

Our domestic poisons; or, the poisonous effects of certain dyes & colours : (especially those containing arsenic) used in domestic fabrics / By Henry Carr.

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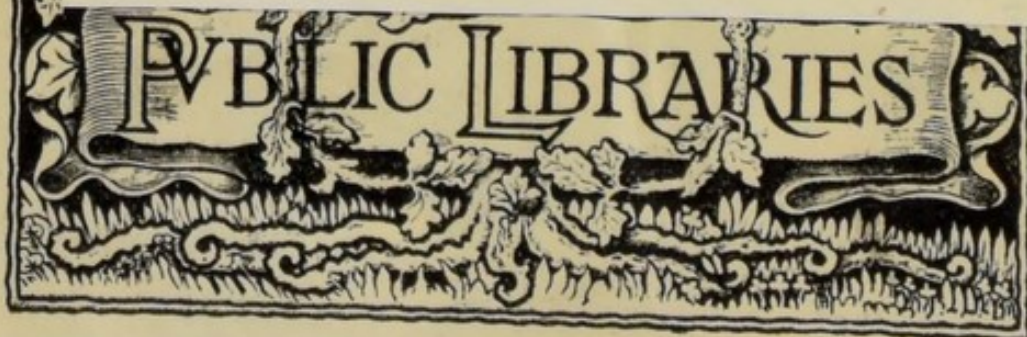
