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NEW YORK, SATURDAY, MAY 31, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

FIREPROOF MAIL CARS

The Editor has received from a California correspondent a clipping from a recent Washington, D. C., paper, which states the Post Office Department has been informed that in a recent railroad wreck in Arizona, the entire mail, which came from southern and central Californian points, was destroyed. Our correspondent reminds us that on several occasions in recent years the heavy overland mail from the Pacific Coast on its way eastward was entirely destroyed by fire. He asks whether we are not very much behind the times in the matter of the safe transportation of the United States mail, and whether the postal cars, on the overland routes at least, should not be made of steel, or constructed by some method that will be fire and collision-proof.

We think that the point is well made, and that the postal authorities would be justified in offering inducements to the various railroads, and particularly to the transcontinental systems, to improve on the present mail cars along the lines suggested by our correspondent. Such an inducement might reasonably take the form of a slightly higher mail subsidy where such cars are used. As to what form of car would afford the most complete protection against injury by collision and subsequent fire, we have little doubt that an all-steel construction would be better than an attempt to secure fire protection by the use of any so-called fireproofed wood. A mail car with the floor and framing built up of channel-iron and angles, and with sides and roof of sheet steel, would not only be proof against absolute loss by collision, but would of course be completely fireproof. If practical evidence be needed upon this point, we have but to refer to the many photographs which have been published in the last few years showing the extraordinary resisting qualities of pressed-steel cars, when they are subjected to the terrific impacts of colliding freight trains. They retain their general form, and frequently come out of such collisions practically uninjured, while the wooden cars adjoining them have been smashed into the proverbial kindling wood. The effects of collision upon the cars of a passenger train are, of course, nothing like as heavy as those in a freight train weighing three or four times as much; and we venture to say that all-steel mail cars would pass through a collision and preserve their contents practically intact. We commend the suggestion of our western correspondent to the serious consideration of the postal authorities.

EARLY USE OF THE WATER-TUBE LOCOMOTIVE BOILER.

The increased attention that is just now being directed to the water-tube boiler for locomotive service is a significant fact in the development of locomotive engineering. We recently illustrated in the SCIENTIFIC AMERICAN a very successful type, which is now in service on the Southwestern Railway, England; and we have reason to believe that before long there will be other attempts, both in this country and in England, to secure in locomotive service the superior advantages which the water-tube boiler has shown itself to possess for certain classes of work at sea and in stationary practice. Those of our readers who believe that the water-tube boiler locomotive is an entirely modern improvement, will be surprised to know that in the early days of steam railroads and, indeed, only a little less than a half a century ago, the Dimpfel locomotive was built with a boiler which was strictly of the water-tube type, and that this boiler gave most excellent results both in firing and steaming. The boiler contained a square firebox and a single, horizontal flue. A large number of small-diameter iron tubes led down through the crown sheet of the firebox, and were curved around to pass horizontally through the flue. The engine steamed remarkably well, the circulation being very thorough; moreover, the combustion was more perfect than with many modern fire-tube boilers, the large amount of air space between the flues allowing a perfect combustion of the gases. Although its firing and steaming qualities were so good, the boiler was not a practical one, for the reason that to get out a defective tube that might be in the center of the nest, it was necessary to tear the whole system of tubes to pieces.

In a later attempt to design a water-tube locomotive boiler in this country, the main central flue through the barrel was made hexagonal in cross section, and the tubes ran athwart the flue between opposite faces. This also proved to be an excellent steamer, but like its predecessor, was exceedingly troublesome in repairs, it being necessary, if a defective tube had to be repaired, either to remove the main flue altogether, or drill through the outer shell of the boiler, remove the tube and plug up the hole. The invariably excellent results obtained with the water-tube system should stimulate engineers to give persistent attention to this problem until a thoroughly practical boiler of this type has been produced.

DANGERS OF PEDDLED ICE CREAM.

