so low a temperature as to lie quite flat in the finished product. The corrugated roller may be adjusted to give it any desired depth in the glass.

Sheets of wire glass six feet long, two feet wide and three-eighths of an inch thick have been rolled at the experimental plant in thirty-five seconds.

The American Wire Glass Co., of Tacony, Philadelphia, Pa., has been formed to exploit this invention. By the beginning of next year they expect to have in active operation their factory already alluded to, with a daily capacity of about 5,000 square feet of wire glass. The most improved appliances are to be used, so as to render the operations as nearly automatic as possible. Gas fuel will be used and the rollers will be heated by the same.

The new product has other uses than those mentioned. It is to some extent burglar proof. It is not known what is the heaviest wire which can be used, but it is obvious that glass several inches thick with one or two sheets of heavy steel wire gauze embedded in its center would be very resistent to any attacks by burglars. For pavement lights it is also applicable, as it has great weight-sustaining power. A heavy man can walk and jump on one of the sheets made in the experimental works. Last not least is its power of resisting projectiles. It can be made so that a pistol ball will not penetrate it, thus affording a material for windows and other lights which will be secure from all ordinary missiles.

Science in Medicine.

The recent address at St. George's, London, was delivered by Dr. Bowles, of Folkestone. The lecturer commenced by welcoming the new students, and urging them all to preserve the tradition that "a St. George's man is expected at all times and under all circumstances to be a gentleman." The apprenticeship system was announced to be dead—defeated by the rapid march of science. This led to the main subject of the address, "the application of physics to physic." It was pointed out that all changes occurring in physiological and pathological processes, formerly supposed to depend on that unknown quantity, "vital force," were really nothing more than the action of the recognized forces of nature on the organs and structures of the body. Coughing, sneezing, snoring, etc., were all shown to have immediate origin in physical conditions. Surgery is the proper application of the laws of physics; injured parts and broken limbs are kept at rest, dislocated parts are placed in their natural positions, redundancies are removed, and natural deficiencies often well supplied; crooked paths are made straight, and blocked and narrowed ones made patent; stiffened joints are made to move, crooked limbs put into shape, eyes are made to see that would not, and ears to hear that could not.

Surgery is a department of physics—a physical art. Medicine, formerly the region of the unknown and the happy hunting ground of quacks, is rapidly following in the same lines. The so-called practical man and the believer in dogmas and nostrums are rapidly giving way to minds trained in the laws of physics. Physiology, Medicine's forerunner and its handmaid, is steadily, step by step, and without prejudice, elucidating the ways and doings of animal life. By instruments of the most elaborate and delicate nature, by patient and continuous observation, by anatomical and histological searchings, and by the application of the laws of gravitation, chemistry, heat, light and electricity, always by ways and means connected with physics, we are getting to understand better and more surely the movements and functions of respiration, of circulation and digestion, of secretion and excretion, and finally we hope to understand the most subtile and mysterious of all functions—the operation of the nervous system.

The lecturer then reviewed the rapid progress made in late years in the studies on which the medical art is based. Schroeder in Germany and Pasteur in France, by their investigations on fermentation and putrefaction, and Chauveau on the particular nature of contagia, have opened up an entirely new world. We have now not only to study the causes as well as the changes of the disease in the body, but also the doings of the bacteria outside the body and within it. In view of the more scientific methods of modern pharmacology and therapeutics, students were cautioned against long and complicated prescriptions. Not a single drug ought to enter the body except under clear intention of what object it is to fulfill there. Compounds may be good cookery, but do not form scientific medicine. Finally, students were warned against mistaken views of materialism. The students of the physical and biological sciences are emphatically the servants of nature. The man of science interprets the physical laws, and equally with the teacher of religion tells us of the greatness and grandeur of the Creator. Every discovery of the scientist can only tend to increase our wonder at the omniscience and perfection of the ways of God.

PROFESSOR C. A. YOUNG announces that the fifth satellite of Jupiter has been seen by his assistant, Mr. Reed, with the 23 inch equatorial, at Princeton.

