OZONOSCOPES WITH SULPHUROUS ANHYDRIDE.

OZONOSCOPES.	DRY	MOISTENED	SAME AFTER 12 HOURS
Houzeau.....	Red		
Alizarine.....	Yellow red		
Manganese Acetate.....		Turned brown?	Became white
Lead Sulphide.....			A little bleached?
The rest unaffected.....			

OZONOSCOPES WITH HYDROGEN PEROXIDE.

OZONOSCOPES.	FIRST SERIES.	SECOND SERIES.
K I.....	Light yellow (7)	Yellow (10)
Cadmium.....	Faint lilac (8)	Intense blue (6)
Moffat.....	Light brown (2)	Very dark brown (1)
Lowe.....	" " (3)	Dark brown (2)
Osann.....	" " (9)	Brown to blue (3)
Schönbein.....	Faint brown (4)	" " (4)
Alizarine.....	Red (6)	Reddened (8)
Houzeau.....	"	Bluish (9)
Thallium.....	"	Unchanged
Manganese.....	Light brown (5)	(Not tried)
Lead Sulphide.....	Somewhat bleached (10)	Bleached to gray (7)
Guaiacum.....	Blue (fine color) (1)	Beautiful blue (5)

A light red rose was exposed for three hours to a current of $3\frac{1}{2}$ liters of ozonized oxygen, containing a little more than 1 mgrm. ozone per liter. No effect was discernible on either leaves or flower. In sulphurous acid, it was bleached in the course of a few moments, though the chlorophyll of the leaves was unaffected. Returned to the ozone, the bleached petals reddened, showing that the sulphurous acid with which they were impregnated had been ozonized. The same effect was produced by dilute sulphuric acid.

An abutilon, a yellow and a blue pansy, cineraria, red geranium, fuchsia, hyacinth, pink, violet, and heliotrope, were exposed for 18 hours, in a quart bottle filled with ozone. On opening the bottle no smell, except the perfume of the flowers, was apparent, and none of the flowers had changed except the violet and heliotrope. These had turned slightly brown, due probably to natural wilting. Other specimens of the same flowers were placed in an atmosphere containing sulphurous acid. The heliotrope began to change immediately, and in ten minutes its colors had entirely disappeared. The hyacinth followed, and in the same length of time, only streaks of red remained. The bouvardia was nearly white; the fuchsia, japonica, geranium, and cineraria were somewhat bleached; the yellow pansy not noticeably affected. At the end of $3\frac{1}{2}$ hours, the darker portion of the fuchsia was nearly bleached, the geranium had become pink, the blue pansy was of a yellow color somewhat darker than the yellow pansy, the abutilon still unchanged. Flowers of *Salvia splendens*, *Camellia Japonica* (red), *Streptisia regina*, *Abutilon venosum*, *Abutilon insigne*, *Inga pulcherrima*, *Ixia*, *Cineraria*, *Nasturtium*, *Azalea Indica*, and *Bouvardia* were exposed for 36 hours to ozonized oxygen, most of the time to a slow continuous current. A few light spots appeared on the azalea and nasturtium, and there was a slight discoloration of the camellia. Similar specimens, left for 3 hours in an atmosphere containing sulphurous acid, changed greatly: the camellia became lighter in spots and finally pink throughout, the azalea turned yellow and finally white, the *Abutilon venosum* saffron-yellow, the change beginning at the outer edge of the flower, the cineraria was somewhat lighter in color, the *Salvia splendens* white in spots, other portions red.

The *Ixia* had become white, the long ends of the mimosa (*Inga*) were also bleached, the reddish markings of the nasturtium had quite disappeared. The flowers of the *Bouvardia* were bleached at their outer edge; in the *Streptisia*, neither flower nor leaf was affected. The same is true of the leaves of all the specimens.

