinary temperatures, making it dangerous to approach an open tank of petroleum with a flame. Others are much less volatile, some requiring a temperature of 700 to 800 degrees Fah. to vaporize them. The volatility of these component hydrocarbons is intimately related to their specific gravity or weight, the lightest oils being the most volatile, while the heavier oils possess the high boiling points. The inflammability of the oils is also intimately connected with their volatility and specific gravity. The light volatile oils ignite on the approach of a burning match, no matter how cold they may be; while the heavy, less volatile oils can only be ignited when they are heated above the ordinary temperature of the air.

The crude petroleum as it comes from the wells is subjected to distillation, when the most volatile constituents pass off first in the form of vapor, and are condensed by passing through a coil of iron pipe surrounded by cold water, and collected as benzine; subsequently the burning oil or kerosene makes its appearance; this is followed by a heavier oil which may be used for lubricating machinery: and there is finally a small residue of tar or coke left in the still. That portion of the product which is designed for illuminating oil is then subjected to the action of sulphuric acid to remove the odor and color, and destroy a little tar which it still contains. It is then subjected by the more careful refiners to a somewhat elevated temperature to expel a small percentage of benzine which it still contains. Thus purified it constitutes the kerosene oil as it is sold in the market.

The conscientious refiner runs all the dangerous oil into the benzine tank, and only when the oil is sufficiently heavy to be safe does he allow it to pass into the kerosene receiver. But as the benzine must be sold at a lower price than burning oil, the refiners are many of them led to collect as little benzine and as much kerosene as possible. It must not be supposed, however, that the specific gravity of the oil can be considered a safe index to its quality. On the contrary, the specific gravity gives very little idea of the quality; for while benzine and naphtha render the kerosene lighter, the gravity of good kerosene is preserved by the presence of heavier oils. So a poor, dangerous oil may be much heavier than a safe oil.

As the products of petroleum are dangerous in proportion to their inflammability, a fire test has long been in use, by which the temperature is determined at which the oil evolves an inflammable vapor—the "vaporizing point"—and the temperature at which the oil itself may be handled with a burning match—the "burning point." The vaporizing point of good kerosene oil should not be much below 100 degs. Fah., and the burning point should not be below 110 deg. Fah. Unfortunately the results of this investigation show but little of the oil sold in New York comes up to this standard.

Processes have been patented, and venders have sold rights throughout the country for patented and secret processes for rendering benzine, gasoline, and naphtha non-explosive. Thus treated, it is sold under such names as "liquid gas," "aurora oil," etc. These patents and secret processes are not only ridiculous, but their sale to ignorant persons is a crime only equaled by murder.

The fire test gives the only sure indication. Apply a lighted match to a little of the oil contained in a cup or saucer, and if it can be made to take fire, it should at once be considered unsafe, even though the experiment be made in one of the hottest days of summer.

Seventy-eight samples of kerosene oil have been procured from the same number of kerosene dealers in different parts of the city, and these have been carefully subjected to the fire test to determine the vaporizing and burning points. Several of the samples have also been subjected to fractional distillation to determine the proportions of benzine and naphtha which they contain. The result was that not one of the seventy-eight samples, selected at random throughout the city, which are all that were tested, is of a good quality, which may be called safe. The only single specimen of safe oil in the entire list is manufactured in Boston.

It is a little singular that Prof. Chandler should have been so unfortunate in the samples of kerosene he obtained. If he is correct, the surprise is not that occasional explosions, and consequent injuries, occur, but that such are not reported almost daily. Several months ago we made repeated trials and tests of kerosene obtained from our family grocer in Brooklyn, and in no case did we find the kerosene below the legal and practically safe test. We could mention the names of refiners of petroleum who would scorn to attempt such a murderous imposition on the public, or such a fatal stroke at their business name as to send out an improperly distilled or refined product. The test is so easily made and the law is so explicit that either manufacturer or dealer should find his attempt to impose on the public a spurious, dangerous, or inferior article a sad and serious failure.

No one possessed of common sense, a thermometer, a saucer, and a match, need ask anybody's opinion as to the explosive or dangerous quality of the kerosene he uses. The facts in regard to the character and tests of the fluid have been repeatedly published in the SCIENTIFIC AMERICAN, and it adds nothing to the importance of the subject that professional chemists should write, and daily papers print, a rehash of facts long ago sufficiently plainly stated.

Foreign Contracts for American Guns.

The gun-making ingenuity of Americans seems to be appreciated in Europe almost as much as that of the Prussian or French, if foreign orders for American fire-arms are any indication. The *Sun* says the Remington Company has recently delivered to the Danish government, 40,000 of their guns, and to the Swedish government 30,000, and the Greek government has contracted for 15,000 which have not yet been delivered. The Remington pattern is a single cartridge breech-loader of superior make and efficiency, of which from 200 to 300 are turned out daily by the Company. The Cuban government has bought upwards of 20 000 of Remington and Peabody rifles, the latter an arm manufactured in Providence. The Cuban revolutionists also have been buying up a large quantity of small arms, but of a poorer class, chiefly muzzle-loaders, being unable to pay for better ones. They hope to achieve their independence with the odds of breech-loaders against them. The Russian government has a contract with the Colt Fire-arms Company at Hartford, for 30,000 rifles, an improvement on the Prussian needle gun.