The ice cream season is at hand, and the street vendor is doing a thriving business among school children and street urchins. Few people realize what a menace to health is found in the sale of this delicacy. Medical authorities are beginning to realize that it is an important factor in the spread of disease. A number of cases have recently been observed in which symptoms of irritant poisoning and even death were the result of eating ice cream bought of street peddlers. A coroner's inquest held in London not long ago attributed the death of a six-year-old boy to unwholesome ice cream. The British Medical Journal in an article on this case recalls a bacteriological investigation of Dr. Klein's, in which some ice cream and the water used for rinsing the glasses containing it were found to be swarming with thousands of microorganisms. The article refers also to a recent case of poisoning in Antwerp, where twenty persons were made ill from the use of ice cream, and it goes on to describe the causes of the danger. Contamination of the cream arises from the habitual filthiness of the Italian vendors. The commonest and stalest materials are used in its manufacture, and at night it is usually stored under the merchant's bed in his dirty tenement lodgings. The next morning, no matter how far gone in decomposition the unsold cream may be, it is rehashed and frozen for the day's business. The public at large seems to have the impression that bacteria are destroyed by the freezing process. This is not, however, the case, for the activity of the bacteria is only temporarily retarded by the cold, and during the nightly respite they thrive vigorously. In addition to all this, every opportunity is afforded for transference of diseases between the customers, for the glasses and spoons are never washed, but are merely rinsed in water that accumulates the filth of the entire day.

THE EXPANSION OF OUR FOREIGN COMMERCE.

In the course of an address recently delivered by the Chief of the Bureau of Statistics, before the Manufacturers' Club of Philadelphia, Mr. Austin gave a very luminous explanation of the causes and extent of the expansion of our foreign trade, an expansion which in suddenness and magnitude has never been approached in the history of any other country. This phenomenal growth is the natural consequence of the rapid expansion of production which followed the great development in railway construction in the closing quarter of the nineteenth century. Following the construction of the transcontinental line which was completed in 1869, came the extension of other lines through the great Mississippi Valley and the South, and this resulted in the opening of the great agricultural, forest and mineral areas, whose natural supplies have made this the greatest producing country of the world; while the multiplication of railways facilitated the assembling of these natural products for use in manufacturing. As a result, agricultural production has doubled, while the output of coal, pig iron, and particularly of steel, has increased many fold. The result of all this is that the United States has become the greatest exporting nation in the world, having risen from fourth place in 1870 to first place in 1901. The value of our exports during that time has practically quadrupled, while imports have scarcely doubled.

The causes of this wonderful development in exports, in Mr. Austin's opinion, are to be found in the fact that the United States is the world's largest producer of the great articles required by man for his daily life, viz., food, clothing, heat, light, and manufactures. The principal articles of food are breadstuffs and meat, and of wheat and meat the United States produces more than any other country, while we raise more corn than all other countries combined. For clothing the article of largest requirement is cotton, and of this the United States produces more than three-fourths of the world's supply. For heat, coal is the greatest requirement, and of this the United States is now the world's largest producer, and our supply exceeds that of any other country; while for light our production of petroleum furnishes a larger quantity of refined illuminating oil than that of any other nation. Our manufactures also are nearly double those of the United Kingdom, and nearly equal to those of France, Germany and Russia combined.

This commanding position in the world's commerce is, in Mr. Austin's opinion, likely to be retained by the United States. The power of production shows no signs of abatement, while we may reasonably expect that the development of science and invention and the application of American energy will still further reduce the cost of production and transportation. This high standing of the United States as an exporting nation will, Mr. Austin said, be welcomed by the commercial world rather than antagonized, as has been intimated and feared in certain quarters. The world buys the products of our fields and factories because it requires them for daily use, and because it can obtain them more readily and cheaply from the United States than from any other part of the world. Suggestions of the exclusion of American products of the field or factory seem scarcely likely, in Mr. Austin's opinion, to be realized. The effect of the refusal of Europe to purchase from the United States any of the great articles of which we furnish so large a proportion of the world's supply would be to cause an advance in the price of those articles in other parts of the world. The United States supplies one-fifth of the wheat entering into international commerce, three-fourths of the cotton, and practically all of the corn; while our proportion in the meat supplies of Europe is also large. To thus eliminate our production from the world's supply of these great articles of daily requirement would be to cause an advance in the prices of the limited supplies which could be obtained from other parts of the world. Hence, in these natural products, it may be expected that the demand will continue indefinitely, while the fact that the United States in 1901 sold to Europe alone more manufactures than she had ever sold to the entire world in any year prior to 1895 shows the progress that American manufacturers are making in Europe, the great manufacturing center of the world.

THE IMPERFECT DEFINITION OF THE PHOTOGRAPHIC IMAGE ON DRY PLATES.