After 18 hours more of exposure the yellow portion of the *Streptisia* was not affected, but the blue had become quite white; the mimosa was a faint pink, the nasturtium a deep yellow throughout, and the *Salvia* bleached entirely. Even after this length of time, the chlorophyll of the leaves had undergone no change. When these same flowers were transferred from the sulphurous acid to a current of ozonized oxygen, the azalea turned red on the edges and colored somewhat throughout; the camellia reddened, so likewise the mimosa; the *Abutilon* became red along the veins, the petals of *Ixia* turned red at the edges, the nasturtiums reddened in places, the *Bouvardia* became brown, the *Streptisia* did not change.

When similar flowers, which had been longer exposed to ozone without change, were placed in an atmosphere containing chlorine, the camellia became buff color, its leaf unaffected; the azalea turned yellow, then white, its leaves partly changing also; the *Ixia* and *Bouvardia* became perfectly white; *Salvia*, yellow-white, its leaves yellow. The red veins of the *Abutilon venosum* were not bleached, but its green calyx and part of the stem were. The leaf of the *Abutilon insigne* was bleached in spots; the leaf and stem of the nasturtium became entirely white. The blue portion of the *Streptisia* was bleached, the yellow in part, the red leaf not affected. Corresponding changes took place in other specimens of these flowers which had not been previously exposed to ozone.

The action of ozone as a bleaching agent differs not only from that of sulphurous acid, as might be expected, but also from that of chlorine; and it is not improbable that its use has been proposed for bleaching in cases where its precise action has been unknown.

It is a striking fact in the economy of nature, that an agent like ozone, which operates as nature's purifier and disinfectant, and energetically destroys decomposing and putrescent organic substances, should have so little action upon the delicate coloring matter of flowers.

My thanks are due to my assistant, Dr. George A. Prochaska, for his co-operation in the experiments detailed above, and to the Rev. S. B. Dod for his aid in the study of flowers.

STEVENS INSTITUTE OF TECHNOLOGY, May, 1878.

LIMITS OF THE COMBUSTIBILITY OF GASES.—M. Schützenberger.—The author proposes the following law: All other circumstances being equal, to every pressure from 0 up to 1 atmosphere, there corresponds a limited length of a gaseous column beyond which the combustion provoked by a spark ceases to be propagated, while for smaller distances it is transmitted to the whole mass.

THE DIFFUSION OF SALICYLATE OF SODA.

THE rapid diffusion through the system of salicylate of soda, which its action and rapid excretion suggest, has been confirmed experimentally by MM. Ch. Livon and J. Bernard. In their investigations they have confirmed the conclusions of previous observers regarding the action of salicylate on the conscious sensibility; the production of tetanic contractions and convulsive movements, and disturbances of respiration and of the cardiac pulsations, due to the alteration of the reflex action of the medulla and cord. Their observations were, however, especially directed to the diffusion of salicylate in the economy, and the means by which it is eliminated. For the detection of the salicylate they have employed the perchloride of iron, which remains the most delicate reagent known. In the first experiment six grammes of salicylate of soda were injected into the stomach of a dog. The œsophagus was tied; two hours afterwards the salicylate was found in the saliva. In the second experiment ten grammes were injected into the stomach, and an hour afterwards the salicylate was found in the bile. In the third experiment three grammes of salicylate were injected into the femoral vein, and an hour later it was found in the bile. In a fourth experiment seven grammes were injected into the stomach, and four hours later the salicylate was found in the pancreatic juice. In a fifth, two centigrammes were injected under the skin of a guinea pig, and one hour afterwards the salicylate was found in the milk. The method of detecting the substance was to heat the liquid with hydrochloric acid, and then shake it up with ether. Evaporation of the ether leaves a residue which gives, with perchloride of iron, the characteristic violet tint. The saliva, the bile, and the pancreatic juice were collected by means of fistulæ. The feces and urine also showed evidences of the salicylate. In all the experiments upon dogs it was found also that the cerebro-spinal fluid contained salicylate, even several hours after the administration of the drug. It is suggested that probably it is the presence of the drug in the fluid which bathes the central organs of the nervous system which accounts for its action upon them. By the injection of from two to ten centigrammes of salicylate through the occipito-atloidean ligament into the spinal canal, all the phenomena of salicylate poisoning were rapidly obtained. The precaution was taken first to withdraw an equal bulk of the cerebro-spinal liquid, so as to prevent any compression of the cord. For the sake of controlling the experiment, simple water was, in another experiment, injected in the same manner, with the effect, however, of causing only prostration, and not the tetanizing effect of the salicylate.—*Lancet*.

