John Goodricke, an English astronomer, who in 1782 determined the period of the variability of the famous star Algol, thought that Tycho's star might be the same as the new stars reported to have been seen in the years 945 and 1264. This would make the period of its variability between 300 and 320 years, and hence this star should re-appear in the latter part of the present century. Goodricke's conjecture seems to be very uncertain, since the reports for the years 945 and 1264 are extremely vague. It will be seen that if we assume the period of the variability of Tycho's star to be 315 years, five such periods would carry it back to near the beginning of the Christian era. Astrologers and others have not been slow to catch at such analogies, and to base predictions on these uncertain data; and thus we have it asserted that Tycho's star is identical with the star of Bethlehem, and that it will re-appear in the year 1887, with wars and social revolutions. Of course it is impossible to reply to such assertions. Wars and social revolutions are continually going on, and such grim predictions are as safe therefore, as it is to say, that to-morrow the winds will be variable, or that we shall have "rain in areas;" or snow next January. The only wonder is that intelligent people are imposed on by such assertions.

At the present time more than a hundred variable stars are known to astronomers, and every year increases their number. Many of their periods are well determined, but what causes the variations of light we do not know. The so-called new stars may be only extreme cases of the variable stars, and the appearance of one is an interesting astronomical phenomenon which should be carefully observed. There is a rich field for observation and for study.

A. HALL.

WASHINGTON, D.C., Nov. 29, 1880.

NEW YORK ACADEMY OF SCIENCE.

We direct special attention to the excellent course of lectures provided by the New York Academy of Sciences, to which non-members are admitted free, on making application to the proper authorities.

The lecture for Monday next, December 6th, will be delivered by Professor W. Boyd Dawkins, F. R. S., of Owens College, Manchester, England, the subject being "The Man of the Caves."

We understand the present will be the only opportunity for hearing Professor Dawkins lecture in this country on a subject on which he is a specialist. We anticipate a large attendance.

The present efforts of the executive of the New York Academy of Science, under the presidency of Professor Newberry, to provide a course of free lectures of the highest order, should be fully recognized by all interested in Science and we advise those who would avail themselves of the opportunity to address Professor D. S. Martin, of 235 West Fourth street; or Professors W. P. Trowbridge and Alexis A. Julien, both of Columbia College, N. Y., as these gentlemen constitute the Committee on Lectures.

HISTORICAL NOTES ON GAS ILLUMINATION.

At the present moment when the public is all impatience to see the electric light perfected for general illuminating purposes, it may be interesting to note a few particulars descriptive of the early days of gas, when it struggled into existence for the same purposes.

In looking over a few somewhat ancient scientific papers I found much relating to the subject, and will now reproduce these historical facts in the order in which I found them.

It appears that in the British Museum there is preserved a paper (Ascough's Cat. 4437), entitled "Experiments Concerning the Spirit of Coals, in a Letter to the Hon. Mr. Boyle, by the late Rev. James Clayton, D.D., *B. Mus.*" These experiments were undertaken by him in consequence of his having observed that the gas, issuing from certain fissures near a coal pit at Wigan, in Lancashire, took fire when a burning candle was presented to it. He therefore distilled coal, and obtained first "phlegm," afterwards a black oil, and then "an inflammable spirit," which he collected in bladders. By pricking these bladders he was able to ignite the gas at pleasure. Hence it is evident that the discovery of the carburetted hydrogen gas took place previous to the year 1664.

So states a paper, No. 66, in the *Philosophical Journal*, by Mr. John Webster, "*On the Discovery of the Inflammable Gas from Coals*;" the date of the paper is not before me, but its republication, in the form I found it, was in 1807.

In the *Phil. Jour.*, No. 67, the subject is again mooted by a Mr. Hume, who states that in the forty-first volume of the Philosophical Transactions, p. 59, is a "sheet-paper," which appears to have been read before the Royal Society in January, 1739, as "A Letter to the Hon. Robert Boyle, from the late Rev. John Clayton, D.D., in which is described how the discovery originated, and also some of the effects produced by this gas or 'spirit' of coal."

Mr. Hume further draws attention to the difference in the Christian names given to Mr. Clayton, in the first instance "James" and the second "John," and draws the very probable conclusion that the same person is referred to in both papers, and states, "At any rate, the merit of this discovery can be no longer claimed by any living person."

