

ADDRESS,
INTRODUCTORY
TO THE
COURSE OF LECTURES
IN THE
CHEMICAL DEPARTMENT
OF THE
Vermont Medical College.

DELIVERED BEFORE THE

CLASS OF SESSION 1854.

By THOMAS ANTISELL, M. D.

PROFESSOR OF CHEMISTRY TO THE COLLEGE, AND TO THE BERKSHIRE
MEDICAL INSTITUTION.

Published by the Class of the College.

WOODSTOCK:
PRESS OF THE VERMONT TEMPERANCE STANDARD.
.....
1854.

ADDRESS

INTRODUCTION

DEPARTMENT OF CHEMISTRY

1854

CHEMICAL DEPARTMENT

WILLIAM B. HALL

LECTURE NOTES

BY THOMAS ANTHONY M. H.

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1854

WOODSTOCK

PRINTED BY THE PRESS OF THE UNIVERSITY

1854

Metamorphosis and Metempsychosis.

As a vesture shalt Thou fold them up,
And they shall be changed.

TO THOMAS ANTISELL, M. D.,

Professor of Chemistry in Vermont Medical College :

DEAR SIR:—At a meeting of the Class of the Vermont Medical College, held this P. M., we, the undersigned, were appointed a Committee to solicit a copy of your Introductory Lecture,—which we hope you will furnish us at as early a day as practicable,—that we may have the pleasure of issuing it in a pamphlet form, for future interest and use.

We are, with great respect,

Your obedient servants,

G. O. SMITH,
CHARLES A. RUGGLES, } *Committee.*
JOS. S. COOK,

WOODSTOCK, March 7th, 1854.

WOODSTOCK, March 8.

TO MESSRS. G. O. SMITH, C. A. RUGGLES AND J. S. COOK,

Committee of the Class of the Vermont Medical College :

GENTLEMEN :—I am in receipt of your communication on behalf of the Class of 1854, soliciting a copy of the Introductory Lecture I had the honor to deliver, for the purpose of publication.

It is almost needless to say how I feel flattered in the compliment you propose me, and shall, at the earliest period possible, give you a copy for the printer.

With good wishes,

I remain, gentlemen,

Yours, obliged,

THOMAS ANTISELL.

ADDRESS.

GENTLEMEN :

You are to be busied, henceforth, with the study of Nature. From it, you will derive your professional title,—Physician. You will observe Nature in her three kingdoms,—in the Animal, Vegetable and the Mineral. You will observe the complex arrangement of these animal parts in health, and the derangements of function and structure in disease. You will have traced the loss and the renewal of these parts, and the ultimate sources whence they come ; and you will go farther,—you will have subjected to your senses the very ultimate elements, of which not only organized matter is made, but of which the whole of the superficies of the globe is composed.

You will find out that all is matter,—and matter in motion,—ever-moving,—never quiescent,—for we know not of any matter which is at rest. The universe itself is the type and the embodiment of restless motion,—revolving on, from when till when, no human thought can span,—each several orb and planet lighted and cheered by its perennial wanderings. Each, too, is in itself but an aggregate of atoms, every molecule of which has imprinted upon it, by the hand of the Deity, that tendency to motion which it cannot forego, nor ever omit to perform. This motion of masses in the great scale, your ordinary education has made familiar to you. The various motions of the atom, or molecule, you will be familiarized with here. Further reference might be deemed unnecessary now,

Yet I would take you in the spirit with me, and hold you in the bonds of sweet constraint, while we trace the course of atoms,—their involutions, intertwining and coalescings,—their preferences and attachments for each other, which, like most earthly ones, are very

partial and very fleeting,—their extreme willingness to break the bonds of union, again to be free but a little period, until some kindred atom appears, for whom the love of union again predominates. To chronicle these would be to relate the transient loves of immortals,—no fitting theme. Yet we may select some passages in their career, full of interest in relation, and profitable to the after-thought.

Suppose a mineral spring at our feet; it is also a warm spring. It has poured up its water from great depths, and with it come a few bubbles of air. What are they, and whence did they come? They have come from far deeper sources than the well itself, and have streamed out through the crevices from the inner and heated part of our planet; they bubble through the water, and mix with the air above. Is this the end of them? Have they no office to perform,—no destiny to accomplish? Let me unfold it.

