both will retain their gaseous state. But if they be subjected to sudden expansion, which according to Poisson's formula should produce a temperature of at least 392° Fah. below that existing, an intense fog is at once seen, due to their liquefaction and possibly to their solidification. The same phenomenon is observed on the expansion of carbonic acid, and nitrous and nitric oxides when strongly compressed." Shortly after having obtained this result, M. Cailletet announced to the French Academy of Sciences his success in liquefying nitrogen, atmospheric air, and even hydrogen itself, hitherto found the most refractory of all gases. M. Cailletet furnishes the following details to the *Comptes Rendus* of the French Academy:

Nitrogen.—Pure or dry nitrogen compressed to about 200 atmospheres at a temperature of 55·4° Fah., then expanded suddenly, condenses and appears first in the form of spray, in drops of appreciable volume. This liquid disappears gradually, its vanishing beginning at the exterior and extending toward the center, until finally a single vertical column remains in the axis of the tube for a few seconds.

Hydrogen.—This gas compressed to 280 atmospheres and expanded gives a thick fog throughout the entire tube, which however suddenly disappears.

Air.—Atmospheric air was first dried and deprived of all traces of carbonic acid, and then treated as above described. The data of temperature, etc., we have already given in our previous article.

In Fig. 3 is illustrated a small and simple apparatus designed by M. Cailletet, which may be used for exhibiting the liquefaction of gases before a class. It is an exact copy of the parts, *a* and *m*, of the large apparatus shown in Fig. 1. The glass cover is modified and the screw press is replaced by a pump. T T is a glass tube filled with the gas to be compressed, it being previously traversed by a gaseous current until all air is expelled. To this end it is first placed in a horizontal position; when it is full of gas, the end, P, is sealed up hermetically by heat, and the other end is held closed by the finger until it is introduced in the wrought iron device below and enters a cylindrical hollow containing mercury. The upper part of the tube is enveloped in a glass cylinder, M, which is filled with a refrigerating mixture, and over all is placed the bell glass, G. The tube, T U, is connected with the hand compressing pump, which is provided with a suitable manometer. The water compressed by the pump acts on the upper part of the mercury, as shown by the horizontal lines in our figure. The mercury is thus driven into the tube, T T, and reduces the space occupied by the gas. It soons becomes covered with little drops of the compressed vapor, which unite in a liquid mass, *b*.

B is a block of very resistant forged iron; E′ and E are screws which allow of the apparatus being taken apart; A′ is an adjutage; P P, three legged strong support for the apparatus; S, support for the bell, G, and cylinder, M; N, supplementary screw designed to close the aperture, R, when mercury is placed in the apparatus. The large lower portion of the tube, T, being subjected to equal pressure within and without, cannot break, and the only portion open to rupture is the small upper part of the tube, which may be made exceedingly strong. The experiment may, by the electric or oxyhydrogen light, be projected on a screen, when all the phenomena may be followed by the eye without incurring any danger through breakage.

Improved Cow Stables.

Mr. J. Wilkinson, of Harvard, Ill., commenting on the article in SCIENTIFIC AMERICAN SUPPLEMENT, No. 105, p. 1674, entitled "Labor Saving Cows," protests against the use of any such device, as well as against all the other methods in general use for keeping stables clean. He styles them all barbarous, and claims that his plan, which he has advocated for twenty years in various journals (and which we remember having read), is the only perfect one.

His method is to construct an open or latticed floor, through which the solid and liquid excrements fall, the former into a concealed gutter and the latter into a receptacle from which it immediately flows out of the building into a cistern constructed for the purpose. By a system of sub-earth ventilation the excrement lying in the gutter beneath the flow is soon cooled and its surface dried so that all fetid exhalations soon cease. The open floor being always dry and comparatively clean, he dispenses with bedding entirely.

Honors to American Scientists.

