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 ych 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 t .ermometer, 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