Messrs. Lumiere and Perrigot have been studying the question of obtaining the maximum degree of sharpness in photographic images. When examined by the microscope, the optical image given by a good objective is found to be incomparably sharper than that of the negative which is obtained under the same conditions. In fact the photographic plate registers an image which seems sufficiently sharp when viewed by the eye alone, but cannot support an enlargement by the microscope. In examining the causes of this lack of sharpness, the experimenters were led to find a method for obtaining negatives under the best conditions. One of the principal causes is the influence of grain in the sensitive film. It is well known that the bromide of silver in the emulsion is in the form of small grains whose dimension varies with the sensitiveness of the emulsion. They made a series of exposures using plates which were prepared by a series of emulsions of very different sensitiveness from the extra-rapid, corresponding to the grains of silver bromide of the maximum dimensions, to the limit of slowness, which is found in the special emulsion used in the Lippmann process of color photography and in which no grains are visible under the microscope, even with the greatest magnifying power. They thus find that it is the granulation of the sensitive layer which is the main cause of the want of precision in the images; the particles of bromide diffuse the light which falls upon them, spreading out the image and diminishing its sharpness in greater proportion as the particles are larger.

Another cause lies in the errors of focusing, even though these may be small. In an ordinary apparatus only an approximate focus is obtained. The use of a simple hand-glass to examine the image, the non-coincidence of the ground glass and the plate, also the want of flatness in the latter are causes which influence the focus. The experimenters fix the limit of movement for obtaining a clear image, and find it to be 1-100th of an inch. The influence of chromatic aberration may be found in the case of inferior objectives which have not been sufficiently corrected, but for the best lenses this is practically nil. Another cause lies in the use of the diaphragm. While in astronomical work and for the opposite extreme, microscopical work, it is desired to increase the opening of the objective, in photography, on the contrary, it is generally admitted that greater precision is obtained by the use of the diaphragm. The experimenters show that this is not always the case. The

diaphragm increases, in fact, the general sharpness of the images by correcting certain aberrations and especially by increasing the depth of focus, but if the central part of the image is considered, and admitting that the objective is already sufficiently corrected for aberrations, it is found upon enlarging the image considerably that its precision is greater as the opening of the objective is larger. The experiments show, in general, that when it is desired to obtain an image of great precision which may be considerably enlarged it becomes necessary to use plates which have no appreciable grain, such as those of the Lippmann process, to use the best possible arrangement for obtaining the focus, also to be assured of the value of the objective, especially as to the corrections of aberrations, and when a chemical focus is found, to allow for this. If the aberrations are sufficiently corrected in the lens, the maximum opening should be used.

THE HEAVENS IN JUNE.

BY HENRY NORRIS RUSSELL, PH D.

The finest region of the sky which is now visible is that near the eastern horizon. It contains the brightest part of the Milky Way, which is here divided into two parallel streams, and diversified with many knots and patches of unusual brightness. At our usual hour of 9 P. M. on June 15 it is well clear of the horizon. Along its course lie a number of conspicuous constellations—Cygnus in the northeast, Aquila south of it, and Scorpio low in the southeast, not yet completely risen. Lyra and Hercules are higher up in the east, and Ophiuchus fills most of the southeastern sky. Corona Borealis and Boötes are overhead. Virgo is the most conspicuous constellation in the southwest, Leo in the west, and Ursa Major in the northwest. Gemini and Auriga are just disappearing. Draco and Ursa Minor are above the Pole, and Cassiopeia below it.

THE PLANETS.

Mercury is evening star at the beginning of the month, and sets about an hour and a half later than the sun. He should be easily visible after sunset, just below the bright stars Castor and Pollux. As he comes into line between us and the sun he disappears from the evening skies. On the 23d he passes through his inferior conjunction, and early next month he will reappear as a morning star.

Venus is morning star in Aries and Taurus, rising more than two hours before sunrise.

Mars is morning star in Taurus. At the end of the month he rises an hour and a half before the sun, and may again be seen.

Jupiter is in Capricornus, rising before midnight, on the 1st, and at about 9:30 P. M. on the 30th.

Saturn is on the boundary of Sagittarius and Capricornus, rising rather more than an hour before Jupiter.

Uranus is in opposition on the 10th, and at his nearest for the year. At this time he is in right ascension 17 h. 13 m. and declination 23 deg. 6 min. south. He may be identified with the aid of a star map. Those without such help may find him by means of Theta Ophiuchi—a third-magnitude star about half way between the head of Scorpio and the Milk Dipper in Sagittarius.

Uranus is about 2 deg. north, and a little west of this star, and should be directly above it at about 10 P. M. The planet's pronounced greenish color will aid in identifying him; but the only sure test is his motion. By comparing two sketches, made a week or so apart, of the stars visible with an opera glass in this region, the planet can be certainly identified. On account of his low altitude, he is barely visible to the naked eye.

Neptune is invisible, being in conjunction with the sun on the 23d.

