Liquefaction of Gases.

At a meeting of the Astronomical and Physical Society of Toronto, Mr. Arthur Harvey, who had been requested to prepare a resume of the recent work of Professor Dewar in connection with the above subject, read the following notes:

The method adopted is to lower boiling points by exhaustion. You know the principle. It comes to our notice practically in mining at or above the summer snow line in the mountains. There are several camps in America so high that boiling water will not cook potatoes or other vegetables so as to make them palatable. Carbonic acid, which boils under ordinary atmospheric pressure at —112 degrees, will, in a vacuum such as the air pump can be made to give, boil at —166 degrees. At this temperature nitrous-oxide liquefies, and, itself boiled in vacuo, lowers the temperature and liquefies ethylene, which in turn runs down the thermometer to —229 degrees. At this point pressure is resorted to, and the pressure of 1,500 lb. to the inch (100 atmospheres) forces oxygen into a liquid state. The evaporation of liquid oxygen, also in vacuo, liquefies, under pressure, air and nitrogen, while these again, worked upon in double receivers by powerful air pumps, will produce solid nitrogen. This was first shown in January of the year 1894. Liquid oxygen is 900 times less in volume than the gas at ordinary temperatures—blue in color, because it stops many red, yellow and orange rays. That is apparently why the sky is blue. Like the gas, it is magnetic, springs from a cup of rock salt to the poles of an electro-magnet when the circuit is turned on, and stays there pending its rapid evaporation. Nitrogen seems to be an inert body, with no striking qualities, good to be a diluter or absorbent of the more energetic oxygen. Hydrogen remains now the only body unsubdued by cold and pressure, so a hydrogen thermometer is used to indicate these extremely low temperatures. If hydrogen be, as Faraday thought, a metal, water is a metallic oxide, and it is remarkable how easily this oxide liquefies, while oxygen only becomes fluid under the severest compulsion, and hydrogen resists it with success.

Gases contract $\frac{1}{460}$ for each degree of temperature. What is to happen when a temperature of —460 degrees is reached? At present it seems below the limit of possibility. All gases will liquefy and solidify before this is obtained; so the method of successive reductions above described must fail to achieve such a minimum. But if this absolute zero is reached, will matter vanish through the total deprivation of heat? Heat is the life of matter; the more heat, the more energetic the molecules. Metals become stiffer and tougher under cold—remarkably so at Professor Dewar's low temperatures—become better conductors of electrical currents; but chemical affinity is diminished, so that alloys do not behave in the same way as pure metals, while carbon and some other substances act quite differently. We know from the everyday experience of the incandescent electric light that heat increases the conductivity of carbon, while it reduces that of metals—a corollary of which property of the latter it seems to be that iron at 1,400 degrees is not magnetic at all; nickel at 340 degrees is also inert to the strongest magnets. If the sun is a magnetic center at all, it is not because of its iron or other metals, and this consideration leads me to doubt if the aurora has any connection with the spots on the sun, either as they pass the center or appear on his eastern limb, or with their maximum or minimum frequency.

What is the cold of space? We approximate to it in these experiments. Is it permissible to think that this cold—even without pressure—would liquefy and solidify gases and so facilitate the condensation of dispersed matter into suns and planets, and forbid the existence of a gas in space which would retard the motions of these orbs? Will cold, rather than gravity, thus fix a limit to the atmospheres, permitting no gas to exist outside the calorific influence of the bodies which are still hot from condensation? Has the air there was upon the moon settled down to be a transparent sheet of ice over her surface, fixing her features in an almost eternal setting as hard as adamant?

One more singular point. Molecular convection of heat ceases as the molecules die of cold, but energy still passes through the frozen mass. A burning glass which concentrates heat and light can be made with a spherical vessel full of liquid oxygen. Radiant or ethereal heat and light encounter no resistance on account of extreme cold, when molecular heat can scarcely creep from particle to particle.