Although it has not hitherto been the policy of the Committee on Foreign Affairs to encourage the receiving of decorations and medals by officers of the United States, it recently reported back, with a recommendation that it pass, the bill authorizing Spencer F. Baird, Assistant Secretary of the Smithsonian Institution, to receive from the King of Sweden a diploma and medal, constituting him a member of the Norwegian Order of Saint Olaf, as a testimonial of distinguished scientific service. In the opinion of the committee of Congress, Professor Baird is not an officer of the United States in any such sense that there could be any serious objection to permitting him to accept a diploma as member of a literary organization of a foreign country. The bill was therefore passed.

Professor Hall, of the Naval Observatory, the discoverer of the two satellites of Mars, has bestowed on them the names of "Deimus" and "Phobus," and the Bureau of Navigation of the Navy Department has approved of them. They were suggested, it is said, by Mr. Madan, of Eaton, England, and will probably be accepted by astronomers.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK.

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

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, postage included..... **$3 20**
One copy, six months, postage included **1 60**

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly; every number contains 16 octavo pages, with handsome cover, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, postage paid, to subscribers. Single copies 10 cents. Sold by all news dealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, postage free, on receipt of *seven dollars*. Both papers to one address or different addresses, as desired.

The safest way to remit is by draft, postal order, or registered letter.

Address MUNN & CO., 37 Park Row, N. Y.

☞ Subscriptions received and single copies of either paper sold by all the news agents.

The Postal Union.—Under the facilities of the Postal Union, the SCIENTIFIC AMERICAN is now sent by post direct from New York, with regularity, to subscribers in Great Britain, India, Australia, and all other British colonies; to France, Austria, Belgium, Germany, Russia, and all other European States; Japan, Brazil, Mexico, and all States of Central and South America. Terms, when sent to foreign countries, Canada excepted, $4 gold, for SCIENTIFIC AMERICAN 1 year; for both SCIENTIFIC AMERICAN and SUPPLEMENT, $9 gold for 1 year. This includes postage, which we pay. Remit by postal order or draft to order of Munn & Co., 37 Park Row, New York. We can collect orders if drawn on London.

VOL. XXXVIII., No. 8. [NEW SERIES.] *Thirty-third Year.*

NEW YORK, SATURDAY, FEBRUARY 23, 1878.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 112,

For the Week ending February 23, 1878.

Price 10 cents. To be had at this office and of all newsdealers.

PARADOXES IN STEAM.

It has been stated by some observers that if a watery solution of any salt is heated to its boiling point, the temperature of the vapor or steam of the same will not be equal to that of the solution, but equal to that of pure boiling water. For instance, if a concentrated solution of common salt, which boils at 260° Fah., is evaporated at that temperature, the vapor has a temperature of only 212°, while pure water has only to be heated to 212° to produce the same result.

This statement has been denied by others, claiming that it could not be so, and that the vapor must always have the temperature of the liquid from which it proceeds; but this is a false conclusion, as, contrary to this opinion, it is well established that steam of 260° cannot exist under ordinary atmospheric pressure, but only at a pressure of 3 to 4 atmospheres; under ordinary pressure it must at once expand, and thus by this expansion have its temperature reduced to the corresponding pressure, 15 lbs. to the square inch, and a temperature of 212° Fah.

It follows from this that the steam of salt water is equal to that of fresh water, and the only difference is that in order to raise steam from salt water, its temperature has to be higher than to raise steam of the same pressure from fresh water. The disadvantage of this fact in the production of steam is, however, more apparent than real, because, after once the proper temperature is reached and maintained, the consumption of heat made latent in the steam evolved is 960 units for every pound of water evaporated, whether this water be salt or fresh.

If we invert the experiment and condense steam in saline solutions we find results perfectly in accordance with the above, but quite surprising and even paradoxical at first sight. If, for instance, we send steam of 212° into a concentrated solution of common salt, its temperature will at last be raised far above 212°; if the solution is concentrated so much as to have a boiling point of 260°, it may be heated in this way to 258° or thereabout. It is indeed paradoxical that steam of 212° would be able to raise the temperature of a solution in which it condenses 45° above its own temperature, but such is the fact, and any one can easily convince himself of the reality of these apparently strange results, and it is only the latent heat of the condensed steam which is set free, and part of which shows itself as sensible heat under the circumstances explained.

