

The Air we breathe.

The subject we have to present this evening is certainly an interesting one, and a comprehensive one, and not to be exhausted in a single lecture. It is much easier to condense the air we breathe, than the air a subject to lecture upon. It expands that is the subject expands, just as we open it up. ~~We do not wish to be too deep, or too superficial,~~ we will desire to present, and seems like the air itself to follow the law of indefinite expansion. — We do not wish to be too deep or too superficial, but we are certain, however, that we will not err, in the former extreme, and as far as time will permit, we will endeavor to avoid the latter extreme. We are aware that many things which we will present, are to most of my hearers trite, and well understood, but we believe it is the case with all true students of Natural Philosophy that, they never tire in their contemplation of the works of the great Creator. It is only the ignorant, and brutish, that must have extraordinary things to excite their astonishment, and make them stare; some brilliant flash of light, some terrific crash, or some mountain bank, commands their attention, they can see no "sermons in stones, or looks in running brooks," or good in any thing." They resemble the pailor, who as the story goes, went to some popular show; When the performance was ~~scarcely~~ finished, an accidental explosion took place under the seats on which the Tax was sitting. Immediately after he found himself, not much ^{the} worse for the accident, in the street, gathering himself up, he went his way, exceedingly

pleased, thinking he had got the full worth of his
money, particularly in the last performance,
which used the show & placed him in the street.
There was something in the ~~idea~~ mind of Jack
striking and elevating in that experiment.

pleased, thinking he had got the full worth of his money, particularly in the last performance, which ended the show, and landed him in the street, there was something in the mind of Jack, both striking and elevating in that experiment.

This intelligent audience I am sure, need no blowing up either literal or metaphorical, in order to interest them in the subject before us.

With respect to the subject itself, - if it is not an interesting one, it ought to be so, - The air, in which we live, and move, and exist. No wonder the Philosophic Greeks, assigned the region of the air to Jove the air! - so essential to life and health - the air the vehicle of speech. ~~and~~ of harsh and terrific as well as of melodious and harmonious sounds. It certainly cannot but be interesting to enquire into some of the properties of this important substance. We will direct your attention, of course in the short time allotted to us, ~~but only in a superficial~~ way, to the Physical condition of the air we breathe, - (2) To some of its mechanical properties. (3) To its chemical constitution, (4) To its relation to life & ~~(5) To~~ the mutual relation of ~~the~~ existing between the animal and vegetable kingdoms.

The Atmosphere is the envelope of the world, completely enclosing it. An ocean of about ¹⁰⁰ fifty miles in depth, with its tides and currents, and its inhabitants, ~~That~~ That the atmosphere is limited appears from the following considerations. If it were not so, it would aggregate about ~~the planets and~~ the moon, but on the moon there is if any, only an extremely attenuated atmosphere, and it seems more consistent with our ideas of the constitution of aeriform bodies, to regard it as having as well a defined upper surface as the ocean itself. The constitution of a gaseous body, ~~the volume it occupies~~ depends on the pressure to which it is subjected, and the repulsion among its particles which grows less and less the further they are removed, and as the ~~particles~~ relative positions of particles depends on the balancing of the forces of attraction and repulsion, ~~and as~~ it

is plain that where there is the superadded force as there is in the case before us, of the attraction of the earth, that there will be a point ^{reaching} where the particles will no longer separate from each other, and that as a consequence the upper regions of the atmosphere will have a perfectly defined surface. — The atmosphere is usually stated as being about 45 miles in depth, but from some observations on the altitude of meteors or shooting stars, it is probable that it is probably more than double that number ^{a miles}. We ~~can~~ do not know that it would ~~be~~ be proper to say that the air has any taste, or when perfectly pure has any smell, but it certainly has color — it is not as many think an invisible substance — ~~we~~ Should we take up a glass of the water of the lakes or of the ocean, we might be disposed to pronounce it colorless, but when we look at the great ~~mass~~ body of it in the lake or ocean, we pronounce it green or blue, so with the air — When we look at the vault of heaven in a clear day — we will speak of the azure sky, and, even the ~~house~~ painter finds no difficulty in making a beautiful sky blue, and what is this blue but the color of the air, as we ascend the high mountains the color of the sky becomes darker & darker, and could we penetrate the atmosphere completely, ^{the heaven alone} it would appear black and the stars would be seen at noon day & the sun would be seen of its beams, — ~~then~~ It is this atmosphere which by the rays of the sun becomes drenched in light, and then diffuses the light of the sun ~~in~~ over the surface of the

earth in places hidden from its direct rays. Were it not for this capability of the air, to throw off from itself in every direction, all shadows would be intensely black, unless in the range of some illuminated surface receiving direct rays from the sun. — It is too to this property of the air, that we have not a sudden transition at sunrise from darkness to light, and at sunset from light to darkness, — and in the eyelid of the morning and of the evening, we see beautifully presented, the round shadow of the earth on which we live. In this connection when speaking of the Physical condition of the air, we should not forget to refer to its refracting power, its capability of deviating a ray of light, thus causing all heavenly bodies, unless at the zenith, to ~~be slight~~ appear slightly elevated above their proper place. By this arrangement, the sun is seen at sunrise, above the horizon, when he is actually below, and the same at sunset, thus lengthening ^{the time} ~~our day~~ ^{that the sun is visible} light by about four minutes. —

