Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

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One copy, one year, for the U. S., Canada or Mexico.....$3 00
One copy, six months, for the U. S., Canada or Mexico..... 1 50
One copy,one year,to any foreign country belonging to Postal Union. 4 00
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MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, for the U. S., Canada or Mexico. $6.00 a year to foreign countries belonging to the Postal Union. Single copies, 10 cents. Sold by all newsdealers throughout the country. See prospectus, last page.

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NEW YORK, SATURDAY, FEBRUARY 17, 1894.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 946.

For the Week Ending February 17, 1894.

Price 10 cents. For sale by all newsdealers.

CHEAP TELEPHONES.

The expiration of the Bell telephone patents is revolutionizing the sale of telephones in this country. It will be seen by the advertisement of the Metropolitan Telephone Company, of this city, who are licensed under the Bell Telephone Company, that they are now offering the genuine Bell telephone instruments for sale at $1.25 each. As these instruments are accurately made, and yield the best results, they are likely to give a great impetus to the construction of short telephone lines in buildings and in country places.

A NEW STREET CAR MOTOR.

A recent number of the *Morning Call*, San Francisco, contains an account of the trial in that city of a gasoline car, the invention of Daniel S. Regan. The propulsion of the car is effected by the injection into the engine cylinder of a small quantity of gasoline, the vapor of which is mixed with air, forming an explosive mixture that is fired by electricity. A pressure of 280 pounds per square inch is produced on the piston. The trial car is said to have operated with great success, demonstrating an economy and ease of working altogether superior to anything in the line of street car motors that has yet made its appearance. The *Call* says a reward of £50,000, or $250,000, has been offered in England for the production of a new form of street car propulsion that shall be better than the overhead trolley or the cable system. But this, we think, must be an error. The only reward offered in this direction, so far as we know, is that of the Metropolitan Traction Company, of this city, who offer to pay a reward of $50,000 for a new system that shall be approved by the New York State Board of Railway Commissioners, as being superior for practical uses in the streets of New York to the cable or the overhead trolley.

THE CALIFORNIA MIDWINTER EXPOSITION IN GOLDEN GATE PARK, SAN FRANCISCO.

On May 31, 1893, in the city of Chicago, a meeting was held in the rooms of the California Club and the suggestion was made by Mr. M. H. De Young, vice-president of the Columbian World's Fair, that a midwinter exposition should be held in San Francisco, California. The idea was acted on, and the next day the announcement was made. Work at once began in the appointment of officers, enlistment of State and city recognition, and in the soliciting of subscriptions. Nearly half a million of dollars was soon obtained. The ground was broken in San Francisco on August 24, in the presence of a concourse of nearly 100,000 people. The work progressed rapidly. Advantage was taken of the Chicago Fair, and exhibits and attractions therefrom were secured. Six main buildings, distributed over nearly 200 acres of ground, lighted by 1,000 electric lamps and 15,000 incandescent lamps from Chicago, one hundred independent buildings, are some of the elements which unite to form what is termed the third most important exhibition the world has ever seen.

The fair grounds are situated in Golden Gate Park, San Francisco, the park being now in its best state, with its semi-tropical trees and plants, the lovely climate adding to the charms of the locality, which forms a setting for the architectural features. For by the use of staff beautiful buildings have been rapidly erected, and the system of the Chicago Fair has been followed in keeping in view the architectural elements of the scene. The cost of the fair, it is thought, will not exceed $1,500,000, nearly half of which has been contributed by the people of San Francisco. As the Chicago Fair was termed the "White City," the name of Palm City has been bestowed on its western sister. The fair opened on Saturday, January 27, with due ceremonies and in the presence of an immense audience.

Speeches, a grand parade, concerts, and at night fireworks and illuminations made the occasion a memorable one. The admissions on that day aggregated 72,248 people.

Throughout the grounds are distributed every imaginable attraction, the Firth wheel, the scenic railway, the cascade, foreign villages and the like, entertaining, and in some cases instructing, the visitors. A reproduction by cyclorama of the Hawaiian volcano Kilauea is described as wonderfully realistic.