SINGULAR USE OF FLUORESCIN.—To determine whether the head waters of the Danube found their way through subterranean passages into the Aach, a quantity of fluorescein was placed in the former river, and three days later the splendid green color with golden reflections was quite distinct. Ten kilos of fluorescein had sufficed to color, in an indisputable manner, 200 million liters of water.

ON A NEW METAL—PHILIPPUM.

By M. MARC DELAFONTAINE.

THE researches in which I have been engaged for more than two years on the Samarskite earths* have led to the discovery in that mineral of a fourth earth belonging to the yttria group. This mineral is yellow like terbia, but its equivalent is lower. My researches on the gadolinite metals had formerly led me to a similar conclusion, which, however, I was prevented from establishing on account of the destruction of my laboratory in the great fire of Chicago.

As this new earth occupies an intermediate position as to color and weight between yttria and terbia,† it might naturally be supposed that it is after all only a mixture of these two bodies. But the numerous and varied experiments that I have made convince me that such is not the case. Further, profiting by the examination which M. Soret has just made of the absorption-spectrum of erbium, and also by his recent study of the spectra of other earthy metals,‡ I have been enabled to confirm the correctness of my other conclusions.

I therefore announce definitely the discovery of the oxide of a new metal, to which I have given the name of Philippum (Pp), in honor of my benefactor, M. Philippe Plantamour, of Geneva, the friend and pupil of Berzelius. I may remark, in passing, that this name adapts itself perfectly to the ordinary terminations of chemistry, not only in the French, but in the English, German, and Swedish languages. Thus the earth will be called Philippine in France, Philippia in England, Philipirde in Germany, Philipjord in Sweden.

The following are its distinctive characteristics:—Admitting provisionally that philippia is a protoxide, its approxi-

mate equivalent is comprised between 90 and 95. I cannot be more precise at present. The metals of the cerite and gadolinite groups are like fatty bodies or alcohols of the ordinary series; they are recognized easily in the pure state, but they are separated with great difficulty, and this difficulty is increased when they are from five to seven in number.

We have yet no means of knowing if philippia is completely free from yttria, although it is easy to reduce to a great extent the proportion of the latter. Erbia and philippia are mutually carried down and held by each other with such tenacity that I have not yet been able to obtain a complete separation of them.

The philippic formate crystallizes with great facility, either on cooling or by spontaneous evaporation, in small brilliant rhomboidal prisms less soluble than the formate of yttria, which is deposited in mammillary form of a sirupy solution. The terbic formate is anhydrous, and soluble in from 30 to 35 parts of water. The sodio-terbic sulphate dissolves with difficulty in a saturated solution of sodic sulphate, while the corresponding salt dissolves in it easily. I avail myself of this property to simplify the extraction of these bodies. The philippic oxalate is more soluble in nitric acid than the terbic salt, but less so than the yttric salt. The philippic nitrate becomes a deep yellow color when it is dissolved; those of yttria and terbia remain colorless. The salts of philippium are colorless; the earth becomes white in a current of hydrogen, and also on being calcined, but it becomes yellow again on exposure to the air during cooling. This color does not appear to be due to any mixture with terbia.

In the spectroscopic the concentrated solution of philippium gives in the indigo blue ($\lambda =$ about 450) a magnificent absorption band, very intense, and rather broad, with well defined edges, especially on the right. This band, which strikes one at a first glance, is not seen in solutions of terbium, yttrium, and erbium. It is, then, characteristic of philippium, and thus M. Soret's conjecture that it belongs to a new simple body is confirmed. In the green I find two rather fine rays varying in intensity, the most refrangible of which belongs to erbium, as well as a faint ray in the blue near to the boundary of the green. The least refrangible of the green rays belongs perhaps to philippium, for if in some specimens it has been less intense, others, on the contrary, show it to be nearly as powerful as the erbium ray. Lastly, in the red there is at least one fine ray which I am not able to identify. By directing the slit of my spectroscopic to the sun I observe through a dark glass with the terbium solutions a very pronounced band situated in the violet ($\lambda = 400$ to 405). This, however, is difficult of observation. It is half the width of the philippium band, and seems to be entirely absent in certain specimens of the latter, while in others a trace of it is visible. I have reason to doubt whether this really characterizes terbium, as M. Soret believes; it is possible that it may indicate yet another element, the atomic weight of which is intermediate between that of terbium and erbium.