Cold affects colors. Sulphur (at —314 degrees) turns white, vermilion fades to orange, iodine in alcohol loses its violet, my authority states, but as alcohol freezes at —202 degrees, the phenomenon must be seen in the solid.

Is the earth homogeneous? When it was intensely hot, too hot to hold any but elementary forms of matter, a time came when it was cooled as to its gaseous envelope, and oxygen, if not hydrogen, combined with its materials to a certain depth. The outer shell thus is alone composed of oxides or rusts, for such we may call all the rocks and other substances that contain oxygen. A time may come when the aqueous vapor and carbonic acid of the air will come down as snow, just as oxygen and hydrogen at a given stage form water, just as carbonic acid and calcium have formed the limestones—and, after that, the interstellar cold will be free to act, and the residual oxygen and nitrogen will form an ice case of eleven or twelve yards in thickness. When, in due course, something like this happens even to the sun, and absolute zero is reached, will matter be loosened from its affinities and disperse? If so, there must be fewer dark stars than Sir Robert Ball thinks possible.

Lodgings for Seamen on Ship Board.

With a view to the promotion of the health of seamen and their protection against the cupidity of owners, a new law was passed at the last session of Congress, the text of which we give below. It will be seen that the cabins must be large enough to give every man a deck space of 12 superficial feet and a total of 72 cubic feet. This is equal to a space of 2 feet wide, 6 feet long, and 6 feet high.

The act was approved March 2, 1895, and is entitled "An act to provide for deductions from the gross tonnage of vessels of the United States." The act will take effect April 1, 1895.

"Every place appropriated to the crew of the vessel shall have a space of not less than 72 cubic feet and 12 superficial feet, measured on the deck or floor of that place, for each seaman or apprentice lodged therein. Such place shall be securely constructed, properly lighted, drained, and ventilated, properly protected from weather and sea, and as far as practicable properly shut off and protected from the effluvium of cargo or bilge water; and failure to comply with this provision shall subject the owner to a penalty of $500. Every place so occupied shall be kept free from goods or stores of any kind not being the personal property of the crew in use during the voyage; and if any such place is not so kept free, the master shall forfeit and pay to each seaman or apprentice lodged in that place the sum of 50 cents a day for each day during which any goods or stores as aforesaid are kept or stored in the place after complaint has been made to him by any two or more of the seamen so lodged. No deduction from tonnage as aforesaid shall be made unless there is permanently cut in a beam and over the doorway of every such place the number of men it is allowed to accommodate with these words, 'Certified to accommodate . . . seamen.'

"That the provisions of this act apply only to vessels the construction of which shall be begun after June 30, 1895."

RECENTLY PATENTED INVENTIONS.

Engineering.

CONSTRUCTION OF VESSELS.—Marie V. T. Dubreuil, New York City. A means of forming two keels in a vessel's hull has been devised by this inventor, whereby the hull will be made stiff both longitudinally and transversely without appreciably increasing its tonnage. The vessel's sides are parallel from the stern to a little beyond the center, and thence tapered to the bow-line, the bottom being tapered upwardly toward the bow for a corresponding distance. The hull comprises an outer covering and a skeleton frame of X braces, the hull bottom following the inverted V shape of the lower members of the braces, and thus forming two keels, giving a stability not attainable in ordinary methods of construction.

THE PROPULSION OF VESSELS BY MEANS OF EXPLOSIVES forms the subject of a further patent by the same inventor, the construction of the vessel being similar, but a cannon-like conductor being located at the stern, and extending from within the hull to its exterior. A rotating receiver has chambers for the explosive material, to register successively with the bore of the conductor, a trip mechanism carried by the receiver actuating the hammer to effect the explosions, which may be made to occur at very frequent intervals, as may be needed to cause the constant forward propulsion of the vessel, and without jar to the vessel itself.

A RUDDER specially designed for the form of vessel above described has also been patented by the same inventor, a rudder being pivoted to the bottom of the vessel at the bow, centrally between the keels, while a fin rudder is located at each side of the hull near the stern, the three rudders being easily operated to steer the vessel much more quickly than would be possible with a single rudder at the stern, the vessel being designed to turn almost on its center.