The fair is managed by the following executive committee: M. H. De Young, president and director-general; Irwin C. Stump, vice-president; P. N. Lilienthal, treasurer; R. B. Mitchell, A. Andrews, F. G. Berry, Eugene Gregory, J. H. Neff, and J. S. Slauson, of Los Angeles.

Divisional Patent Applications.

A late decision of the Supreme Court involves certain considerations as to patents issued upon divisional applications, the results of which the *Electrical Engineer* thinks are likely to be important and far reaching. Briefly, the doctrine now laid down by the court, as we understand it, is that only one patent can be taken for a single concrete invention, or for any part of such invention; and consequently, that when more than one patent has been issued purporting to cover different parts of the same subject matter, all except the one bearing the lowest serial number are void. Especially is it held by the Court to be inadmissible to distribute the subject matter of an invention between two patents, distinguishable from each other only by the different functions ascribed to a common mechanical structure.

We entertain no doubt that the ultimate effect of this decision will be wholesome and salutary. As to its immediate effect, there is certainly abundant room for interesting speculation. One important patent may be mentioned, which would seem to be in imminent danger of being overthrown by the new doctrine—the famous Berliner transmitter patent, which, in reality, covers the employment, as a transmitter, of a certain mechanical structure which, in its capacity as a receiver, was patented as long ago as November 2, 1880. There are also a very large number of patents on electric railway apparatus and devices, heretofore assumed by their owners to be controlling, and upon which a considerable number of pending suits have been based. which are founded upon divisional patents Some of these, at least, must unquestionably be obnoxious to the doctrine now laid down by the Supreme Court.

Compound Glass.

According to a report of the technical glass laboratory at Jena, O. Schott has introduced a glass which is of great technical interest and value. It is free from alkali, but can be worked before the blowpipe, has a small co-efficient of expansion, and is distinguished by many excellent qualities. Hitherto the view has been generally held that good glass must contain, together with silica and a divalent or trivalent metallic oxide, the oxide of a monovalent metal (an alkali metal or thallium). By the glass referred to (121^{III}) is free from alkalies and has the following composition:

BaO=25 per cent., ZnO=5 per cent., Al_2O_3=4·5 per cent., B_2O_3=14 per cent., Mn_2O_3=0·08 per cent., SiO_2=51·22, As_2O_5=0·2 per cent.

Schott was led to the production of his compound glass (*Verbundglas*) by studying the state of strain in ordinary glass vessels and tubes cooled in contact with the air. A hollow glass vessel cooled in contact with the air has its outer skin in a state of compression, whereas the inside is in a state of tension; hence it is easily damaged on the inside, but is resistent on the outside. A hollow glass vessel, if introduced when cold into warm air, has its outer skin thrown into a state of compression; if, when it is hot, it is exposed to cold air its outer skin is thrown into a state of tension. This is the reason why cold air causes glass to crack more readily than hot air does. Schott succeeded in throwing the outer layer into a permanent state of compression by covering the glass vessel with a thin outer layer of glass which has a small co-efficient of expansion. The flasks made of this compound glass can be filled with boiling aniline and immediately sprinkled on the outside with cold water; and glass dishes can be heated over the naked Bunsen flame without cracking. Pressure tubes of this compound glass can be made to meet all the requirements of practice. They have been kept in continuous use on locomotives for five months, and when heated to 200° C., they can be sprinkled with cold water without any fear of cracking.

Incandescent Gas Lights.

According to a paragraph in a recent number of the *Journal für Gasbeleuchtung*, a trial has been going on since June last in the Badgasse, Budapesth, and since October in the Ofen Tunnel, with Dr. Auer's incandescent gas lights. So satisfactory is the effect, that when the Budget estimates come on for discussion, it is intended to put forward a request that all streets in which the electric light is not to be used shall be lighted by the incandescent gas system, as by it the amount of illumination afforded is increased by five or even six fold. In Agram also Dr. Auer's burners have been tried with equally favorable results. While under the old system each 630 square meters of street surface received light equal to only 32 candles, every 300 square meters of surface is now illuminated to the extent of 100 candles. The lighting, therefore, is more than six times as great as that ordinarily employed for streets.

The Maxim Gun in Action.