I have for some time been pursuing the parallel study of the compounds of philippium and terbium, and in a few weeks I shall be able to publish a memoir in which I shall describe at length the methods of preparation and purification which I have employed.—*Comptes Rendus*.

BETTER PHARMACEUTICAL EDUCATION.*

By RICHARD V. MATTISON, Ph.G.

THAT "there is no training like the training of the shop," practically, we admit, but we hail with ever-increasing pleasure the advent of the usual winter courses of lectures in the various colleges where pharmacy and the allied sciences are taught. Here the training of the shop is supplemented with the theories and facts, the thorough knowledge of which all combine to make the successful pharmacist. The day is at hand when pharmacy ranks as a profession, and we trust the day is never to return when the pharmacies of an enlightened civilization are to be left at the mercy of any others than professionally educated pharmacists.

Steadily, year by year, the increasing number of students gives promise of a wider field of usefulness, is evidence that the hearts of many are beating in unison upon the question of the better education of the pharmacist; each one of us, individually, can do little, but collectively we can do much good, and in this connection we should each resolve that some portion of our time, at least, shall be given to the cause of better pharmaceutical education.

To the young man just entering the favored domain of science, we can lend a helping hand, and assure him that up the ladder there is plenty of room. To the student we can say, learn everything thoroughly, know every preparation of the Pharmacopœia thoroughly, do not learn, simply, that to make a successful tincture of aconite, requires percolation of a powdered aconite root, in fine powder; make a thorough analysis, through the aid of reason, of every preparation; ask yourselves why, e. g., aconite root must be in fine powder? Why do we use stronger alcohol as a menstruum? keep the dose, and when an article or preparation is poisonous, the antidote, in your mind, ready at a moment's warning, should use require it.

Remember why potassic sulphate is used in Dover's powder; why the water of ammonia is used in the purification of ammoniac chloride, or the zinc carbonate in the purification of zinc chloride; why sugar is used in the preparation of Vallet's mass, and why the water is directed to be previously boiled that is used in washing the precipitate.

Remember why acetic acid is used in the formula for fluid extract of ergot, or why the Pharmacopœia directs the moistened powder of wild cherry bark to remain a number of hours before percolation, and why glycerine and water is used as a menstruum in the first portion of the process.

Why should large doses of mercurous iodide, when prescribed with potassic iodide, command your undivided attention, or prescriptions containing poisonous alkaloids or alkaloidal salts be a dread when associated with the aromatic waters?

Why ammoniac chloride is added in the analysis when magnesium is sought, or why the potassic solution is to be first acidified with hydrochloric acid, are things to be not simply remembered, they are things to be understood. Almost every process of the Pharmacopœia is a text for study, a text for thought, and the analysis of reason.

It is not simply the remembrance of these things which go to make the pharmacist, it is the understanding of them; the thorough appreciation of the reasons why, that makes the man the master of his profession. It is the understanding, embracing the structure of drugs, which leads the pharmacist into the field of original research, which leads to the

* *Archives des Sciences Phys. et Nat. de Geneve*, March, 1878, p. 273.

† YO 745, TbO = 114.

‡ *Archives des Sciences Phys. et Nat.* August 1, 1878, p. 89.

* Read at the social meeting of the Alumni Association, of the Philadelphia College of Pharmacy, October 3d, 1878. (*Phil. Druggist and Chemist*.)

perfecting of imperfect formulæ, the purification, the preservation, or the preparation of remedies.