5.
2. We will now mention a few of the mechanical properties of the air. —

First. The air has weight. We are sorry that we have not the apparatus for proving this directly. the experiment however is a simple one. A light copper flask is taken, and ~~is~~ is accurately weighed the air is pumped out of it, and it is then found to weigh less. A hundred cubic feet of air weigh one seven and a half pounds. ~~the~~ The weight of the air in ~~a room~~ an ordinary sized room, fifteen by fifteen feet square & 10 feet high, would weigh about 172 lbs, and this would measure the ascensional force of the air, we mean by that if we had a void space, of this dimension, and contained in an envelope without weight, it would be carried upwards with this force. — Or if we had a balloon of this capacity, filled with a gas lighter than air, it would be elevated with a force equal to the difference of its weight & the weight of the equal bulk of air, for example suppose the balloon is filled with hydrogen, the weight of which is about 14 times lighter than air and the balloon itself weighed 50 lbs, there would be a downward force of about 62 lbs, and an upward of 172, leaving a balance in favor of the upward effort of 110, lbs, and of course the balloon would go up, and could too carry a considerable load with it. — As every heavy body that has weight, presses on the surface on which it rests, so this air presses, with great force on the surface of the earth and sea and on all bodies on the surface. — The instrument by which this pressure is shown and accurately measured, was one of the

great inventions of the nineteenth century. It was noticed by Sallies that water would not rise by what is called suction, higher than about 34 feet, and Toricelli, ~~the~~ the inventor of the barometer showed that the pressure of the air was the cause of the water standing at the height of 34 ft and of mercury which is 13.5 as heavy as water standing at 30 inches. — The barom. is a very simple instrument —

Exhibit. tube filled with mercury.

Show that it is the perpendicular elevation that is sustained by the air. ~~idea~~

Explain how it is proved that the weight on a square inch is 15 lbs. —

Water held up by a card —

All bodies in the air are subjected to this pressure, sometimes a little more & sometimes a little less depending on the varying pressure of the atmosphere. And as a column of water of 34 feet presses with the same force the fishes of the sea have to sustain in proportion to the depths at which they are found correspondingly great pressures. ~~The case of a man~~. The hide of a common sized man, would measure about 11 square feet, and the pressure he sustains without feeling it is as many tons what would be considered as several wagon loads. To understand ^{how this pressure occasions no inconvenience} this, we must remember, that air has not only weight, but that it is highly elastic, and, a small bubble can resist the pressure of arising from the dead weight miles of a column miles in length, that ~~our~~ bodies are pervaded by these elastic fluids, and the pressure without is thus resisted by pressure within, and the forces so nice,

by balanced and distributed that we are unconscious of them. And it is only when the equilibrium is destroyed that we are made sensible of them. This is readily illustrated by the cupping & glass. and by the air pump. —

Expts. The pressure on the hand.

The pressure on a membrane

The hemispheres.

The fountain, The fountain & condensed air.

We have already referred to the elasticity of the air, its springiness, ~~and~~ in virtue of which the small bubble resists the pressure of the whole atmosphere ~~dead~~ weight of the atmosphere to which it is subjected. An interesting and important principle, the same or analogous to, that we see in hard bodies such as glass, ivory, or steel, or in the softer bodies Indian rubber, woolen yarn &c, in virtue of this principle the bulk of a given quantity of air enlarges, just as the pressure is decreased, and its bulk decreases just as the pressure is increased. If we had a column of air say one inch in ~~height~~ ^{cross section} and six inches ^{compared in a strong glass tube & air} long, such as we are now breathing and connect it with a steam boiler for example in which the force of the steam is exerting a pressure twice as great as the atmosphere, — the air would be compressed to half its size, and occupy but three inches, if subjected to the pressure of 3 times, the ordinary pressure, it would occupy but two inches or one third of the space, and so on. It is in this way certain steam gauges are made, to indicate the pressure exerted by the steam in the boiler of an engine. — ~~We~~ We living in this world are adapted to this pressure, & were it greatly increased or

or diminished, it would put us to great inconvenience. A kind creator has admirably given to the human system, a great adapting power. Man can endure great changes of temperature, he can live in the torrid and in the Frigid zone. He can live in deep mines and at ^{considerable} ~~great~~ elevations above the level of the sea. But travellers feel the effects of the rarified air of high mountains in the lassitude and oppression that they experience. If we were to take a barometer to the height of 3 miles above the level of the sea, the "mercury" would stand at 15 inches. at 6 miles, 7.50 inches. at 15 miles 1 inch. → A diminution in pressure would no doubt affect very much the growth of plants, it would influence evaporation, reducing the temperature at which fluids boil, ~~and~~ —