The Maxim gun has been well tested in the Matabeleland campaign. In the skirmish of October 25 the Maxim gun effectually checked the natives. Although the natives were armed with Martini-Henry and Winchester rifles, they were powerless before the terrible fire of the Maxim gun; which mowed them down like wheat before a scythe. In the morning the sight was terrible, bodies being literally torn to pieces by the shot. Each time the natives approached they were quickly repulsed with the aid of the machine gun. The Armstrong 7-pounder has also rendered efficient service in the campaign. On one occasion a shell dropped harmlessly upon the ground, when the negroes immediately began firing upon it. The shell then exploded, killing several.

The Armies of Europe.

The military statistics of the European nations supply a suggestive object lesson in relation to our present civilization. The importance of the war footing of Europe cannot be overestimated. In case of a general war, the principal belligerent nations of Europe, excluding Turkey, could hurl 14,991,000 men into the contest. The standing army alone of the greater European nations consists of 3,274,000 men. Russia leads the list; her "peace footing" or standing army consists of 868,000 men. These soldiers are drawn from a population of 124,000,000. The enormous strength of this army may be shown by comparing it with the army of Rome during the palmy days of the empire. The permanent military force of Rome on sea and land was only 450,000. France comes next to Russia, the strength of the army being 600,000 men. This army is drawn from and charged upon a population of 38,500,000. The Chauvinistic spirit of the French people has been somewhat modified by the increased permanent military force of Germany, which now numbers 596,000 men, drawn from a population of 49,000,000. Austria, with Hungary, comes next, the army numbering 326,000 men, the population of the monarchy being 41,000,000. Fifth on the list comes Italy, whose armies number 247,000 men, drawn from a populaton of 30,000,000. England, notwithstanding her naval superiority, comes only sixth on the list, the population being 30,000,000 and the standing army 247,000. Spain has an army of 115,000 men, drawn from a population of 17,500,000.

With the size of the country the size of the army gradually decreases until the pitiful handfuls of men are reached who form the armies of Andorra, San Marino, and Monaco. Switzerland is an exception, as the constitution of this tight little republic forbids the maintenance of a standing army. When the "war footing" is considered, Germany leads with 4,000,000 men. Russia, which has the largest standing army, takes a second place as regards the war force, as she can only muster 2,530,000 men. France, with 2,500,000 men, is not far behind. If the size of the war footing of France and Germany be compared with the population, it will be seen that France, taking population for population, is a little ahead of Germany in preparing her whole available material for war. The war strength of Austria-Hungary is 1,753,000 men; that of Italy, 1,650,000 men, while Spain comes next, with 1,083,000 men and Great Britain follows with only 713,000. Switzerland, in case of necessity, can furnish 485,000 trained men.

War is constantly becoming more expensive, and while the war cloud of Europe is settling down, the financiers of the great powers are looking with great apprehension at the cost of throwing armies into the field composed of millions of men. Emperor William will do well to increase his war fund locked in the Juliusturm of Spandau if 4,000,000 of men are mobilized, as 120,000,000 marks will not last long at the present average expense of armies. The statement which is sometimes made that the fortunes of war are decided behind the green baize doors of bankers' private offices contains more truth than is at first apparent. War is now a luxury, and, like all luxuries, can only be enjoyed at great expense. The fact of the expense connected with modern war has made it unattainable to a bankrupt country, and undoubtedly tends to make even the great powers think twice before leaping. Anything which helps to discourage war and favors the settlement of difficulties by pacific means should be encouraged, so that increase in the production of war material may be regarded as a step in the right direction.

What Shall we Eat?

Every once in a while there is recrudescence of vegetarianism and also many reappearances of special recommendations as to diet that are so extreme, not to say "cranky," as to suggest that the persons making them must have spoken out of the sufferings of stomachs so far from normal as rightly to be called "cranky."

The traveler from a distant planet, returning to his home and describing our habits, would say: "They prey upon other animals." It has a repulsive sound; but, of course, it is just what meat-eaters do, in spite of all the refinements and transformations that, as Emerson says, "intervene between the slaughter house and our plates," where the slice of steak or roast reposes so tranquilly as to give no hint that it was once alive and as full of sensitive nerves as is the mouse on which the cat so ruthlessly pounces.