This is the meaning of a better pharmaceutical education, a thorough knowledge of all the facts in connection with the science of practical pharmacy. What our country needs now is, not *more* pharmacists, but *better* ones; it is not *more* colleges of pharmacy, but *better* ones. Our need is graded courses of instruction, longer terms of study or closer application, the former preferably; the personal interest of preceptors, and the direct personal interest of students in their life work. The student must be taught to forget that he comes to the college of pharmacy to earn its diploma. He has a brighter future than earning a degree, however honorable may be the standing of the college conferring it. He comes to the college of pharmacy, of this and of our sister cities, for the purpose of laying the groundwork of his future life, for the purpose of acquiring a knowledge of how to study, for the purpose of ever after being a better, brighter, more active member of the great brotherhood of scientists. This is what we mean by better pharmaceutical education. It is the appreciation of this which makes the future of pharmacy the silver lining in the dark cloud of the past, and from its edges glance the warm rays of the bright sun of better pharmaceutical education.

AN EL DORADO FOR APOTHECARIES.

THE following we quote from a local paper of Carlsruhe, capital of Baden, Germany:

"The Board of Charities has entered into the following contract with the apothecaries of this city:

"The apothecaries shall quarterly prepare lists of those of their debtors for medicines, etc., whom they believe unable or unwilling to pay. The Board shall select from those lists those cases in which public charity is called for, or in which the city might for some reason be held responsible, the bills incurred in such cases being subsequently paid by the city. The cases rejected shall be legally proceeded with by the respective apothecaries within three months after the lists have been returned to them. The judgments received shall be brought to execution immediately. Should any of the judgments remain unsatisfied, the city pays the respective amounts and costs of court." It must be added that in Germany no apothecary has a right to refuse dispensing medicines and other articles, when ordered by a regular physician, no matter whether they feel inclined to trust the customer or not. Medicine must be furnished under all circumstances; hence the responsibility of the Charity Board.

PROF. HUXLEY ON THE HAND.

FOR his recent inaugural lecture as President of the South London Working Men's College, Prof. Huxley took as a subject "The Hand, and what is to be learned from it." He said that this portion of the human frame was, perhaps, the most important next to the brain itself. He did not know that he should except even the brain, because if man had not the hand, whereby so many messages were conveyed to the brain, the latter organ would be comparatively worthless. The hand was capable of an endless diversity of operations, while it was the most delicate organ of touch that man possessed. By its aid we learned the hardness, temperature, and weight of bodies; it was the instrument by which the great majority of manual labor and all sorts of handicrafts were performed. Besides, it was one of the most powerful instruments of communication, by signs, between man and man, and travelers who have been to the West of America, particularly among the trappers of that region, testify to this fact. Prof. Huxley next went minutely into the anatomy of the hand, explaining lucidly the various tendons, muscles, and joints. The various motions of the fingers, wrist, and arm he showed by diagram, as also the position of the thumb to the other fingers. The muscles supplied the steam, so to say, to the human machine. These were made up of long fibers, having this peculiarity—that when an impression was sent by the will to them they changed their form and became shortened, and at the same time thickened to a corresponding extent. Every movement of the hand depended upon this contraction of a single muscle, or a combination of muscles. The hand and fingers of a man playing a fiddle went through a most astonishing operation. A good player had to guide the movement of the hand to the fraction of an inch, or he did not give the string the tension necessary to produce a certain note. He had at the same time to regulate the bow, and yet all this he did with the greatest accuracy and nicety, though the operator himself, if he were not an anatomist, knew nothing about it. Many of his hearers, said the professor, might have read "Paley's Natural Theology," though it was now almost forgotten. Paley, speaking of design, used the argument that if a man found a watch on a heath, and observed the number of contrivances to mark time, could he fail to conclude that the watch had been made by some one, and put together with the intention of doing that which it did perform? Paley scouted at the supposition that any one would come to any other conclusion. He then drew a like conclusion from the human fabric, which was formed to execute certain functions, which it faithfully performed. There might be considerable difficulty raised as to the safety of applying the argument from analogy to a new case in all its strictness and force, as Paley did, but it was not necessary to do that. Professor Huxley, having traced the various stages of man's development, observed that the frame of a man did not bear a precise analogy to human means of construction. Man had not the materials in the one case as he had when he made a watch or a steam engine; and the difference was as great as the difference between making a steam engine out of iron, and taking a bit of iron and letting it grow into a steam engine. It was important to know that so complicated a structure should be developed through natural operations. Topsy, in "Uncle Tom's Cabin," when asked who made her, replied that she did not know; and had she, instead of being an African negress, been instructed as her white neighbors, she could not have given a more correct answer, or one more in accordance with the fact. In the same way as the hand had grown, so, on a larger scale, had the whole fabric of the human body grown in the sense that Topsy said she had. There was a time when the human body was only the 120th of an inch in diameter. As the hand had been evolved, so had the whole of the human body; and every one was a living example of the fact that the most complicated machine in nature took its process on that which he called evolution. It was a thousand pities that those who had to do with children and young people took the course that Topsy's excellent friends did with her. There were two courses to be taken with the young—first, if you know what you are talking about, say what you know, though the subject may not be suited to them; if you

