Correspondence.

To Prevent Frost on Windows.

To the Editor of the Scientific American:

If F. P. R., in query 5481, November 18, will make his glass double, leaving one-half inch or more space between, and make it air-tight, he will have no more trouble with frost. I have used windows made in that manner for fifteen years, and never saw any frost on them when the space between the glass was air-tight.

W. DAYTON.

Wallingford, Conn., December 4, 1893.

Watching for Shed Fires, Central Pacific Railway.

To the Editor of the Scientific American:

On page 346 is an article under the heading "Snow Sheds of the Union Pacific." The locality described is on the Central Pacific.

In this connection it may be of interest to some of your readers to know that as a further guard against fire a watchman is located high up the mountain side, at Cisco, from which vantage ground he has in view almost the entire line of these forty-odd miles of sheds. Part of his apparatus consists of a dial, with a pointer so arranged that in case of fire at night, by bringing the pointer in line with the blaze and then consulting the dial he is at once able to locate the fire and give the alarm to the fire train at Summit.

The enormous cost of the structure causes the company to take every precaution to guard against its destruction.

WM. L. PATTIANI.

San Francisco, December 1, 1893.

Steam, Heat and Water.

BY JOHN M. TAYLOR.

Steam is pure water expanded by heat into an invisible vapor. Perfect steam is in no way moist, but is as dry as are the permanent gases. It has in a complete degree those properties of fluidity, mobility, elasticity and quality of pressure in every direction that distinguish gases.

Saturated steam is the normal condition of steam generated in free contact with water, and the same density and same pressure always exist in conjunction with the same temperature. It therefore is at both its condensing and generating points, *i. e.*, it is condensed if its temperature is reduced, and more water is evaporated if its temperature is raised.

The pressure and density of steam, generated in free contact with water, rise with the temperature, and reciprocally its temperature rises with the pressure and density. The higher the temperature the more exactly proportionate to the variations of temperature. Under this condition, steam is termed "saturated" from its containing the largest amount of water possible at any given temperature.

The pressure of steam at a boiling point of 212° is equal to the pressure of the atmosphere, which is 14·7 lb. upon a square inch.

The expansive force of the vapor of all fluids is the same at their boiling points.

A cubic inch of water evaporated under ordinary atmospheric pressure is converted into 1,640 cubic inches of steam, or nearly one cubic foot, and it exerts a mechanical force equal to raising $14·7 \times 144 = 2{,}120$ lb. 1 foot high.

One pound pressure of steam will support a column of mercury = 2·0376 inches high.

The boiling point of water varies with the pressure of the atmosphere or vapor under which it is effected.

Steam for heating purposes possesses an advantage over hot water in the ease of its application where great inequalities and frequent alterations of level occur, and particularly when the boiler must be placed higher than the place to be heated. For buildings occupied at intervals, steam is more effective than hot water in its rapid generation of heat.

The most prominent of the properties of steam are its high expansive force, its condensation by the abstraction of its temperature, its concealed or undeveloped heat, and the inverted ratio of its pressure to the space it occupies.

The expansive force of steam arises from the absence of cohesion between and among the particles of water. If a known volume of steam of a certain pressure be made to occupy but one-half of its volume, its elastic power will be doubled.

Steam has an expanding force always equal to the pressure under which it is generated, and its temperature theoretically is always the same as that of the water in contact with it.

The sum of its sensible and latent heat is always the same and is equal to 1,146° above the freezing point of water. Under ordinary atmospheric pressure 27·222 cubic feet weigh one pound, and it has a gravity about equal to one-half that of air at 34°; but if the temperature of air be increased 160°, the gravity of steam will equal two-thirds of the weight of air.

HEAT.

Heat is simply a mode of motion or an influence by which motion is produced among the atoms of substances. The motion is imperceptible, heat being detected only by sense of feeling.

It is a universal force, and is referred to as cause and effect. Heat and cold are conditions and not substances. They are relatively, not absolutely, different, being merely higher or lower degrees of heat.