REGENERATIVE FURNACE VALVE GEAR.—John Kernan and Robert B. Yuille, Pittsburg, Pa. This is a simple and durable gear, easily reversed, to connect and disconnect the gas supply and the furnace and the latter and the chimney flue. Diagonal valve seats are formed in a casing, which may be water-jacketed or lined with fire brick, and which is formed with an open top and bottom and side openings, slide valves sliding on the seats so that when one moves inward the other moves outward, while a plug is held in position in one side of the casing by a weighted lever. The valves can be readily repaired while in an outermost position without stopping or interfering with the work of the furnace.

ANGLE COCK.—William J. Waldron, Fort Worth, Texas. This is a device to be applied only on a manually operated angle cock, by means of supplemental fluid pressure pipes, so that the plug cannot be turned by unauthorized persons and without the knowledge of the engineer in charge of the train. It is a device for locking the train pipe valve or plug, by means of a connection separate from the train pipe and under the control of the engineer.

Railway Appliances.

CAR COUPLING.—Thomas Gaskins, Arcadia, Fla. Two patents have been granted this inventor for improvements in couplings of the Janney type, in which the drawhead has at one side a knuckle to couple with a similar knuckle on the other drawhead, there being means of locking the knuckles rigidly in coupled position or turning them outwardly to be disengaged from each other. The first invention consists chiefly in an improved construction and arrangement of the locking lever which holds the coupling knuckle, whereby the draught strain on the pin is so reduced as to permit it to be operated by hand, even when the draught strain is on, the whole coupling being very cheap, simple, and effective. According to the other patent, means are provided for so locking the knuckles that they may be freely and easily disengaged while the draught strain is on, and there is no necessity for slacking or backing the train to uncouple.

CAR COUPLING.—Charles H. Smith, Birmingham, Ala. This inventor has also devised an improvement in couplings of the Janney type, adapting the coupling for an automatic release of the coupling jaw if the securing devices that retain the coupling drawhead in connection with the cars should accidentally be broken or become loosened, the release preventing the coupling from falling on the track, to occasion the possible derailment of a car in the rear. The improvement is simple, costs but little, and all the parts are substantial and not liable to be deranged by ordinary wear.

NUT LOCK.—Henry Hagon, West Superior, Wis. This is an improvement primarily designed as a simple and effective means of joining the ends of rails and holding the several parts from loosening under the jarring and vibrations incident to train travel, the fish plates being secured to the rails and effectively braced by grip flanges or members, so that they will always be held tightly up against the under face of the rail tread.

NUT LOCK.—Henry B. Eareckson, New York City. This improvement consists essentially of an arm pivoted on the nut and adapted to swing into recesses on the outer end of the bolt and in the nut. While especially designed as a lock on railroad rails, joints, and vehicle axles, it is also applicable to a wide range of other uses, being of simple and durable construction and positively locking the nut in place when screwed up.

Mechanical.

HEEL NAILING MACHINE.—John F. Hines, New York City. This inventor provides an automatically-acting and effective mechanism for bending the rand into the requisite shape and inserting it between the sole and the heel plate. The rand-bending device consists of a series of clips having an articulated connection with one another, a slide having a guided movement to bend the clips, as they hold the rand, around the heel-supporting plate. Spring-pressed followers, arranged between the clips and having a sliding connection therewith, engage the outer edge of the rand and force it inward from between the clip members, a cutter severing the ends of the rands, should they project in front of the heel-supporting plate.

WRENCH.—Alf L. Winge, Miles City, Montana. This inventor has patented an improvement in that class of wrenches which have a sliding jaw adjustable by means of a movable rack, to retain the jaw locked at different points on the lever bar, with means for holding the rack stationary. The improvement presents novel details of construction, affording increased efficiency without adding to the cost of the implement.

Miscellaneous.