This remark was called forth on account of the public papers of that day, 1808, being much taken up with the proposal of a Mr. Winsor to light cities with gas. It appears that Mr. Edward Heard also obtained a patent in June, 1806, for "Obtaining inflammable gas from pit coal, in such a state that it may be burned without producing any offensive smell."

There was money in this patent, for Mr. Winsor was organizing a large company, which was not to buy the patent, but to pay a royalty as a license for the exclusive right to make use of it. As usual in such cases there was a great outcry, and the attempt was made to break down the patent by asserting that the invention was not new, one Nicholson taking the ground that the patent was invalid, because the inflammable nature of coal gas was demonstrated by "Boyle" before 1691; and he further stated that Lord Dundonald used gas from coal to give light many years ago, and that a Mr. Murdock also put it in practice upon a large scale in 1792 and 1798, so that it was absurd for Mr. Winsor to claim the invention for the public use of gas.

To parry these attacks Mr. Winsor published a small pamphlet, and boldly asserted that it was true that the inflammability of coal gas had been long known, but that no one *had purified gas*, and thus made it fit for general illuminating purposes, until he took out his patent in 1804. He also accused others, who were in the field, of having obtained their knowledge from him.

Mr. Winsor had to contend against other difficulties; for, at that date, the statute law of the realm prohibited more than five persons holding a patent as joint property, and it was held that as the shareholders of the proposed company would share the profits, they would be joint holders of the patent. To this Mr. Winsor replied that he retained the patent himself and merely sold the right to use it. To show the poor prospects for gas illumina-

tion entertained in those days, the remark of the editor who published these papers is significant, for he says he "regards the whole scheme as a bubble."

The next paper before me "On the Application of the Gas from Coal to Economical Purposes," by Mr. William Murdock—*Phil. Trans.*, 1808, shows the question to have advanced to the stage when a large building had been illuminated by gas; this building was the cotton manufactory of Phillips and Lee, of Manchester, England, the whole of which, together with the dwelling house of Mr. Lee, was lighted with gas.

This was thought, at the time, to be a great feat, and shows by what slow degrees the process of gas illumination was developed; the idea of a central manufactory of gas, and that of carrying it by pipes throughout a district, never entered the minds of the most advanced advocates of the system, but that each house or establishment should manufacture its own gas and use it, was considered the perfection of gas lighting.

Mr. Lee distilled the coal in large iron retorts, and the gas was conveyed into large gasometers, where it was washed and purified, and then conveyed to the burners. There were 271 burners on the principle of the Argand lamp, each of which gave a light, as measured by means of shadows, equal to four mould-candles of six to the pound; and 633 burners, called cockspurs, having three apertures only of 1-30th of an inch, and of which the light was equal to two and a quarter of the same candles; so that the whole of the lights were equal to 2,500 candles of that size, each of which consumed 4-10ths of an ounce, or 175 grains of tallow in an hour. Mr. Murdoch continues, "the quantity of gas required by this number of burners was 1250 cubic feet in an hour. In some mills where the work is light, the average time required will be three hours, but in this manufactory the yearly averages is two hours a day, or 2,500 cubic feet of gas. This quantity of gas required the distillation of 7 cwt. of cannel coal." The expense of the lights used in this manufactory may therefore be stated thus:

Cost of 110 tons of best Wigan cannel, at 22s. 6d. is	£123
Cost of 40 tons of common coals to heat the retort at 10s. is	20
	£143
Interest on capital, and wear and tear of apparatus	550
Attendance, the same as when candles are used, therefore need not be stated	0
	£693
Deduct value of 70 tons of coke. £93	
Value of 1250 ale gallons of tar not yet sold 0	£93
	£600

"The expense of candles to give the same light would be, at 1s. per lb., nearly £2,000. The light is peculiarly soft and clear, and of almost unvarying intensity, so as to be very pleasant to the workmen. It is also free from the danger of spark."

This will give an idea of the method of making comparative calculations then used to determine the merits of gas as against the use of candles. The editorial remarks on this paper, might, if the word gas be substituted for electricity, be taken for one of the criticisms so lately in fashion, and now a little obsolete.

"The present paper furnishes the necessary data for calculating the quantity of coals that would be required to yield a light equal to that of a given number of candles; and it affords an easy means of investigating the economical advantages of this process, which seems well adapted to the illumination of public buildings, large manufactories, and generally speaking, all establishments where a great number of lights are required; but we fear the *expense of the apparatus will always be against its introduction in domestic establishments* on a small, or even middling scale."