The asteroid Vesta, the brightest of the more than 400 planets of this group, comes to opposition early in July, under unusually favorable circumstances, being just visible to the naked eye.

We defer fuller comment till next month, only noting that on June 26 the small planet passes just south of Saturn, being but half a degree distant, and can easily be picked up with a field-glass. It is moving toward the bowl of the Milk Dipper, at the rate of a degree in four days.

At four o'clock on the morning of June 22, the sun enters the sign of Cancer, and, in the language of the almanacs, "Summer commences." But at this time the sun is in the constellation of Gemini, and he will not enter that of Cancer for a full month to come. Here is a great discrepancy, which demands explanation. How does it happen that the signs of the zodiac, while bearing the names of the constellation, do not agree with them in position?

The fact is, that, when the signs of the zodiac were named, they coincided with their respective constellations; but, during the 2,000 years that have passed since then, the signs have moved, while the stars have stood still, so that they no longer agree.

The signs of the zodiac have their positions fixed by the equinoxes—the intersections of the ecliptic with the celestial equator. The ecliptic moves but little among the stars, but the equator shifts its position in such a way that the equinoxes, carrying the signs of the zodiac with them, travel entirely round the ecliptic in a little over 25,000 years.

During the last 2,000 years they have moved westward about 30 deg., so that each sign has "backed" into the constellation which originally preceded it.

Partly on account of the resultant confusion, the signs of the zodiac are no longer used in astronomical calculations. Their appearance in the almanacs in the present connection is the last survival of a method of reckoning better adapted to the days of astrology than to the present time.

This change in the position of the equinoxes is called precession. It is due to the attraction of the sun and moon on the bulging equatorial regions of the earth—which, it is well known, is not exactly spherical. This action combined with the earth's rotation, causes its axis to move, in very much the same way that gravity, acting on a spinning top, causes its axis to revolve about a vertical line, instead of making it fall over.

THE MOON.

New moon occurs on the morning of the 6th, first quarter on the afternoon of the 12th, full moon on the evening of the 20th, and last quarter on the afternoon of the 28th. The moon is nearest us on the 5th, and farthest away on the 18th.

She is in conjunction with Venus on the 3d, with Mars on the 4th, with Neptune and Mercury on the 7th, with Uranus on the 20th, with Saturn on the 23d, and with Jupiter on the 24th.

INSPECTION OF GAS METERS.

BY ALTON D. ADAMS.

Illuminating gas manufactured in the United States during 1900 had a value of $69,432,582, according to the Federal Census of that year. Substantially all of the gas valued at this great sum was measured out to consumers through meters. These facts are sufficient to show that accuracy in gas meters is highly important to the public at large.

The office of a gas meter is to automatically record on its dials the number of cubic feet of gas that pass through it. After such a record is made by a meter the consumer is liable to pay accordingly, unless it can be demonstrated that the operation of the meter is inaccurate.

To guard the interests of consumers Massachusetts has for many years required that all meters, through which gas is to be supplied to customers of public systems, be tested and sealed by the State Inspector of Gas before they are put into use. Moreover, any consumer of gas from the public supply may apply to the State inspector to test the meter through which his gas passes. A meter is considered correct under the law if it registers within two per cent of the actual number of cubic feet of gas passing through it. Meters are owned by the gas companies, and they are subject to fine if they supply any meter for the use of consumers that does not have the seal of the State inspector. Meters are liable to get out of order, however, though once correct, and any company is at liberty to reinspect its meters as often as it thinks proper. If a meter tested by the State inspector at the request of a consumer proves to be correct within two per cent, the cost of inspection, amounting to about one dollar, exclusive of transportation charges, is collected from the customer. If the meter is not correct the gas company owning it must pay all charges.

Under these regulations all of the new or repaired meters put into service by the gas companies each year are first submitted to the State inspector for his test and seal. The numbers of new and repaired meters thus tested before being put into use increased from 13,412 in 1889 to 27,451 in 1895 and 35,319 in 1901. When any of the new or repaired meters are found to be incorrect they are returned to the companies that presented them, and must be changed and resubmitted for test before they are used. The rising numbers of these tests serve to illustrate the importance of the work in which the State inspector is engaged.