These bubbles of fixed air, or carbonic acid, are made up of charcoal and the vivifying part of our atmosphere, oxygen. This gas, coy, aerial in its form, yet has earthly longings, and loves to creep close to the bosom of the earth, and twines within the deepest folds and wrinkles which Time has made upon her surface; bathes itself in the placid stream, and with it floats along, until it is carried to the sea, where it descends from its exalted position, and seats itself upon the billows of heaving ocean, and mingling in the foam and the waves, it pierces several fathoms deep, to the ocean bottom. There, on the dark slopes of a subaqueous hill, lie in wait myriads of beings, little sacs of membrane, invisible to the unaided eye; they twist their tiny arms about, and catch a bubble, with its coating of water, and greedily devour it; the water they return, the bubble is retained; presently a little limestone coat or shell is formed by the animal, and half the amount in weight is caused by this imprisonment and solidification of the gas. These little animalcules work and build together, and by numbers illimitable and succession continuous, they raise their limestone to the water level,—and behold, the coral reef. Trace it emerge steadily above the water, and the yam and the bread-fruit, the cocoa-nut and the screw-pine clothe its flat and whitened beaches with food and shelter for the wayfaring navigator or current-drifted Polynesian. Here is the restless activity of the atom. Vomited forth from the earth, it emerges into air—sinks down into the water—passes into the

body of an animal, and becomes an integrant part thereof; and when the latter dies, it remains behind to form the basis of a durable rock. It is the real proteus; with its change of place it has changed its form;—in the air a gas, in the water a liquid, in the animal and the reef it is imprisoned as a solid. Nor is this a new office to it. Ever since that period in our planet's history, when the waters were gathered together into one place, has this carbonic acid fulfilled the same office, and built up, in the slimy depths of the ocean, these numerous mountain masses of limestone, which, by the movements of time and elevation, become the dry rock of the valleys around us. The labors of man fall into insignificance when compared with that of a minute animalcule, and less enduring monuments of his existence remain, than that of one of the smallest of God's creation.

But some one will now say, your atom is now at rest. It is a solid rock, and has been so for ages. But are rocks eternal? Why does Nature's bosom throb and heave within continually, and seem almost ready to burst, until, as it were, no longer able to confine herself within the tight girdle that encircles her, she bursts the zone and raises up the land around us. What for? Because the limestone will not stay among us. It, too, has its office;—it yields itself to the rains of heaven, to the rivers of earth, and to the demands of growing vegetables, and the plant and tree draw it in for nutriment, and destroy its composition. The river yields it to the animals in drink, and the remainder is carried down and deposited as a fine chalk mud at the embouchure of the stream,—again, in the cycle of change, to be raised to dry land, and again to be removed. Where, then, is the period of rest? Shall we call the quiescence of even a series of ages in the life of an indestructible and an immortal, a permanent condition? It is rather delay than rest. We must not measure the periods of creation upon the Procrustes bed of our short lives; nor dare to imagine the duration of even the life of our species as more than a dot of sand in the hour-glass of eternity. "How old," said one young rose tree to another, "our gardener must be. He has tended us, morning and evening, ever since we were born, and I never recollect any change in his appearance." "True, sister," replied the other, "he is immortal; he always appears the same; he is incapable of change. My recollection goes farther back than yours. He

never looked otherwise than as he does now ; and our cousin, the tulip, who died of old age, just after I came into being, has told me the same thing.”*

We have just now seen the chalk to be produced by the progressive movements of the coral reef,—first above water, and then back again to line the sea bottom, again to be upraised. We find a dark mass of flint imbedded ; we find it has some marking in its interior, when looked at closely, and find it to have been the case of a sponge. Fine sand dissolved in water has been separated out by contact with the sponge, and took its place,—each atom of the sponge case being replaced by an atom of sand ; and at some distance farther on, we find immense deposits of silicious matter lining the ocean bottom miles in extent, washed down from the highlands and inlands, filling up the seas. Here, then, is the hard-flint observed moving from land toward the sea. Its motion is complete, though not self-derived, and so powerful that, were there no counteracting agencies, the land would fall to the level of the ocean, and then would chaos come again. This motion is visible even in our short life-time. The late Mr. Webster, in one of his letters describing his farm, said he could not lately see, from his hall door, the water of the Merrimac which encircled Marshfield, although it was easily discernible by him some years before. It had worn its way deeper down, and carried the sand into Boston bay. The quantity of matter which this river carries down has been estimated by Messrs. Dana and Francis as one million six hundred and sixty-seven thousand pounds per year, and is sufficient to account for the change. This appears a large quantity ; but as the Ganges carries down two hundred and fifty times as much, the Mississippi nearly an equal quantity, and the Amazon much more, how necessary does it become that even the rocky bosom of the earth should move and raise its shoulders again above the seas. Beautiful is the idea of ancient mythology that Pluto, Jupiter and Neptune were brothers ; for terrestrial heat, air and water work in unison and fraternize in the results obtained. By the joint agency of the two latter, the dry land is worn away and new beds deposited for future organized beings ; by the former, the old beds are being continually raised, to keep sufficient land above the deep for existing life. We can trace on our globe the proofs of gradual elevation in our continents, and we

* Introductory essay by J. W. Draper, M. D.—*Oxygen*.

can establish a rough chronological table of the periods of emergence of each continent and country ; and like as topographers contrast in drawings the situation and extent of Boston and New York two hundred years ago, so can geologists map out the coast line of the two Americas at long intervals apart : they can go beyond that, and point to a sinking continent, Polynesia, which exposed its naked cliffs to an uninhabited dry land, while yet the land we call our own was being formed in the vast profound of waters. Can any example more strongly impress our minds that nothing, not even the earth, is stable, and that the only immutability is the law of mutability ?

