REPORT

ON THE

RECENT CONTRIBUTIONS

OF

CHEMISTRY

TO

THE MEDICAL PROFESSION.

READ BEFORE THE

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THE contributions, which chemistry has made, during the past year, for the elucidation of subjects of interest to the medical man, are quite numerous. This department of study presents so many attractions to energetic and faithful students, that, with each year, we find the number increasing, and the facts they accumulate becoming of greater interest to the physician. It is true that we are not able, at the present time, to simplify the immense mass of material that has been collected in organic chemistry, yet this fact should stimulate the student to renewed exertion. When the induction can be made from a sufficiently large number of particulars, we have the right to believe that simple laws of combination will present themselves, and that the mass, *rudis indigestaque* though it be, to a great extent, at present, will arrange itself like particles of some beautiful crystal in exact relation to certain axes and assume the symmetric outline of regular geometric forms—or rather, that they will show themselves to be parts of a science, not only concerned *with* that which is organic, but *itself* an organism, in which each fact bears a vital relation to the whole series, and is meaningless when separated. Such a belief must stimulate the student to continued exertion. The analogy derived from other branches of science, from even the inorganic portion of chemistry itself, justifies him in the anticipation that all the various facts connected with organic chemistry, will be intelligible when the real character of the simple laws, which underlie them, is understood.

In looking over the mass of material which the journals have furnished us during the last year, the writer despairs of succeeding in presenting even a summary of all the new facts and applications, interesting to the physician, which have been announced by chemists. An effort will be made to present such as seem to have special practical importance. These have been grouped under four heads: I. Physiology and Pathology. II. Materia Medica and Therapeutics. III. Toxicology. IV. Hygiene.

I. Physiology and Pathology.

The subject of the so-called glucogenic function of the liver has been brought before our state faculty in the two last reports on chemistry, and the arguments advanced by Bernard and Lehmann in favor of the theory, with those of Figuiér and Longet against, have been given at sufficient length. It may, however, be not uninteresting to state what are Bernard's views with regard to the uses of sugar in the animal system.* He opposes the old notion that its principal use is for the support of animal temperature, which *is* developed largely by the destruction of the sugar, and holds, on the contrary, that the largest amount of heat is generated during its formation in the liver, as is shown by the temperature of the blood in the hepatic veins being greater than that of any other portion of the body. The main use of sugar in the animal economy, in his opinion,

* Med.-Chir. Review, xix, 21.

seems to be as an essential agent in the development of organic cells. Hence he endeavors to prove that, at the period, when this development is proceeding with greatest activity, during the uterine existence of the fœtus, sugar is most easily to be detected. His results have been collected by a reviewer in the Medico-Chirurgical Review, and they may be condensed as follows: "1. Both the muscular and pulmonary tissue of the fœtus, when exposed to the action of water, give up considerable quantities of lactic acid, while those of the adult furnish alkaline solutions. In the former case, the acid must have been originated from the presence of sugar, and indeed it may be detected in those tissues by the use of Trommer's test. This remarkable condition remains, until the fifth month of uterine life with the calf, when it begins to diminish; and *when* the muscular elements are formed, *then* its production absolutely ceases. 2. Notwithstanding its easy detection in the tissues just mentioned, not a particle of sugar is found in the liver or any other glandular organ, until the period arrives when it begins to disappear in such tissues, and then it begins to make its appearance in the liver. 3. Until the fifth month of uterine life, the sugar resists its normal metamorphosis into lactic acid, but permeates the system in the blood vessels, makes its way into the urine; and the urine, accumulating in great quantity, fills not only the bladder, but the allantois, which communicates with it, and thus the allantoic fluid also becomes saccharine." It is also to be found in the liquor amnii. 4. Bernard also claims, that "its presence in the blood prevents the infiltration of that fluid into the tissues and promotes the circulation generally," and that in consequence of a species of viscous fermentation it undergoes, the liquor amnii acquires its peculiar glutinous character.

Now we know that there is produced by the splitting up of an atom of glucose (C^{12} H^{12} O^{12}) two atoms of lactic acid (C^{6} H^{6} O^{6}); and the advocates of Bernard's theory hold that, as this process takes place in the laboratory upon the addition of some decomposing nitrogenous substance to a saccharine solution—being in fact established by the catalyzing effects of molecular changes—it is but fair to suppose it may also result from such molecular changes as take place during the formation of nitrogenous compounds. But if we look at the many theories which exist with regard to the nature of catalysis, and consider that it is, at most, but a word employed to rid the puzzled chemist of the difficulties which arise concerning certain changes, we shall see how difficult it is either to confirm or disprove any such theory. The whole subject of the changes to which sugar is liable in the animal system, and wherein a *sufficient* cause exists for the explanation of its conversion into lactic acid, still seems to be one open for much study before we can arrive at undoubted conclusions. The theory however of Dr. Pavy, just given, is highly ingenious, and commends itself to our consideration as the most plausible yet advanced on this interesting subject.

M. Baudrimont* of the Ecole de Pharmacie has noted the fact that in a case of diabetes, of six years' standing, the amount of sugar varied from 30 grammes in the litre, down to a mere trace, depending upon the period of the day when the urine was voided, and that the largest quantity was present a few hours after dinner, but that, after 12 or 14 hours had elapsed, only a slight trace could be detected in the urine. Thinking it might be important to see what effect a large amount of sugar taken into the stomach would have on the amount found in the secretion, he commenced taking large quantities of syrup daily—as much indeed as 500 grammes—near 8,000 grains troy. He was forced to relinquish the experiment, however, in consequence of the extreme disgust occasioned by the use of so large an amount of sugar, and the severe pain which it produced in the lumbar regions. By means of experiments similar to this, much may be obtained that will elucidate this subject. The glu-

* Journ. de Chim. Med. ii, 69.

cogenic function of the liver is an established fact now in physiology, but the laws which control its action are by no means perfectly understood, and years of patient, toilsome investigation will be required before a theory, sufficiently comprehensive to embrace all the phenomena of glucogenesis, can be formed.

The subject of the chemical nature and properties of the fatty matters of the bile has been re-examined lately by M. Gobley.* He undertook a series of experiments to test the truth of the opinion that the fatty matter of the bile consists of cholesterine and some fat acids in combination with soda. These experiments were exceedingly singular, and brought their author to the conclusion that the fat acids, which we obtain from the bile, do not pre-exist in it, but are the products of decomposition. Indeed, although bile, when after some days it begins to give off an unpleasant odor, may exhibit an acid reaction, and being agitated with ether, will yield up to it cholesterine and fat acids, yet fresh bile, according to M. G. will not furnish such results. Oleic and margaric acids are the results of the *dedoublement* of *lecithine*—a neutral substance first discovered by Gobley† in the yolk of the egg—under the influence of chemical agents or of putrefaction. Olein, margarin, cholesterine, and particularly lecithine, are always found with the constituents of the bile. We have no right to uphold the theory that the bile is of no special utility, when once formed, to the system, since, whenever it comes into contact with the intestines, its fatty constituents are speedily absorbed, so that but a small quantity is found in the excrement. Gobley draws the singular conclusion that an animal, deprived of the presence of these fatty substances in the bile, would really soon suffer from their removal, and would require the introduction of a large proportion of healthy and substantial food to compensate for such deprivation.

* Journal de Pharmacie et de Chimie, xxx, 241.

† Lehmann's Phys. Chem. ii, 360.

The presence of starch corpuscles in certain secretions of the body has been claimed as proved in some cases published within the last few years in the journals. Virchow* has investigated this subject apparently with great care. The substances supposed to be amylaceous are not of that character in many instances, as the failure of the characteristic iodine test clearly shows, but amyloid degeneration *does* take place, in his opinion, and it may be found in the nervous system, in the spleen, in the waxy degeneration of the liver, and in the kidneys. The affection in the latter organs first shows itself in the malpighian bodies and the arteries leading to them; after which the areolar tissue near the urinary tubes of papillæ is affected, and then the whole viscus. The starch grains are called, by Carter of Edinburgh, the thermogenic magazines of the body—matters which are by no means to be considered as of pathological but rather of physiological importance—and are to be looked upon as capable of possible conversion into sugar and lactic acid in the system. He saw them in "a tumor involving the optic nerve," in the liver, spleen, kidneys, brain, mesentery, lungs, ovaries, scrofulous matter, pus, urine, epidermis and blood. The first announcement of the discovery of this substance, which had always been considered as essentially vegetable in its origin, was received with much hesitation and doubt, but the careful examinations of Virchow and Carter demand from us respect if not absolute credence. They show how rudimentary, as yet, our knowledge of pathological chemistry is, and stimulate every faithful student of the science on in his career of investigation. If the albuminous substance of tissues may under certain circumstances, however inexplicable they may seem to be now, be replaced by amyloid substances, in one case existing as starch, and in another as cellulose, surely the therapeutic requirements in all such cases are exceedingly obscure. The substitution must proceed from constitutional causes. Virchow says that the tis-

* Medico-Chirurgical Review, xvii, 415.

sues thus affected are indurated, enlarged, and exhibit a waxy or lardaceous appearance. Wherever cellulose has been found, "chronic and extensive disease of the osseous system existed; and this species of disease seems to deprive certain of the secretions of their natural elements, and thus to insure the production of this substance.