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NEW YORK, SATURDAY, NOVEMBER 5, 1892.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 879.

For the Week Ending November 5, 1892.

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NEW YORK AND BROOKLYN BRIDGE CABLE RAILWAY OPERATIONS DURING THE WEEK OF THE COLUMBUS FESTIVAL.

Never was the bridge so crowded with people as during the gala days of the Columbian anniversary. Commencing on Sunday, October 9, 453 trains were dispatched, 392 of which had a headway of from 3 to 2 minutes.

On Monday 549 trains were dispatched, 120 of which had but 1½ minutes' headway. Tuesday, 558 trains, 212 at 1½ minutes' headway. Wednesday, the rush day, 697 trains were dispatched, of which 346 were on 1½ minutes' headway. The number of passengers carried was, on Sunday 99,309, Monday 188,677, Tuesday 158,085, and on Wednesday 223,625, gradually falling off to the normal number at the end of the week. The whole number for the week was 1,091,539. The greatest rush was from Wednesday, 8:15 A. M., until Thursday, 8:15 A. M., 24 hours' continuous run of the cars carrying 258,593 passengers.

The speed of the cable is 10⅓ miles per hour; it is 1½ inches diameter, and 12,000 feet long. It wears out in about 15 months, having a haulage service of about 20,000,000 ton miles. The greatest recorded work of the cable engines is 1,093 horse power. Cars weigh from 17 to 19 tons, and there are 60 in service, 48 running during rush hours. The above enumeration only includes railway passengers riding by ticket. The immense throng by the foot and roadway can only be estimated, and probably reached the number of 200,000 or more, making the total travel over the bridge on Wednesday, October 12, nearly half a million people. Not the slightest accident is known to have occurred. When we consider that one-half of the immense train service of Wednesday was run on 1½ minutes' headway, without a break, we cannot but accord the highest praise to its management.

PHOTOGRAPHY AT THE WORLD'S FAIR.

When the question of granting photographers the right to photograph, for a small fee, at the World's Fair grounds was submitted to the Ways and Means Committee last spring, it was announced that no such privilege would be permitted, as it would interfere with the parties who might secure the sole right to photograph, from whom large payments were expected.

As soon as this announcement was made, a movement was inaugurated by the editor of the *American Amateur Photographer* to obtain the sentiments of the various photographic clubs and societies on the proposition to exclude the camera of the amateur photographer, which resulted in nearly every organization disapproving the idea and urging the authorities, through special petitions, to reconsider their decision, on the ground that more money would be raised by admitting the camera at a small fee than could be derived by restricting the privilege to a few at a higher charge.

We are gratified to be able to state that the desires of the amateur photographers have been substantially acceded to. It was officially announced on the 25th of October by the official photographer of the World's Columbian Exposition, Mr. C. D. Arnold, that on and after that date "Hand cameras using plates up to and including 4 × 5 inches, without tripods, will be allowed within the grounds of the World's Columbian Exposition, on payment of a fee of two dollars in addition to the regular price of admission for each day. Cameras using stereoscopic lenses will not be admitted, however small the plate may be."

This decision practically opens the grounds to photographers and will enable those desiring to secure photographs for themselves from their own point of view to do so. It is we think very creditable to the World's Fair authorities that they have decided to grant some concessions to the amateur photographers, and will undoubtedly be the means of greatly increasing the amount of free advertising the fair will get, while the manufacturers and dealers in photographic materials will also greatly profit by the increased demand for their goods.

Photographing the Sound of Vowels.

At the recent International Congress of Physiology at Liege, Professor Hermann demonstrated his method of photographing the sound of vowels. The vowels were sung out before one of Edison's phonographs. Immediately afterward they were reproduced very slowly, and the vibrations recorded by a microphone. The latter was furnished with a mirror, which reflected the light of an electric lamp upon a registering cylinder, covered with sensitized paper and protected by another cylinder with a small opening which gave passage to the rays of light from the reflector. By this means was obtained very distinct photographic traces, and the constancy was remarkable for the different letters.