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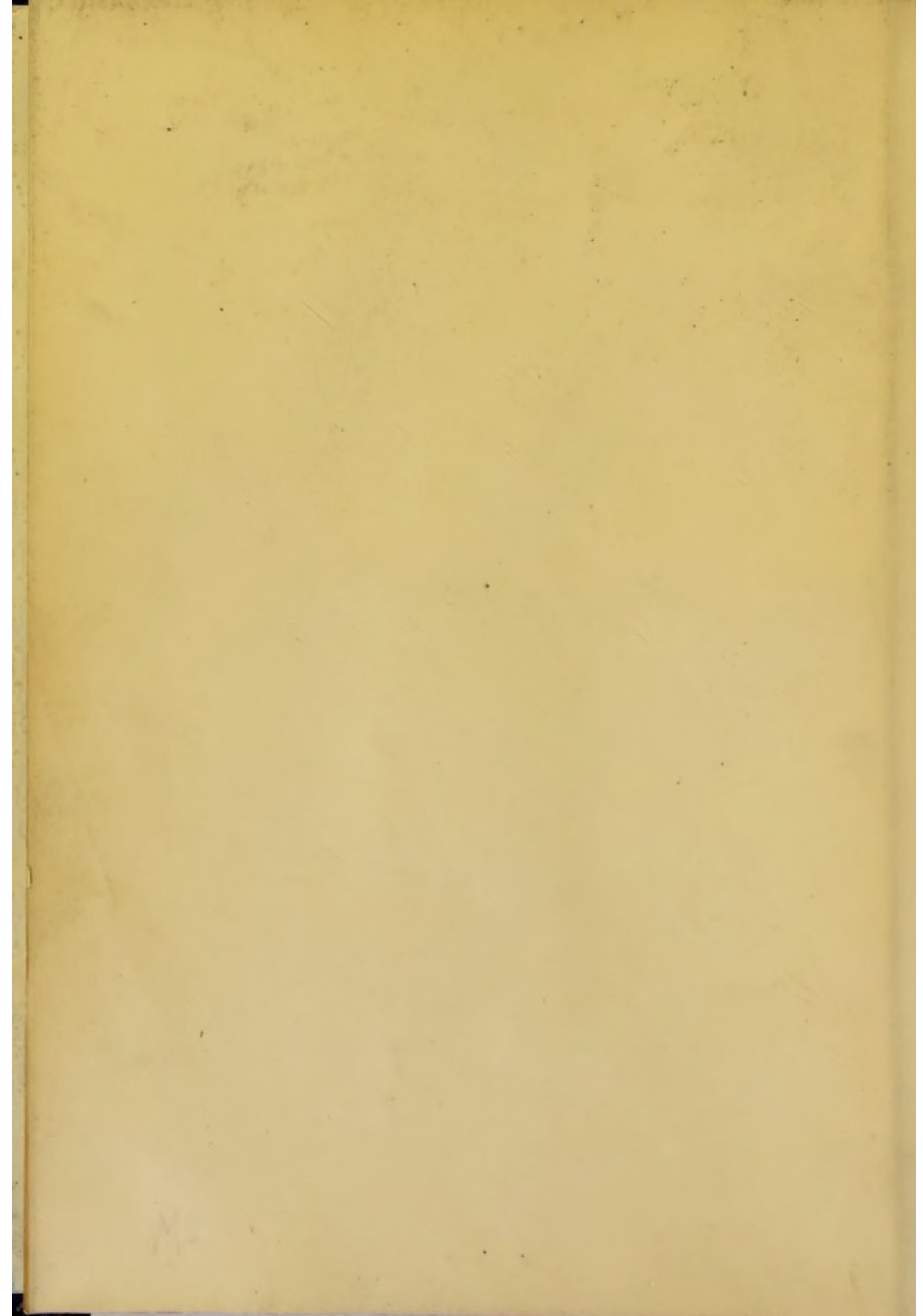
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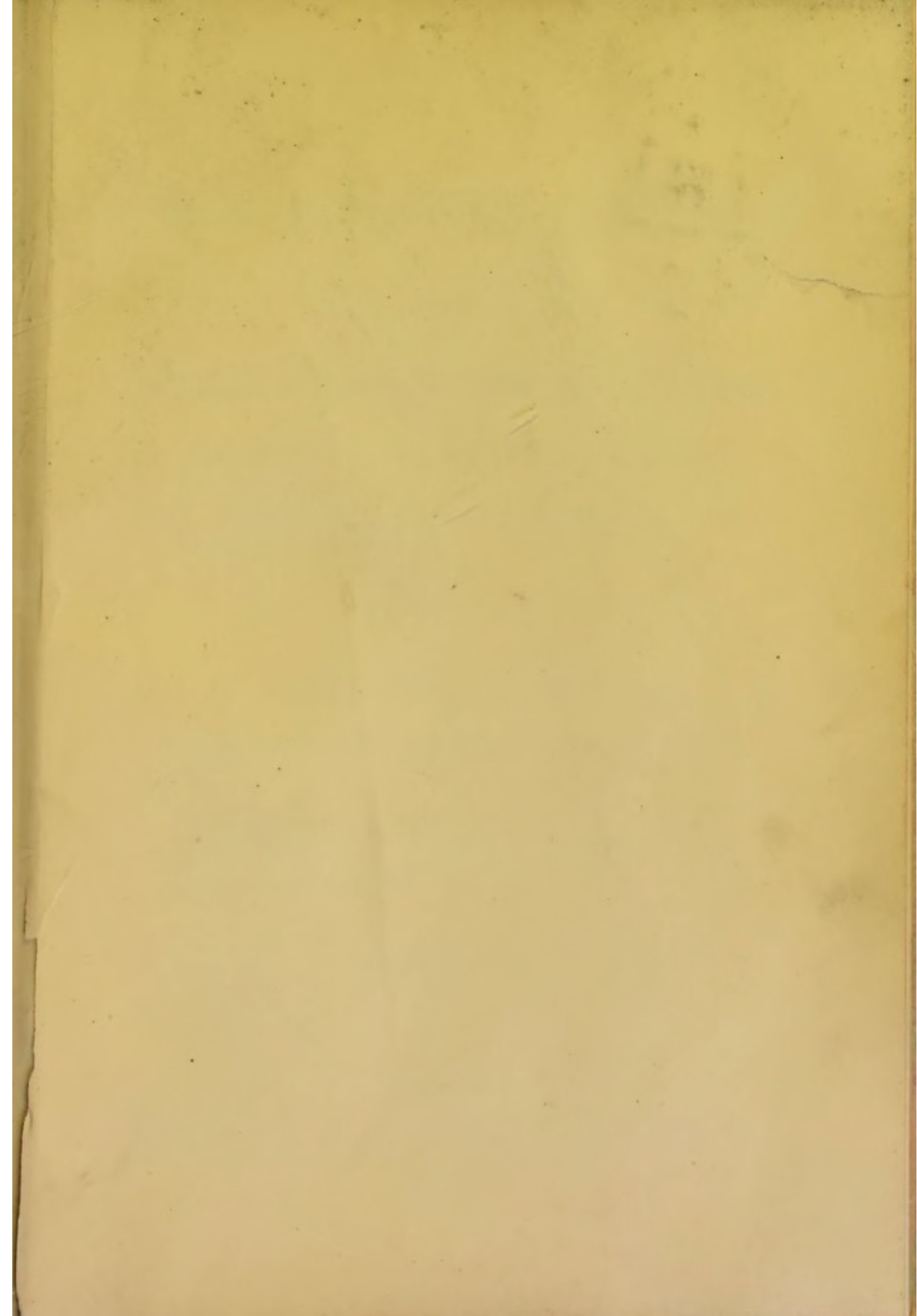
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OUR DOMESTIC POISONS;