Soluble salts have strong affinity for water, and will promote the condensation of its vapor, absorb the water, and change the latent heat of the vapor into sensible heat, which latter means a rise of temperature. This action is analogous to that of water absorbing hydrochloric acid gas or ammoniacal gas. In both cases the water becomes very hot, much hotter than the temperature of the gas it is absorbing, and the strong affinity of water for these gases is, as well as the affinity of salt for water, the key to the understanding of all these apparently strange phenomena.

ARCTIC EXPLORATIONS.

There is a fascination about explorations in unknown lands that makes men count as nothing the extremes of heat and cold, hunger, thirst, fatigue, and danger. The mystery which surrounds the polar regions, and the success with which its barriers of ice have guarded its secrets in the past, are maddening to the explorer and geographer. The pole attracts those who yearn to know the hitherto unknown, in the same manner as it attracts the magnetic needle that always points toward it; and notwithstanding the large amount of money spent and the number of lives heretofore lost in Arctic explorations, there are now so many expeditions either organized or organizing for further effort in this direction that it would seem as if the secrets of the polar regions would soon be secret no longer.

In addition to the Howgate expedition, which has already made a start from our shores, other nations are hurrying forward exploring expeditions on a somewhat similar plan. England is about to fit two vessels under Captain Nares, who will operate by way of the east coast of Greenland. Sweden, during the present year, will explore the polar regions by way of Behring's Strait, under the auspices of Professor Nordenskjöld. Holland has determined upon one also. Germany, under the direction of the Arctic Exploration Society, has an Obi expedition, commanded by Captain Wiggins, now on duty. Russia, during the coming spring, will push forward an ethnological expedition, under the Helsingfors professor, to the Vogels and Ostyacs, of the Obi and Irtysh. Besides these expeditions many eminent explorers and scientific societies in different countries are busying themselves in an endeavor to establish stations at different points in the Arctic regions, with a view to those systematic synchronous observations so necessary in making proper progress in the discoveries in meteorological and other kindred sciences.

There is little doubt but that many of the natural sciences might be much enriched by observations directed especially in their directions. Geographical discovery has hitherto been the main point of the expeditions sent out, and while this is no doubt a very important feature, yet there are many others which should receive attention. Usually the expeditions have been so conducted as to preclude anything beyond mere locomotion, all appliances for discoveries in other directions than that of geographical science being left behind.

Under the colony system, or what is now known as the Howgate plan, there is no doubt that many interesting discoveries in various sciences can be made that have hitherto escaped observation under the systems which made locomo-

tion in a northerly direction almost the only thing sought for. At least, this is the opinion of many scientists, including such men as Professor Loomis of Yale College and Professor Henry of the Smithsonian. Of the practicability of the colony scheme as a means of geographical discovery we may say that it was brought forward as long ago as 1868, by Dr. Hayes, the Arctic explorer, who still believes in it; that it was a favorite idea of Captain Hall, who would, no doubt, have endeavored to carry it out had he lived; and that the survivors of the Polaris expedition all indorse it. As to discoveries and researches in other sciences Professor Henry gives the following as some that would and should be made by such expeditions: Pendulum experiments, to better determine the shape of the earth; a greater number and more continued observations for the more perfect elucidation of the magnetism of the earth; a series of observations on the tides for at least a year; and the results of a larger series of observations on the winds of the globe than those now possessed are necessary for completing our knowledge of that subject. Besides these particular observations the Professor thinks that the whole field of natural history could be enriched by collections in the line of botany, mineralogy, geology, etc., and many facts of interest obtained with regard to the influence of extreme cold on animal and vegetable life.