While nature thus performs her round of change in the great deeps, let me direct your attention to what is going on in the air. See yonder forest trees, with leaves glittering in the sunbeams, like the well polished armor of the serried ranks of infantry, busy drinking in illimitable volumes of this same fixed air, carrying it into its branches and meeting with the water sucked up by the roots, forming, by the union of this gas and water, the woody tissue, starch, and sugar. To accomplish it, the gas is decomposed, broken up into charcoal and oxygen ; the oxygen is given off, the charcoal retained, to unite with the water to form from these substances in different proportions the solid wood, the gummy ferina, and the saccharine sap. Wonderful fecundity of nature ! which can fashion from the same elements three different substances, and has power in addition to transmute them, one into another, with the least possible expenditure of force, as often as occasion demands the change.*

Here, is this acid solidified for the second time, but it has suffered change ; it is broken up, and has given back its oxygen to the air ; it has purified the air and rendered it fit for man, and while so doing, has aided in building up the timber of the forest, and increased the growth of the corn. But these are not the whole uses of vegetation, to purify the air, form a little gum and sugar, and lay up a store of combustible matter for our winters. No ;—it drinks in ammonia by its roots, and by mingling it chemically with water, it forms the gluten, the oil and the albumen which go to make up the seed of the plant, and in the animal, blood, muscle and bone. These things are

* Dumas Org. Bal.

not produced by animals; an animal cannot make them; the very first respiration would be fatal to the attempt. Vegetables are the chemical laboratory of nature. They are the factors; animals are the consumers. Thus, as all animals which breathe are incapable of forming their food, they are wholly dependent on vegetation for the constant supply, and the identical elements which constitute an animal are found ready made in the plant. Complex substances, made out of simpler elements,—water, carbonic acid, ammonia, and a few ounces of earthy matter, build up the whole temple which may, perhaps, clothe a godlike intellect. Thus it is literally true, that “man is made from the earth;” and “all flesh is grass.”

Yet these elements will not bear the constrained imprisonment put upon them by vegetation, and in the animal body they break themselves up, re-arrange their particles in simpler forms, and return back again into the air, from whence they came. The animal aids;—it breathes them out as water, carbonic acid and ammonia, burning up by a gentle combustion in its interior its own blood, muscle and fat, to accomplish this end. Thus the animal destroys what the plant forms. The plant is a creator; the animal is a destroyer. What the former takes from the atmosphere the latter returns to it. So that, surveying such facts from a lofty point of view, and in connection with the physics of the globe, it would be imperative for us to say, that plants and animals are *the offspring of the air*; they are but condensed or consolidated air. In the vegetable kingdom is the great elaboration of organic life. There, and there only, are both animal and vegetable substances compounded, and all alike formed at the cost of the atmosphere. From vegetables these substances pass, ready formed, into the bodies of herbivorous animals, and from them they are transferred by the carnivora. During the life of these animals, these created elements return to the atmosphere from whence they originally came, in proportion as they are destroyed; and after death, by fermentation and putrefaction, these restless elements are finally resolved into gases and water. Such is the mysterious circle of animal life, and thus is it commenced, maintained and completed.*

* Dumas Org. Bal.

See plastic nature working to this end—
 The simple atoms each to other tend,
 Attract, attracted to, the next in place
 Formed and impelled its nature to embrace.
 See matter, next, with various life endued,
 Press to one centre still—the general good.
 See dying vegetables life sustain ;
 See life dissolving vegetate again.
 All forms that perish, other forms supply,
 (By turns we catch the vital breath, and die,)
 Like bubbles on the sea of matter borne,
 We rise, we break, and to that sea return.
 Nothing is foreign,—parts relate to whole.
 One all-extending, all-preserving soul
 Connects each being,—greatest with the least ;
 Made beast in aid of man, and man of beast.
 All served, all serving, nothing stands alone ;
 The chain holds on, and where it ends, unknown.

POPE.