WALL PAPER MANUFACTURE.—Paul Groeber, Rutherford, N. J. This invention provides a method of and machine for manufacturing paper having an embossed face with a water color effect. The paper is composed of two firmly united layers of pulp, one sized and the other unsized, to form an absorbent face to receive successive colors and a final embossing impression, the sized pulp sustaining the facing during the processes of printing and embossing. By this means water colors may be employed alone or in connection with the regular pigments, some of the rollers also applying gold, mica, flock, flitters, or other illuminating material, oil, distemper, or varnish pigments.

ROLLER CHUTE.—Edwin W. Fuller, No. 304 Guerrero Street, San Francisco, Cal. This is an improved and extremely simple construction for use on grades to convey sugar cane, lumber, firewood, and other materials. It consists of a series of sections pivotally connected at their adjacent ends to have a limited lateral movement, and each section having in its bottom and side walls transverse openings where rollers are journaled in plates, the plates being removably bolted to the outer faces of the sides of the chute, so that any single roller may be removed without disturbing the others. The chute is inexpensive and easily erected, may be adjusted to varying curves, is very strong, and the material thrown into it will be carried forward and downward by gravity and with but little friction.

FOLDER AND PUNCHER.—Frederick C. Mehnert, Goshen, Ind. In devices for folding blank book sections and punching holes in them, preparatory to binding, this inventor has produced a very simple machine adapted to simultaneously fold the sections and punch the holes, doing the work very rapidly and making the holes all alike. The table has in its top, parallel jaws adjustable toward and from each other to vary the width of the slot, which is entered by a vertically reciprocating folder blade having a lower non-cutting edge with projecting needles or perforating spurs to perforate the paper in the fold for the binding thread without cutting the sheets in two.

CARPET STRETCHER AND JACK.—Hosmer F. Jackson, Tyrone, Pa. This is a simple and inexpensive combination household tool, which may be used as a jack for lifting stoves and other heavy articles, or as a carpet stretcher, a removable crank arm of the tool being also adapted to serve as a tack hammer and claw. The implement is readily manipulated by any one capable of handling even the simplest tool.

DRAPERY FORM.—William H. Knapp, Brooklyn, N. Y. A form readily adjustable to a desired waist or hip measurement, and held in such position, has been patented by this inventor, the form resting upon the floor or other support throughout its entire circumference, thus dispensing with the ordinary base. The form may be worked upon without danger of toppling it over or shifting its position, and may be quickly folded up around a central standard.

BUCKLE.—Solomon Z. Quinn, New York City. Suspender buckles constitute the feature of this improvement, the buckle designed by the inventor securely fastening into the web, while it may also be conveniently unlocked to be shifted on the web to shorten or lengthen the suspender. The frame of the buckle has a crossbar extending over the web at the front, while a clamping toothed bar engages the web at the back, opposite the cross bar, the toothed bar being carried by an auxiliary frame hinged on the main frame and adapted to be locked thereto. The buckle is simple, and may be cheaply made.

CRUMB REMOVER.—James B. O. Shevil, New York City. This is a simple device for table use, having a revoluble brush arranged in front of a crumb-receiving pocket. The brush and its operating gearing are inclosed in a longitudinally slotted casing, to the top of which is pivoted a handle, the oscillation of which is limited by stops. The device is moved over the table in the same manner as a hand brush, and when lifted and taken away the crumbs held in the pocket are not liable to drop out.

THILL TUG.—William H. Cable, Staunton, Va. This is a simple, cheap and automatically locking tug, adapted to snugly embrace the thill, and readily operated to release the thill when desired. The tug holding devices are so arranged that the usual draught braces are dispensed with and the pulling and backing are effected entirely by the tug. The tug proper has a hinged member arranged to be swung up around the shaft, and be detachably connected with the other section, to which the harness is attached, and the releasing devices may be operated from the vehicle to almost instantly unloose the animal in case of a runaway.