Besides the meters just considered, the State inspector tests many other meters every year that are complained of as being inaccurate while in use. Records of such meters are here presented for each decade, beginning with that of 1872:

Year	Meters Tested	Meters Fast	Meters Slow	Average Per cent Fast	Average Per cent Slow
1872	202	87	32	4.80	9.55
1881	141	41	28	5.68	6.44
1891	230	52	34	4.74	10.08
1901	943	456	71	4.76	7.89

As the law only requires a meter to be correct within two per cent, all of the meters recorded as fast or slow were wrong by more than that amount. A meter is said to be fast when it records more gas than passes through it. A slow meter does not record all of the gas that passes through it. The per cent fast or slow as given is the average of all the meters that were fast or slow by more than two per cent in each year.

The number of meters tested after complaints has greatly increased since 1890, being more than four times as great in 1901 as it was in 1891. The per cent of fast meters to the total number tested in each year has also materially risen during the period. In 1891 this percentage was only 22.6, but for 1901 it stood at 48.3. The ratio of slow meters to the total tested on complaint has changed at a less rapid rate. For 1891 this percentage was 14.7, but in 1901 it dropped to 7.6. During the entire period since 1872 the average percentage of error for meters fast by more than the legal limit has been between four and six. For the same years the percentage of error in meters slow by more than the legal limit has been as low as 5.02 and as high as 23.60, but shows no permanent tendency to either increase or decrease.

During the eleven years of 1891 to 1901 inclusive 6,913 meters were tested as the result of complaints. Of this total number tested, 3,500 meters, or 50.6 per cent, were correct within the legal limit, 2,680 meters, or 38.7 per cent, were fast, and 660 meters, or 9.5 per cent, were slow. Seventy meters, or about one per cent of the total number, did not register any of the gas passing through them, and seven meters would not allow any gas to pass. One meter varied on test from four per cent fast to eighteen per cent slow. From this it appears that the number of fast meters was four times that of slow meters.

The average percentages by which meters are fast or slow have been taken from the official records, but it seems clear that the percentages for slow meters have been computed on an incorrect basis, or at least in a way liable to mislead. The actual amount of gas passing through a meter should be taken as 100 per cent in every case. If this is done the meter may be fast by any percentage, but it can never be more than 100 per cent slow. In the official record the amount of gas actually passing through the meter seems to have been taken at 100 per cent for fast meters. For slow meters, however, the record of the meter dials seems to have been taken at 100 per cent, and the actual amount of gas passing the meter divided by the slow dial record. On this plan, if a meter registers only one-half of the gas passing through it, the meter is said to be 100 per cent slow, when it is actually only 50 per cent slow. This method no doubt explains the higher figures of percentages given for slow than for fast meters, also the cases where meters are said to be more than 100 per cent slow, which follow:

From 1893 to 1901 inclusive the total number of slow meters tested on complaint was 577. Of this number 163 meters were between 2 and 5 per cent, 276 meters between 5 and 10 per cent, and 57 meters between 10 and 15 per cent slow. The percentages for the remaining slow meters range from 16 to 237, as given in the official reports, 7 being above 100.

During the same period, from 1893 to 1901, the number of meters complained of that proved to be faster than the legal limit on test was 2,521. Of these meters, 1,599 were between 2 and 5 per cent fast, 798 were between 5 and 10 per cent fast, 97 were between 10 and 15 per cent, and 19 between 15 and 20 per cent. Two meters were 20, three were 22, one was 27, one was 23, and one meter was 36 per cent fast.

It should be held in mind that all of these meters were tested by the State inspector before they were put into use, but subsequently grew inaccurate. What the conditions of meters may be in States where they are put into service without official test, and where there is no public inspector to whom consumers can appeal, may be surmised but cannot be stated.

British trade, which has been somewhat on the decline for some time past, is now showing a sharp revival. The trade returns for the year 1901 show tremendous drops in the imports of certain raw materials for manufacture, aggregating some $35,000,000. Especially is this the case in connection with gutta percha, the imports of which have declined about 40 per cent. The imports of raw materials for textile manufacture, however, on the other hand, show an increase of $10,000,000. In the shoe trade there has been a great increase in exports to British South Africa, due to the military demands. Elsewhere there has been a decline. Foreign imports of boots and shoes, however, have risen in the year from $3,473,490 to $4,694,565. The returns do not show the separate countries from which the imports have come, but doubtless this country has supplied the largest share. With regard to the exports, the construction of ships for foreign countries was abnormally heavy. Healthy advances were also shown in the manufacturing of yarns and textile fabrics for abroad. The foreign demand for apparel and articles of personal use showed a decided increase. British railroad material is again in nearly as good demand as two years ago. The value of British locomotives sold abroad is steadily rising, and the demand for English telegraph wire has grown by leaps and bounds, having increased considerably over 100 per cent in two years.