Light and Life have, in all ages, been looked upon as Cause and Effect. Wherever occur the suitable terrestrial circumstances, solar influence immediately develops organic life as food ; and where these exist, animals appear and gather up the fragments, that nothing be lost in the economy of nature. The electrodynamic action of the sun in the production of organic formations constituting food, appears to be carried on to the extreme extent for developing the greatest possible number of animal existences and of animal enjoyments : for even the living substance of peerless man finally serves as food, and becomes the prey of worms, who convert every charnel-house into a banqueting hall, and we, Polonius like, are called to supper,—not where we eat, but where we are eaten ; and this is a wise provision to remove what would else be noxious. Marvellous is it to find life so suddenly developed in millions of little animals, whose sole office appears to be to feed upon death and remove its signs. Born to be the scavengers of creation, they fulfil their office and fall a prey to other species ; and this is due to Light. Light and Life go hand in hand. “ Organization, sensation, voluntary motion, life,” says Lavoisier, “ only exist on the surface of the earth and in places exposed to the light. The fable of Prometheus was but the expression of a philosophical truth

which had not escaped the penetration of the ancient Greeks. Without light, nature were without life and soul. A beneficent God, in shedding light over creation, strewed the surface of the earth with organization, with sensation, and with thought.”*

We have now felt that it is the eternal motion of the atom which gives us the varied forms and natures which inhabit our globe. The atoms of air enter into a series of combinations, which, as soon as formed, they appear desirous to break up, and again return to their simpler constitution ; in this circle, from simplicity to complexity, and from complexity to simplicity back again, are contained organization and life. Thus, suppose an animal body decaying in the ground : the solid parts ultimately escape into the air in the form of gases ; but to become such, these atoms have to form the bodies first of plants, and then of animals, by whom it is breathed off in the simple and desired form.

Man, then, is but a thing of air,—a substance formed from air,—the substance of a shadow,—a shadow’s shade,—every thing around him fleeting, himself continually changing,—breathing off nearly one pound of charcoal daily, his career would soon be terminated, were the waste not supplied by daily food,—daily loss, daily gain,—nothing remaining permanent but memory, and the consciousness of identity ; and this is retained in a body which is wholly changed within a period of five years,—thus giving to every mortal the possession of several bodies in succession during life.

At the rate of consumption of charcoal stated, a man burns in his lungs about thrice his weight of charcoal every year. That is, as far as charcoal is concerned, he has changed his body and received a second one within the time. This is supplied by blood, one-half of which, when dried, is charcoal ; the blood is derived from the food, the food from the plant which took the elements from the air,—thus carbonic acid, plant, food, blood.

Another element of weight in man is the fluid portion of the body. This is water, and amounts to seventy per cent., or seven-tenths of the whole. This is removed and replaced every five or six weeks ;

* Lavoisier’s “*Elemens de Chimie.*”

and thus nearly three-fourths of our body is renewed nine times a year. As all this water had to enter the blood, and form its liquid part, and as there are about twenty-eight pounds of blood, it is evident that the great bulk of the blood is changed every month.

Probably next to water, in point of rapid loss and gain, is fat, which individual experience informs us may increase or diminish every month; and in emaciating diseases we perceive how rapidly it is absorbed and removed. The corneous and bony tissues are removed very slowly. Bruise-marks on the nail are very slow in disappearing; the rate of travel of these marks is in some people at the rate of one inch per month. In the diseases rachitis and phthisis, the bone-earth is thrown off more rapidly; still this element lingers longer than others, and this is why so long a time is required to renew the whole body; but during such a period, parts of the body have been several times replaced.

The saline matters, excepting bone-earth, amount to about three per cent. of the solid matters, or just three pounds in each individual. This is in great part supplied by the fluids, as drink; allowing it, however, to be supplied in our solid food, the amount is furnished to us in three months,—so that the saline matter is renewed four times every year.

Thus the metamorphosis of our particles occurs: as regards the watery portion, or three-fourths of the whole, nine times a year; the saline matters, or one-thirty-third, four times a year; the flesh portions, or one-fifth, twice yearly; the fatty portion, or one-fifth, twice yearly; the bone and bony tissue, once in four years.

These allusions to the successive transmutations of the grouping of the same atoms from air into various animal bodies, are not to be deemed derogatory to man, fanciful in operation, or unimportant to consider. To the medical man, the loss and renewal of parts is his constant study, and at all times his object to attain. The numbers indicated here are rather below than above the average, and if the case stated differs from the actual fact, it is by under-estimation.

This is the history of but one species,—MAN. Now, when man is thus rapidly changing his body, and calling into play fresh atoms to construct new frames, how much matter is demanded by one thousand

million such? How stands the matter with the other species tenanted this earth? Now there are of

| | |
|------------------------|--|
| Mammalia, - - - - - | 1,000 species. |
| Birds, about - - - - - | 6,000 species. |
| Reptiles, - - - - - | 1,500 species <i>described</i> ,—perhaps 2,000 |
| Fishes, - - - - - | 8,000 species described in European Musea,—probably 10,000 total. |

Mollusca, in collections,—Marine, Univalve

and Bivalve, Land and Fluvial, 10,000 species.

Insects, - - - - - 120,000 described species.

Other Articulata and Radiata, - 20,000 species.

Echini, Medusæ, Polypi, - - - 10,000 species.

These, with species not described, would bring the total number of species near 250,000. Some writers estimate the number of species as high as two millions.