In the chemistry of digestion some important additions have been made to our knowledge, by a series of experiments performed upon Alexis St. Martin, whose case is celebrated in the history of physiology, from the experiments made many years ago by Dr. Beaumont. It was right that the opportunity of witnessing the various stages in the process of digestion, presented by this case, should have been again used by scientific men, with the lights of modern science aiding them, so as to clear up, as far as observation ever can, this important process of the living organism. Prof. Smith of Philadelphia,* aided by Prof. Rob. E. Rogers, has accordingly repeated Beaumont's experiments, with regard to the nature of the acid contained in the gastric juice, and its influence upon different kinds of food.

In every instance this fluid, when obtained *during* the process of digestion, was *acid*, although it was entirely *neutral* when obtained from the stomach *after* the process had been completed. This accords with the results of the experiments made upon the same individual in 1833–4. It was then asserted that this acid reaction was due to the presence of hydrochloric and acetic acids, and the former was supposed largely to preponderate over all other acid bodies that might be normally or abnormally present. Modern investigations have led Lehmann and others to believe that this was an error, and to attribute to lactic acid all the peculiar acid indications of the gastric juice. The peculiar effect which was produced on a solution of nitrate of silver, by the distillate of the gastric juice, was formerly attributed to the presence of hydrochloric acid. Lehmann, however, insisted

* Phil. Med. Examiner; Chemist, iv, 228 and 305.

upon it that the lactic acid present decomposed some chloride of sodium, and hence the vapors which were given off contained chlorine, and these, when passed into a solution of silver, would necessarily form chloride of silver. It was certainly a matter of the highest importance to test the accuracy of the latter chemist's views in the case, which had given strongest support to the opposite theory.

As in previous experiments, the gastric juice was found to be *decidedly* acid, and the microscope showed it to consist, during the digestion of bread, of "epithelial cells, mucous corpuscles, amorphous granular matter and starch granules, some broken down, others perfect, together with a few cells of cylinder epithelium." The product of meat digestion gave, in addition to these, "oil globules in great abundance, and transversely striated muscular fibres, in some of which the sarcolemma was softened and ruptured, and the sarcous elements just liberated" without the presence of starch granules. These products, being freed as much as possible from the solid matters they contained, were then subjected to careful chemical examinations, and the following conclusions deduced:

"1st. That the secretions of the stomach when digesting are invariably acid.

2d. That the acid reaction was not due to the presence of phosphoric acid.

3d. That *if* hydrochloric acid was present, it was in very small quantities.

4th. That the main agent in producing the characteristic reaction was *lactic acid*."

With regard to the quantity of free acid, no conclusions are given which would lead us to doubt Lehmann's position,* that it is as variable as that of alkali in the saliva. Its formation in the case of vegetable diet can be clearly accounted for, through the metamorphosis of amylaceous or saccharine matters, similar to that which takes place in the acetification

* Lehmann's Phys. Chem. ii, 44.

of milk. More difficulty is presented, however, by its normal appearance in the gastric juice, during meat digestion, but we are not prepared to deny that it may not result in some way from changes produced in proteinaceous or gelatine compounds; indeed, Lehmann* considers that "there would be nothing incongruous in assuming, that in the natural metamorphosis of creatine in the animal body, where no sarcocine is found, the creatine is still decomposed into urea, but that, in place of sarcocine, there is an abstraction of water, and lactic acid and ammonia are formed," and hence, as the presence of this acid in the form of alkaline lactates may be presumed in the blood, its presence may be accounted for in the secretion of the gastric juice itself.

The second question considered by Prof. Smith was the action of this juice on the various alimentary substances, as divided by Prout into, *albuminous*, *amylaceous* and *oleaginous*. Mialhe's views with regard to the action of the juice upon the nitrogenized articles of food, showed us that not only was albuminous matter dissolved by it, but was converted into a substance called peptone (albuminose), or as some say substances designated as peptones. Positive examinations, through the use of artificial fistulæ in the stomachs of animals, showed, indeed, that all the protein and gelatine portions of food were converted into *such* albuminose compounds, which, as they do not differ in chemical constitution or physical properties, but only as regards their solubility in water and dilute alcohol, may be considered illustrations of organic allotropism. Furthermore, these peptones are capable of ready absorption, which is not the case with the substances from which they are formed.

The examination of this second question resolved itself into a consideration of the different classes of aliment; and as both albuminous and oleaginous matters are found in meat, the experiment was conducted with the use of rarely done beef steak. After two hours had elapsed, the liquid,

* Lehmann, i, 102.

resulting from the digestion of the meat, was examined, and notwithstanding an exposure to active ebullition, it presented *no* marks of coagulation. The same result attended the use of strong mineral acids when cold, although when boiling hydrochloric acid was employed, the purplish hue of protein bodies was produced. This was satisfactory with regard to the presence of albuminous substances, although these refused to yield indications of presence to the coagulating tests. It was fair also to conclude that "a portion of the dissolved material had doubtless been absorbed," so that we can understand how the lactic acid of this juice, along with these peptones, passes into the circulation.

The oil globules were recognized in the liquid taken from the stomach, and had evidently not been altered chemically, but had only undergone such physical changes as would insure their disaggregation into exceedingly minute globules.

The action of the juice on *amylaceous* articles of food was not quite so satisfactory as some other results of this examination. It would have been specially interesting to have examined into the amount of lactic acid present, when this class of food alone was used, as compared with that present in the case of meat. No quantitative determinations, however, were made, although we learn that, in 2½ hours after deglutition, starch granules were readily detected by the iodine test, and Trommer's test gave satisfactory indications of the presence of glucose, into which the starch had been converted by some catalyzing substance. What is singular, however, is the conclusion that the gastric juice does *not* interfere with the glucogenesis, as has been supposed, and that this latter process will take place *without* the presence of the saliva. Bread was moistened with water, and then introduced into the fistulous orifice of the stomach, care being taken to avoid the flow of saliva down through the œsophagus. The same effects in kind, though not in degree, were detected as when preliminary mastication of the food had been employed—that is to say, there were traces of starch and decided manifestations of the presence of sugar.

The saliva thus is deprived of what was thought to be its peculiar and special province, the metamorphosis of starch into sugar, and this seems to result from a variety of catalysing agents in the human system exactly as it does without.

Poggiale has been examining into the chemical composition and nutritive equivalents of the food of man,* and his researches are of so much practical importance that it is felt to be demanded, as it were, that they should be included in this report. The first portion of these researches, which considers the aliments furnished by cereals and leguminous plants, has already been published, and the student of hygeine awaits the appearance of the continuation of the researches with much interest.

