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(Illustrated articles are marked with an asterisk.)

THE USES OF SULPHUROUS ACID.

This acid has assumed a great importance in the arts, and we find the best method for its production the frequent subject of discussion in our works on technology. It is employed as a gas, as a solution in water, and in combination with bases under the name of sulphites. There are numerous ways of making the gas, some of which it may be well to recapitulate before proceeding to speak of the applications.

One of the best methods is that proposed by Stolba, to heat in suitable retorts one part of sulphur and four parts of common sulphate of iron. Other manufacturers simply burn sulphur in atmospheric air, or deoxidize sulphuric acid by means of charcoal or some metal. In some instances, sulphurous acid is an incidental product, and is not allowed to go to waste. We do not, however, purpose to speak of the manufacture and properties of the acid, but of its uses.

In Belgium, sulphurous acid, obtained by roasting sulphur, is conducted through heaps of alum slates, arranged on floors, and, in this way, the yield of alum is greatly increased. Under the old process, sixty-eight parts of slate were required to make one part of alum. By employing sulphurous acid, it is said that eight parts of slate will yield one of alum.

In the manufacture of phosphorus from bones, the bones, previously freed from fat, are digested in aqueous sulphurous acid, by which the bone phosphate is dissolved. By boiling the solution, all of the sulphurous acid can be expelled and condensed in coke towers, to be used again. The bones thus extracted can subsequently be treated for glue. In the preservation of meat, sulphurous acid appears destined to play an important part. The meat is suspended in large boxes or chambers and sulphurous acid gas admitted. To prevent the formation of sulphuric acid, it is necessary to have something to absorb the free oxygen, such as the sulphate of iron, in the bottom of the vessel.

In the Paris Exhibition of 1855, we saw specimens of meat exhibited by Laury, which had been kept fresh in this way for five and ten years. Many of the modern processes for the preservation of meat are founded upon the use of sulphurous acid, either alone or in combination with other agents.

In the purification and refining of sugar sulphurous acid plays a most important part. Its effect is not only to clarify the molasses, but also to prevent the fermentation, by which the yield of the sugar is largely increased.

For the extraction of purpurine and alizarine from madder, Kopp proposes to treat the madder with sulphurous acid, and afterwards, with sulphuric acid. The two coloring matters are in this way separated, and the labor of extraction facilitated.

Oils and fats are purified by sulphurous acid. The fat is heated to 500° Fah., and gaseous acid passed through it for about four hours, and, afterwards, the sulphurous acid is removed by steam and water. In the refining of petroleum sulphuric acid is employed, which is partially deoxidized into sulphurous acid, and thus accomplishes the purification of the crude oil.

The preservation of hops, by impregnating them with sulphurous acid, was an important discovery, and, we believe, was chiefly due to the researches of Liebig. The gas destroys the lower forms of insect life and prevents any change in the properties of the hops.

Glue is made from leather refuse by soaking the scraps in running water and afterwards digesting them in strong sulphurous acid, and occasionally changing the water. The colorless jelly thus obtained is afterwards converted into glue.

The value of sulphurous acid, in obtaining iodine from Chili saltpeter is explained in another place. It is capable of a similar application in the treatment of copper ore, also, of the ores of many of the rare metals. Very poor copper ores are capable of being profitably worked by the sulphurous acid process.

In the manufacture of alcohol and spirits from malt, sulphurous acid has been advantageously employed. In the manufacture of sulphuric acid, and for the bleaching of straw goods, sulphurous acid has long been known. In medicine it is a valuable remedy, and rapidly attaining the first rank. For the preservation of wines and cider; to prevent the rusting of instruments; to destroy vermin; and as a disinfectant, we often hear of this acid, and the more we become familiar with its properties, the further will its uses be extended. It is one of the most important agents at the disposal of the chemist.

EFFECT OF ASSOCIATION UPON MENTAL DEVELOPMENT.

Young men, and young women, are generally ignorant of one of the most valuable as well as the most accessible and most cheap of all educating forces—the power of association on mind. This power is not commonly discovered and appreciated till experience teaches it, and when many valuable years have passed. The associations of young people here are mostly formed for the furtherance of pleasurable pursuits and without regard to mental ability or acquirements. No greater mistake can be made by a youth desirous of rising to eminence in any profession. To secure rapid mental growth, one's associates should, if possible, be chosen from those of greater mental power, wider experience, and more varied acquirements, than he himself possesses.