These are SPECIES; under these are numerous varieties of each, and under the varieties come the individuals. Now, the number of individuals constituting these species, to our finite comprehension, appears to approach infinity. Even the ice-cold waters of the polar regions teem with living animalculæ, and in warmer climes each leaf of the forest-trees sustains multitudes of living beings. Every plant has its appropriate insects and animals, every animal has its appropriate parasites; and, that no space may be lost, one species is even found living within and upon the bodies of others. The sounding-lead which comes up from the depths of ocean, beneath the Gulf-Stream, demonstrates that hundreds of millions of organisms of the calcareous polythalamia exist in every cubic inch of the specimens raised. Equally numerous are the monads of fresh water, thirty-six thousand of whom, laid alongside cover only one inch in length. In the polishing powder of Bohemia, Ehrenberg tells us there remain the perfect cases of forty-one thousand million animals in the space of a cubic inch; and in the slimy mucus which floats as a film of iron-rust on boggy pools, Prof. Bailey, of West Point, tells us there are ten thousand million of animalcules in a similar space,—this being ten times more in number than the whole human population. This enormous plethora of life has existed from remote periods in our globe's history. In the imbedded remains found in the rocky basins, we infer their number and duration; in some instances, being found seven miles deep from the

surface,—that is, since their death seven miles of deposit has accumulated over them ; and this, at the slow rate of deposit over our globe, not more than an inch per year, leaves an incalculable long period for the redundancy of vitality to occupy our globe.

See through this air, this ocean, and this Earth,
 All matter quick and bursting into birth ;
 Above, how high progressive life may go !
 Around, how wide,—how deep extend below !
 Vast chain of being ! which from God began,
 Nature's ethereal, human, angel, man,
 Beast, bird, fish, insect, what no man can see,
 No glass can reach,—from infinite to Thee,
 From Thee to nothing. POPE.

Since this is a law of creation, that life shall be infinite in extent, (duration,) and eternal in succession, you can readily understand why this metempsychosis of matter exists. Did not matter filter itself through successions of species, each would require its own peculiar molecules. But I hazard no rash statement, when I say that there is not available matter on this earth to form bodies for all its inhabitants. Air is limited, water is limited, and so is the earth, and therefore life would be limited if special molecules were required for each species. Physicists inform us that, by the present modes of men rendering air impure, it would take as many as ten thousand years to make a sensible alteration in its properties. But this is only counting on one species : but as there are over a quarter of a million species, their conjoint action must tell on our atmosphere every year ; and were matter stationary, life would poison itself out in a very short period.

The situation of our globe is this : matter limited, succession of organisms unlimited, it is a calculation of how much and after how long a time, is matter to be granted to each succession to constitute individual life ? The period of temporary rest of the atom is life ; the moment of transmutation, death. Our life, and that of every living being depends on this metempsychosis of matter ; so that—

“ By ceaseless action, all that is subsists.”

COWPER.

That Apostle of Human Nature, whose intellect appeared to comprehend all knowledge, puts this idea of metamorphosis in the mind of the reflective Dane :

To what base uses we may return, Horatio !

Why may not imagination trace the noble dust

Of Alexander, till he find it stopping a bung-hole ?

* * * * as thus : Alexander died ; Alexander

Was buried ; Alexander returneth to the dust ; the dust is earth ;

Of earth we make loam ; and why of that loam

Whereto he was converted, might they not stop a

Beer-barrel ?

“ Imperious Cæsar, dead and turned to clay,

Might stop a hole, to keep the wind away.”

What was “ imagination ” in the days of the poet, is now matter of demonstration, and is a striking illustration of Professor Playfair’s remark, “ How much farther reason may go than imagination may venture to follow.”

But in this universal mystic maze of matter, is there nothing that is absolutely ours ?—ours by peculiarity, ours by detention ?—nothing material. We are but the transitory occupiers of matter, the leaseholders, for a few years, of a few organized molecules which were occupied by other organisms before, and will be the occupiers of future structures when released from us. The air we breathe in has successively passed into the plant and become a part of its integral life ; it has formed a portion of an herbivorous animal afterwards, and that same air has built up the carnivorous creature, and it has repeated this office of occupying plant herbivor and carnivor for ages upon ages, and through innumerable myriads of bodies before it has entered ours. The air which we breathe out into the atmosphere will be taken up by vegetation, will form food, will be transferred to the two classes of animals, and continuously and forever pass through this round, until the fiat of the Creator otherwise is expressed. Were the conjectures of Pythagoras and Plato day-dreams and folly, or were they not rather the expressions of a beautiful truth, which modern learning has unfolded to our eyes ? Yes, Metempsychosis is a truth, a continually occurring fact. That which was in the body of former beings and lesser animals passes into ours, the parts of plants into animals, that of animals into plants. The elements of a mastodon or a saurian may be transmigrating through our system, and that which is ours to-day may to-morrow become the property of an insect, or a reptile. They of old ridiculed the Grecian sage, because he denied

himself the luxury of beans at his table, lest he should devour the bodies of any of his relatives. And how well we can afford to join in it, judge ye, when we mow the grass off a cemetery for our cows, and thus literally cannibalize on our progenitors ! That which of old was called a mental vagary, was a glimmering of the truth not yet appreciated by the multitude. *We* may hold this truth now without the revilings which it then received from the Epicureans ; we may teach it publicly, and not be treated as was an English dramatist, of the name of Lee, upon a different occasion, who tells us of himself : “ I asserted that the world was mad, and the world said I was mad,—and, confound them ! they outwitted me.”