Another result of the elasticity of the air, which we can barely stop to mention, is its being the medium by which we hear. Connected with this faculty of hearing, there are some most wonderful and interesting facts. That the air is the medium of sound, is proved by the very simple experiment, of striking a bell in the vacuum of an air pump, a very feeble sound is heard, weaker in proportion to the completeness of the vacuum, and the care with which the experiment is conducted. The mechanism of the ear proves the same thing, and though the sound-wave may travel through the solid rock or liquid water, the wave motion is always at the ear communicated to air, before it makes its impression on the auditory nerve. — When a stone is thrown into water, we can see the concentric waves proceeding in circles from the point of disturbance, so when the air is disturbed, by a sudden impulse, the wave or

1

pulse runs out, and at last communicates the motion to the air. The different tones, from the lowest bass to the highest squeak, are caused by the different lengths of these waves. The loudness, not at all by the length of the wave, but by the ~~lissing force~~ degree of motion, that the moving particles of the wave have, - and these waves creep and recrawl each other, and do not perceptibly interfere or destroy each other, persons talking ~~at the same time~~ ^{together}, & while perhaps a band of music is playing can hear at the same time a multitude of sounds, the waves producing which must be creeping and recrawling continually. - and all these different tones & noises, caused by waves varying from an inch and a quarter, to 32 ft, ~~perhaps~~ all travel through the air at the same rate, if it were not so, a piece of music would be completely deranged, and thrown into confusion, by the ~~person changing his~~ ^{hearer changing his} distance from the source of sound. If for example, a note and its octave should be sounded in succession, if the second and higher note moved more rapidly than the lower, though sounded last it might be heard simultaneously with the first or before it, and of course a sound, ^{or succession of sounds} altogether different from the one at the origin be produced. - We need not here refer to the excellency of the sense of hearing, and to the pleasure derived from music, all know, and doubtless appreciate them, let us ~~admission~~ for a moment reflect on the wonderful structure of the air, capable of being thrown into such a tremulous motion, and this too so little affected by heat or cold, or wind, and so extensively, that the last perceptible wave ^{front} of the steam whistle is at least in every direction 6 miles from its origin, ~~so gently that,~~ and notwithstanding the loudness of the sound, the per-

ticles of dust in the sunbeam are not disturbed by it, and what shall we say of that piece of mechanism, the ear, which the creator has made for the reception and distinguishing of these sounds so that, it can hear a dozen sounds at once, and make a distinction in some mysterious way of the qualities of sound, sound the same note on a flute and on the violin, the ear can perceive a difference. Two persons speak, and though they may speak in the same key, yet ~~we~~ there is a difference in the tone which the ear easily takes up. —

Much might be said of the agency of mechanical force of the air in motion. The air is very seldom stagnant, it is very seldom we can say with truth, that "there is not a breath of air stirring". In a warm summer day, we are refreshed by the gentle breezes, and in winter, at gambols of the wind rattling our shutters, and ~~so~~ whistling around the house while we sit comfortably and cozily around the fire, and sometimes too, when thus enjoying the comforts of home, we forget that this very wind, which enhances our feeling of comfort, is toppling the vessel on our narrow lakes, as if they were straws, and perhaps stranding them on the shores, & straying both vessel & crew. One great use of the wind, is to stir the atmosphere, & give it uniformity. ^{The aerial currents or winds, which have some uniformity about them are caused} ~~and this is in a general way effected~~, by the unequal heating of the earth, at the equatorial regions, the air is heated and rises, distributing itself toward the north and south, and in the upper regions of the atmosphere, while the colder

air rolls in from the north, and influenced by the rotatory motion of the earth, produces the trade winds, which constantly blow, from the N.E. to S.W. & nearly parallel to the equator, in the torrid zone. . . . Sometimes there are extraordinary Disturbances of the equilibrium of the atmosphere, giving rise to tornadoes which sweep with such destructive violence over the earth. - Nothing can give us a grander idea of the mechanical power, there is, in the light, and almost imperceptible fluid in which we are constantly immersed, ^{than these hurricanes} Large trees, are torn up by their roots, or twisted off, as we twist off a green corn stalk, Houses are swept off, and their fragments scattered over miles - Destruction and desolation mark the path of the hurricane throughout the whole extent of its course. When we reflect on the what has already been said respecting the immense pressure of the air, we will not wonder at the great force it can exert, when this pressure is not fully resisted, ~~the~~ as is the case when from heat or other causes the equilibrium of the atmosphere is disturbed. - Men take advantage of this power, and use the wind to propel their vessels, over the ocean, and to drive the sails of the windmill, to grind their corn, and sometimes they attempt, metaphorically to raise the wind for special purposes. . .