The cereals and leguminous plants furnish substances as aliments, which contain "water, mineral salts, cellulose, nitrogenous matters, both soluble and insoluble in water, fatty substances," and peculiar products, such as tannin and resinous matters. The author thinks that it has been already proven that food must consist of "plastic substances, fatty matters, salts and alimentary hydro-carbons." Three of these have been considered as necessary by every writer from the time of Prout down to the present, while the inorganic constituents have been overlooked. As each one of the four is necessary, there must be some ratio existing between them all, and we shall understand this best, when we have examined into the wants of the animal system. Then will the proportions of the saline, fatty, nitrogenous and hydro-carburetted matters contained by each article of food, enable us to determine what may be its value and what its deficiencies. The necessities of the body require that the food must contain at least an amount of saline matter, carbon and nitrogen equivalent to that which is thrown off during the 24 hours. In case any of these should be deficient, there will be injury to health, unless some other aliment is added in order to make up for the deficiency. Be-

* Journal de Pharmacie et de Chimie, xxx, 180 and 255.

tween the amount of carbon required and that of plastic material, there is the ratio of four to one. Poggiale, however, insists that we must not depend alone upon the theoretic results arising from chemical investigations, but must permit them to be controlled by the practical, because much depends on "the strength, cohesion and digestibility" of alimentary substances. Meat is a more nutrient aliment than white of egg, gelatine will not support life as well as meat, and we cannot substitute one article of food for another without keeping in view the capability it possesses of producing the same or different physiological effects. The quantities of the various aliments, however, which are capable of producing like effects, constitute what Poggiale calls *the alimentary equivalents.* The necessity of considering the physiological effects is shown in the fact that if we were to take *one article of food alone* as the source of the four different materials, three of them would generally be present in improper quantities, being either greatly too large or too small. This is shown when we take nitrogen, for example, as the important agent, and bread as the source. There would be required 1,850 grammes of bread to furnish the proper amount of nitrogen, and an immense amount of carbon would be taken into the system, which would have no other effect than that of debilitating the whole digestive apparatus. But if we were to take carbon as the important agent, and meat as the only article of food, each adult would be obliged to consume three kilogrammes, in order to obtain fuel enough for the preservation of animal heat, and the superabundant amount of nitrogen thus taken would injure the whole system.

Poggiale thinks that the larger proportion of matters, which are nonassimilable in bran, justifies its removal from flour. He does not think, however, that bran is useless, but considers the removal of 20 per cent. as quite enough. The value of bran especially, with him, is as a means of retaining the assimilable portions of flour longer in the stomach, permitting a more thorough digestion, and augmenting the amount of fecal matter, so as to render the digestive functions *plus faciles et plus regulières.*

Composition of various Vegetable Aliments.

	Wheat.	Rice.	Barley.	Oats.	Rye.	Corn.
Nitrogenous matters, -	14.40	7.80	10.665	11.254	8.790	9.905
Starch and dextrine, -	63.30	74.47	60.330	61.850	65.533	64.535
Fatty matters, - -	1.90	0.235	2.384	6.108	1.992	6.680
Fixed matters, - -	1.70	0.320	2.623	3.085	1.772	1.440
Lignine, - -	4.20	3.445	8.779	3.460	6.383	3.968
Water, - -	14.50	13.730	15.229	14.243	15.530	13.472

Omitting what the author has said on the first of these grains, we find that he draws some important deductions as regards the other five. Rice contains so little of the nitrogenous, saline and fatty matters, that to make it at all adapted for animal support, it must be accompanied with articles rich in these substances, such as meat, fish, milk, &c. 550 grammes of it would be required to substitute 250 of meat, and would then contain so large an amount of carbon as to do injury to health. Barley, although a better material, yet in consequence of its nitrogenous matter being in the condition of albumen, it is impossible to be converted into bread. Rye is less nutritious than wheat, but furnishes a bread which remains sweet for a longer time. Indian corn, in consequence of the large amount of oily matter it possesses, in addition to other necessary constituents, is one of the most nutritious substances used for food.

The chief of the hospital at Luneville,* M. Saucerotte, considers the frequency of constipation in the present day, as due to the bolted flour which is now universally employed by the bakers. He shows that our flour is occasionally bolted until as much as 25 per cent. is removed.

M. Mouriet's† views on the value of the presence of bran in bread lead us to believe that it mostly depends on a peculiar nitrogenous principle, which possesses the property

* Journal de Chimie Medicale ii, 232.

† Transactions of the Med. and Chir. Faculty, 1855.

of liquefying starch, and converting it into sugar. Saucerotte does not enter into a discussion as to the truth or fallacy of this theory, but simply insists upon it that the use of bran bread does aid the evacuations, without having the disadvantages possessed by medicines, as it does not fatigue the digestive organs, and never loses its efficiency by habit. He humorously styles the process of bolting a measure of luxury and not one of hygiene. The effects of the celebrated German *pumpernickel* on the digestive organs of the Westphalians, where dyspepsia and constipation are unknown terms, show what is the value of bread which is manufactured from flour entirely undeprived of the bran. If we conjoin to Saucerotte's views those of Mouriet, there will be formed a strong argument adverse to the entire removal of the bran from our flour.

The chemistry of respiration has been very carefully examined during the last five years, and a review by Harley* of what is positively known on this subject, published during 1856, puts us in possession of a clear account of the extent of the contributions made by chemistry to our knowledge of this important organic function. Some important corrections of old errors are made in this review, a few of which it may be interesting to notice here.

Oxygen gas has been found existing not only in the arterial, but also in the venous blood, and carbonic acid has been detected in both. This is contrary to the old notion that these gases were restricted to the different kinds of blood. Magnus considers this fact as proving that oxygen exists in the arterial blood, *not* in chemical combination with it, but as mechanically united; the writer feels inclined to coincide with Mr. Harley in believing that this fact only shows that the blood has not *unlimited* power of combination with oxygen gas, and hence the superabundant quantity of the latter would be found only mechanically present. Blood can absorb one and a half times its volume of car-

* Medico-Chirurgical Review, xviii, 321.

bonic acid gas, and but one-tenth of its volume of oxygen. This proves clearly that to get enough of oxygen into the arterial system for the uses of the animal economy, there must be chemical combination as well as mere mechanical mixture. Mr. Harley, by various experiments in Bunsen's laboratory, has succeeded indeed in demonstrating that the oxygen of the air *cannot* be brought into contact with blood without entering into "chemical combination with one or more of its constituents."

Valentine and Lehmann having shown that the amount of urine excreted in a day depends upon the amount of nitrogenized food taken, it seems to be a fair conclusion that some of the oxygen in the blood combines with the hydrogen of the ingesta, and thus water is formed, through the oxidation of nascent hydrogen. But if this be so, then we should have a larger quantity of urine discharged, as a general thing, than the quantity of water or other fluid taken into the system. That this *is* so, the writer is not prepared to admit, although Böcker asserts its truth, and states, "that if 1.260 grammes of liquid be taken, 2.621 grammes of urine will be passed; if 3.360 grammes be taken, 4.994 grammes will be passed in 24 hours."

The blood is then oxydized not only by the combustion of its carbon but also of its hydrogen, and besides there are other oxidations in the blood, which may be preliminary to the formation of secretory and excretory products. The superabundant nutritive material which is taken into the blood vessels during digestion is always excreted before it has become tissue, and this may be due to the active agency of oxygen under the controlling and directing influence of vitality. Indeed, in this way we are able more philosophically to account for the enormous amount of carbonic acid gas which is daily thrown off from the lungs, than by the old theory that it *all* resulted from the oxidation of effete portions of tissues in the capillaries. We do not see even how such an hypothesis would militate against the old notion, that the capillaries were "the furnaces of the system," as Townes* not inaptly styles them. *There*, the greatest amount of animal heat must be generated, but as every chemical action (and who can tell how many such take place in the system?) is accompanied with the loss or absorption of caloric, each must contribute or abstract something from the quota of the whole.

Harley further shows that the pure coloring principle of the blood "by exposure to the air, gives off carbonic acid gas, and becomes oxidized in two ways—firstly, by a loss of carbon; secondly, by direct combination with the air." This by analogy we can understand, as in animals where the circulating medium is employed in the absorption of oxygen and the elimination of carbonic acid, the blood is highly colored, and in the plant, coloring substances are always most abundantly found where respiration is carried on, i. e. in the leaves. If this be true, then the coloring matter of the blood corpuscles has more to do with respiration than the iron which they contain.

II. Materia Medica and Therapeutics.

The contributions of chemistry to these departments have been, as usual, very many and interesting. The writer will endeavor to present such as seem to be most important in a practical point of view. Prominent among these may be mentioned the experiments of Poggiale† with reference to the action of alkalis on sugar in the animal economy. The sugar which appears in the system, whether furnished by the food or formed by the liver, never presents itself in any normal secretion. It is employed as one of the materials used in the production of animal heat. The decomposition may be represented, according to some chemists, by the formula $C^{12} H^{12} O^{12} + O^{24} = 12\ HO + 12\ CO^2$; or, according to others, the sugar is removed by the action of alkaline carbonates, which insure the formation of alkaline lactates,

*Actonian Prize Essay, 100.

†Journal de Pharmacie et de Chimie, xxix, 179; Chemist, iii, 419.

that are then decomposed into carbonic acid and water. In accordance with this latter view, the existence of diabetes depends on a deficiency of alkalinity in the blood, which permits the nondestruction of some of the sugar. Poggiale's experiments were directed towards the investigation of this theory.