The fermentation of wine will, to every mind, present a plain example of what is desired to be enforced upon the present occasion,—namely, the metamorphosis and metempsychosis of matter. The grape-juice is acid, and contains a little cheesy matter floating with the acid in a pulp ; the first contact with the air, as by exposure in the vats, is sufficient to break up this cheesy body, and as soon as this commences to separate into simpler forms of combinations, the motion is communicated to the acid and the pulpy matters, and fermentation, as it is termed, sets in. Not that the cheesy body either gives any of its particles to or derives aught from the others,—the decomposition of both bodies goes on independent ; it would appear as if the acid was waiting for the cheesy body to take the initiative steps towards change of form,—a step which, once taken, never ceases until the whole of all the elements are differently arranged, and takes place equally well in vessels protected from the air. These atoms are all endeavoring to arrive ultimately at that simplest of all arrangements,—carbonic acid and water ; and to gain this, they have to transmigrate through several forms which have a tolerable degree of permanence. Thus the grape acid passes first into sugar, then into alcohol, then into vinegar, and finally into carbonic acid and water ; now the grape acid had been originally wood formed of carbonic acid, so that the metamorphosis of the atom is—carbonic acid, woody fibre, grape acid, sugar, alcohol, acetic acid, carbonic acid.

Again, it is remarkable that in order that any substance be suitable for food or nourishment, it is also necessary that it should be capable of fermentation. As the air is drawn into the body by the lungs, it

commences a fermentation in these particles, which, once commenced, cannot be quenched until the whole of the original particles are removed as carbonic acid ; and thus, at one glance, you may understand how unavoidable it is that we are the machines through which particles are continually streaming with ceaseless rapidity.

There is one feature about this fermentative process of interest, which is this: the body fermenting is capable of communicating fermentation to another body quiescent, but it is only fermentation of its own kind. Thus, sugar fermenting into alcohol can only produce alcoholic fermentation in the other. Matter in inoculation only produces cell germs of a similar kind. Vaccination only produces vaccine matter ; and so of cancer, and others. Now a number of facts show us that certain states of putrefactive fermentation when taken into the healthy system, can communicate the putrefactive movement to the particle of the living body. Magendie has shown that a portion of a human body, when laid on abraded surfaces, produce a train of symptoms which terminate in death. Dissection wounds amply prove it ; putrefied sausages, venison, hams, have produced adynamic fevers. These may be termed the irregular metamorphosis of the atom, and to this class must typhus be referred, as also the poison of the plague, and of serpents.

Some physiologists and physicians believe that, in the case of fermentation in vegetables, it is necessary for it to be carried on that a little vegetable, vital form like a mushroom or an alga should be produced ; and in the case of animal bodies fermenting, there must be certain animalcules present. In the must of wine the little microscopic cellular vegetations are remarkable, and the same bodies occur in yeast. The disease produced by the acarus, and porrigo favosa, and the disease of silk-worms termed muscardine, are familiar to you as diseases of putrefaction, produced by organic development, as are blight, must, mildew, and ergotine, the must of vegetation. Curious is it here to trace the atom of carbonic acid in its round of dissolution, entering into and giving rise to a minute animal form, even in the midst of decomposition ; and while enjoying a life, serving to assist in the process of decay. Life and death here meet together. Life developed produces death, and death is necessary to further life :

All are but parts of one stupendous whole,
 Whose body nature is, and God the soul,—
 That, changed through all, and yet in all the same,
 Great in the earth, as in the ethereal frame ;
 Warms in the sun, refreshes in the breeze,
 Glows in the stars, and blossoms in the trees,
 Lives through all life, extends through all extent,
 Spreads undivided, operates unspent. POPE.