In view of these reasons, and others which our space forbids us to give, the House Committee on Naval Affairs have reported a bill authorizing the formation of a colony on the Howgate plan on or near the shore of Lady Franklin Bay, near where a seam of coal has been discovered. Strong substantial buildings are to be carried there, and the colonists are to be furnished with provisions and other necessaries for three years. The scientists accompanying the expedition, who are to be under the direction of the National Academy of Sciences, are to be provided with all the necessary appliances for scientific discovery, including telephonic lines for maintaining communications between successive stations, and balloons for purposes of observation. It is thought that the colonists will gradually become acclimated, and by training the natives to help them will thus be enabled to push forward into regions hitherto unknown by taking advantage of such favorable seasons as may occur. Whether they will succeed or not remains to be seen. All that we can say is that if the secrets of the far north are to be discovered, this plan seems more feasible than any before brought forward.

WHAT STEAM HAS DONE FOR FRANCE.

According to recent official statistics the total power of all the steam engines existing in France is 1,500,000 horse power, representing the actual labor of 4,500,000 horses or 31,590,000 men. This last aggregate is equal to ten times the present industrial population, which amounts to 8,400,000 souls, but from which must be subtracted old people, women, and children, leaving a remainder of 3,200,000 working men.

It is interesting, says *La Nature*, to compare the above data with the condition of affairs in 1788, before steam engines were introduced in France, as we are thus led to appreciate the enormous revolution which steam and improved machinery have produced. Just ninety years ago in every $200,000,000 worth of French products, sixty per cent of the value represented labor and forty per cent raw material. Today this ration is exactly reversed, although labor has increased forty per cent. At the present time the total industrial productions of France aggregate a value of about $2,400,000,000. Of this $1,400,000,000 represents raw material, and the remainder labor. If the same proportion as existed in 1788 applied now, taking into account the increase in labor noted above, no less than eleven twelfths of the above amount, or $2,200,000,000, would be the cost of handiwork. Roughly, then, steam engines and improved tools have produced an economy of $1,200,000,000; but more than this, if they were suddenly swept out of existence and forgotten, there are not enough men and animals in the country to supply an equivalent amount of power, and even if there were, there would be no way of procuring the necessary food for their support.

IMPROVEMENT OF RIVERS.

A detailed statement of the losses of property on Western waters during the year 1877, owing to obstructions in the various large rivers, shows that it reached the large sum of $5,330,000. On the Mississippi river the greatest loss is sustained between St. Louis and Cairo, at the mouth of the Ohio. Here the river is shallow, and snags are frequently found imbedded in the river, upon which occur wrecks that themselves form further obstructions. The Red river is one upon which the Government has spent much money and labor in order to cut a channel of sufficient width to afford easy navigation; but where the channel was cut through the passage has been obstructed by jams of logs and driftwood. A bill providing for the removal of obstructions from there, as well as from the Missouri and Arkansas rivers, was passed a few days since. The first section of the bill appropriates the sum of $60,000, to be expended under the direction of the War Department, for the removal of snags, etc., from the Mississippi, Missouri, and Arkansas rivers, and for the preservation of Government vessels in that service. The second section appropriates $6,000, to be expended under the direction of the War Department, for the purpose of opening the navigation of the Red river above Shreveport and keeping said navigation open and free from rafts. Bills have since been introduced providing for the improvement of the Osage, Detroit, Galena, and St. Mary's rivers; referred to the Committee on Commerce and ordered printed. On the 5th of December, pursuant to a call from the Governors of Tennessee, Alabama, Kentucky, Mississippi, and Ohio, a convention met at Chattanooga for the purpose of perfecting measures and making an earnest and united appeal to Congress for a sufficient appropriation to secure the completion of the improvement of the Tennessee river, especially at the Mussel Shoals, at as early a date as possible. The committee appointed by this convention has presented a memorial to Congress of very great importance. It sets forth that the Tennessee river is navigable for steamers of from four to five feet draught, the year round, a distance of 330 miles from its mouth to Florence, Alabama; that a section extending a distance of 38 miles above Florence is obstructed by a series of impediments known as Mussel Shoals; that the river is further navigable for steamers of three feet draught from the head of Mussel Shoals to the city of Knoxville, a distance of 389 miles, for nearly nine months annually; that this vast region, although possessing all the latent elements of prosperity, languishes for cheap transportation. It therefore urgently asks for the improvement of the river, especially at Mussel Shoals, as a work of national importance, required as a commercial highway and as a ligament to bind together the States commercially and politically. The memorial was ordered printed and referred to the Committee on Commerce.