Dogs being fed on meat for some days to which bicarbonate of soda had been added, were afterwards killed, and the blood of the crural artery, the vena cava inferior, the hepatic veins, and the liver was examined, but in no case was any diminution in the quantity of sugar detected, and the amount noticed was the same as that found in dogs that had been fed on meat alone. When the same animals were fed on amylaceous or saccharine food, mixed with the same alkali, it was demonstrated that sugar could exist in the blood and even in the urine, notwithstanding there might be large quantities of alkaline salts present. When glucose was injected, along with bicarbonate of soda, into the jugular vein of a rabbit, even this did not prevent the appearance of sugar in the urine, although the injection of tartaric acid seems most frequently to prevent its appearance.

Poggiale has also studied the action of alkalis and their carbonates on glucose *out* of the system, with results as follows: When the temperature was at 98°, 140°, 176°, and even 194°, there was no change in color or character of the saccharine solution. When the alkali was present in large excess over the sugar, then there was some small disappearance of the glucose, on the liquid being exposed to a boiling heat for some time.

The results of these experiments show us that no confidence can be placed in the use of alkalis as therapeutic agents for the establishment of a healthy condition of the system, when sugar has begun to appear in the secretions. They certainly show that Mialhe's theory as to the cause of the disease, is not tenable.

As to the other two theories: Bourchardat's simply requires, in treatment, that a man should avoid amylaceous matters in his food, which course of diet we know will not stop the disease—and Bernard's requires that the liver should be attended to. M. Baudrimont,* without reference to theory, has been experimenting on the employment of brewers' yeast on the glucose in a diabetic patient, and the results are exceedingly curious if not valuable. The patient, a boy 11 years of age, had been treated, in accordance with the alkaline method, with no diminution of sugar, for over two months. At the beginning of the treatment, the urine contained 36 grammes of glucose to the litre. Brewers' yeast was administered at first in 20 centigramme doses, and it was increased up to 2 grammes per day. On the fifth day symptoms of intoxication presented themselves, continuing for a few days and then declined, and the thirst declined at the same time. The intervention however of a severe illness, resulting in a serious effusion on the brain, and death, prevented the issue of the treatment being noticed. Mons. B. however, is satisfied that "beer-yeast is capable of transforming the sugar of diabetic patients into alcohol." The writer is not indisposed to admit the probability of this theory as to the therapeutic action of the agent, but he has not sufficient credulity to admit the conclusions with regard to the supposed intoxicating effects in the case quoted.

Dr. Gray† of Glasgow, who adopts Bernard's theory as explaining some cases where the liver is the offending organ, as well as Bourchardat's as explanatory of others, where the stomach is at fault, considers that in some cases both liver and stomach are joint offenders, and hence divides the disease into three kinds: diabetes hepaticus, d. gastricus, and d. gastro-hepaticus. In the d. gastricus, he prefers the rennet treatment. He gives of the liquid, obtained by macerating the salted and dried stomach of a calf, in two pints of water for 4 days or longer, a tablespoonful from 3 to 6 times a day. This is accompanied by a small quantity of

* Journ. de Chim. Med. ii, 161, and Chemist, iii, 766.

† Chemist, iv, 123 and 183.

alkali, such as the tribasic phosphate of soda, or the carbonate of potash, and a little tincture of nux vomica as a stimulant tonic. The diet is principally animal, bread made of eggs, butter and bran, salted fish, bran bread occasionally, greens, beans, lettuce, and such like vegetables. The sugar, on such treatment, has disappeared in from 2 weeks to 9 months. In cases of complication with phthisis, cod liver oil and morphia should be employed. Out of 28 treated, seven have recovered their ordinary health, and there is no indication of sugar in their urine at present; three of them died from other diseases; seven were still under treatment, and the remaining eleven are very much benefited. He conceives that the disease is owing to some substance which acts as a ferment, and that the use of rennet will destroy its character, and thus allow a return to health to the whole system. The facts in these cases bid us hope that something still more clear and satisfactory will be discovered.

The use of pepsine as a therapeutic agent, in cases where the digestive functions are much enfeebled, is attracting some attention in France, and Boudault's late researches* into the mode of its action are exceedingly important, as they present a condensed view of the physical, chemical and physiological properties of this substance. He compares the results of its action, where it is dissolved in water constituting the artificial gastric fluid, with the action of the natural gastric juice obtained directly from the stomachs of dogs through fistulous orifices made for the purpose. The latter is of a light amber color, when separated by filtration from the mucus always mixed with it; has a density somewhat greater than that of water, a slightly saline, styptil taste and an odor resembling broth when heated. It may be preserved, out of contact with the air, for years. Alcohol precipitates the pepsine and separates it from its acid. On an examination of its action, he found that pepsine may be regarded as a true ferment, but that it acts on

*Journ. de Pharm. et de Chim. xxx, 161; Journ. de Chim. Med. ii, 718; The Chemist, iv, 155 and 206.

food "by dissociating its particles, making them undergo a kind of transformation but not a decomposition." Acid or neutral pepsine converts glucose in solution, when exposed to a temperature of 104° for 12 hours, into lactic acid, and then fibrin will be digested in a few hours completely. The formation of this acid, however, seems necessary in order that there should be perfect digestion. The whole process may then be stated as consisting first in the conversion of starch, through the agency of salivary diastase principally, into glucose, and then the metamorphosis of this into lactic acid. The acid must be present in order that pepsine, whether normally present or supplied *ab extra*, shall succeed in digesting fibrin. When both are present, then we have perfect digestion, that is to say, that peculiar condition of the food which allows of its being brought into the uses of the system through means of proper vessels.

The preparation of pepsine is best accomplished by Boudault's process, and is as follows:* The rennet bags of sheep are taken, "opened, reversed, and washed under a thin stream of water, to free them from alimentary matters, &c. The mucous membrane is then carefully scraped off with a knife, the cells are bruised in a mortar, and digested for twelve hours in distilled water. The liquid is then filtered, and neutral acetate of lead is added, which precipitates peptate of lead." This is then acted on by sulphydric acid gas for the removal of the lead, and filtered. The filtrate constitutes neutral pepsine, to which lactic acid must be added in order to make acid pepsine. In order to obtain this, in pulverulent form, it is evaporated to a syrupy consistence, and then mixed with dried starch. The result is a fawn colored powder, of a peculiar odor and taste, and slightly coherent. This substance, as sold in the shops, is often adulterated. A spurious article introduced in England, has been shown by Mr. Squire† to be recognized by the following distinctive differences existing between it and the genuine:

* Chemist, iv, 434.
† Chemist, iv, 436.

Tests.	True Pepsine.	False Pepsine.
Acetate of lead. - - -	Abundant precipitate. - - (Peptate of lead.)	Slight cloudiness.
Tannin. - - - - -	Abundant precipitate. - - (Tannate of pepsine.)	Ditto.
Alcohol. - - - - -	Precipitates the pepsine. - -	No effect.

Corvisart first recommended the use of pepsine in dyspepsia. Boudault finds that it is a powerful digestive agent "in cases of want of appetite, of slow and painful digestion, diarrhœa, vomiting and the weak digestion which exists at the commencement of convalescence from serious fevers, and in the course of most chronic diseases." It may be administered, before eating, in unleavened bread, or after meals, in cherry syrup. Mixed with hydrochlorate of morphia, it is useful in violent pain in the stomach during digestion, with strychnia when there is deficient peristaltic action, and with many other medicaments, without impairing their properties.

As anæsthesia has attracted considerable attention for the last ten years, every substance capable of producing such a condition is investigated with care as soon as this property becomes known. Dr. Snow* of London proposes an entirely new agent (amylene), which was first discovered by Balard of Paris in 1844. It is a colorless liquid substance, with a peculiar, disagreeable odor; boils at 102° F. and has a specific gravity of 0.659. It is formed by distilling fusel oil along with anhydrous phosphoric acid, or chloride of zinc, and has a chemical composition represented by the formula $C^{10} H^{10}$. Alcohol and ether are its appropriate solvents, while it is only sparingly soluble in water. The author of its use as an anæsthetic sums up its properties as follows: "In regard to its odor—it is more objectionable than chloroform, but much less so than sulphuric ether. In respect to its pungency—it has a great advantage over both ether and chloroform, being much less pungent than either of them. A patient often complains of a sensation of choking at the

* The Chemist, iv, 377.

attempt to inhale chloroform, requiring at times two or three minutes before it can be overcome. The amylene can be inhaled at first of full strength, within a half minute from commencing, and the operation may generally be begun within three minutes. It prevents pain, with less profound stupor than that occasioned by other agents, and in the ready waking and recovery of the patient, it has an advantage over chloroform and ether. There is an absence of sickness from its use, and of the struggling and rigidity which are occasionally produced by the ordinary anæsthetics."