Such is carbonic acid, or fixed air. Now in the animal, now in the vegetable, and again in the mineral; in the earth, in the water, in the air,—pent up in a solid rock, or delayed for a time in a vital frame, yet it bursts its electrical bonds, and spreads itself abroad upon creation again. There is the most intimate connexion between us and fixed air; fixed air is a constituent of our clothing,—we cook by the aid of fixed air, and we travel by its assistance with the utmost speed,—and, more singular still, a couple of thousand boxes filled with this fixed air are placed opposite to an equal number of similar boxes, with directions to destroy one another, and it is with condensed air the murder is accomplished, and for what?—generally to obtain a greater abundance of fixed air, so necessary for support.*

The law of motion and change we perceive written on every page of the broad volume of nature. Through the wide canopy of heaven rolls the restless wind, ever with its heaving currents passing on to a suppositious goal, round which it wheels but to begin the race again, carrying with it the seeds of life to scatter broadcast over creation,—wafting sighs from Indus to the pole,—now convulsing whole masses with a common sympathy, or becoming the medium of that touch of nature which makes the whole world kin. The same air which tunes the organ-pipe and peals the lofty anthem, passes on and is converted into the curses of the wicked. The tones of a Malibran and a Pasta are merged in the low moan of the miserable, and the anguish of despair. The airs of heaven have long wooed the waters of the earth, and have won them successfully; hand in hand they pass to and fro, and as the fleecy clouds on high they pass along and travel the wide expansive vault, till, weary of wandering, they alight on some heaven

*Lett. sur la Chimie.—LIEBIG.

kissing hill, and, glad to overflowing to find the haven of their rest, they pour their dewy tears as they lave upon his shoulders, making the land to revel in life, variety and enjoyment.

Call to your minds the beauties of autumnal scenery. Who that looks upon the splendid drapery of the forest, with its variety of tint and changes of tone, the warmth and depth of coloring, the display of the beautiful and its daily ever-changing aspect, does not class it in his mind as an embodiment of change,—of change which, to most, conveys the idea of death. But this is erroneous. To the eye of the observant—to the ear of the lover of nature, is revealed another and a more engaging lesson. These leaves, that now hang with daily deepening colors, have fulfilled their office; their atoms long to part asunder; they fall to the ground; and in the matted rug they form, they become the dwelling-place of numerous species, whose office is to assimilate them into their own body. These leaf atoms become insect and reptile atoms, from whom they ultimately escape into the air, again to be enslaved within the tree. Life and death are here blended together;—it is not death, but variety of life. Death cannot seize the atom: with it, it is succession and exuberance of life. Nature, that she can no longer revel in enjoyment in the air, descends joyfully, in her richest dress, into the earth; and lives an humbler and more chrysalis-like life in the exulting anticipation of the vernal resurrection.

As with nature, so with man. The royal stamp which has been laid every where with its decided mark, has been imprinted also on him. The human mind is like the broad ocean, ever in motion;—whether in the slow current which wends its silent way, or in the angry roar and lashing of its sides when obstacles have to be overcome; it has its depths and its shallows,—its under-currents and tortuosities: all that is mental possesses motion and change. The ideas which crowd upon us are not ours; we cannot always evoke them—we cannot retain them. Layers upon layers of images, reflections and feelings have permeated through the brain and passed away from us, to become the property of another. The same idea diffuses itself through a whole meeting or nation. There are ideas peculiar to childhood, to age, to sex, to nation,—which, like dissolving views, preserve their distinctness only for a short period, and become lost by

insensible change in their antecedents and successors. Though we may not be able to control individual ideas, we can determine what class shall flow through our minds,—and this power to control is a blessing or a curse, as we employ it. The rapidity of the flow of ideas is such, and the manner in which they are welded together to make a common chain, is so fine as to elude observation, and prevents us from discerning clearly where one thought ends and the next begins; if we admit a thought, we can hardly exclude its successor, and the nervous tenement may become the abiding place of the weak and the wicked. We cannot deny our thoughts,—while with us, they are ours; we may not have called them *now*, but we have invited them, and they are not only *our own*, but they are *us—ourselves*. “*Cogito ergo sum*” is probably the best proof which can be given of existence. Since, then, our thoughts mold us and make us what we are,—and with the change of ideas we cannot for one day remain stationary in our progress of learning or wisdom,—since we must daily and even hourly gain or lose, advance or retrograde,—how needful is it that we select and cultivate that class of ideas which only is followed by similar successors,—how needful for this purpose that the mind should be trained to study itself. The study of mind forms no part of your college education; but if you value your position in society, you will add to your stock of learning this exact science. From the nature of a medical education,—being chiefly that derived from observations,—the minds of those so educated are apt to be defective in schooling in three particulars. The first is—

1. The incapability to abstract the mind or keep it steadily upon one idea or class of ideas; the result is that as the ends of the chain are not distinctly seen, and the whole presents but a misty or hazy conception.

2. Taking too much for granted; not examining first the premises laid down; and then the inferences drawn. The story of King Charles and the fish is a good illustration.

3. Using too limited data,—drawing general conclusions from particular facts,—*ex uno disce omnes*. In logic, the argument is always from the universal to the particular, but with the bulk of medical men one case or symptom is enough to build a theory of disease upon.