A MINE ON FIRE SINCE 1858.—The burning mine at Summit Hill, near Mauch Chunk, Pa., has been on fire since 1858.

The World's Fair after the Dedication.

After the great success which attended the dedicatory exercises at Chicago, a lull in the work of the fair seems to have ensued. This, however, is but an appearance. After the celebration was over, and after the troops from all parts of the country had returned or were *en route* to their respective homes, the public attention has been directed to other channels. But the impressiveness of the recent ceremonies grows as they are thought over. The great building, with the thousands of spectators, the band and chorus, the presence of so many eminent civilians, army and navy representatives, members of diplomatic corps, and the like, was a worthy step in the way of progress of the great work. After the interruption caused by the proceedings the operations are again actively under way. The prospect is that America will produce not only an unequaled exposition of arts and industries, but that it will be conceived and executed in a period of time unequaled in brevity for such an affair.

The location of the site for the buildings is a very recent event. Even the chosen city was an object of speculation until within a few months, and already the city of the lakes has shown that her enterprise and energy are more than a matter of reputation. The buildings are nearly complete. Probably the greatest assemblage of spectators ever gathered under similar conditions under one roof were witnesses of the progress already made. They found many of the great structures practically ready for occupancy. The participants and spectators in general saw a great part of a veritable city of industry rising from the plain.

The buildings harmonized well with the mass of humanity surrounding them. The route of the military procession, as it wound through the grounds, was overshadowed by the buildings. These formed a fitting background for the military parade. The water and bridges and other features of the grounds added to the picturesque effect.

Another element of interest was incident to the occasion. For the first time the grounds and buildings appeared with their proper concomitants of a great assemblage. The effect of the structures is not to be judged of as they stand isolated and untenanted. But when the isolation is destroyed by surrounding crowds, and when their interiors are filled with an immense concourse of people, some judgment can be reached as to what the final effect will be. In this aspect the celebration possessed peculiar interest. The suitability of the edifices for human occupancy was tested. Their adaptability and power of harmonizing with a mass of humanity seemed perfect. The sense of desolation that the enormous empty structures have hitherto inspired was done away with. The hum of life gave a new and, as yet, unseen aspect to the scene; for, until the celebration, so great an audience had never tenanted the great hall, and so many people had not yet visited the grounds in one day.

We have alluded to the scope of the celebration. The exposition commemorates an event in the world's history. It is no national or municipal event that has called forth the fair. America felt that her turn had come in the family of nations to hold an exposition. The lapse of four hundred years has produced the anniversary it celebrates. Unequaled in this feature, it is to be hoped that all will progress to a favorable issue. That such will be the case it is hard to doubt. So much has been done that the future is secure. The fair will be in fact as in its origin a celebration worthy of its historical anniversary.

Amidol—a New Photographic Developer.

When, in the fall of 1889, we found that eikonogen was what may be termed a universal developer, working equally as well in the development of negatives and positives either on plates or paper, we were certain that further improvements would be made, as the introduction of hydroquinone and eikonogen opened a new field in developing agents. Previous to that time the ferrous oxalate and pyro developers were used almost exclusively. Last year the para-amidophenol developer was introduced, and was accelerated in its action by the use of a caustic alkali or a carbonate, particularly carbonate of potash.

The claims for these improved developers were that they possessed unusual oxidizing power on the gelatine bromide film, but would not, even in prolonged development, cause it to stain.

The newest chemical of the same class is called "amidol," which is a diamidophenol. It has lately been introduced into this country, and possesses unusual characteristics as a photographic developer. It is supplied in minute grayish white crystals, resembling those of hydroquinone. It is almost as soluble in cold water as pyro, and requires no other accelerator to produce developing action than the sodium sulphite, so long used as a preservative in other developers. A plain solution of amidol dissolved in distilled water tests acid with blue litmus paper. By itself, poured on a plate having had a time exposure, after five minutes' action no image is discernible; but by adding a solution of sodium sulphite until there is an equivalent of three grains of sulphite to one of amidol, development at once gradually begins and continues steadily until the negative is completed. The solution made in these proportions also tested slightly acid. These facts were ascertained after several experiments.