The last paper I notice is "*On the Advantage* of Employing Coal-gas for Lighting Small Manufactories, and for Other Purposes," by Mr. B. Cook, *Philosophical Journal*, No. 94.

Mr. Cook in this paper drew attention to the increased price of tallow, on account of the "rupture with Russia," so that the advantage of using coal-gas becomes evident. It is true, he says, that coal itself might increase in value, but, as he suggests, it might lead to an increased search and greater production.

Mr. Murdock explains the method of making gas for large manufactories, and Mr. Cook in his paper describes his plan for making gas for dwelling houses. "Such an apparatus," he says, "should be an 8 gallon iron pot, with a cover of the same metal luted on with sand. About 20 to 25 pounds of coal are put into the pot, and distilled, which requires the combustion of about 25 pounds more of coals. The quantity of gas varies with the quality of the coals, it is passed through water into the reservoir, which only holds about 400 gallons, but in general more is produced; so that the overplus, perhaps 200 gallons, is wasted. From the reservoir the gas is conveyed round the house by means of old gun barrels, used as tubes, and coated once a year, or seldomer, with the produced tar.

"The gas flame is found superior to that of a lamp for soldering with the blow-pipe. The moment the stop-cock is turned on, the frame is ready for use, while with oil or cotton wick, the workmen are forced to wait until the lamp is sufficiently on fire."

The expense of this apparatus was £50, but he thought others could be put up for £40.

In regard to the light produced, Mr. Cook offers the following facts: "The lights employed in the manufactory are 18 or 20, equal to eighteen shillings a week for candles, for 20 weeks, which amounts to £18. It used to cost £30 a year for oil and cotton for the soldering lamps; and the coke is certainly worth £2, 10*s.* a year, so that, setting the tar against any little accident that may happen, the whole produce may be taken at £50. 10*s.* a year.'

Supposing 50 lbs. of coal are used daily, the weekly expenditure on that head will be 2 shillings, and allowing part of a man's time to attend to making the gas to be worth 5 shillings, the whole will be 7 shillings per week or £18, 4 shillings a year; this however is one fourth more than it ought to be, because for 25 to 30 weeks the gas will not be required for lights. And adding to this expense £2 a year for interest on the cost of the apparatus, there will remain a saving of £30. 6s. in the year.

For a family using only six candles and one lamp, a gas apparatus would cost from £10 to £12, the cost of which will be saved during the first year.

The critical remark of the editor of this paper is truly amusing, for, by a train of reasonining, he states that he is compelled to oppose the introduction of gas, because *it will raise the price of butchers' meat.* The editor argues that if gas supersedes candles, the price of tallow will fall; therefore, as the fat of animals will be reduced in value, butchers will have to charge a higher price for the leaner portion of the meat, so as to realize the value of the beasts. "*Therefore, as food is of more consequence than artificial light, it is rather to be depreciated.*"

A year later Mr. Cook read a second paper "On the Advantages of Coal Gas Light" (*Phil. Trans.* 98), which shows that the methods of preparing the gas was very imperfect, and an unpleasant oder was given off when it was used. In regard to this, Mr. Cook says, in reference to this objection that the smell occasioned by the gas is injurious to health, and that "it rather tends to preserve

health by destroying contagion, *and purifying the air*."

This absurd statement appeared to give satisfaction to the editor, who in his observations on the paper states: "Information of this kind has long been wanted, and those who have made the greatest bustle on the wonderful advantages attending the use of the gas light have, in this respect, been deficient." Possibly public opinion was leaning towards the introduction of gas, for the same editor, who in 1809 observed, on Mr. Murdock's paper, that "the expense of the apparatus will always be against its introduction on a small or middling scale," now observes, in 1810, "The statement of Mr. Cook clearly proves the great advantages connected with those lights, *even on a small scale*."

It is not intended that the foregoing represents the history of the introduction of gas for illuminating purposes, but it gives phases of the question which are of interest at this moment, and shows that, as in the introduction of the electric light for the same purpose, its development was very gradual. It will be seen that the economy of both gas and electricity for lighting purposes was at first disputed, both were afterwards considered only adapted for large buildings, then came the time when each was shown to be fitted for domestic purposes. The introduction of gas was considered "*a bubble*," and when all other objections had been exhausted, scientific testimony of that day finally stated that gas lighting would raise the price of beef. When gas lighting was first introduced, the idea of a great central manufactory for a city was not even dreamed of; possibly at that time the mere suggestion of such a design would have caused a panic; but that it was successfully accomplished we all know. Gas was also first used for lighting large buildings, but it required the genius of one man to invent a process for its purification, so as to make it practical for general illuminating purposes.