The column which supports the future arch, requires to be made

strong before the supports are removed,—youthful minds, unaided by our maturer judgments, will need schooling and self-discipline.

Gentlemen, as you propose to be observers of nature, be ye also lovers of her ; examine all her processes towards formation and renovation ; remember the idea which I have striven in these last words to impress upon you. That the organic and the inorganic are undiscernable in their natures ; that life is like water spilled upon the earth, which sinks down but a little, and is carried up again to go its everlasting round and general diffusion ; that change and renewal, mutation and metamorphosis, are the constants of creation,—and with the laws which invest matter, it is impossible to be otherwise. The very time which I occupy in expressing this, and which we call the present, is gone, and no longer is,—change is so constant, there is no present.

“Put,” says an agreeable writer, “into a Roman clepsydra one hundred drops of water ; let them run out as the sands of our hour-glass, every drop measuring the hundredth part of a second, so that each shall represent but the three hundred and sixty thousandth part of an hour ; now count the drops as they run along, and when the fiftieth of the hundred is passing, behold forty-nine are not, because already they have perished, and fifty are not, because they are yet to come. You see, then, how narrow, how incalculably narrow, is the true and actual present ! Of that time which we call the present, hardly a hundredth part but belongs either to a past which has fled or to a future which is still on the wing. It has perished, or it is not born. It was, or it is not. Yet even this approximation is *infinitely false*. For by sub-dividing this drop which represents the present into a lower series of similar fractions, the actual present which you arrest measures now but the thirty-sixth millionth of an hour ; therefore the present, which only man possesses, offers less capacity for his footing than the slenderest film that ever spider twisted from her womb.”* Progress and change is so rapid that time cannot be measured ere it is past, and “in to-day already walks to-morrow.”

This ever-acting mutation of the atom is due in part to our air, which, containing so much oxygen loosely mingled in, readily yields

* De Quincy ; Seq. to Confessions.

that element to the first petitioner which presents itself, and it, like a Circassian beauty in the market, seems waiting for the offer, and anxious for the union. The brightest plate of metal is soon tarnished by it, and where it cannot corrode, it will film. It is the trouble of the daguerreotypist to keep his plate clean; he washes, he rubs, he dissolves, and he coats anew the surface occasionally, to keep a pure metallic surface; and when gotten, he has to shut it up from the light, for, strange to tell, every ray of light lays its image there, unseen by our coarser gaze, but then needing only the more sensitive surface to make it plain to us.

The slightest article which we leave out of our hands leaves its image where it rests. A copper coin upon a silver one—a silver coin upon a mirror, leave images which even our breathe can make evident to our eye; and it is possible for us to take upon a warm copper plate an image or copy of a newspaper.

Nature does not merely condescend to paint the portrait or the landscape upon the coated plate in the atelier of the artist. She is no niggard in her pencil. Every where and at all times where there are rays of light wandering,—where there is a movement to be chronicled,—where there is, to speak technically, a ground to receive the painting, there the image is drawn, painted in an invisible ink. Wherever in crowds we gather within a building, wherever individuals may transact private business together, there is the angel of light tracing on the walls the images of the acts going on, whether they be good, or whether they be evil;—images invisible, ineffaceable; and, like as the manuscript of the middle ages, contain many works copied in one over the other,—those underneath not effaced, but only covered over, so as suitably to receive the more modern thoughts: so like leaves in a book, on these walls are there depicted the successive acts of individuals.

With this power of the sun to record passing events, may we not understand, in a holier sense, the office of this luminary, who was set for us, “to rule the day;” and how awfully does the suggestion flit through our minds, that against every one of us there is a *handwriting of God* recorded upon the wall, which it needs little more than the learning of Egypt to expound and explore.

In conclusion, Gentlemen, ever bear in mind these eternal prop-

erties of matter,—Mutability and Metamorphosis,—painted in such high relief as they are in the symbols of creation ; in the motion, the disappearance, and the varied lustre of stars ; alike in the varieties of the human race—the transition of empires—the history of dynasties, and the progress of man in civilization, and in every form that embellishes the pages of the Book of Life, which tell us, in language not to be mistaken now, what we had learned previously by Revelation:—“That we shall all be changed.” These will explain to you many phenomena hitherto obscure ; they will teach you the necessity of careful and rigid habits of mind ; that a fact unperceived, or viewed improperly, is a link lost to the chain of truth ;—that constantly to observe and accurately to distinguish are needful to form true decisions ;—that exact ideas are only dependent upon clear perceptions : and as each phenomenon has its successor as well as its antecedent, each is worthy of notice ;—and by the habits of training which you give to your intellect, so as to isolate individual facts and connect them in their true relation of Cause and Effect, can you only truly attain that eminence among your brethren, which, for your own sakes, as well as for the credit of that institution,—whose certificate you may bear,—it is the earnest wish of colleagues and self that you may honorably occupy.