PRINTING THE PATENTS.

While we agree with so much of Commissioner Spear's recommendation relative to printing patents which states that it would be desirable in point of cheapness, convenience, and rapidity, if the work of printing could be done in the Patent Office instead of in the Government Printing Office, we do not coincide in the suggestion to increase the final fee by adding thereto the cost of printing the patents. It is proposed to graduate this tax in accordance with the length and complexity of the specification.

Our objection is that under this arrangement the Government would be paid twice for the same extra printing, first by the inventor and second by the public, as the charge to the latter for copies of patents is also to be increased with their length, etc. It would be less objectionable to charge only purchasers of copies of patents the extra price; but this might necessitate a relay of clerks to calculate the various costs. The result would be useless and unprofitable labor. The aim should be to reduce the present charges, not to increase them. The present uniform rate asked for copies of patents has proved satisfactory and remunerative. If any change is to be made in the price, let us lessen it.

THE CARBOLIC ACID OR ANTISEPTIC TREATMENT OF WOUNDS.

Reports are now beginning to come in giving the results of those who have practiced Lester's new system of antiseptic treatment of wounds, and Dr. Robert F. Weir, Surgeon to the New York and Roosevelt Hospitals, has communicated to the New York *Medical Journal* the result of some 56 cases in which Mr. Lester's treatment was adopted.

As American surgeons have been slow to test this mode of treatment, and as many improvements have been suggested by Mr. Lester since its first introduction, we will briefly describe the principles involved and their mode of application. Dr. Weir presents the following synopsis of the theory:

First. That in the dust of the atmosphere, and in matter with which it is in contact, there are the germs of minute organisms, which under favorable circumstances induce putrefaction in fluids and solids capable of that change, in the same manner as the yeast plant occasions the alcoholic fermentation in a saccharine solution.

Second. That putrefaction is not occasioned by the chemical action of oxygen or other gas, but by the fermentative agency of these organisms.

Third. That the vitality or potency of the germs can be destroyed by heat or by various chemical substances, which are called in surgery antiseptics.

Lester himself describes his system as "the dealing with surgical cases in such a way as to prevent the introduction of putrefactive influences into wounds."

The general reader will not demand the whole details of the proper application of this treatment, which are presented with much care by Dr. Weir. The leading points, however, may be interesting:

The antiseptic medium employed is carbolic acid, used in solution of various strengths. The operation is performed while the air surrounding the limb is impregnated with carbolic acid by means of a spraying instrument, working on the same plan as the well known perfumery spray.

Carbolic acid is forced into the wound, and during a surgical operation, such as the amputation of a limb, all the cut and exposed parts, and all textures and substances used for dressings or coverings, are thoroughly treated with the carbolic spray.

The catgut ligatures and silk sutures are also carbolized, and even the hands of the surgeon treated with the spray.

Three solutions of carbolic acid are employed—1 to 40 for the protective layers, 1 to 30 for the spray, and 1 to 20 for a solution in which are immersed the sponges, instruments, and teeth of forceps.

This latter solution is also used to wash the epidermis of the patient adjacent to the wound, the hands and particularly the finger ends of the surgeon.

To work the spray, Mr. Lester has devised a steam spray apparatus, operated by a spirit lamp.