Exp^t Influence of air on temperature. Water frozen on evaporation - ether in vacuum

Let us now, after this hasty glance at the physical condition and mechanical properties of the air, ~~to~~ ^{enquire} look at its chemical constitution. — For some 5700 years, commencing with the time that God breathed into Adam's nostrils the breath of life, till toward the close of the last century, during which time every human being ~~that breathed~~ and every animal, that ~~breathed~~ has been inhaling, this vital air, this indispensable to life, ~~and~~ ^{but while then} knew nothing about its constitution. We mention this more for the sake of showing how strange it is that so easily a demonstrable fact, could have escaped observation so long. It gives us no special advantage to ~~know~~ ^{what the air is} as to our use of the air in respiration to know what it is composed of. God made the air, & has adapted the lungs, and ~~the~~ ^{the} ~~circulation~~ ^{respiration} to it, and this useful function is in no way dependant on our knowledge, and hardly on our will. We may however from a knowledge of the constitution of the air, & the wants of the respiratory system, be able sometimes to ~~tell~~ know what is ~~what~~ wanting when we feel languid, ~~or~~ what is necessary for a patient ~~in~~ suffering from disease & poisoned by the suffocating air of a close room. —

The ancients regarded the air as one of the elements, the researches of Beutherford, Priestly, Scheele, Cavendish & Lavoisier, established its compound character, It is hard to say to which of these distinguished Philosophers, the greatest credit is due, It was Lavoisier however who determined with precision its composition.

We need not detain to trace the steps by which this important discovery was made, for many years before the discovery of oxygen by Priestly, chemists were just on the eve of getting insight into the nature of air, but the dogma, that air is one of the four elements seems to have blinded the minds of chemists, that in the experiments made, in which both the constituents of the air manifested themselves they failed to see them, and regarded all gaseous bodies as that were obtained as only modifications of common air. — Now, it seems strange on account of the simplicity of the analysis, that the discovery was not made long ago, — but in this, as in the case of Columbus' egg, it is easy to prove the composition of the air, when we have learned how. —

The air is composed of Nitrogen and Oxygen, 79 parts of the former to 21 of the latter. or in other words, about one fifth of the air is Oxygen. —

— The Nitrogen of the air is obtained in the following simple way —

~~Burn out~~ Remove the oxygen by burning a piece of phosphorus in air. —

Exhibit the eudiometer. Made by slow combustion of P.

Exhibit, Nitrogen, show that it will not support combustion. —

Use of N. as a diluent. +

Mention some of the compounds of. —

Show, as an illustration of the different substances produced by the union of the same elements, the action of Nitric Acid on Copper. —

The other element, in one respect the most important, since it gives to air its power to support combustion and life, while the Nitrogen acts as a mere diluent, like water in the strong alcohol, is Oxygen. - This ^{quite} so easily prepared. - We must mention here ^{Priestley's} Lavoisier's experiment. He put some of the red oxide of mercury, before his time called as it is yet by many, red precipitate and after heating it floating on the surface of some liquid ~~Hg~~, in a jar of dry air, Mercury in a glass bell, a gas was evolved which depressed the Mercury, and in which the taper burnt as in the air, only more vividly. - This was oxygen. Lavoisier conducted the experiment thus, "he heated the mercury in contact with a known portion of air, it gradually acquired a red film, which after some days ceased to be formed, and the metal remained unaltered he then withdrew the fire, & suffered the vessel to cool, he found that the air had diminished in bulk and that the mercury had increased in weight, that the loss of the one was equal the gain of the other, having absorbed the oxygen of the air leaving the N. unaltered." - And on mixing together O & N in the proportion as indicated by their experiment he formed a gaseous mixture with all the properties of atmospheric air. -

If red oxide of Mercury were sufficiently cheap this would be, perhaps not a very healthy, but a very convenient way of preparing this element. -

There are many ways of preparing it, the most convenient, per chlorate of Potassa. -

Exhibit the gas. Burn stick -

Burn, charcoal. Phosphorus. Iron wire. -

It is that which corrodes iron, it is that which de-¹⁵
stroy, the dead timber in the woods, & it is to guard against
its destructive power, that air tight cans are so much used now
for the preservation of articles of food. It is the Prince of the ~~period~~
^{of the air}

This Oxygen was called by Condorcet, vital air,
the air of life. - It is also the great destroyer.
As soon as the vital spirit has gone, it immedi-
ately falls to work on the lifeless body, and consumes
it, and sometimes before life is extinct, it com-
mences its destructive work -

In addition to the Nitrogen & Oxygen, we find
in the air always a small ^{variable} percentage, ~~vari~~ of Car-
bonic acid gas. - Small as it is, it plays a
most important part in the atmosphere. -
We will not detain with the exhibition of this
substance, It is easily generated & produced. Now
every animal that breathes & every fire that burns
throws Carbonic acid into the air, - All ferment-
ing liquors, cider, wine, beer, throw it off.

It is the gas that puffs up our bread and makes
it light, ~~and~~ which ~~also~~ imparts an agreeable
pungency to all effervescing drinks. - We sometimes
hear of ~~direst~~ ^{bad} consequences, in having a man
who would be first rate on the farm, figuring in the
halls of legislation, and some who are great in the
forum would starve on the farm, so it is with
this Carbonic acid, it goes into the stomach
easily, and sits there well, ~~but~~ & promotes health
but, let it be taken ~~by~~ into the lungs, & soon
a stupor follows, & then death. CO_2 is a deadly
poison, & we frequently see the papers accounts of
persons losing their lives by the damp, the ~~damp~~
damp, in wells...