do not know, say so. This will have the effect of dealing fairly with your own conscience, and respectfully with the conscience of the child, together with preventing your being put in that disagreeable position of being considered a cyclopedia of information that can never be in the wrong. A child, continued Prof. Huxley, could understand one theory as well as another, just as he understood how a seed placed in the ground grew up into a plant. Besides, this theory of evolution had the advantage of being true, while the other statement conveyed an erroneous idea, which had, some time or other, to be shaken off. If these ideas, which were so simple in themselves, and beyond doubt, were put into people's minds as a part of their instruction, could any one imagine there would be that preposterous outcry against the application of the theory to the animal and vegetable world? If they were to make use of any argument, depend upon it that for the purpose of natural theology the fact of evolution afforded a vastly more noble and enduring ground on which to build that argument than any other.

PAINT FROM A SANITARY POINT OF VIEW.

IN a paper entitled "The Chemistry of Dirt," read before the Sanitary Institute of Great Britain during its recent congress at Stafford, Dr. H. C. Bartlett, the author, after strongly recommending the abolition of absorbent surfaces on the walls of our dwellings, goes on to say:

"If we have lath and plaster let it be painted, and if we cannot have wainscot or mahogany kept brilliant by continued clean friction and polish, let us have a clean painted wooden surface, as artistic in tint and in the disposal of the colors and decoration as taste and means will permit, but to carry out a determined war against dirt and disease, let us have paint. These are no longer notions peculiar to the Dutch. They are sanitary axioms which we cannot afford to ignore.

"But there is another side to the proposal to 'paint and believe in paint,' as I observed in the commencement of this paper; sometimes the very means taken to keep our dwellings clean adds to the real dirt. So it is with paint, for there be paint and paints; some leave little to be desired from a hygienic point of view; others, as I shall show, are injurious to health and even deadly in their direct effects.

"In July, 1873, I was instructed to investigate the causes which brought about, I believe, some of the severest cases of lead poisoning ever made public. I found at Devonport Dockyard twenty-four cases had occurred among the shipwrights working there, dating between May 3 and June 30. There were 64 painters employed, and on the average about four cases of lead poisoning per annum were reported of these men, or at the rate of 8 per cent. of those engaged in laying on the white lead paint. When the space to be painted was confined and ill-ventilated, the symptoms were such as Dr. Thomas Brown, R.N., described in his report, which by permission of the Director-General of the Medical Department of the Navy, I am able to quote: 'After a few weeks' work, a pasty, lusterless look appeared upon their faces. There was a sense of great depression and weakness, together with headache and loss of appetite. A metallic taste was sometimes complained of, and a blue line was observed upon the margin of the gums. It was only after persevering for a few weeks that the graver symptoms were produced, and the men becoming wholly incapacitated sought medical advice.