The effects of sweet spirits of nitre,* when inhaled, have also been found to be anæsthetic, but of a character that makes us fear its use by inhalation, as deaths have been produced in this way. It seems to act by destroying muscular power first, then reducing the pulse so that the feebleness of the circulation in the extremities causes these to become quite cold. The mind remains calm, and there is no feeling of pain or even consciousness of muscular debility until efforts are made to make special exertion. These symptoms have been particularly noticed in those engaged in making the article. It is suggested that great precautions being adopted, it might be used in the mania of delirium tremens.

Collodion† is employed by Dr. Macke of Sorau as the medium for the application of corrosive sublimate to nævi materni, and the compound is called caustic collodion. It commends itself to use for two reasons—on account of its application to parts where it would be difficult to keep a liquid caustic from attacking adjacent parts, and to those where the discharge of excretions might wash off the caustic employed. The proportions necessary for its preparation are 4 parts of the chloride of mercury to 30 parts of collodion, and the application is accomplished simply by the use of a camel's hair brush. The collodion dries rapidly, and thus confines its action to the part covered, in the first case. When much inflammation follows, it may be necessary to

* The Chemist, iv, 429.

† Chemist, iii, 572.

use cold applications. The eschar separates in from three to six days, having rarely more than a slight cicatrix. This additional use of collodion, for which the surgeon has already found so many applications, is another illustration of the contributions medicine is daily receiving from the hands of the chemist.

Gutta percha and caoutchouc have also been employed for the preparation of caustic agents, being used in combination with caustic potassa or the chloride of zinc. This application was first proposed in France by M. E. Robiquet.* He had been requested by a surgeon to suggest some method by which the two caustic substances just mentioned could be employed so as to cauterize fistulas, more or less sinuous in their character, with the further power on the part of the operator to leave them as long in contact with these parts as might be required, and to withdraw them at pleasure. He found that it was an exceedingly easy matter to unite either of the caustics named with gutta percha by the aid of heat, and then to form out of the plastic mass either cylinders or pastilles. The proportions seem to be a matter of very little importance, depending on the strength of caustic required. Two parts of chloride of zinc might be heated along with one part of gutta percha, in a porcelain capsule over an alcohol lamp. The gutta softens under the action of the heat, and becomes thoroughly impregnated with the caustic. Such caustics are like sponges, and retain the caustic agent within their pores so as to resist the deliquescent action of the atmosphere, although they yield it up to the force of capillarity existing in living organic tissues. The inventor advises, in order to use these caustics, that they should be first dipped in alcohol. The advantages claimed for this application are simply these: "The gutta will not itself undergo any changes in the tissues; it preserves its consistence and flexibility; on account of its suppleness, it can be forced into natural canals, such as the nasal and the urethra, or into

* Jour. de Chim. Med. ii, 31; Jour. de Chim. et de Pharm. xxx, 275.

diseased and tortuous passages like fistulas; the capability of being applied in any way that the surgeon desires, and the property of allowing, as already mentioned, the exudation of the caustic material employed." These are by no means small advantages, and all of them are really possessed by these caustics. The caustic does not require heavy appendages such as the usual porte caustique, but is light, convenient and efficacious; and, furthermore, every medical man can manufacture these caustics as well as he can purchase them. Economy certainly cannot complain of the cost of materials in this case.

Some interesting facts have been educed, from a variety of publications, embodying the studies and researches of savans, on the subject of glycerine. Its discovery dates back as far as 1789 by Scheele, but little or nothing was known of it until Chevreul began the study of oils and fats. It is known as the sweet principle of fats, and is really the base with which the fat acids are united in the composition of all fatty bodies. Whenever the latter are exposed to the process of saponification, glycerine is set free. There have been three sources of the article as found in commerce; one, the manufacture of lead plaster, when the glycerine generally held some of the lead in solution—another, the manufacture of soap, and the impurities contained in the filthy materials were very difficult to separate from the glycerine; and third, the manufacture of stearic acid candles. Mr. Geo. F. Wilson* of England proposes a method which furnishes an article, better and purer and cheaper than either of the three methods just mentioned. It was discovered that glycerine could be distilled, and with this new fact in its history, the new process for its manufacture was contrived. "Steam at a temperature of from 500° to 600° F. is introduced into a distillatory apparatus, containing a quantity of palm oil. The fatty acids take up their equivalents of water, and the glycerine takes up its equivalent;

* Chemist, iii, 100.

they then distill over together. In the receiver the condensed glycerine, from its higher specific gravity, sinks below the fat acids." This can be afterwards purified and concentrated, by redistillation and evaporation.

The profession is already aware of its application as a soothing and protecting agent in cases of chapped hands, or injuries resulting from exposure to the sun, how well adapted it is to all affections of the skin where it is necessary that this should be kept moist, and how serviceable it has been in the treatment of various diseases of the ear, as suggested by Wakely of London in 1849. Quite a number of new applications have been proposed lately. It had been applied as a dressing to wounds, with results that show it possessed of an antiseptic property, which makes it a most valuable agent in hospitals where the foul emanations from old ulcers can thus be measurably restrained. M. Demarquay* has been making a series of experiments with regard to its action in preserving organic matters from decay. Beef and mutton were immersed in glycerine and kept for 2 months without any perceptible modification. These experiments coincided with those of Wilson, who found that fish could be preserved in it without any alteration of color, and the preservation was just as perfect if they were cleansed and only wrapped in a cloth which had been saturated with glycerine. M. Demarquay further tried the effects glycerine would have when injected into the arteries. On Nov. 19 the foot of a man who had died on the 13th was injected with glycerine. On the 21st of the following month it presented a natural appearance; the articulations were flexible; the tissues had natural firmness. These experiments were repeated on different portions of the body with the same effect. Finally he injected two still-born infants with glycerine, through the umbilical cord, and up to the time of his communication the preservation was undoubted. The query now is, as to the length of time that this preservative

* Journal de Chimie Medicale, ii, 169.

action will endure. Should it be absolute, the value of glycerine as an agent for embalming purposes may be well imagined. Should it prove to be only an agent that is temporarily conservative, still we can employ it to very good purpose in the preservation of dead bodies for dissection. It has also been employed in the preservation of objects for microscopical examination.

But the possible applications of this substance are indeed quite numerous. Thus we can see the propriety of its employment in diseases of the mucous lining of the stomach, and as an injection in cases of dysentery when it might be made the menstruum for the administration of medicinal agents of various kinds, and by its direct soothing agency bring relief to inflamed parts. Again—as it is a solvent for both urea and phosphate of lime, is the recommendation that it be employed by injection into the bladder, for the purpose of effecting a solution of calculi, to be overlooked? There is no liquid that unites so many remarkable properties as glycerine; a solvent for a vast range of substance, presenting resistance to drying on exposure to the atmosphere, and freedom from irritation. These combined, constitute qualities, which must eventually develop hundreds of uses not dreamed of now. As an illustration of its solvent properties, its employment for the preparation of a solution of iodine and iodide of potassium may be mentioned. When any other solvent is employed, as it dries rapidly, the absorption of the iodine is speedily checked. This is not the case if glycerine be used as the solvent. The solution is prepared by dissolving one part of iodide of potassium in two of glycerine, and then pouring this liquid on one part of iodine. Any physician can recognize how great a number of applications might be made of this iodized glycerine. The solution is used by spreading on the diseased parts, then covering with gutta percha paper or oiled silk to prevent the evaporation of the iodine as well as to increase perspiration from the part, which will insure a more rapid absorption. Dr. Richter, who proposed this application, says that it occasions some pain, "has a really heroic action in cases of lupus, a remarkable efficacy in nonvascular goitre, scrofulous ulcers, constitutional syphilitic ulcers; but it is doubtful in primitive chancres and eczema, and *nil* in psoriasis."

In addition to these cases, it is available *wherever* the physician wishes to employ iodine topically, and the advantages it possesses over the simple alcoholic tincture can be appreciated by every one knowing the properties of the two menstrua.