OR, THE

Poisonous Effects of Certain Dyes & Colours

(ESPECIALLY THOSE CONTAINING ARSENIC)

USED IN DOMESTIC FABRICS.



BY HENRY CARR, M. INST. C.E.

WITH CONTRIBUTIONS BY NUMEROUS MEDICAL AND CHEMICAL
AUTHORITIES.

"Thus ornament is but the guiled shore
To a most dangerous sea."—*MERCHANT OF VENICE, Act III, Sc. 2.*

" . . . look like the innocent flower
But be the serpent under it."—*Act I, Sc. 5.*

THIRD EDITION.

LONDON:

WILLIAM RIDGWAY, 169, PICCADILLY, W.

1883.



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CONTENTS.

	PAGE
Medical and Chemical Authorities - - - - -	v
Introduction to 3rd Edition - - - - -	1
Paper-stainers who exclude Arsenic - - - - -	4
National Health affected - - - - -	7
Manufacturer's liberty of action - - - - -	9
Colour no guide as regards Arsenic - - - - -	10
Dust or Gas - - - - -	11
Aniline Dyes - - - - -	16
Symptoms of Chronic Arsenical Poisoning - - - - -	18
Cases, Dr. Guy, Artificial Flowers - - - - -	19
„ Dr. Hinds - - - - -	21
„ Dr. Halley - - - - -	22
„ Dr. Lander Brunton - - - - -	23
„ Dr. Hodges - - - - -	24
„ Dr. Leonard Sedgwick - - - - -	25
„ Dr. Alfred Taylor - - - - -	26
„ A Nursery Paper - - - - -	27
„ Dr. Hardwicke - - - - -	28
„ Dr. Myrtle - - - - -	28
„ Dr. Blair - - - - -	29
„ Dr. Owen Rees - - - - -	29
„ Dr. Habershon - - - - -	30
„ Dr. March - - - - -	30
„ Dr. Gamgee - - - - -	31
Testing for Arsenic - - - - -	32
Reinsch's Process - - - - -	34
National Health Society's Report - - - - -	38
Test by Modification of Marsh's Process - - - - -	41
Manufactured Articles, Arsenical - - - - -	47



MEDICAL AND CHEMICAL AUTHORITIES

ON CHRONIC POISONING BY ARSENIC IN DOMESTIC FABRICS.

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 ERNEST HART, Editor of *British Medical Journal*.
 CHARLES HEISCH, F.C.S., late Professor of Chemistry, Middlesex
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 WILLIAM HINDS, M.D., Birmingham.
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JOHN SIMON, C.B., F.R.S., late Medical Officer of the Privy Council.

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OUR DOMESTIC POISONS.

As an introduction to the third edition of "Our Domestic Poisons" it may be well to give a slight sketch of the progress of the movement with regard to arsenical fabrics, which has been made since the issue of the first edition in 1879; that edition was founded principally on information received from medical men and chemists in reply to a circular addressed to some of the leading authorities on such questions. Further information received in consequence of the issue of the first edition soon led to a second, and as considerable interest has been steadily manifested, a third edition appears to be now desirable giving some account of the action taken since the above-named dates.