LUBRICATOR FOR VEHICLE AXLES. Henry B. Eareckson, New York City. A nut is adapted to be secured on the threaded end of the axle spindle, according to this invention, and the nut has in its top an

oil chamber with an opening leading to the upper end of the feed groove on the spindle. As the chamber is an integral part of the nut, it is always in the proper position, and there is no danger of wasting the lubricant, the spindle being thus oiled without requiring the removal of the wheel.

OVERDRAW CHECK BIT.—Joseph Carter, Blyth, Canada. This bit is independent of the driving bit, and is designed to stay in any position in which it may be placed, not moving up or down in the horse's mouth when the horse is checked. It has a central raised section which may be covered by a cushion, and the ends are slightly curved upward and terminate in eyes, cheek bars connected with the ends of the bit receiving near their connection the check rein, while a nose band is adjustably connected with the cheek bars, there being means for locking the nose strap in a given position.

SLEIGH BRAKE.—Adelbert Mecham, Edinburg, North Dakota. Should the team stop when the sleigh is being drawn up a hill, this brake acts automatically to prevent the sleigh from running backward, and when descending a hill, the action of the team in holding back operates to apply the brake, and thus control the descent of the sleigh. By means of locking devices the brakes are made inoperative when the sleigh is to be backed. The device is inexpensive and is applicable to any form of sleigh.

POLICE NIPPERS.—Leon Brown, Chicago, Ill. This is an improvement in chain nippers, whereby they are so made as to require but a single handle, the loose end of the chain being readily thrown over to an engagement with the handle, forming a loop, which may be contracted upon the wrist of the prisoner by the manipulation of the handle.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
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Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6464) W. C. E. writes: In a town in this State the water supply is pumped from a lake to a reservoir situated at a distance of about 1,800 feet from the pump house, and at an elevation of about 300 feet above the town; the power used to elevate the water is two Worthington compound pumping engines, with steam cylinders 12 and 18½ inches diameter respectively, water cylinders 8½ inches in diameter, all 10 inches stroke, and are of 750,000 gallons capacity each per 24 hours. As the capacity of the pumps greatly exceeds the wants of the village at present, it is proposed to use a portion of the water from the reservoir to operate a 6 inch turbine water wheel, which it is claimed will develop 100 horse power under 300 feet head, to operate a dynamo with which to light the streets. Would this be practicable? Would it cost more or less for fuel to furnish the power for a dynamo in this manner than by an engine directly attached? A. Your pump has a capacity of 520 gallons per minute, and 100 horse power by the best impact wheel requires 1,560 gallons per minute under 300 feet head. So that the total horse power of your pumps is but one-third of the power required. It is a decided waste to pump water by steam for generating water power. Direct steam power for the dynamo is proper and practicable, and the best of all is a combined compound engine and multipolar dynamo.

(6465) J. W. H. asks: What is the loss in friction between the transmission of 100 horse power with direct connections with engine and a bevel gear? Also loss in friction between a direct connected engine and a machine driven by belt? A. The loss of power transmitted by belting is somewhat variable, depending upon thickness, tightness and velocity. On an average the loss is about two per cent by creepage, and the loss by increased journal pressure and flexure of the belt is from ½ to 1 per cent more. A total of 3½ per cent variable. The loss by gearing of equal size and of the larger dimensions, well made and adjusted, is very small, embracing only the friction of the teeth, amounting to from ½ to 1 per cent of the transmitted power.

(6466) G. W. S. writes: I am a reader of the SCIENTIFIC AMERICAN, and would like to know whether in the manufactnre of a small experimental dynamo one would get as good results from a drum armature as a shuttle armature? And if so, ought the size and amount of wire on the armature be the same as would be used in the same dynamo on a shuttle armature? By all means use a drum armature. Make it larger; two or three times the diameter of the shuttle armature. We refer you to SUPPLEMENT, Nos. 161, 599, 600 and 844, for information on the construction of small dynamos; price 10 cents each by mail.