The three most apparent effects of heat, so far as they relate to the form and dimensions of bodies, are expansion, liquefaction, and vaporization. Its effect is most evident in those bodies which are the least influenced by the attraction of cohesion; thus in solids it is comparatively trifling, in liquids it is much greater, while in gases it is very considerable.

The force with which bodies expand and contract under the influence of an increase or diminution of heat is irresistible, and is one of the greatest forces in nature.

The ratio of expansion in solids and liquids increases with temperature, while in gases it is sensibly uniform at all temperatures.

A unit of heat is the quantity of heat necessary to raise 1 lb. of water 1° F.

Specific heat is the capacity of a body for heat, and is the number of heat units necessary to raise 1 lb. of any substance 1°. The specific heat of all bodies, except gases, increases with their temperatures.

Latent heat is the number of heat units absorbed by any body in passing from a solid state to a liquid or from a liquid to a gaseous condition.

Heat is transmitted or lost by radiation—projected in rays and in straight lines. By convection rising in fluid masses or through flues. By conduction—passing from one body to another in contact.

The heat necessary to warm a pound of water 1° will warm about 4·2 lb. of air 1°, or 2·1 lb. of vapor of water, or 9 lb. of iron, or nearly 2 lb. of ice one degree. The heat necessary to convert 1 lb. of water from 178° (which is about the temperature of return water) to steam is about 1,000 units, and this will heat 52,000 cubic feet of air 1°, or 5,200 cubic feet 10°, or 52 feet 100°, without making allowance for the increase of its bulk because of its expansion, which for a difference of 100° will equal nearly 20 per cent of its original bulk.

WATER.

Whether as a solid, liquid, or gas, water is one of the most wonderful substances in nature. At all temperatures above 32° F. the motion of heat is sufficient to keep its molecules from rigid union; but at 32° the motion becomes so reduced that the atoms seize upon each other and aggregate to a solid.

It is composed by a chemical union of oxygen and hydrogen in the proportions of: By weight, oxygen, 88·9 parts; hydrogen, 1·11 parts. By volume, oxygen, 1 part; hydrogen, 2 parts.

Liquids transmit pressure equally in all directions, unchanged and without loss of power. This equality of pressure is their most characteristic property.

Water at 1,000 ounces is assumed as unity in the comparison of gravity of different substances.

It evaporates at all temperatures, dissolves more substances than any other agent, and has a greater capacity for heat than any other known substance except hydrogen gas.

Twenty volumes of water absorb one volume of air under atmospheric pressure.

A miner's inch is a measure for the flow of water, and is an opening 1 inch square through a plank 2 inches thick, under a head of 6 inches of water, to the upper edge of the opening. It will discharge 11⅝ gallons in one minute.

A cylinder 3½ inches in diameter and 6 inches high will hold almost exactly one quart, and one 7 inches in diameter and 6 inches high will hold very nearly one gallon.

The ratio of fresh water to salt water is about as is 36 to 35 by weight.

Radiation is effected by nature of surface of body; thus, black and rough surfaces radiate and absorb more heat than light and polished surfaces.

Bodies which radiate heat best, absorb it best.

Radiant heat passes through moderate thicknesses of air and gas without suffering any appreciable loss or heating them. When a polished surface receives a ray of heat, it absorbs a portion of it and reflects the rest. The quantity of heat absorbed by the body from its surface is the measure of its absorbing power, and the heat reflecting, that of its reflecting power.

When temperature of a body remains constant, it is in consequence of quantity of heat being equal to quantity of heat absorbed by body.

Reflecting power of a body is complement of its absorbing power; or sum of absorbing and reflecting powers of all bodies is the same. Thus, if quantity of heat which strikes a body=100, and radiating and reflecting power each 90, the absorbent would be 10.

Air and gases are very imperfect conductors. Heat appears to be transmitted through them almost entirely by conveyance, the heated portions of air becoming lighter, and diffusing the heat through the mass in their ascent. Hence, in heating a room with air, the hot air should be introduced at lowest part. Convection of heat refers to transfer and diffusion of heat in a fluid mass, by means of the motion of the particles of the mass.