The profession of teaching affords many instances of the effect of constant association with inferior minds. In this profession, unless special care is taken to avoid mental contraction by occupying the mind with topics out of the usual routine, and which call into play all the faculties of the mind, men become dwarfed in intellect, and find themselves at an age when the mind should have attained its fullest vigor, less able to grapple with difficult and original trains of thought than at the outset of their professional career. It is chiefly because of the educating power of association that schools are more efficient than private instruction for youth. A young man entering college goes there not alone to learn Greek, Latin, and the sciences, but to learn human nature, to acquire self-control, to rub his wits against other wits, to encounter and resist the temptations which will beset him in after life.

All this constitutes a sharp discipline which some do not escape from unhurt. Those who do, however, are men who, having been educated by association, know the peculiarities of men in general, and are able to penetrate and understand the motives which influence action. They are not likely to fall an easy prey to deception or to over-estimate the men they encounter in active life.

This view of association as an educational force has an important bearing on the subject of schools for both sexes. Perhaps no single educational topic has given rise to more widely divergent opinion than the question of educating the sexes together or apart. So far as those who approve the mixing of the sexes in schools base their opinion upon this alleged comparative inefficiency, the admission of the power of association to educate seems to us to completely refute such an allegation. Even if it be admitted (we are by no means prepared to make such an admission, however) that these schools show at their examinations less progress made in book studies, we believe that important ends of education are subserved, which more than compensate for such deficiencies.

On this account we favor the tendency of the age to admit to colleges, seminaries, and schools, whether technical or otherwise, all students of both sexes who may desire such admission.

It is perhaps somewhat singular that in technical schools those devoted to medicine and surgery should be among the first to feel the demand of females for greater educational facilities, and to have acceded to this demand. So great a triumph over superstition and prejudice is an honor to the age. The questions of the equality of the sexes, or the mental peculiarities of each, have, in our opinion, nothing to do with the higher and more important one of equality of opportunities. Grant the latter equality, and the question of general equality will soon be settled.

WHO MAKE MISTAKES?

"Everybody," will be the reply from every one whose eye catches the above heading. A true answer, indeed. From Solomon, reputed wise, but often foolish, down to George Francis Train, often called foolish, but who not unfrequently speaks wisdom—everybody has made, and everybody will make mistakes. Adam and Eve could not live long in Eden without making a mistake, which the whole human family ought to deplore, if indeed their mistake was the cause of all the mischief in the world, which perhaps there is reason to doubt.

But who make the greatest mistakes and the most numerous? We answer those who know least, and those who are generally supposed to know most. Those who know least are those who suppose and act upon the supposition that books—the records of other men's thoughts and discoveries—are worthless, who believe in themselves as able to solve the profoundest problems without the help of previously acquired knowledge, and therefore cut and try upon questions which have long since found a thorough solution, and fritter away their time and energy to re-discover what has already been discovered. These men delight in styling themselves *practical* men, which in nine cases out of ten in which the term is used boastfully, means ignorant, obstinate men—men who never can accept an idea with relish unless they can be deceived into the belief that it emanated from their own stolid brains. How often have we seen such noodles cajoled into accepting a statement of fact, simply because some man of tact put it to them as "the same thing in another form," as some tom-fool's nonsense they had themselves uttered a few moments before. "It is only another way of putting it, you know," and, "You were entirely right in your mind about the matter," and you see them straighten up and assume the pride due to a sagacity they do not possess, and brains their skulls are too thick and too small to hold.

The mistakes of this class of men matter little to the world. It is not so, however, with the second class we have named. These are men who, having explored large areas in the field of human learning, give themselves up thereafter to profound speculation, and not content with muddling their own heads with metaphysics, print and publish their speculations to muddle others.

Among these we find the greatest and most hurtful blunders committed because their mistakes are too often accepted as truth by inferior minds.

The class of men who make the fewest mistakes, and even whose mistakes very often serve a useful purpose, lie wholly between these extremes. They are men who gratefully receiving the facts and formulæ discovered and wrought out for them by the illustrious line of workers whose labors have forever ceased, build thereon a sure structure of practical knowledge.