The air is the receptacle and solvent
of all volatile substances, just as ~~the~~ our
streams and lakes and the ocean itself
are the receptacles of grosser soluble
matter that finds its way into them

But we ^{say} ~~will~~ that the ocean and lakes
 and ~~at~~ rivers are bodies of water; so the at-
 mosphere in its purity may be regarded as
 composed of oxygen 21 , and Nitrogen 79 , regard-
 less of those instances that, though always
 found in it, some of them essential indeed to the
 life animal and vegetable life, ~~but~~ are found
 in it in variable proportions. - for example
 we do not regard air as a constituent of Water;
 But the air dissolved in water as nature usually
 presents it, is essential to the life and com-
 fort of the fishes as it is to human beings.
 Strange as it may seem, we could smother
 a fish in water, by covering ~~it~~ up the vessel
 of water containing it in an air tight vessel
~~almost~~ as readily as we could kill what is
 called an air breathing animal, by confining it
 in a limited portion of air, & thus while the
 fishes have the air held in solution in their
 medium, the water, animals have the water
 held in solution in their medium, the air,
 sometimes in large quantities sometimes in
 smaller, but we may say never, though sometimes
 we call ~~it~~ the atmosphere very dry, never destitute
 of it.

There are various other substances, that are
 found in the air. - Some of these readily detected
 and measured by the chemist, & some so exceedingly
 by subtle, as to preclude their isolation, but
 present themselves to the sense of smell, and
 shows what a delicate test, the nose is, in
 some cases. - "The spicy breezes which blow
 from Ceylon's isle", as well as some other
 breezes that are not so spicy, are only

known to the nose, it is only the nose that knows them. And what a variety of substances there ~~differs~~ ^{must be} in the atmosphere, the almost infinite variety of odors, perfumes, scents, which every one who has a nose, can perceive, testify. It is said that Coleridge, when in ~~the city of~~ Cologne, the seat of the manufacture of Cologne-water, counted no less than seventy distinguishable, bad-smells, while walking through the streets of the celebrated city, which is always associated in our minds with the most delightful fragrance. In this case it is certainly the distance that lends enchantment to the nose. —

We might discourse largely here on the subject of effluvia, ~~but~~ but we pass on, saying nothing about the carbonated hydrogen, the ammonia, the sulphuretted hydrogen, which are found in ~~general~~ only in small quantities, or as the chemist would say, ~~in~~ in traces, in the atmosphere, except where there may be some local source, to the more interesting subject, that of respiration, ~~and~~ and here we must necessarily be brief ~~and superficial~~. —

It has already been stated that we live in this Ocean of air ~~surrounding~~ enveloping the world. ~~Whether~~ Whether the Creator whose wisdom is unsearchable, made the atmosphere with reference to the wants of the animated beings on this world, or adapted the beings that he has created and endued with life, to it, we do not know, but, as we believe that Creator ~~has~~ knew from all eternity, every thing that has happened, and every thing that will happen in all time to come, we believe in a mutual

adaptation of, of that is the air was constituted as
 it is to suit air breathing animals, and all animals
 in whose nostrils is the breath of life are adapted, to
 it, so with the light and the eye, so with the
 strength of the body, and the force of gravitation, ~~so~~
 so with the mutual relation of the animal & vege-
 table creation. If we were to look at a Picture
 and we should see some of the trees with green
 foliage, and others close beside them stripped of their leaves
 and covered with snow, and in one field, hay makers
 in the warm sunshine making hay, and in the adjacent
 field covered with to it a pond covered with ice
 and skaters upon it, some persons sitting under
 trees cooling themselves with fans, ^{others} ~~and~~ drying post, a
 sleigh load muffled up in the robes of winter -
 we would exclaim ~~the~~ what a picture, the painter
 must be cracked, or in jest, when he created
 such an absurdity. The things are not in keeping.
~~The scene would suggest~~ The snow, the skating
 the muffling up, all ~~and~~ are concordant, this one
 naturally suggests the other, ~~and~~ the one is
 dependent on the other. So when we look at
 God's creation, we see none of these inconsistencies
 brought together, ~~and~~ wonderful harmony pervades
 the whole, so that it almost seems to us, that
 as Agassiz, from the scale of a fossil fish
 reconstructed so to speak the fish, so we can con-
 ceive of an intelligence, ~~to whom~~, if an animal
 cule were given, could reconstruct the universe.
 But to the subject before us. The air is
 the breath of life. How is used? ~~and~~ It is we
 may call it the food of the lungs. ~~the~~ It is as
 necessary for our life & health as the food we
 eat, indeed respiration and digestion are