Besides the above contracts, shipment of guns to other governments have been made by American firms. The standard arm of the United States Government, is the Springfield musket, converted into a breech-loader, upon what is known as the Robert plan. It is a beautiful and very effective piece, and is admired by the ordnance departments of foreign governments. The regular army is now supplied with them. The great quantity of muskets which our Government had on hand at the close of the war is being disposed of at auction and private sale.

The only repeating rifles now made in this country are the Winchester at Bridgeport and the Spencer at Boston. The former is an improvement on the celebrated Henry rifle, carrying eighteen shots, and can be fired with great rapidity. The latter is a seven-shooter, and in Sherman's campaign through Georgia six men on a picket post armed with the Spencer carbine kept at bay for some time a whole battalion of the enemy by the rapidity of their firing. These repeating rifles are used for hunting on the Plains, and meet with much favor in foreign countries. American gun makers regard the famous Prussian needle gun as inferior in every respect to our best patterns.

PRIMEVAL CHEMISTRY---LECTURE BY PROFESSOR J. STERRY HUNT.

Reported for the Scientific American.

Professor Hunt, of Montreal, delivered the eighth lecture of the scientific course before the American Institute, on the evening of the 14th instant. Subject, Primeval Chemistry. Whatever may have been the opinions of his hearers in regard to the peculiar views of Professor Hunt, all will concede the singular ability with which he maintains them. The lecture, although from its subject, a dry and abstruse discussion might have been anticipated, proved, on the contrary, one of great popular interest, both on account of the order in which the points were arranged and the happy method of illustration employed by the speaker. We have only room for an abstract of the lecture, but we shall, as far as we can, give its leading features.

Upon his introduction to the audience by Judge Daly, Professor Hunt said:

MR. PRESIDENT, AND LADIES AND GENTLEMEN: You have already been informed that the subject of this evening's lecture is Primeval Chemistry—the chemistry of the earlier condition of the world's history---chemistry before there were chemists, before there was any eye, except the eye of the great All-seeing One, to investigate or to study His marvelous phenomena. As this has reference more especially to the history of this earth, it may be well spoken of as chemical geology, a term which has been very frequently applied. We speak of geology as if it were a science, but in reality under that name we include a whole group of sciences. In the first place, to the astronomer this world is one of a system revolving around our sun—the so-called solar system—and that so-called solar system is but one of many more such great systems, thus occupying a very insignificant position in the great cosmos. Thus our world appears to the astronomer. To the physicist, again, who studies it in relation to the laws of gravitation, with regard to the laws of light, it appears altogether in another light. Then comes the chemist, who examines the relations of its rocks, its waters, and its atmosphere. He has also his history of the globe. Then comes one who studies the changes in its crust, the movements which give rise to mountains, which cause all the geographical diversities of the earth's surface. This has been discussed before you by my distinguished predecessor, Professor Hall. Later, comes a period in the history of the planet, in which life appears upon the surface, animal and vegetable. Already Dr. Dawson has explained to you the laws which govern the evolution of vegetable life, how during successive periods, successive creatures, flora after flora, each more beautiful and more perfect than its predecessor, appeared upon the surface of the planet. Then again comes the zoologist, who investigates the various forms of animal life. All these studies, beautiful and important as they are, are mere branches of that great complex study which we call geology. Professor Hunt said he would merely discuss the chemical relations of our globe, but he must to a certain extent go outside of our globe, because he must look at it from the astronomer's point of view. The chemist had to look to the rocks, the waters, and the air; but behind all these came in another question, whence was the origin of rocks, of water, and of air? There must have been a time when these were not, and the first question of the student was as to the origin of these things. It was the rare privilege of the scientific eye to look backward, to solve this problem, and to learn, as it were, the history of these pre-historic times. From the astronomer, who recognizes the fact that our globe is but one of many worlds, there comes in a strange and unexpected light to aid us, and physical science here contributes most curious stores of knowledge Speculating upon the origin of our earth, and seeing the curious harmony which existed between its motions and those of its satellites, and of the other planets that moved around the sun, the great Kant was induced to ascribe a unity of origin to all. Later, the idea was developed by La Place, who supposed that from a great nebulous cloud existing in space there was formed, in accordance with certain physical laws, successive planets, successive satellites, the sun finally remaining in the center; the result of the condensation of one immense cloud of vapor, for whose origin, still further back, we must only look to the great Author of existence, who created it, and imposed upon it the laws which, in after ages, regulated its development. This great nebulous cloud rested in this condition until Sir William Herschel, in studying the skies, examined certain masses of light which had before been known as certain cloudy, milky masses of white light. He viewed them with his great telescope, and was unable to resolve them. Here he said, "I have the origin of this cosmic matter; here I really see the stuff of