The reader, with a knowledge of recent events, can easily compare them with the facts here recorded respecting the early days of gas, and notice how history has again repeated itself.

First the possibility of using the electric light for general illuminating purposes was denied, then its adaptability for large buildings was admitted, and now finally its use for domestic purposes is unquestioned.

The economy of electric lighting was also assailed, but the arguments are now getting stale. As each consumer had at first to make his own gas, so the first idea of electric lighting was coupled with the necessity on the part of each consumer to own his own electric generator and it was reserved for Edison to reform the whole system, and put it on a practical footing. He first publicly exhibited an electric lamp, that could compete with gas, and that was adapted for the general illumination of houses by electricity; he first subdivided the electric current, and thus demonstrated that its economic use was a possibility, and he will be the first to achieve the final triumph of establishing a central station for the manufacture of electricity and conducting it to the houses of the people.

Capitalists combining with scientific experts and patent pirates may endeavor to strip Edison of the honors due to him, earned by patient and exhaustive study of the question. That the electric light would eventually supersede gas for general illuminating purposes, no one doubted, but that Edison by bringing to bear upon it his great inventive powers, combined with almost unlimited resources, has advanced the time for accomplishing the result by at least fifty years, will be admitted by all unprejudiced persons. J. M.

THE DISTRIBUTION OF TIME.

By Professor Leonard Waldo.

From time to time within the last twenty years there have appeared articles in the public prints which indicated an awakening and growing interest in the practicability of having wide sections of our country transact its business and govern its social duties by a common time. Within the last few years official reports from various observatories, departments of the Government, scientific societies and telegraph companies, have shown so considerable a progress in the introduction of uniform systems of time, and these systems have been so cordially received by the communities interested, that there can be no doubt that the country is ready to be divided into a few great sections, each of which shall be governed by its own standard, which shall bear some simple relation to the standards governing the neighboring sections.

The principal systems now in operation comprise the United States Naval Observatory system, which extends its distribution of Washington time to Chicago and the West; the Harvard and Yale systems, which distribute, respectively, Boston and New York time over New England; the Alleghany Observatory system, which is concerned chiefly with the Pennsylvania Railroad; and the more local services emanating from the observatories at Albany, Chicago, Cincinnati, and St. Louis. Unfortunately, except in New England, the distribution of the time of an observatory has not always resulted in the adoption of that time for general use, and it is often the case that the local jewelers who are guardians of town clocks, and local time as well, will convert the time received by telegraph into their own local time, and thus make it inconveniently different from the time in use in any other city of their region.

A railroad may or may not secure the adoption of its own time in the cities along its route. It is generally a question as to which is the most important, the railroad or the town. But certain it is that there is not an important railroad in the country, outside of New England, along which the commercial traveler may go without having to compute the discrepancy between his watch and the time kept by the business men at one-half of the stopping-places. Thus it happens that, even where cities are closely connected by large railroads, the people have been dictated to by their jewelers regarding their standard of time, when a little reflection shows that there is only a very questionable advantage arising from having a local time simply because the jewelers of the city insist on a time which shall appeal to the local pride of their customers.

On the other hand, the disadvantage of having the factory operatives begin work on railroad time and stop on local time, because they gain ten minutes a day by that sharp practice; the jostle and inconvenience in the commercial interchange between two neighboring cities, because the stock exchanges, business offices and the banks, close with a difference of ten minutes; the thousand engagements broken by the discrepancies of time—all indicate the need of the adoption of such a common time as already exists in the European countries.

The writer has always felt that the railroads ought to be the most influential means in securing uniformity. They can be successfully appealed to for the financial support which any accurate system demands, because they have a direct and strong interest in the use of the same time at every office and by every employee of their roads. The superintendents, too, with whom the decision of such matters generally rests, are keenly alive to anything which lessens the risk of accident, and they at once appreciate the advantage of having the clocks of intersecting roads, and of the towns through which their roads pass, all indicate the same time. The control of a telegraph wire for railroad business gives them the means of transmitting time-signals, and in New England it is the railroads which have virtually caused the all but universal acceptance of the Boston and New York standards referred to. Outside of New England there has been scarcely any concert of action among the railroads, and there are about seventy different standards of time in use. The result of the experiment in New England fairly just-