mutually dependant, ~~and~~ operations. The food we eat is digested, and undergoes in the first place a proximate analysis, and a portion of it is thrown into the blood, and is conveyed to the heart, and from thence to the lungs, where it undergoes a remarkable change, the ^{dark} ~~blue~~ ^{arterial} blood of the veins being converted into the red blood of the arteries, through the agency of the air, & then is returned to the left ^{chamber} ~~side~~ of the heart and from thence, laden with vitality and nourishment it is conveyed to all parts of the system distributing, heat and its precious load of material, and receiving ~~at the~~ at the same time and conveying to the veins, waste material which the veins also gather up in their course, it is returned to the heart, ~~there~~ & the lungs there to be revived, and prepared again to run its course. — This operation of respiration is part mechanical and part chemical. Supposing that something is known of the anatomy of ~~human~~ body, we may regard the inflation of the lungs, as dependant on the enlargement of the cavity of the chest. Any one can notice for himself, that when air is inhaled, the ribs are raised up, and this in conjunction with the depression of the diaphragm, enlarges the cavity of the thorax. The air must then of necessity rush in through the nostrils, and fill the air cells of the lungs. — Expt. This may be thus illustrated. —

~~Expt~~

Expt

You will please to observe that just as in this cup¹ the air on the one side of the membrane is separated from the air on the other side by the membrane so it is in the lungs, ~~as in~~ The blood is on the one side, and the air is on the other side of the little vessel into which it is drawn, and the action takes place through the membrane in a very remarkable way. The doctors, who love to use big words, call it endosmose & exosmose. In other words, the constituent of the air, already presented, as its active principle oxygen, leaks inward, while at the same time, Carbonic acid and watery vapor leak outward, that there is such a leaking out and leaking through membranes can be proved by a variety of experiments which I have not time to detail, let alone present. - -

The functions of digestion, circulation of the blood, & respiration are as already hinted, intimately connected with each other, The growth and the waste of the system, depends on the proper carrying on of these operations, and the proper carrying on of these operations, supposing the apparatus to be in order, that is in a healthy condition, depends on the air we breathe, if that is not of the proper constitution, if it is vitiated by poisonous gases and effluvia, of course, the lungs cannot do their duty, the heart cannot receive and distribute through its different arteries, healthy blood, and digestion cannot be properly performed, & in a word the whole system is deranged. We ^{do} not wish to convey the idea, that all that is necessary for healthy action, is pure air. Should the stomach be

crammed with un~~be~~ wholesome food, the disorder may
 commence there, and so also if any important
 portion of this ~~wonderful~~ ^{complex} aggregation of systems
 which is so fearfully and wonderfully made, is
 put in circumstances either through carelessness
 or abuse, where it cannot perform its functions
 properly, the whole ~~structure~~, machinery is thrown
 out of order, and disease and often death are
 the result. — But our desire here is to bring more
 prominently forward the mutual relation of the
~~health of the body~~ ^{functions of respiration} and the air. — We are
 in this world adapted to its degree of purity in
 our bodies, and no doubt our bodies could adapt
 themselves to considerable variations in the degree
 of purity, but a sudden & considerable change, ~~and~~
~~no doubt~~ either making it less or greater, would
 be attended with injurious consequences to the ani-
 mated world. — The heat of our bodies as well as
 of our houses depends on the air. There is a close
 analogy in the heating of house by a furnace
 and the heating of the body. We feed our fires, with
 fuel, all of which fuel contains both charcoal &
 Hydrogen, ~~the~~ one of the most, if not the most com-
 bustible substance known, by the union of the oxy-
 gen of the air, ~~and~~ every one who has made a fire
 knows the necessity of giving the fire air, in order
 that it may burn, carbonic acid, and water
 are produced which are carried up the chim-
 ney, now this union of the carbon & oxygen,
 as shown in the experiment, produces much heat,
 the union of oxygen & hydrogen produces still more,
 and ~~that~~ a portion of this heat is thrown into
 our rooms, and renders them ~~very~~ comfortable in
 the season of cold. — In like manner, we take

food, all of which contains carbon & hydrogen; this food undergoes a chemical change in the digestive organs, ~~preparing it for being carried through the system by the blood, and a portion of it deposited~~ and in the circulation, and as from ~~our~~ ^{our nostrils} ~~are evolved~~ ^{are evolved} Carbonic Acid and Water, ~~as we breathe out of our nostrils, these very same substances,~~ ^{as are produced in our fires.} We present this, as an analogy, and doubtless to a great extent the process by which animal heat is maintained, is that which we have presented, yet, there are many things, as to the precise mode in which the heating and nourishing of the body through the intervention of food and air, which ^{about} Physiologists are still in the dark. ~~concerning~~

Expt. To show the CO_2 of the breath.