But let even the hypersensitive founders of the Society for the Prevention of Cruelty to Animals reflect a moment, and ask themselves if the deliberate killing of an animal, by intelligent and humane methods, is not a more merciful fate than the slow perishing by disease or old age, which certainly would occur in a state of unassisted nature.

At the two large abattoirs of Lyons, France, the guards protect the animals to be slaughtered from seeing anything connected with the slaughtering of other animals, as terror is found to have an injurious effect upon the secretions and flesh of dumb creatures. Zurich, in Switzerland, twenty years ago, invented a merciful way of killing cattle; a leathern strap completely covering the eyes is slipped over the animal's horns before he is taken to the slaughter house. In the center of this strap is a perforated iron block, the hole being directly over the center of the forehead. Standing in this hole is a short, sharp, hollow steel spike, which is driven into the brain by a single blow of a heavy hammer, producing instant unconsciousness. Immediately, a sharp iron rod is made to penetrate that point in the base of the brain which corresponds to the "vital knot" of the human system, and absolute death is the result. The large blood vessels are then severed. As civilization advances, we see everywhere more humane laws being enacted for what must be considered the *indispensable killing of animals*, if man is to continue on his upward career, in knowledge, wisdom and happiness; for the brain worker, far more certainly than the muscle worker, must have flesh food to work upon.

The vegetarian can point to a considerable array of facts that sustain his theory. Many tribes of North American Indians have attained a very high physical development upon a vegetable diet; many Scotch farmers live principally upon oatmeal; meat is a comparative rarity among European laborers. Many Englishmen formerly lived on bread, cheese and beer (though cheese can hardly be called a vegetable); the Roman legionary carried a weight of sixty pounds and performed astounding feats of strength and endurance without eating flesh, and some people have substituted eggs and milk for meat, under the delusion that they are less atrocious than flesh-eaters; but the opinion of the cow whose calf they have robbed of its natural food should be asked, before final judgment.

Dr. C. N. Folsom, then Secretary of the Massachusetts Board of Health, wrote twenty years ago:

"The Brahmins of India eat nothing which contains the germ of animal life, although they can hardly be said to have attained a vigorous physical or mental culture."

Mr. Edison puts the truth here hinted at more tersely in "Those that eat rice think rice," while Dr. Folsom still further says:

"Although physiologists are not agreed that *animal* food is absolutely essential to a high degree of civilization, there are certainly many facts which seem to indicate that it is resolvable into a greater amount of force than the other nitrogenous foods."

That the kind and quality of food gets into a man's thought and disposition is not to be denied. The physicians at Sebastopol, after the Crimean war, testified that when a Russian soldier was intoxicated he became disgustingly maudlin, affectionate and silly, while the Briton in that state became at once "full of fight;" and they accounted for it by the fact that the first lived on black bread and the second had meat. Dogs that are quiet and subdued on vegetable food grow fierce on meat, and there are persons of fine nervous organization who find in meat a stimulus similar to that of wine.

The great advances in analytical chemistry in these last two decades have done much to reveal wherein the "potential energy" of foodstuffs lies, and the "training" of our athletes shows that we are beginning to prescribe food with as much precision as we can use the most familiar drugs—say as quinine and opium.

When James Russell Lowell went out to "rough it" among the Maine lumbermen, he was astonished to find that the essential article of their diet was fat pork, against which he at that time held a genteel prejudice; a few days of heavy tramping brought him to a complete appreciation of its merits as a heat and strength producer. These lumbermen labor intensely in the cold and snows of winter, and in the icy water in spring, and beans and fat pork are the staple of their diet; and the modern chemist comes along with his physiological yardstick and tells us the exact reason why men performing the severest tasks prefer pork to the choicest cuts of beef.

Prof. W. O. Atwater says:

"The energy from the sun is stored in the protein and fats and carbohydrates of food, and the physiologists of to-day are telling us how it is transmuted into the heat that warms our bodies, and into strength for our work and thought."