(6467) E. W. H. writes: 1. Kindly tell me how walls are wainscoted with tiles, that is, how the tiles are best fastened to the walls, and what backing is first laid down upon which to lay a tile floor over wooden joist, so as to insure a water tight job free from cracks. A. Portland cement freshly mixed is the best bedding for tiles for walls and floors. For floor backing put in a deafening floor two inches below the top of the beams, well fastened to prevent springing, and fill with good mortar concrete even with top of beams, and on this surface bed the tiles with Portland cement. 2. What thickness of plate glass would you specify for a residence, size of glass 3×3 feet, and how thick should the frames be for such glass? A. If polished plate is to be used, it should be ¼ inch thick. For common plate ⅛ inch or $\frac{3}{32}$ inch is the usual thickness. Frames for the ¼ inch glass should be 1⅞ inch thick, for the thinner glass 1½ inch thick. 3. Would Portland cement be preferable as a mortar to lay brick in a foundation wall, to lime mortar tempered with cement? If so, please give proportions of sand and Portland cement best adapted, and say if such mortar would be unfavorably affected by the heat if it were used in laying chimney brick. A. Portland cement is best for foundation walls in varying proportion with lime according to economy desired. Lime 3 parts, Portland cement 1 part by measure makes a strong mortar with 8 to 10 parts sharp sand. This also makes a good mortar for ordinary house chimneys. 4. What proportions of Portland cement and sand would be best adapted for plastering the inside of a brick cellar wall to make it water tight? A. Equal parts of Portland and clean sand for cellar wall plaster. 5. Is there any objection to the use of sheet lead for gutters, flashings, and flats, and how should the edges of the sheets be soldered together? A. There is no objection to the use of sheet lead for flashings. The edges should be turned up, cleaned by scraping and burned together with a hot iron without solder.

(6468) H. S. L. A. asks: What is the latest theory of electricity? We have several theories of our own make, and would like to know how far we are from the most generally accepted theory of electricity. A. Your question is a very broad one. You will find excellent articles on the subject in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 666, 719, 857, and 995. We can also supply any books on the subject.

(6469) L. B. asks: 1. In what way does the difference in distance between the carbon and platinum points in the Blake transmitter affect the intensity of the current? Does the current decrease according to the amount of air between the points of contact? A. The points are always in contact. The pressure constantly changing causes the variations in current effecting the transmission of sound. 2. If a thin rubber ball filled with carbonic acid gas were placed near to the mouth piece of a bell receiver while in operation, would the sound be increased? Could this sound be retransmitted? A. It would concentrate, not increase the sound. It could be retransmitted. 3. Do you think that it would be in any way possible to obtain power from the rotating of the earth? Has any one ever attempted it? A. This is among the possibilities, but has not yet been demonstrated to be practicable. 4. Have made Page's rotating armature as described in Sloane's "Electrical Toy Making," and it works well as a motor but it will not generate. Cannot surmise what the cause is. If possible suggest a remedy. A. It will generate some current if rotated rapidly enough. 5. Please refer me to some periodical or book telling of the advantages of galvano-cautery. A. For a good treatise or galvano-cautery we refer you to Bigelow's "International System of Electro-Therapeutics," 8vo, cloth, 1160 pages. Price $6 by mail post paid.

(6470) J. D. says: 1. I have constructed storage battery like one described by you some time ago. What would be proper resistance to discharge them through in forming; size of plates 10×12, 7 plates to cell, 26 cells in all? What would be number of hours they would run, and how many 16 candle power lamps would they run, and how long? A. Four ohms resistance will answer for dischargingin series. They should run ten hours and maintain about twenty 16 candle power lamps, but it would be safer to make a large deduction to allow for imperfection of construction. 2. Have motor sixteen segments to commutator, leads give one-quarter turn, brushes work on opposite sides, have three ¼ inch carbons in each brush holder, and in a few minutes' run, commutator and brush holders become so hot that you cannot touch them, and in a short while so hot that it will unsolder leads from commntator. Run with 50 volts about 10 or 12 amperes. Please give me cause for this, and remedy. A. Your field may be out of proportion to your armature, but try giving it less potential. Interpose a resistance in series with it.

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March 26, 1895,

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