They are the true practical men who do not waste their time in useless original experiment unless they discover defects in the experiments, the results of which have been accepted as truth. Availing themselves thus of the store of knowledge contained in books, they make use of it in the conduct of new investigations or in the application of them to the useful arts.

They are, in whatever degree they thus avail themselves of stored-up knowledge, the true scientific men, who avoid vain speculation and test every proposition by its accord or discord with well-established fact.

They are thus matter-of-fact men, not in the ordinary sense, perhaps, for many of them, among the most brilliant of the class, as Tyndall, Huxley, Faraday, and a host of other brilliant names, have clothed their facts in such beautiful robes of fancy that their lectures are worth reading for their literary merit alone. But they are matter-of-fact in this, that whatever conclusion they adopt must have a solid substratum of fact. These men are at the present day making such a combined attack upon all that has not fact to support it, that superstition, which has long usurped reason, finds itself unable to maintain its ground, and slowly retires before their quiet but determined onslaught.

PEN STAMMERING.

Some time since we called attention to the great necessity of simplifying our present cumbrous system of penmanship. We should not, at this time, return to the topic had not our attention been called to it by the perusal of a little work written by A. J. Graham, an expert in short-hand and phonetics, whose abilities have made him well known to all the reporting fraternity in this city.

There is much in this book which is valuable, and the system set forth therein would, if adopted, save much labor. It consists mainly in the use of abbreviations, and when carried out to its fullest extent, will save some forty per cent of the labor of ordinary penmanship. But it does not appear to us to meet the requirements of modern business, be it either commercial, editorial, or clerical. What is wanted, in our opinion, is something that may be easily acquired, and easily understood, yet which shall enable the writer to spell out all words accurately, to punctuate with precision, and yet not occupy more than one half the time employed in ordinary writing. This can only be accomplished by the adoption of more simple letters, not by word contractions.

The simple forms used in short-hand writing are perfect in simplicity and legibility, and, when written out in full, give as graceful combinations as need be desired. They can be so thoroughly learned in a short time that they can be read with equal, and even greater rapidity than common long-hand, and their use saves more than half the average labor of long-hand.

There are, however, many reasons why a jump from long to short-hand, for business use, cannot be tolerated. All sound reforms necessarily are of slow growth. It nevertheless seems to us possible to hasten the ultimate abandonment of our present clumsy system for short-hand, by requiring that the system of penmanship taught in our schools should constantly tend towards simplicity rather than complication. If one hundred years since, a proposition had been made to at once eliminate all the superfluous letters in English orthography struck from our lexicons since that date, the movement would have met with very serious opposition. This has been done gradually and written language is very much improved thereby.

A steady tendency towards reform in chirography would ultimately lead, naturally, towards short-hand, or it could, we think, be made to do so, would some genius like Mr. Graham take into consideration the best manner in which long-hand may be made to gradually approach short-hand.

We have not had time to elaborate any theory by which such a desirable result can be accomplished, but have thought enough upon the subject to get a glimpse of possibilities in this direction which an expert might easily develop.

We trust that Mr. Graham, who has done so much for the cause of brief writing in this country, will examine these possibilities, as we are confident such examination will lead his active mind into a new and interesting channel.

RADIATION OF HEAT.

We not long since briefly discussed the communication of heat by convection and conduction, endeavoring to place in a prominent light some popular errors upon these subjects. and mistakes in the construction of steam boilers, refrigerators, etc., resulting from such errors. It will not be amiss to notice the third way by which heat is transmitted, namely, radiation.

The term, radiation, itself indicates the chief peculiarity of this mode of transmission. All the so-called radiant forces, as heat, light, attraction, etc., act from a center outwards, and all other things being equal, they act equally *in all directions*, the straight diverging lines in which they act being called rays. It must be borne in mind here, that the word center, as used above, is not employed in its strict mathematical sense, but rather means the source from which the heat or light is derived, as these modes of motion may often be generated wholly upon the surfaces of bodies.

Although, to explain the radiation of heat and light through apparently absolute space, a medium called "ether" has been supposed to exist, and although this hypothesis most admirably accounts for the principal phenomena of radiation, and changes in the direction of radiation by refraction and reflection, and though this fact gives such an hypothesis a strong claim to the very general acceptance it has received, still we must remember that it is not a demonstrated fact.