III. Toxicology.

The journals have been replete for the last 12 months with interesting monographs on the physiological and toxicological effects, and the chemical detection of strychnia. These have all resulted from the intense interest which the trial of William Palmer for the murder of John Parsons Cook, produced throughout the world; and they contain many novel and important facts in the history of this powerful and most important medicament. It is thought that a *resume* of the most valuable suggestions in these monographs would be useful to the profession, as they are spread on the pages of a number of journals, both chemical and medical, that are not always accessible to the student.

In the case of Palmer, it appears that he was the intimate confidential friend of Cook, and that the two were largely concerned in betting on the various races in England. The former had become largely indebted through his pursuits, and was obliged to raise money with the view of saving himself from imprisonment. "Cook had been slightly indisposed for four or five days, the indisposition consisting chiefly in attacks of nausea and occasional sickness, but without purging. On the 19th of November he had a fit, from which he recovered, and on the 20th, about midnight, he was seized with convulsions, and went off suddenly."* On an examination being made by Drs. Taylor and Rees, of

* Taylor on Poisoning by Strychnia, 7.

the stomach and contents, and the contents of the viscera, which had been, owing both to the imprudence of the anatomist and supposed tampering of some unknown person, completely mixed together, indications of the presence of antimony were furnished, but no satisfactory proof of the presence of strychnia or any other alkaloid was obtained. The symptoms, however, exhibited in the two attacks of convulsions which the deceased had experienced, pointed to the administration of strychnia, and could be accounted for in *no other* way. The jury, notwithstanding then the nondetection of strychnia, found the prisoner guilty of the charge of having "feloniously, willfully and with malice aforethought, committed murder on the person of John Parsons Cook," and he was accordingly sentenced to be publicly executed; which was done on the 14th of June 1856.

This case is interesting in a medico-legal point of view, as conviction was the result, although the supposed cause of death was not positively detected. The one link in the chain, necessary to have given the evidence the character of *positive* instead of circumstantial, that is the detection of the poison itself, was absent. There was a reliance on the evidence furnished by symptoms and by pathological means, in despite of the negative character of that which was given by the chemical analysis; and this reliance was so strong that the verdict of guilty was unanimously rendered by the jury. The defence strongly urged the fact that no poison had been detected, and therefore none had been employed. Now this position involves two suppositions: first, that poisons *always* can be detected when given to an animal for the purpose of producing death; and second, that their identity can be proven beyond possibility of cavil. The first supposition is not justified by the history of toxicology, since poisons have been again and again designedly given to animals, and experimenters of the highest ability have failed to detect them. It is true that the certainty of detecting what has been taken is becoming greater with the increase of knowledge of chemical manipulation, yet the fact nevertheless exists that some poisons, even with all our present knowledge, have eluded detection when taken into the animal system. Experiments have been made by the best chemists in England on this point, and failures have occasionally occurred. Dr. J. E. De Vrij* of Rotterdam failed in detecting strychnia even when mixed with urine intentionally after this fluid had been voided from the bladder. In two experiments on dogs, where a comparatively large quantity of strychnia had been employed to destroy their lives, the most minute chemical analysis failed to detect the presence of this agent, nor were there any indications whatever in the examinations of the viscera, which pointed out its probable presence. So clearly have the results of this chemist's experiments satisfied his mind, that he advances the following as his conclusions: "That if poisoning by strychnia has been chronic, and has resulted from a quantity not greater than just necessary to cause death, the cause of this death *cannot be proved*, either by the *post-mortem* examination of the body, or by a chemical investigation of the intestines; and that it appears to be highly probable that that part of the strychnia which acts mortally, is decomposed in the living body."

Now as to the second supposition, that poisons can be proven so as to forbid cavil, there can be no doubt, we think, provided care be taken to eliminate all probable error. We cannot admit that a chemist has the right to claim the mere appearance of a colored precipitate as positive evidence of the existence of a substance in any organic mixture, which substance he fails to separate in the shape of one of its definite compounds. We must have corroboration by all kinds of proof. But in the case of some of the elements, there are peculiar tests that point out their existence, simply from the fact that so far as our knowledge goes we are not acquainted with the same reaction, as produced by the given test, in the case of any other substance. The same thing is

* Chemist, iv, 406.

true with regard to a series of tests, of which neither one is satisfactory, yet taken together they constitute a series which our present knowledge of chemistry only recognizes as belonging to one substance. Mr. Carpenter has written an article on this subject in the Medico-Chirurgical Review for October 1856, which carries out this idea still further, and shows how from the category of *contingent* proofs, which did not seem furnished by the chemical evidence in this case, but were largely supplied in the circumstantial evidence by the crown; how from such a series of circumstances, connected with the acts and motives of the criminal and the symptoms of the victim, a jury might be justified in coming to a positive and just verdict.

This case, tried by the most learned authorities in England, should make us wary as to positive determinations with reference to guilt or innocence, where chemistry has failed to detect the offending cause. The science has done much to reveal and clear up what was formerly dark in medico-legal investigations, but there is much yet to be done. For the former, all praise be given to faithful students and honest investigators, and on account of the latter let us all "learn to labor and to wait!" Let not chemistry be taunted with what she has *not* done, but rather be properly honored for what she *has done*. In an examination of the contents of viscera, she furnishes results that serve to fasten conviction on minds which have only had suspicion excited by the symptoms and post-mortem appearances of any particular case. Hence her aid and assistance are most important in a legal investigation, and will serve often to clear up doubt. We must not, however, learn to depend on her *alone*, and reject *good evidence* from *other quarters*, on points that she is unable to explain. Although the greatest aid in toxicological examinations, yet not the only means of conducting such, or of arriving at correct results. The case of Palmer has been exceedingly valuable in teaching both jurists and chemists the value of *all kinds of testimony* in a case of this character.

Nine cases of poisoning by this agent have been collected by the Med. Chir. Review,* and 16 by Mr. Taylor,† so that the subject of a proper antidote becomes an exceedingly important one. Dr. Pindell announced lard as an antidote, but it seems that, in some cases, where it was employed by Dr. Hammond, it hastened the action of the poison. De Vrij thinks that it retards (but does not neutralize) the mortal effects. Dr. Shaw reports cases, where a negro woman and child had been poisoned by eating a piece of dried beef which had been covered with strychnia, but when olive oil was administered freely to them it had the effect of producing vomiting and absolute relief from the poisoning symptoms. But the action of the oil cannot be considered as that of an antidote, since the emesis was really the curative agency in each case, as was proven by the fact that dogs who licked up the oil which was vomited were immediately seized with symptoms of strychnia poisoning, and died. Indeed all the cases on record, where any account of treatment is preserved, show that nothing has been of avail, except free, copious emesis. Camphor or conium may be used, or any other medicinal agent whose therapeutic action is found to be different from that of strychnia, but our main reliance must be now as ever in the use of an active emetic. No one can neglect this point in the treatment of a case of strychnia poisoning without being considered as highly culpable. If too much of the poison has not been absorbed, life *may be* saved by the administration of the emetic.

An interesting monograph on the subject of strychnia as a tonic agent has been published by Prof. Stevenson Macadam‡ of Edinburgh. He groups together the reactions of strychnia with such liquid tests as afford peculiar precipitates, from which are selected those which are most characteristic.

I. Bichromate of potassa (or ferridcyanide of potassium,

* Medico-Chir. Review, xviii, 407.

† Taylor on Poisoning by Strychnine, 78.

‡ Journal de Chim. Med. ii, 707, and iii, 13.

according to De Vrij), and sulphuric acid producing a violet red coloration—at first blue, then violet red, and finally, after standing some time, becoming yellow. $\frac{1}{600000}$ of a grain may be detected, if the liquid containing it is carefully evaporated to dryness, then moistened with an exceedingly small quantity of sulphuric acid, and a very small fragment of either of the first named tests be placed in this solution, and stirred about with a glass rod.

II. Perchloride of gold gives a citron yellow, and if there should be a small quantity of organic matter present, a coffee color.

III. Chlorine in solution, a white precipitate which dissolves in ammonia and furnishes a colorless liquid. Sulphcyanide of potassium and corrosive sublimate give similar colored precipitates.