"But it was among the shipwrights that the symptoms appeared in a still more aggravated form. These men were employed in cleaning off Day's cement together with the paint and red lead. All the symptoms previously enumerated were presented, but in a more intense degree, attended with greater depression, and in every case epigastric pain was described as a dull heavy pain giving the sensation of the bowels being drawn towards the spine. Cramps in the muscles of the extremities were common and of great severity, but it was observed with surprise that there were no cases of paralysis. The most stringent precautions have since been taken; perfect cleanliness of the skin and frequent washing of the working clothes were insisted upon. A chemical respirator was recommended to be worn while at work, and sulphuric acid drinks were always to be kept in readiness. No precautions, however, prevent the use of white or red lead paints being exceedingly injurious, both to the painters and to those who inhabit rooms in which the paint has not properly dried.

"Now comes the important question, how long a time must elapse before white lead paints can be considered to be so perfectly dried as to be absolutely free from diffusing their injurious influence? I will reply that it depends upon circumstances over which we have frequently no control. I state this feelingly, as in my house, a few doors from Grosvenor-square, London, the whole staircase from top to bottom has paint upon it which is not dry now, although it was laid on at Easter last, while I was at Brighton.

"The slightest greasy deposit upon the old paint will prevent white lead paints from ever really drying, and while a skin of apparently hard paint cheats the superficial observer, there is a continual exosmosis of volatile poisons being given off. The truth is not revealed until a general tone of depression and lowered vitality throughout the house arrests the attention of observers on the lookout for such causes and effects. Or, perchance, the spirit of cleanliness, that handmaiden to the goddess Hygeia, insists upon an early cleansing of the paint all over the house, with the unpleasant result of detaching the false skin of the new paint and leaving the greasy under-coat which no length of exposure will ever dry. It is no exaggeration to assert that very little paint, containing white lead as its basis, becomes so hard and dry within months of its application, as to preclude the possibility of poisonous matters being given off.

"I have had distinct proof that the injury accruing from the diffusion of lead in the air exists to an extent far surpassing the well-known poisonous influence of minute quantities of lead in drinking water. I have, therefore, always recommended the substitution of zinc white for white lead, for the all-important reason that it is harmless. Many reasons, however, tend to limit the use of the ordinary zinc white (oxide of zinc), the weightiest of which are that it does not possess the body of white lead, will not cover so much surface, and is therefore not so economical either in labor or in cost. Several coats of zinc oxide are required to equal the opacity of white lead, and in mixing with other colors a much larger quantity of zinc oxide must be used.

"I have lately had brought before me a new preparation of zinc which is stated to have overcome all these defects. As I have carefully investigated its properties, I am happy to find that we have at length obtained an antiseptic white zinc paint, which is free from the objections raised against zinc oxide. I find the oxy-sulphide of zinc pigment, invented by Mr. Thomas Griffiths, of the Liverpool Silicate

Paint Company, to be a very curious instance of the fulfillment of the demands of sanitary science. We insisted that we must have a non-poisonous white as the basis of the oil paints used in our dwellings. Zinc oxide was proposed, and, I believe, large fortunes have been made out of its manufacture, notwithstanding the drawbacks. The economies of labor and expenditure must, however, be included within the demands of sanitation, or the use of the best and most harmless pigments is certain to be evaded. The fiat of the trade is issued against it, and it becomes doubly dear and difficult to insure its use. Oxy-sulphide of zinc is then brought forward, as dense as white lead, and as opaque, its covering qualities even exceeding those of the lead paint; and, as it does not change color like white lead, is as cheap, all things considered. We may welcome another powerful auxiliary, which, while innocent of itself, will help us immensely in our campaign against dirt and disease."

THE PURIFICATION OF SEWAGE.

PROGRESS IN PURIFYING SEWAGE BY PRECIPITATION.*

By HENRY ROBINSON, M.I.C.E., F.G.S.

THE object of this communication is to lay before the congress certain practical and economic results which the writer has arrived at in regard to perfecting the purification of sewage by chemical treatment, and in facilitating the disposal of the sludge derived therefrom. He desires to acknowledge the valuable co-operation he has received from Professor Wanklyn and Mr. J. C. Mellis, C.E.