It is advisable to use only rain, melted ice water or distilled water, as water containing a lime or a similar alkali produces a turbidity and a precipitate. The strength of the solution recommended by the manufacturers is, in our opinion, too great for convenient working, and instead of mixing the amidol and sulphite in one solution we prefer to mix the amidol fresh each time it is desired to develop a batch of plates. The following method may be recommended: First, prepare a stock solution of neutral sodium sulphite:

Sodium sulphite	100 grs.
Water	1 oz.

To make a two ounce developer, dissolve eight grains of amidol in one and three-quarter ounces of water, then add two drachms and a half of the sodium sulphite solution, pour this combined solution on the plate. If no action is observed after a minute's time add half a drachm more of the stock solution; continue these additions *ad libitum* until the developer works up to the rapidity desired. By operating gradually in this way, an overtimed plate may be developed perfectly without the addition of a bromide.

Amidol dissolved in distilled water changes from a colorless solution in three hours to a dark clear ruby red. The sulphite acts as a preserver and as an accelerator. A solution having 100 grains of sulphite to 10 grains of amidol in distilled water changes in an open graduate exposed to the air from a colorless solution to a deep orange in a week's time. In either case the sulphite keeps the solution clear.

The formula recommended by the makers is:

Amidol	80 grs.
Sodium sulphite	800 "
Water	8 oz.

To form the developer the above is diluted from three to four times and a few drops of bromide may be added if desired to check development.

Taking two ounces of the above strong solution, we added thereto in a graduate six ounces of water, which gave a solution of amidol equivalent to about three grains to the ounce. With this eight ounces we developed perfectly in a few minutes ten 10 x 12 bromide prints.

The rapidity of this developer, as well as its absolute freedom from stain, are its remarkable features, and bring it up to an equal with the iron developer used in the wet plate process. It acts as rapidly on a shutter-exposed plate as one having a time exposure, and builds up the density with equal rapidity, thereby producing easily brilliant negatives. For all kinds of plates or bromide paper it appears to be the most simple and perfect developer yet devised. For lantern slides it is admirable, giving high lights in clearness equal to the wet plate, while the density is regulated by the amount of amidol in the developer.

We developed a shutter-exposed plate in less than two minutes to full density where usually it takes ten. It will be seen also that no alkali is required, in fact an alkali added to a plain solution of amidol, after being on a plate for five minutes, produces no result except to oxidize the solution and turn it quickly to a deep ruby red. The new developer is one of the best improvements that has been made.

Cheese.

Experiments have been made at the New York Agricultural Experimental Station in conjunction with the New York State Dairy Commission.

The details of these experiments are given in the Bulletin No. 43, published at the Geneva Station, N. Y., from which we cull the following summary:

Fat.—The amount of fat lost in the whey increased in some cases and decreased in others, when the amount of fat in the milk increased.

The average amount of fat lost in the whey in all the experiments was 0·29 pounds (about 4½ ounces) for 100 pounds of milk, which was about 7·5 per cent of the fat in the milk. In the factory experiments, the average loss of fat was about 9 per cent of the fat in the milk; while, in the station experiments, the average loss was about 7 per cent of the fat in the milk.

Casein and Albumen.—The amount of casein and albumen lost in the whey increased quite uniformly when the casein and albumen in the milk increased.

The average amount of casein and albumen lost in the whey in all the experiments was 0·74 pound (about 12 ounces) for 100 pounds of milk, averaging 0·64 pound in the factory and 0·81 pound in the station experiments. From 23·5 to 24 per cent of the casein and albumen in the milk was lost, the proportion of loss being quite uniform in all the experiments.

Of the 0·74 pound (or 12 ounces) of casein and albumen lost, 0·15 pound (about 2½ ounces) consisted of casein and 0·59 pound (about 9½ ounces) of albumen. About 6 per cent of the casein and 82 per cent of the albumen in the milk was lost, on an average.