De Vrij states, what is still more important in an examination for this substance, that "the precipitate formed by bin-iodide of potassium is brownish red, and if dissolved in weak warm spirit, acidulated by sulphuric acid, beautiful crystals are formed of sulphate of iodo-strychnia, which polarize light. The precipitates formed by sulphcyanide of potassium and neutral chromate of potassa are both crystalline. The color of the former is white, and that of the latter yellow—the form of the crystals of the former is characteristic as observed under the microscope. Macadam relies, however, on the first named test, which was first proposed by Otto, and has received universal approval. But it is necessary to get rid of all the organic matter in order to employ this reaction with any satisfactory results.

The mode of treatment of organic substances supposed to contain strychnia, employed by Macadam, was essentially that advised by Stas. Being cut up into very small pieces, they are treated with common rectified spirits acidulated with pure oxalic or tartaric acids, and allowed to macerate for 24 hours, being shaken from time to time. Filtering through muslin is then employed; and the solid substances are washed on the filter in order to remove any soluble matter they may possess. These washings are added to the filtrate, and the resulting mixture is boiled in order to coagulate all albuminous substances present. The liquid is then filtered through fine paper, and its filtrate being mixed with pure and well washed animal black, is frequently shaken during 24 hours. At the end of this time it is filtered, and if there should be any strychnia present, it will be retained by the animal black, from which it can be recovered by the action of alcohol at a temperature near ebullition. The evaporation of this alcoholic tincture will furnish us the strychnia pure enough for testing. If not, it can be acted on by oxalic acid, animal black and alcohol again, and thus obtained perfectly pure.

Macadam asserts that he detected the alkaloid in the liver, lungs, kidneys and heart, a month after death, by this process. His conclusions differ somewhat from those of De Vrij's as to the detection of the poison in cases of chronic poisoning by this substance. He considers that such doses as have really shown but slight physiological effects are those which are most favorable for the chemist afterwards; and that in proportion as the physiological evidence diminishes as to the antecedent action of the poison, the surety of chemical detection increases. He only admits that the decomposition of the body of an animal might cause the destruction of strychnia it had contained, "but time could not efface more easily every trace of its presence than it could of the knife of an assassin."

While we are indebted to this experimenter for a careful series of experiments, we are not willing to admit that any one, whose whole researches have been confined to the chemical examination of a few animals intentionally poisoned by strychnia, is justified in making statements such as the above, or deducing conclusions as regards the certainty of detecting the substance in the human body. We like chemical certainty, but we know that that is least reliable which vaunts loudest of its own reliability. An examination for strychnia is not one of the easiest ~~of the~~ problems in toxicological research. Its results are always clear and accurate, but that organic decompositions *may* occur so as to destroy the original constitution of strychnia, and arrange its particles under different forms as other bodies, in the present state of our knowledge on the subject, we have no right to deny.

In marked contrast with the spirit of Prof. Macadam's paper, is that pervading those which have been read by Mr. Jno. Horsley* before the British association. In some experiments performed on rats, he perfectly failed to detect any indications of strychnia, or indeed any bitterness in the liquors obtained in the analyses. Now this seems to support the theory advanced by Baron Liebig, that the alkaloids are always decomposed in order to produce their effect on the system. Mr. Horsley was not satisfied with such an explanation. The idea then occurred to him that a compound, more or less insoluble, might be formed of the strychnia and animal organic matter, such as albumen. One experiment made by him with reference to this point is very interesting. He took the contents of an egg, and "after agitating them with a solution of strychnia containing one and a half grain," they were boiled in a water bath. The effort was then made to abstract the strychnia by boiling alcohol from the coagulum. The extract thus obtained being subjected to proper after treatment, furnished about one-sixth of the original quantity. The solid residue of the egg being afterwards digested in strong sulphuric acid, the liquor which it furnished gave *no* bitter taste, and but the slightest trace of strychnia could be detected. Mr. H. concludes that this proves "that the strychnia must either have been destroyed by combination with solid organic matter, so as to render it incapable of being extracted as pure strychnia, or else decomposed by the sulphuric acid in the attempt to extract it from the albuminoid matter."

Mr. Horsley† suggests, also, that bleaching powder—the

* Chemist, iii, 710.

† Chemist, iv, 2.

so-called hypochlorite of lime—may be employed in examinations of putrefying animal matter to get rid of the odor, and further that the addition of this substance insured a precipitate of the hypochlorite of strychnia, which was soluble in alcohol or glacial acetic acid. He found that with the putrid liquid from the liver of a dog, to which a solution of the hypochlorite of lime in excess was added, there was a precipitate, which, when treated with alcohol acidulated with sulphuric acid, yielded a solution containing the sulphate of strychnia. This seems to be another happy suggestion that could be employed in some examinations, when Orfila's, Flandin's and Stas' processes had been used with no satisfactory results.

Considerable attention has been paid lately to the effects of tobacco on the nervous system. Siebert* shows that pernicious effects from smoking, when they do occur, result principally from the nicotine which is thus introduced into the system, producing indeed chronic poisoning. He has given several cases where the most singular forms of nervous affections were produced from smoking segars. "The neurosis takes the form of irritation of the spine, and produces, according to the point of the spinal marrow principally affected, different eccentric phenomena, such as bronchial spasms, a feeling of suffocation, palpitation of the heart, gastrodynia and vomiting, mesenteric neuralgia, &c." It seems that these symptoms follow the use of segars more than that of the pipe, in consequence of the tobacco which is used in the latter having been subjected to processes which really remove much of the nicotine. Segars of a fine and narcotic character are the most injurious—and these act also like opium, since a repetition of the habit brings relief from the symptoms produced by previous indulgence. The Athenæum† takes up the subject of the war against tobacco as waged at present in England, and shows very clearly that though the use of the article cannot be supported by any

* The Chemist, iii, 246.

† Athenæum, 1857, 303.

valid series of arguments, yet the arguments brought up *against* smoking are wholly inconclusive. These are, the fact that it is a poison, that it produces nervous diseases, and that it engenders cancer of the lip. To which, the fair answers may be brought: First. That tea and coffee are also poisonous when used in large quantities, and all food, if used in improper quantities; and we may indeed press any one of the natural causes of life till it becomes a source of disease. Second. Granted it does produce nervous diseases under certain circumstances, but are those who are constantly employed in its manufacture more liable to such diseases than others, since they should be if its constant effects are nervous derangements, and is not the greater number of nervous diseases to be found with the gentler sex, who do not use tobacco in any form? Third. As to cancer of the lip—this is but a development, in one place, of a disease that the profession are beginning to believe is general in its character, making its appearance in different places in accordance with peculiar irritations that may exist there. All the arguments, then, against its use are inconclusive, and they might be adduced against a number of articles of food. We repeat that the use of tobacco cannot be justified by any other arguments than that it is a luxury to those who have accustomed themselves to it, but on the other hand, all the arguments brought forward by opponents to its use, are simply efficacious when directed against its *abuse*. Dr. Siebert found that the only treatment in cases of nervous derangement from smoking, was entire abstinence, and the employment of preparations of iron.

IV. Hygiene.

One of the most important subjects claiming attention from the profession is necessarily the removal of all causes that vitiate the atmosphere, and thus engender disease. This involves the whole subject of disinfection, both as applied to the deodorization and destruction of noxious odors. Mr.

Davy of Dublin has published* a tabular view of the relative deodorizing power of a number of substances, as applied to the destruction of a given amount (125 grains) of night soil, which exhibits the essential oils as possessed of high deodorizing properties, greatly above those of chloride of lime, one grain of either of the essential oils being equal in efficacy to 47 grains of the latter substance. The oils of lavender and peppermint are more efficacious than turpentine. The deodorizing effects of coal tar and creosote were found to be very high, and these were increased by their solution in water or vinegar. He also notices the effect of roasted coffee when exposed in places where offensive odors are generated, and thinks it however not very great, comparing only with that of alcohol, which latter substance he found specially efficacious by rinsing the mouth, in case nausea was produced from exposure to such odors.

Stenhouse† of St. Bartholomew's hospital, London, has furnished an exceedingly valuable monograph on the subject of the use of vegetable charcoal for sanitary purposes. An abstract of the facts contained in this paper seems to be in place in this report.

It has been known for a long time that both vegetable and animal charcoal are possessed of the remarkable property of absorbing large quantities of vapors and gases; in the case of ammoniacal vapor, to an amount 90 times their own volume, and 55 times in the case of sulphuretted hydrogen. On this account charcoal, in one form or other, has been employed for years as a deodorizer, though it seems to have been first employed for this purpose by M. Löwitz, at St. Petersburg, between the years 1785–91. The greatest number of experiments on the subject have however been made by M. Saussure of France. These have been already communicated to the people at large, so that every one is more or less acquainted with the properties of charcoal as a deodorizer. But at the same time the erroneous idea that

* Chemist, iv, 4.