It is not, however, necessary to our present purpose to dwell upon this point, as we wish only to notice some of the most leading facts of radiation, considered in their practical application to the arts, and some facts which have been recently discovered.

A common error is the idea that "heat rises." We have already alluded several times to this error, and shown its fallacy, and we will not dwell upon it now. Suffice it to say that only when the source of heat is placed in a circulating medium, does heat even *appear* to rise.

A heated body, placed within a space void of any liquid or gaseous medium, will radiate heat *in all directions*, the intensity of the heat at any point being to the intensity of the heat at any other point inversely as the squares of the respective distances of the points from the radiating body. This is a fundamental law of radiation, which experiment has demonstrated beyond dispute.

Experiment has also demonstrated that heat radiation is affected by the physical characters of the surfaces of the radiating bodies, and this point is of considerable importance in the arts. Kettles, with smooth polished bottoms, transmit heat to the liquids contained therein much less rapidly than those the bottoms of which are blackened and rough. A steam boiler well lagged, and having the lagging inclosed by polished sheet metal, retains its heat better than by the use of the lagging alone.

Dark colored bodies radiate heat more rapidly than light colored ones. They also absorb heat to a greater extent than light colored and polished bodies. Ice would keep much longer in a bright tin pail than in a dark and roughened one. The polishing of stoves, while it improves their appearance, diminishes their radiating power.

The power of radiation is diminished by hammering and rolling metal. A hammered copper vessel is therefore not as rapid a radiator of heat as a cast one. We have often heard people wonder why copper sauce pans tinned on the interior, are preferred over all others by professional cooks. The reason is that they do not absorb and transmit heat so rapidly as vessels of iron or tin plate. They are hammered out by the coppersmith, who leaves their bottoms quite thick in proportion to the sides. The metal is thus consolidated, and being brightly tinned on the inside, and kept bright externally, the heat cannot pass through them faster than the evaporation of their contained liquids can convey it away. Thus a cook may have twenty different sauces all boiling at once, and yet he has no fear that any of them will scorch. The same reason is doubtless the basis of the favor with which copper is regarded for vessels used in distilling, sugar refining, etc.

All, or nearly all the heat existing upon the surface of the earth, may be properly traced to the radiated heat of the sun. This heat converted into various forms of force, or, according to many modern thinkers, "modes of motion," is reconverted into heat motion again in the combustion of coal, and other chemical reactions, in friction, electric resistance, etc.

Sir John Herschel and M. Pouillet found that, were no heat absorbed by the atmosphere, about 83 foot-pounds per second would fall upon a square foot of surface placed at right angles to the sun's rays. Mr. Meech estimates that the quantity of heat cut off by the atmosphere is equal to about 22 per cent of the total amount received from the sun. M. Pouillet estimates the loss at 24 per cent. Taking the former estimate, 64·74 foot-pounds per second will therefore be the quantity of heat falling on a square foot of the earth's surface when the sun is in the zenith. And were the sun to remain stationary in the zenith for twelve hours, 2,796,768 foot-pounds would fall upon the surface.

The last number of *Silliman's Journal of Science* contains an account of some investigations made by the celebrated Magnus—whose death we recently announced—on heat radiated at low temperatures. It is supposed this was his last work previous to his death.

We will close the present article by transcribing the results he obtained:

"Different bodies at 150° C. radiate different kinds of heat. These kinds of heat are more absorbed by a substance of the same kind, as the radiating body, than by others, and this absorption increases with the thickness of the absorbent.

"There are substances which emit only one or a few kinds of heat, others which emit many kinds.

"To the first of these belong rock salt when quite pure. Just as its ignited vapor, or that of one of its constituents, sodium, radiates but one color, so rock salt, even at a low temperature, emits but one kind of heat. It is monothermic, as its vapor is monochromatic.

"Rock salt even when quite clear, emits, together with its peculiar rock-salt heat, heat which is not more absorbed by a plate of rock salt 80 mm. in thickness, than by one 20 mm. in thickness.

"Rock salt absorbs very powerfully the heat it radiates. It therefore does not, as Melloni supposed, allow all kinds of heat to pass through it with equal facility.