Expt. To show that CO_2 will not support life

This gas, Carbonic Acid, which is breathed out mixed however with common air, is exceedingly poisonous. It is however as already stated constantly thrown into the air, by animals breathing, fires burning, and from some natural sources in the earth, - When as is sometimes done by persons who are not aware of this, the air tight stove is in cold weather heated strongly, the windows tightly closed, and sometimes the cracks tightly stuffed, a candle or lamp burning in the room, and perhaps two or three persons breathing, we see at once what a source of vitiated air there is, and the Physician who knows anything about his business, can easily account for the headache, languor, depression of spirits of those who thus without knowing what they are about, are gradually

undermining their health and cutting off half their
 days. — An air tight stove, bad ventilator as it
 is, may do in a large room, where the doors
 are frequently opened, or where the foul air can
 be suffered to escape from above, but used as
 we have described, and as they frequently are, they
 are an abomination. — Much better is the
~~board~~ settler in his log cabin, with the door
 wide open by day, and plenty of air holes in every
 corner of the house, which he cannot conveniently
 close at night, far better is he with us say,
 with his big fire and roaring blaze, drawing
 through the house a new supply of fresh air
 every minute. — But some one will say, open
 fires are so expensive, they consume a power of
 wood, no doubt they do, but, this will be found
 to be the case, that we do not require so much
 external heat, ~~the~~ provided we inhale fresh air
 and take proper exercise, we have then a source of
 heat within ourselves; & further it may be a
 matter of taste, but I, much as I respect the pro-
 fession of the Physician, would prefer to pay to
 the honest wood ^{chopper} ~~the~~ the ^{gains arising} difference of cost, than
 this very miserable economy, than to the
 Physi-Doctor, skilful and gentlemanly though
 he might be. — We find sometimes in rail cars
 and in rooms of public houses, air vitiated, by
 the roasted saliva, of some persons, who seem to
 have special pleasure, in ~~seeing~~ projecting this
~~secretion~~ ^{secretion} upon the moldering stove. First one
 comes in and then another, each presents his
 offering, and ~~the~~ if as too often is the case, the
 infusion of tobacco is mingled with the saliva.
 What a Stygian Stench we have.

Sometimes again, we are compelled to remain a little while in some public place, and some one not knowing what decency is, vitiates the air, with the fume of a cigar. It is a matter of indifference to him whether the odor is agreeable or disagreeable to others, so long as he is gratified, what odds is it to him, whether others are piqued or disgusted, "let every one take care of himself," is his motto, as the jacks said when he danced among the chickens."

The baleful effects of vitiated air are well illustrated, by the dreadful death of the British soldiers in the black hole of Calcutta. ~~The~~

"In the year 1756 ^{when} Siraj-ud-Daulah, who reduced Calcutta, the English prisoners in number 146 were confined in the black hole prison; it was about 8 o'clock, when the unhappy persons exhausted by continual action and fatigue, were thus crammed together into a dungeon about 18 ft square, in a close sultry night in Bengal. shut up to the east and south, the only quarters from whence air could reach them, by dead walls, and by a wall & door to the north, open only to the west by two windows, strongly barred with iron, from which they could receive scarce any circulation of fresh air. They had been but a few minutes confined, before every one fell into a perspiration, so profuse that no idea can be formed of it. This brought on a raging thirst which increased in proportion as the body was drained by its superfluities. Every man was stripped, and every hut put in motion, they put down several times, but at every time ~~the~~ ^{some} ~~of~~ the poor creatures fell & were instantly suffocated or ~~too~~

to death. Before 3 O'Clock, every man's thirst grew
 intolerable, and respiration difficult, efforts
 were again made to force the door, but
 still in vain. Many insults were used to the
 guards, to provoke them to fire in upon the
 prisoners, who grew outrageous and many de-
 licious. Water Water was the general cry.
 Some water was brought; but these supplies
 like sprinkling water on fire only served to
 raise and feed the flames, the confusion be-
 came general and horrid, from the cries &
 ravings for water & some were trampled to
 death. This scene of misery proved entertain-
 ment to the brutal wretches without who
 supplied them with water, that they ^{might} have
 the satisfaction, of seeing them fight for it.
 and held up lights to the bars, that they
 might lose no part of the inhuman over-
 sion. Before 11 O'Clock one third of the whole
 were dead; thirst grew intolerable, but Mr
 Adull (the commander) kept out his mouth
 moist by sucking the perspiration from his
 shirt sleeves, and catching the drops as they
 fell from like heavy rain from his head & face.
 About half after eleven, most of the living were
 in an outrageous delirium, they found that water
 heightened their uneasiness, and air 'air' was
 the general cry, — — — About two O'Clock in the
 morning ~~was~~ they crowded so much to the
 windows that many died standing; unable
 to fall from the pressure around them. When
 the day broke the stench arising from the
 dead bodies was insupportable. — At that juncture
 the Soubah who had received an account

of the havoc that death had made among them
 sent to enquire if the chief survived, Mitchell
 well was shown, and near 90°C . an order
 came for their release. Thus they ^{had} remained
 in this infernal prison, from 80°C . at night
 till 6 in the morning, when ~~the~~ but 23
 of the 146 came out alive, & most of these
 in a high putrid fever. Res. Exp. Cal. —
 We have here presented to us, ~~the~~ the terri-
 ble effects, and concentrated misery produced by
 breathing impure air. ~~What a dreadful disease~~
~~is this dreadful disease.~~ We have no doubt
 but that many distillate over a number of years
 and thus of course diminish the intensity of suffer-
 ing, a similar disease condition, by constantly
 breathing vitiated air. —