In the various lots of milk used there were, on an average, 2·4 pounds of casein and 0·72 pound of albumen, or for every pound of albumen there were about 3·3 pounds of casein.

The proportion of fat in the cheese increased, as a rule, when the amount of fat in the milk increased, but the increase of fat in the cheese was not uniform with the increase of fat in the milk. Green cheese, made from factory milk that contained about 3 pounds of fat in 100 pounds of milk, contained about 33 pounds of fat in 100 pounds of cream. Cheese made from whole milk, to which cream had been added, and which contained 6 pounds of fat in one hundred pounds of milk, contained 42 pounds of fat in 100 pounds of cheese. Cheese made from milk containing about 3·35 pounds of fat in 100 pounds of milk contained about 35 pounds of fat in 100 pounds of cheese. When the milk contained about 4·25 pounds of fat in 100 pounds of milk, the cheese contained from 36 to 36·5 pounds of fat in 100 pounds of cheese. In case of milk, partially skimmed, containing 3·56 pounds of fat in 100 pounds of milk, the cheese contained nearly 32 pounds of fat in 100 pounds of cheese.

Basing a comparison of results upon the water-free cheese, instead of green cheese, we obtain results that are quite similar in their relations.

In general, the fat exercised a greater influence upon the composition of the cheese than any other constituent of the milk.

In the cheese made from the normal milks, the amount of casein and albumen in one hundred pounds of cheese was a fairly uniform quantity, varying in the green cheese from 22 to 24 pounds and in the water-free cheese varying from 36 to 38 pounds. The milks containing least fat made cheese containing a little more casein and albumen. Skimming the milk partially increased largely the amount of casein and albumen in the cheese, while adding cream to whole milk diminished the amount of casein and albumen in the cheese.

The results appear to indicate that in cheese made form normal milk containing from 3 to 4·25 pounds of fat in one hundred pounds of milk, there should be about 1·4 pounds to 1·5 of fat for one pound of casein and albumen in the water-free cheese. Partial skimming reduced this ratio to 1·22 pounds, while addition of cream raised it to over 2 pounds.

Of the increased yield of cheese obtained in the various experiments, nearly one-half of the increase, on an average, was due to an increase of fat in the milk from which the cheese was made.

The amount of fat retained in the cheese made from one hundred pounds of milk increased when the amount of fat in the milk increased, but not with exact uniformity.

On an average, the increase of casein and albumen in the milk produced a little over one-fifth of the increased yield of cheese observed in the various experiments.

The amount of casein and albumen retained in the cheese made from one hundred pounds of milk increased quite uniformly when the amount of casein and albumen in the milk increased.

Water.—About one-third of the increased yield of cheese was due to an increased amount of water retained in the cheese.

The amount of water retained in the cheese made from one hundred pounds of milk was quite variable, and increased when either the fat or casein and albumen in the milk increased.

Pounds of Cheese Made from Milk.—Of the factory milk, there were required, on an average, 11·4 pounds to make one pound of cheese.

Of the station milk, 8·8 pounds sufficed to make one pound of cheese.

The low yield of cheese from the factory milk was mainly due to the small amount of fat, casein, and albumen contained in it, that is, to the poor quality of the milk; and, in addition, the loss in manufacture was a little greater. The poor quality of the milk was probably due to the fact that the cows were in the earlier stage of their period of lactation.

Variation in Amount of Rennet Used.—In two sets of comparisons, only one case showed any difference in loss of fat, casein, and albumen, and this was when the amount of rennet used was much less than the usual amount. No difference of yield was shown that could be attributed to variation in the amount of rennet used.

Cutting Curd in Hard and Soft Condition.—In two sets of comparisons, one case of soft cutting gave a little larger loss of fat and casein. In one case the soft cut curd gave a little larger yield, owing mainly to the retention of more moisture.

The loss of weight varied, for the first month, from 5·5 to 8·87 pounds, and averaged 6·95 pounds for each hundred pounds of green cheese.