At an early stage the question was taken up by the Medical Society of London and a Committee of that Society was appointed to report on "arsenical poisoning by means of wall papers, paints, etc." Their report was published in *The British Medical Journal*, 21st February, 1880.

The Committee issued a large number of circulars to medical men, and they express their regret that a

more general response was not received; this they attribute to the fact that "the attention of medical men had then only recently been directed to the subject." They further point out that—

A most important feature elicited by this enquiry is that a very large proportion of the instances of poisoning occurred in the persons of the medical men themselves, or in members of their families, which, in the first place, is very strong evidence of the difficulties attending the diagnosis of this form of poisoning, and, secondly, tends to show that the better opportunities for observation afforded to a medical man in his own house may lead to the detection of mischief, which, from its insidious nature, baffles ordinary tests, or, by assuming symptoms of a general character, is often erroneously treated as indicating a different class of ailments.

This fact proves most clearly that the attention of medical men had not been given to the subject by any means to the extent demanded by its importance, and that this cause of illness had been very generally overlooked by them unless brought prominently and forcibly to their notice by suffering within their own family circle. The large proportion of cases noted in the families of medical men is an incontestable proof that a vast amount of injury from chronic arsenical poisoning was continually inflicted, the origin of the mischief escaping the notice of the medical attendant;

for there can be no reason to suppose that the families of the medical men would be more affected by arsenical fabrics than their patients in general. Had, therefore, circumstances permitted of observations being made with regard to all patients as closely as were made with regard to members of their own families, it may be fairly assumed that the cases reported would have been multiplied in proportion to the number of families attended by each practitioner.

The next action was in connection with the Society of Arts. Mr. Malcolm Morris, M.R.C.S., Hon. Secretary to the Committee of the Medical Society of London, was requested to write a paper, but finding that his engagements would prevent his giving the time requisite to deal with the subject in a satisfactory manner, it eventually devolved on the author of this pamphlet to undertake it. The paper was read on 21st Jan., 1880, and published in the journal of the 23rd. The title chosen was "Our Domestic Poisons in relation to Trade and Art," the trade and art view of the question being more especially the department of this Society. The result of this paper was the appointment of a committee of this Society also, to act in concert with the committee of the Medical Society of London. Their first step was to issue a circular of inquiry to certain classes of manufacturers. Little, however, was gained by this, for manufacturers were not found willing, and could hardly be expected to

communicate information freely when the object was Parliamentary interference with their own proceedings. Good work was, however, done by the committee, especially by the chemists, who carried out a lengthened series of experiments with regard to the tests to be used and the amount of arsenic to be allowed as accidental and unavoidable contamination, and at the same time too small to affect health injuriously.

The question of tests and testing will be dealt with further on.

Three firms of paper-stainers, manufacturers who carefully exclude arsenic, have rendered most valuable assistance, and their works have been of great importance as proving that, where there is the disposition, arsenic may be excluded to the extent required and competition still maintained in the open market.

These paper-stainers have abandoned the use of arsenical pigments for a length of time, others are now ceasing to use them, and are supplying papers guaranteed free from arsenic, stating that this change is made on account of the public feeling in the matter. It is, therefore, to be hoped that all may soon follow the same course, for it will be to the makers of non-arsenical papers that, at all events, the intelligent portion of the community will look for their decorations.

The following statement from a paper-stainer is satisfactory:—"Since the question of arsenic has arisen, the attention of the colour-manufacturers,

mostly abroad, has been given to the subject, and they have produced colours, guaranteed free from arsenic, so nearly equal in brilliancy that the general public could not detect the difference, except by such a close inspection as they are not likely to give. These non-arsenical colours do not add to the cost, or not to any serious extent." The ceasing to use arsenical colours would not involve any expense in alteration of plant; this is a matter of some importance.

Another writes—

"I exclude all arsenical colours most carefully. Nine-tenths of the colours I use are made in Germany and Belgium, and are guaranteed free from arsenic; nevertheless, I also have them tested by a public analyst in this country."

Again—

"We may state that we have not used any emerald green for a long time, and we take every precaution to purchase such other colours as are guaranteed to us free from arsenic."