Since the writer's book on the "Purification of Water-carried Sewage" was published in 1877, he has continued to follow the lines laid down therein as requiring, from his experience, to be adhered to in treating sewage chemically, and his more recent experiments and practice fully bear out their correctness. They may be briefly stated to be as follows:

To employ chemicals, which, besides being precipitants, are also disinfectants and deodorants, which are readily obtainable in large quantities and at low prices, and which can be used in solution so as to avoid adding solid matter to the sludge. The fulfillment of these several conditions is what has now been accomplished to a greater extent than hitherto.

In considering every system for dealing with sewage it is desirable that the question should be regarded as a means of enabling sanitary authorities to overcome the great and increasing difficulty in the disposal of their sewage refuse at the least cost, rather than as one for making money out of sewage, which has been too much aimed at, and has thereby thrown back sanitary improvement considerably.

In the course of the writer's experience in advising with reference to precipitation works and systems, he has seen more and more clearly that sulphate of alumina aided by milk of lime proves the most efficient agent to comply with the before-mentioned conditions for purifying sewage. This he has now advanced upon, inasmuch as he has discovered that the efficiency of sulphate of alumina is greatly increased by the presence of some proto-sulphate of iron which apparently produces results altogether out of proportion to its chemical equivalent (the salts of iron being known to chemists as purifiers of foul fluids), the proportion varying with the composition of the sewage, but their combination having a marked sanitary and economic advantage.

Practical data on a large scale have already been obtained at the sewage precipitation works of the Rivers Purification Association at Coventry and Hertford (to whom the writer is engineer), where the improved system of working has been adopted with complete financial and sanitary success. The process previously employed at these places, was (as is well known with reference to Coventry), crude sulphate of alumina and milk of lime, which gave results admittedly of a highly satisfactory kind. The addition of the salts of iron has, however, led to the production of an excellent effluent and at a cost less even than previously.

The employment of this combination has also resulted in the tanks and the sludge being deprived of the slight smell hitherto noticeable at times. The economic results attending this compound system of precipitation will be recognized when the writer states that at Coventry Sewage Works the purification of the very foul sewage (containing between six and seven grains of chlorine per gallon and between twelve and thirteen parts per million of albuminoid ammonia, with a large amount of dye from the manufactories) is now accomplished for £1 1s. 6d. per million gallons.

This sewage is equivalent to fifty gallons per head of the population per diem, the minimum flow being two and a quarter million gallons a day. The necessity for the adoption of such a standard of flow cannot be too strongly insisted on, as the most fallacious estimates about sewage treatment by every system have been arrived at through ignorance or neglect of this essential consideration.

The writer has frequently met with cases where the cost of purifying the drainage from only a partially water-closeted town, largely diluted with subsoil water, until its flow is equivalent to a hundred gallons per head per diem and upwards, has been compared with the cost of purifying a concentrated foul sewage of less than fifty gallons per head per diem. At Hertford the improved system of working has been applied with equally satisfactory results.

The way to dispose of the sludge from precipitation works has long engaged the attention of the writer. Artificial heat will accomplish it, and several ingenious appliances have been devised for this purpose. The cost, however, is heavy, and the value of the resulting manure is not yet sufficiently established to justify its employment on commercial grounds.

The writer has now adapted the system of removing the water from the sludge by means of filter presses, and he has devised a simple appliance to economically effect this, a model of which is in the museum of this congress.

This press, which is founded on an old and well-known Belgian apparatus for filtering impure liquids by means of a combination of disks with filtering cloths on their surface, has been arranged in order to economize labor and time in working, so that the disks open and shut automatically, by which the pressed sludge is removable quickly and without disturbing the filtering cloths. The fluid sludge is thus converted rapidly and economically into the form of cakes, and the drying can be further carried on to any desired length either by exposure to the air or otherwise. The difficulty hitherto experienced in disposing of the sludge to farmers for utilization upon land is thus got over, as the writer has found that there is no difficulty in selling the sludge from the process he is referring to, provided it is made portable. The theoretical value assigned to sludge from the writer's process is, according to eminent chemists, 16s. 9d. a ton if it contains about 50 per cent. of moisture, or 27s. a ton if dried down to 15 per cent. of moisture. Although in time the value of this sort of manure will be more fully recognized than it has been, at present it is wisest to

* Paper read before the Sanitary Institute of Great Britain, at Stafford.