A low pressure gravity apparatus is the most healthful, economical, cleanly, and perfect heating appliance known, and may be constructed to heat a single room or the largest building with a uniformity that cannot be attained by any other means.

A gravity apparatus is one without an outlet whose circulation is perfect, wasting no water and requiring no mechanical means for returning the water of condensation to the boiler. It has been very properly likened unto the circulation of blood in the human system.

This form of apparatus is extensively employed in warming private houses, churches, schools, and other public buildings, with very satisfactory results. Its chief merits are its safety, noislessness, the ease with which it is managed, the low and uniform temperature of its surfaces, and the positive return of the water of condensation to the boiler under all conditions.

A low pressure gravity circulation apparatus consists of the boiler with its various attachments for the automatic regulation of its draughts and pressures; main steam pipes and risers for conveying the steam to the various parts of a building to be warmed, and the corresponding return risers and mains for the return of condensation to the boiler; relief pipes for relieving the mains and risers of the water of condensation, and for equalizing the pressure throughout the apparatus; radiators for the several rooms to be warmed, with their necessary valves and connections.—*Master Steam Fitter.*

Astronomical Notes.

Professor E. E. Barnard, of the Lick Observatory, recently gave a lecture on astronomy in San Francisco, which is spoken of by the *Scientific and Mining Press* as having been interesting. Many stereopticon illustrations were shown. Professor Barnard said that photography had enabled the astronomers of to-day to see that of which their brethren of a few years ago had never dreamed. Even the trained eye of the most eminent astronomer begins to grow tired after looking through a telescope a minute, and after that his vision becomes less acute. Any object that he fails to notice in that short time passes by unseen. The plate in a camera, however, may be left exposed for hours, during which time even the faintest star will have left at least some slight trace.

About sixty stereopticon views were presented, showing some of the most interesting of the heavenly bodies under varying conditions. In a photograph of the moon's surface could be seen the dark areas called seas and the vast lunar craters.

A picture of the sun's disk revealed a sun spot said to be three times as large as the earth. Ragged-looking holes that looked as if they had been made by a tremendous explosion were plainly visible, and were said to be shattered places in the sun's atmosphere.

Two drawings of the planet Mars were particularly interesting. It will be remembered that this brilliant neighbor of ours is about 35,000,000 miles distant from the earth, and therefore the difficulty of obtaining an accurate representation of it may be imagined. The planet as a whole is of an ocher cast, but the trained eye of the astronomer detects little green spots, believed to be water, and others supposed to be land. At the poles are white spots, evidently ice and snow. This white region diminishes in density as it approaches the equator, and finally disappears altogether. Professor Barnard said that these spots increase in extent as the planet moves away from the sun and the temperature presumably grows colder, thus tending to substantiate the theory that the poles of Mars are surrounded by ice and snow, as are those of the earth.

The streak across the sky commonly known as the Milky Way becomes a thing of beauty when reproduced on canvas by means of a camera. The clouds of countless stars, each one a great sun in itself, assume an added brilliancy that one would hardly suppose exists when looking at them with the naked eye. It requires four hours for this collection of heavenly sparklers to make an impression on the supersensitive plate of a camera, and during all this time the camera is moved by clockwork to keep pace with the stars as they seem to be winging their tireless way through space. The great comet of 1882, which startled all the world with its long tail, was reproduced with startling effect. This comet has a tail 100,000,000 miles long, and will not be again visible to the inhabitants of the earth until 800 years have passed away.

Good Lemonade.

For a quart I take the juice of three lemons, using the rind of one of them. I am careful to peel the rind very thin, getting just the yellow outside; this I cut into pieces and put with the juice and powdered sugar, of which I use two ounces to the quart, in a jug or jar with a cover. When the water is just at the tea point I pour it over the lemon and sugar, cover at once and let it get cold. Try this way once, and you will never make it any other way.