In ~~concluding~~ this very imperfect sketch of
 of this most interesting subject, we have said
 nothing of electrical Phenomena, of rain &
 snow, ~~as before in air~~, — the connection
 of which with our well being in this world,
 are very obvious, and ought not to be passed over
 in silence. There is another subject, which we
 had designed to refer ~~to~~ somewhat in detail,
 viz. — the purification of the air. & We have
 spoken of the poisonous Carbonic Acid, which
 from so many sources is constantly thrown
 into it, and in very large quantities too, still
 we have no reason to believe that the air
 in the days of Adam was purer than it is now.
 The interesting inquiry is how has this purity
 been preserved? Modern Science has solved this
 problem & presented another evidence of the great

the sky were always, covered with unbroken clouds,

+ the transparent air! Suppose, that God had made every day ^{like some we have had} ~~like this~~, the sky overcast, we doubtless could have lived in such an arrangement of things, — What wonderful things there would have been hidden from the view, we would have the light of the sun and the moon, but what the faces of those luminaries, would not be seen; As travellers tell us sometimes of the strange appearances in the sky presented in the icy and almost unapproachable regions of the North, so, we might learn from some who had with much toil ascended high mountains, above the regions of the clouds, of the ^{magnificent} ~~the~~ ^{orb. of light} ~~the~~ sun, and the ^{beautiful} ~~gorgeous~~ appearance of the heavens illuminated by the constellations, ~~if this had been the case~~ ^{if this had been the case} ~~what would have been the science of Astronomy, the ability of men to find their way through the pathless deep, we hardly say too much, that should we say that human civilization depends on the transparency of the air.~~

acc

wisdom of the creator. ~~The~~ The vegetable productions of the earth, in addition to the innumerable other purposes they ~~serve~~ ^{serve}, are the purifiers of the air. They take up the carbon a charcoal of that poisonous Carbonic Acid of which we spoke and throw back into the air the oxygen with which it is united, All know how much charcoal there is in wood, the greater part of this is taken from the air by the plants, through their leaves. ~~By~~ By this beautiful arrangement, a circulation is kept up, and the normal condition of the air maintained. —

The beautiful air! As pleasing to the eye what color makes a more agreeable impression than the pure sky blue, & what presents to us more pleasing spectacles than the atmosphere around us. The ^{rich} gorgeous coloring of the clouds when rising purpled Aurora is heralding the approach of the King of Day - or when in setting the graceful and often fantastic forms of clouds ~~are~~ shining in golden & in silver light, remind of a still brighter & more beautiful land beyond the skies. ~~There~~ ~~which~~ And often variety is given, by the haloes and coronae of the sun and moon, and the sacramental rain-bow, ~~the~~ decorated with the colors of the divided rainbow. ~~The~~ The morning air! sometimes ^{wafting} us with its gentle breezes, ^{the pure} and again ^{the pure} sweeping over the earth in its fury, bearing with the terrific thunder, tearing up trees like straws, and lashing old Ocean into a fury, and ~~being~~ ^{being} destroying the mightiest strong ships, the proudest works of human art.

The ~~air~~ undulating air! So constituted by the creator as to be capable of being thrown into a regular tremulous motion, and that motion ~~is~~ though so rapid, ~~known~~ only by the effect produced on the delicate organ made to receive it, producing all the sweet strains of music, & articulate sounds, by which mind communicates with mind, and the multitude is swayed and controlled by the voice of the eloquent orator. All that is delightful and desirable in the sense of hearing depends on the air.

The invigorating air! Pure air - Fresh air, - What a luxury, without money & without price, every where present for the use of man. Animals snuff it in and are refreshed thereby, they know how to breathe the invigorating air, they have not learned yet how to lace their short ribs, so as to give them graceful forms, at the cost of not being able to inhale aught but fresh air. They ~~have~~ ^{seek} no air tight stoves and close apartments, ~~unless compelled~~ but they love the pure fresh air, and ~~show their gratitude to the creator~~ ^{praise} by the enjoyment of this his precious gift. - Look at the ~~boy~~ school boy after his imprisonment in a badly ventilated school room, how he enjoys the air, how he runs and jumps & shouts & hurrahs - And look at the ^{so much of his life is} red glow of health, upon his cheeks, and his deep and sweet breathing when sleeping ~~in~~ ^{where} he has an abundant supply of pure & health giving air. - Contrast this with the yellow cadaverous look of those who prefer Carbonic acid gas, tobacco smoke, sulphuretted hydrogen, & all such poisons, ^{& those who have to poison themselves} and then we will perceive the ~~adverse~~

importance of fresh air - This first gift of
God to ^{living} man, for when man was formed of
the dust of the earth, God breathed into his
nostrils the breath of life, and man be-
came a living soul. - ~~No wonder that~~
~~the~~ May we not then close these remarks
with the words of the Royal Poet -

Let every thing that hath breath
Praise the LORD.