Professor Frankland determined the heats of combustion of many substances, and reckoned them in units called "calories." Among forty-five substances tested, he found that very fat pork contained an amount represented by 3,452, while fat beef contained 2,750, lean beef 807, and turnips only 139, while beans came up to 1,519, and peas to 1,476. Many of us do not require so much "energy" in our food, but we do need material which will restore the worn-out and ever-wearing-out tissues of the body, and for this we must have foods that contain much protein, and these are beef, some kinds of fish and eggs. All food substances have more or less of water, but the driest of all is fat pork. For a most interesting study of the whole subject, where the relative value of different substances, for nutrition, is shown by an ingenious diagram at a glance, the reader is referred to a series of articles by Prof. W. O. Atwater, in the *Century Magazine*, beginning in May, 1887.

Fortunately, the healthful preparation of food is being studied by our scientists theoretically and by our wide awake, intelligent women practically. Mr. Edward Atkinson truly says:

"If the masses of the people are to be well nourished, each adult person must have the due proportion of protein, or nitrogenous material, of fats, and of carbohydrates, or starchy materials: because, if either one is deficient, vital force cannot be sustained. Neither can there be any true mental vigor or spiritual life when the body is not well nourished."

There has been too much despising of "this vile body," as some have dared to call the exquisitely adjusted temple of the Holy Ghost which God has given into our individual keeping, and for the neglecting or abusing of which he will make inquisition. If we intend to care for the soul, we must first care for the body. He who knew "what was in man" set the example when he saw to it that the multitude was fed before he attempted to instruct them.—*The Independent.*

Coloring Gelatino-Bromide Prints.

The *Archiv* gives the following plan for getting different colors on bromide prints. The prints are feebly developed with eikonogen, fixed, washed and then immersed in a solution of:

Nitrate of lead	4 parts.
Red prussiate	6 "
Water	100 "

This bleaches the image, which may then be colored thus:

Brown.

Schlippe's salt	10 parts.
Ammonia	5 "
Water	150 "

Yellow.

Neutral chromate of potash	4 parts.
Water	100 "

Green.

Immerse the yellow prints in

Iron perchloride	1 part.
Water	10 parts.

Red.

Immerse the yellow prints in

Chloride of copper	1 part.
Water	10 parts.

Nickel Green.

Chloride of nickel	1 part.
Water	10 parts.

Orange.

Mercury bichloride	3 parts.
Potassium iodide	4·5 "
Water	100 "

—*Br. Jour.*

Co-efficients of Expansion of Glass.

Most of the published data relate to glass of unknown composition, and are therefore of comparatively little use. Regnault is the only investigator who appears to have supplied information respecting chemical composition with the physical data; and even his researches do not enable us to draw any conclusion as to the influence of different oxides upon the expansion of glass. A careful and extensive investigation of the co-efficients of expansion of a large number of glasses of various compositions (made by the Jena firm) have been carried out by Prof. Winkelmann, Dr. Straubel, and Dr. Pulfrich, using a dilatometer according to Fizeau's method as modified by Abbe (Wied. Ann. 38, 453). The tabulated data occupy the best part of three large pages, and the principal results can only be given here. Of these the most striking is the predominating influence of alkalies upon the value of the co-efficient of expansion. By increasing the amount of alkali in a glass, its co-efficient of expansion could be increased until it approximated nearly to that of nickel or iron. The tables further show that the expansion of different glasses for equal intervals of temperature varies within much wider limits than has hitherto been believed; for example, a specimen of glass containing 12 per cent of alumina was found to have a co-efficient of expansion 0·00003369; whereas a specimen of zinc borate glass free from alkali has a co-efficient of expansion of only 0·00001097. In the case of the usual silicate glass it is found that metallic oxides, such as zinc oxide, alumina, lead oxide, and baryta, do not produce any considerable increase in the expansion. Phosphate glass behaves much like the ordinary silicate glass with respect to expansion, whereas borate glass is distinguished by a low co-efficient of expansion.

Artificial Stone.

Thirty parts of tin are dissolved in 40 parts of muriatic acid and 30 parts of sal ammoniac are added. A powder composed of freestone 50 parts, zinc oxide 20 parts, pounded glass 15 parts, powdered marble 10 parts and calcined magnesia 5 parts is prepared and made into a paste with the liquid above mentioned. Coloring matter may be added. The composition may be used as a damp-proof coating for walls or for repairing stone work or for moulding statues or ornaments.