† Stenhouse on Economic Applications of Vegetable Charcoal.

it is an antiseptic has invaded every text book on chemistry, and has in this way obtained so full a hold on the faith of the public, that it seems almost impossible to overthrow it. It really masks the progress of decay and putrefaction. Ordinarily, we recognize the latter process by the evolution of offensive effluvia, and estimate its advance by the increase of the latter. The nose furnishes the test which we apply for the detection of putrescence in animal organic matter. But charcoal we have learned is a deodorizer. Have we the right, merely from the fact that it decomposes odors, to conclude it will also remove the process which engenders those smells; in fact, remove their cause? Would it be good logic to conclude always because a certain thing counteracts baneful effects, therefore it destroys their causes, and they will necessarily cease? No! this is not the kind of reasoning which is conclusive. Experiment must be brought to bear as to the particular effects of charcoal on the process of putrefaction itself. Has it ever checked this process, or prevented it altogether?

Mr. Trumbull of Glasgow imbedded "the bodies of two dogs in a wooden box, on a layer of charcoal powder of a few inches in depth, and covered them over with a quantity of the same material. Though the box was quite open, and kept in his laboratory, no effluvia was ever perceptible; and, on examining the bodies of the animals at the end of six months, they were found to be in a very advanced state of decay." Mr. Trumbull has also found, on mixing up a quantity of charcoal powder "with some excellent manure made by boiling down the flesh and bones of horses into a pulp, with oil of vitriol," that the mixture, after some months, had diminished in weight and become deteriorated in value.

These experiments, which have also been repeated both in England and this country with the same effect, lead us then to a conclusion as to the preservative properties of charcoal, different from that given in our text books. It is not an *antiseptic*, but it really hastens the decay of all animal substances which are imbedded in it, masking however the process by removing those odors that we commonly consider as characteristic of putrefaction.

How shall we explain, then, the fact that it hastens putrefaction, and yet destroys the odorous results? In examining the charcoal powder which had been in contact with the bodies of the dogs in Mr. Trumbull's experiments, Mr. Turner found that "it contained comparatively little ammonia, not a trace of sulphuretted hydrogen, but very appreciable quantities of nitric and sulphuric acids, with acid phosphate of lime." There were comparatively no indications of nitrogenous material present in the charcoal. Now, Stenhouse shows that putrefaction is, as a general thing, nothing more than a species of oxidation. The odorous substances it gives off in gaseous form are secondary products, which, if brought into contact with oxidizing substances, such as sulphurous, nitrous and hypo-nitrous acid gases, are always oxidized and converted into inodorous compounds. Charcoal may act, as these substances do, simply from the fact that it contains a large amount of oxygen condensed within its pores. It is capable of absorbing from nine to ten times its volume of this gas, and this does not prevent it absorbing large quantities of the gaseous products of putrefaction; nay, it rather facilitates their evolution, as the oxygen rapidly oxidizes them and resolves them into simpler combinations, forming carbonic acid, water and nitric and sulphuric acids out of the hydro-carbons, ammonia and sulphuretted hydrogen which are given off. This oxidation or slow combustion cannot be detected by odor, and can only be infallibly recognized by the loss of weight sustained by the animal substance, or the application of chemical tests to the results of the process which are commingled with the charcoal. Stenhouse concludes that it is "on its absorbing and oxidizing power that the great efficiency of charcoal as a deodorizing and disinfecting agent depends."

Now, in the way of practical application of these facts, we may learn the utility of exposing pans containing vegetable charcoal, wherever noxious odors are given off, as in the wards of hospitals and in sick rooms, with the expectation that the effluvia which arise from the bodies of the sick, and which, if not producing contagious miasmata, still vitiate the atmosphere, and enfeeble the constitutions of those necessitated to breathe it continually; also how valuable an agent charcoal is for admixture with night soil, bodies of animals in a state of putrescence and animal substances in general which are undergoing decomposition. Its admixture with the earth used to fill up graves would also diminish the exhalations that are always given off from well filled grave yards.

Stenhouse has, however, made a suggestion of its use as a filter for the air which may contain putrid emanations of so great dilution that the nose could not detect their presence, and which would be intercepted by their passage through a layer of charcoal. "The charcoal air-filter consists of a thin layer of charcoal powder interposed between two sheets of wire gauze, and can be readily applied to buildings, to ships, to the gulley-holes of sewers, to respirators, and to various other purposes." They have been tried in London in the ventilation of public buildings where the air had to be taken from streets, where nuisances of the most offensive character existed, and yet when it had been passed through the charcoal it proved to be unobjectionable to the most delicate olfactories. The charcoal layer employed in these is about an inch and a half in thickness, and the fragments are about the size of a pea. It is well always to make it red hot before using it, which can be done by exposing it to the action of heat in a covered iron pot.

The charcoal filter might be employed with advantage in miasmatic regions, where the principal fear is with reference to the admission of air during the night into sleeping apartments. Mr. Stenhouse has also contrived respirators which fit over the mouth and nose, consisting of two sheets of silvered wire gauze, between which there is a layer about a quarter of an inch thick, of coarsely powdered charcoal.

These may prove useful in many circumstances that will suggest themselves to the minds of the faculty, particularly in employments where men are exposed to putrid odors, such as are given off from sinks, sewers and cess pools, to men employed in time of action, on board ship, at the batteries, and to persons traveling through regions of country where disease almost continually rages in consequence of exhalations evolved from putrefying organic substances.

Since the first announcement of these new views with regard to vegetable charcoal, Stenhouse has offered an improvement,* which, without increasing the expense of the article very much, is likely to be of immense benefit. He proposes as the property possessed by charcoal, of absorbing oxygen and retaining it in its pores, is not as great as its power of absorbing other gases, hence its absorbent power being greater than its oxidating power, that if some other substance could be added to it which would act as an oxidizer without injuring the absorbing power, the efficacy of the charcoal would be greatly increased. He succeeded in accomplishing this by the addition of minutely divided platinum, which is itself possessed of enormous oxidating power. With such a combination then we are furnished with an excellent deodorizer and disinfectant.

The process of platinizing charcoal consists in boiling it "either in coarse powder, or in large pieces, in a solution of bichloride of platinum, and when the charcoal has become thoroughly impregnated with the platinum, requiring from 10 to 15 minutes, heat it to redness in a close vessel." Two per cent. of platinum he has found most advantageous. This combination is of course only recommended where charcoal is intended to be used for respirators.

The fecal discharges of patients at our hospitals, jails, alms-houses and other public institutions, where a large number of persons are collected together, often become so fetid, during the progress of an endemic, that doubtless

* Stenhouse on Charcoal, Journal de Chim. Med. ii, 309.

much disease is propagated by this cause of vitiation of the atmosphere. Under such circumstances it is important that some agent should be at hand which can at once destroy the odor in consequence of the strong affinity it may have for one or other of the odorous compounds that are thrown off into the atmosphere. Nothing can be found better adapted for this purpose than chloride of zinc, which should be used in solution. Where the discharges are very fetid, as in cases of typhous and similar affections, the solution should be placed in the vessel before the patient uses it for the purposes of defecation. The chloride may be most economically made by taking commercial hydrochloric acid and adding zinc until a saturated solution is formed. This then should be diluted with about an equal volume of water.

Where we have collections of night soil, or the putrescent contents of sewers and cess pools, the most convenient agent to employ for their deodorization is a solution of the sulphate of iron. The researches of the younger Chevallier have shown that from 20 to 25 kilogrammes (from 50 to 63 pounds) of this salt in solution will perfectly deodorize 10 cubic metres, that is about 11 cubic feet of night soil. Ordinarily not as much as this will be required, but for perfect deodorization the amount mentioned will be needed. When such a solution is added there is immediate action, and the odor possessed by the fecal matters is simply that which is proper to the vegetable matter that they may retain. There is an advantage in employing this salt, since the fecal matters, being thus deprived of their odor, can be used on our fields, where their invigorating action will soon repay all the expense incurred. When it is recollected that the ammonia, unless seized in this way by sulphuric acid, and as it were, fixed, escapes into the atmosphere, thus depriving the fecal material of its most active agent as a manure, it will be seen that economy should demand the use of sulphate of iron as much as considerations of public hygiene.