"The great diathermancy of rock salt does not depend upon its less power of absorption, for different kinds of heat, but upon the fact that it radiates only one kind of heat, and consequently absorbs only this one, and that almost all other substances send out heat containing only a small fraction or none of the rays which rock salt emits. But all rays which differ from those radiated by any substance, are not absorbed by it, but pass through with undiminished intensity. From this we may infer that every substance is diathermanous, only because it radiates but few waves of quite definite length, and consequently absorbs only these, allowing all the others to pass through.

"Sylvin (native chloride of potassium) behaves like rock salt, but is not monothermic to the same extent. In the case of this substance also an analogy exists with its ignited vapors, or those of potassium, which, as is well known, yield a nearly continuous spectrum.

"Fluor spar completely absorbs pure rock-salt heat. We ought, therefore to expect that the heat which it emits will be equally absorbed by rock salt. Nevertheless, 70 per cent of this heat can pass through a rock-salt plate 20 mm. in thickness. This may doubtless be easily explained with reference to the quantity of heat which fluor spar emits in comparison with that of the rock salt; still it is possible that fluor spar at 150° emits rays other than those which it absorbs at ordinary temperatures. This behavior is however probably connected with the great reflecting power of fluor spar for rock-salt heat.

"If it were possible to produce a spectrum of the heat radiated at 150° C., the spectrum would, if rock salt were the radiating body, exhibit only one luminous band. It sylvin were used as a radiator, the spectrum would be much more extended, but would still occupy but a small portion of the spectrum which the heat radiated from lamp-black would form."

THE COMMISSIONER SUSPENDS A PATENT AGENT FOR GROSS MISCONDUCT.

Section 17th of the Act approved July 8, 1870, provides, "that for gross misconduct the Commissioner may refuse to recognize any person as a patent agent, either generally or in any particular case; but the reasons for such refusal shall be duly recorded and be subject to the approval of the Secretary of the Interior."

The Commissioner, indeed, has had this power since 1861, but during all that time, so far as we know, the penalty has not been inflicted until now upon any agent practicing before the office. Some complaints, however, have been made against agents for irregularities, and we have reason to know that ex-Commissioner Foote had occasion to regret his leniency in one particular case of a Washington agent, who had violated the confidence of the Office by writing to the clients of another agency during the pendency of the application.

The case brought to the notice of Commissioner Fisher was that of a firm styling themselves "McGill, Grant & Co.," of Washington City, who are charged on seven distinct counts with the crime of misappropriating the moneys of their clients, and in maintaining a false correspondence in relation to the progress of business within the Patent Office.

George W. McGill, senior member of the firm, entered a general plea that the irregularities in the practice as complained of, were the result of having intrusted their Patent Office business to an irresponsible and drunken clerk. The Commissioner, however, refused to accept this answer, inasmuch as all the correspondence of the firm appears to have been carried on in McGill handwriting; and the order of the Commissioner is, "that the said firm of McGill, Grant & Co., as well as the said George W. McGill, be hereafter excluded from practicing before the Patent Office in any and all cases."

McGill has appealed to the Secretary of the Interior to examine his case, and the matter is to undergo further investigation by that official, who directs that the publication of the order be suspended.

THE PRESENT EUROPEAN WAR.

Doubtless all our readers are deeply interested in the great struggle now going on between France and Prussia. While the general discussion of its causes and probable political effect upon European affairs is foreign to the scope of our paper, we cannot refrain from calling attention to an article copied from the New York *Times* of August 17, which is decidedly the best explanation we have yet seen of the causes of the recent disasters to the French army and the success of the Prussians.

In our tour through Prussia in 1867 we were most deeply impressed with the great military strength of the nation. Not only had this kingdom at that time added to the martial spirit of its citizens by a most brilliant military success against Austria, but it was evident that in point of military organization, in the character of her arms, and the *morale* of her troops, she was then, as now, the most formidable military power in Europe.

In a letter published in this journal in August of that year we expressed the belief that the people of Prussia anticipated another war. Whether that surmise was correct or otherwise, certain it is that the event has found them fully prepared for the emergency.

Should the present war result, as now appears likely, in the defeat of France, the first rank in military prowess among the nations of Europe must be accorded to Prussia.