The results that have been obtained from this mode of dressing wounds must necessarily be of absorbing interest to surgeons. Dr. W. H. Van Buren, of this city, in a recent address to the students at Bellevue, stated that he considered it the greatest advance in surgery since the introduction of anæsthetics.

The experience of Dr. Weir comprises about five months of hospital practice, and he considers it the duty of every one having the charge of hospital cases to diligently try it.

In Chambers Street Hospital in 16 cases 8 were failures; an explanation was, however, found for this apparently moderate success, it having been found that from motives of economy the larger pieces of gauze had been washed and recarbolized. This had been poorly done, for when an investigation was made as to why the dressing had failed, the gauze was found to have been imperfectly cleaned and unfit for use.

At the New York and Roosevelt Hospitals the result of 26 cases showed but 6 instances of failure. These cases were chiefly in Dr. Weir's own wards and under his own observation, and he states that even in these 6 cases of failure, retrospection detected some imperfectly followed detail which accounted for the unfavorable condition of the wounds.

THE WASHINGTON NAVAL OBSERVATORY.

Some days ago a petition from Professor Newton and others, of Yale College, was offered, calling the attention of Congress to the present unfortunate location of the Naval Observatory, and asking for such legislation as will authorize its early removal from its present situation to a better and healthier location. Subsequent debate on the bill developed the fact that since the establishment of the Observatory (in about the year 1840) the malarial influences of the Potomac have increased to such an extent as to endanger the health and lives of those who are assigned there for scientific duty. The testimony given on the subject was abundant and conclusive.

This proposition for the removal of the Observatory has since been made the occasion to agitate another and distinct proposition, namely, that its management be transferred from the Navy Department to some other branch of the government, or else that it be made a separate institution under the entire control of a general superintendent. This proposition, which has no legitimate connection with that embraced in the petition before Congress, is a direct attack on the present management of the Observatory, and has called forth a circular from the professors connected with the latter, addressed to the National Academy of Sciences, asking that no member of that body place himself on record as approving of the statements contained in the document of their opponents. Thus the matter at present rests.

The Commissioner of Patents on Models.

Commissioner Spear takes very sound and sensible ground on the model question. He says in substance that the models usually forwarded with applications are unnecessary, that they always add largely to the expense, and are troublesome to keep in the Patent Office. This coincides with our own opinions already expressed. Models are a great tax on the resources of inventors; any examiner ought to be able to obtain as clear ideas as he desires through good drawings and clearly written specifications; and the late fire in the Patent Office has shown that to the dry accumulation of old models might well be applied a stronger term than troublesome. The Commissioner proposes to reserve the right to call for a model where an examiner is in doubt as to practicability of an invention. This is well enough, but there is no need of the Commissioner proposing when he has only to issue the necessary order. The law already says that "the applicant, *if required* by the Commissioner," shall furnish a model, etc. The Commissioner has only to break loose from mere precedent, which is not at all obligatory, establish at once the better regime that he contemplates, and so earn the thanks and commendations of his countrymen.

Restoring the Models.

The result of the attempt to restore the models damaged in the late fire bids fair to more than realize expectation. About 5,000 models have already been restored, and from present indications the whole number capable of being put in good condition will reach at least 5,000 more than the Commissioners estimate, or about 15,000. It is doubtful, however, if the present appropriation will be sufficient for the purpose, as it is believed that it will be exhausted by the time that the restoring of the 10,000 models originally estimated for has been completed.

WHEELBARROWS FOR THE SICK.—The Police Commissioners of Dundee, Scotland, have supplied each police station with a double springed wheelbarrow, for the transportation of drunk and incapable persons. The new vehicles are said to be more convenient and easily managed than any other conveyance that has been tried for the same purpose.

FOR the safe storage or shipment of explosives Herr Gossie, of Antwerp, constructs, either in a railway car or in the earth, a water-tight reservoir, divided by means of T and angle irons into compartments of equal capacity, in which the explosives (suitably packed in water-tight boxes) are placed after the reservoir is filled with water.