Our readers will find the article to which we have called attention full of instructive interest in this connection. As a fair, candid review of the situation, we commend it to their attention.

THE USE OF TORPEDOES FOR COAST DEFENSE.

It appears that the Prussians, not having a navy equal to the French, have laid a regular network of torpedoes along their Baltic coast, and at the mouths of the rivers Ems, Weser, and Elbe. Both classes of torpedo are said to be in use, the charge being in general dynamite, which, although a dangerous, is a fearfully explosive material. Many of these torpedoes are believed to be mechanical, and, if so, are exceedingly dangerous to both friends and foes. Others are arranged on the ordinary electrical principle, and are perfectly safe except when the electric communications are established. Thus the navigation of the coast, with its rivers and harbors, is quite open to the friendly ship. The merchantman fleeing like the dove from the hawk may safely steer over and among the hidden mines; yet the next moment, by the mere turn of a key, the channel may be effectually closed to the pursuer. The torpedo is the war ship's *bete noir*. The proudest iron-clad that ever floated is powerless against these submerged volcanoes.

Many English sailors remember the Russian torpedoes during the Crimean war. Harmless and insignificant as they were, yet they caused a good deal of trouble; and if they had only been on half or quarter the scale of the present mines, several English ships would be now lying in Baltic mud. We shall not be the least surprised, therefore, some morning to hear of the sudden disappearance of a nautical belligerent.

DEATH OF PROFESSOR PALMSTEDT.

The death of this distinguished chemist, the friend and cotemporary of Berzelius, occured at Stockholm, on the 6th of April, 1870, at the advanced age of 85. He devoted his long life to the good of his country. For twenty four years he was director of the polytechnic school at Gotheuburg, and was thus enabled to introduce into Sweden the inventions and improvements of other countries. Technology and agriculture were his chief studies. He was the leading spirit in the organization of new schools and public exhibitions, and at the time of his death was actively engaged on a committee for the arrangement of a permanent exhibition of the products of Swedish industry, in Berlin. He made numerous journeys into foreign countries, the results of which have been published in Sweden—and among his papers have been found an extensive correspondence with nearly every chemist of note of the present century; among his letters, are 268 from Berzelius, which will be published by his executors, and doubtless throw much light on the history of chemistry.

He was a true patriot, an unselfish scholar, a useful man, and his death will be severly felt in Sweden.

SCIENTIFIC INTELLIGENCE.

TETRABROMIDE OF CARBON.

Messrs. Bolas and Groves have succeeded in preparing the tetrabromide of carbon for the first time, by heating together in a sealed tube, at a temperature of 150° C. (302° F.), for about 48 hours, two parts of bisulphide of carbon, fourteen parts dry bromine, and three parts iodine. and subsequently distilling the product off of a caustic soda solution, dissolving in hot spirits, and allowing to crystallize.

The tetrabromide of carbon is a white solid, crystallizing in lustrous plates, and melting at 195° F. It has an ethereal odor, somewhat resembling that of tetrachloride of carbon, and a sweetish taste—nearly insoluble in water, but easily dissolved in ether, bisulphide of carbon, tetrachloride of carbon, chloroform, bromoform, benzole, petroleum, and hot alcohol. It is not particularly acted upon by aqueous solutions of caustic soda and potash, or cold sulphuric acid, and with care can be sublimed unchanged. The authors have not had time to investigate the action of this interesting compound upon silver salts, ammonia, nor its physiological relations. It may prove to be a valuable salt in photography, as well as in medicine, and hence we have given a full notice of it.

ACTION OF SULPHURETED HYDROGEN ON THE SYSTEM.

Max Schaffner has recently made some observations on the action of sulphureted hydrogen that are worthy of publication, as the facts are not generally known.

When a workman remains for days or weeks in an atmosphere containing a very small quantity of sulphureted hydrogen, the symptoms are loss of appetite and headache. The sudden respiration of a large quantity of the gas produces immediate insensibility, as if the person had been shot by a bullet, all the muscles become rigid and motionless, the eyes are staring, and the lungs give out a rustling sound. Brought into the open air, and the head washed with cold water, the patient revives in a few minutes, and complains of lassitude, but not of any pain. Too long delay in such an atmosphere