In reply to the question, "What disadvantage does a manufacturer labour under, who does not use arsenic?" the following reply has been received from a firm manufacturing on a large scale:—

"None whatever; but the contrary, as long as the present feeling exists. We have found it desirable to issue our price lists this year with a printed label to the effect 'that the patterns are made from colours

guaranteed from the manufacturers free from arsenic.' It never has been any advantage to use arsenical colours, and so soon as others were produced we discontinued them."

The above quotations may be taken to a certain extent as expressions on the part of the trade, and from them it may be fairly gathered, that there would be no difficulty whatever in the total abandonment of arsenical pigments as regards wall papers.

A caution should, however, be given that the assurance of a manufacturer that a paper is free from arsenic cannot always be relied upon. A paper selected by the writer, marked "non-arsenical," was, after being hung, found to be highly arsenical, and this from a first-class London firm, of the highest respectability.

The fact is, that many paper-stainers do not appear to be well informed as to whether their colours are arsenical or not; and it may be safely assumed that the retail dealers know very little indeed about the matter, judging from the erroneous assurances so constantly given.

The National Health Society has taken up the question, and a committee is taking action with a view to pressing the matter on public notice, and more especially to promote legislative restriction. Application has been made to Government, and valuable information has been obtained through our Ambas-

sadors and representatives abroad, and furnished by our Government to this Committee.

The question of arsenic in domestic fabrics has also been raised by the Sanitary Institute of Great Britain, and a paper was read at their last annual meeting at Carlisle by Dr. Lediard.

In a movement of this kind, however, much rests with the public. The public must be still further aroused as to the injury inflicted, and public feeling must be brought to bear on Government as well as on manufacturers.

It is an unquestionable fact that the national health is suffering from the use of arsenic and other poisons, in the manufacture of domestic fabrics, to an extent not yet fully appreciated by the public, notwithstanding that from time to time the injurious effects have been pointed out by numerous medical and chemical authorities, whose attention has been given to the question. Public feeling has, nevertheless, been aroused to an extent sufficient to effect considerable diminution in the evils complained of.

In entering upon the consideration of the injury to health, arising from such use of arsenic and other poisons, it may be well, in the first instance, to remind the general reader what great results frequently arise from very slight causes: how, for example, the life of a family may be affected by an apparently trifling exhalation from a drain, or by the inappreci-

able contamination of milk. Men who have studied these questions do not require to be told that a poison may be invisible, that there may be a deadly influence in the brightest water, or in the clearest atmosphere, though the sense of smell, taste, or sight may be incapable of detecting the mischief. In a similar manner, our rooms and clothing may be charged with poison without attracting observation, till illness is produced. It is most important also to draw attention to the effects of breathing an atmosphere in which arsenic has been diffused, as contrasted with arsenic taken by the mouth and acting upon the stomach. Medical men, whose attention has not been drawn to poisoning by arsenical surroundings, raise the objection that they are in the habit of giving more arsenic as a medicine, than can possibly be imbibed from arsenical fabrics. True, they do put more arsenic into the stomach than can be imbibed from a wall paper; the legitimate conclusion to be drawn is, not that arsenical surroundings are uninjurious, but that arsenic taken into the stomach does not act in the same manner as when breathed and received through the lungs.

The consideration of arsenical poisoning at once raises the question of freedom of action. Perfect liberty consists in freedom for every man to do that which is right in his own eyes; but it clearly is not a justifiable use of freedom for manufacturers to charge

our walls, furniture, or clothing, with subtle poison, which, by impregnating the air we breathe, frequently produces serious illness, and often has led to loss of life.

The manufacturer's action is supposed to be condoned by the fact of the ignorant purchaser being a free agent and a consenting party. But has a manufacturer a right thus to take advantage of a customer's ignorance? Does not the manufacturer know perfectly well that the public would not purchase a single piece of his wall-papers, were they marked, "*Impregnated with arsenic, a subtle poison, which may diffuse itself for an indefinite period through the air of the room?*" In selling arsenical fabrics without appending such notice, does he not, to say the least, take advantage of a purchaser's ignorance, and endanger the purchaser's health in an unjustifiable manner?

If the law as it now stands does not prohibit the sale of these injurious articles, and if there really be any advantage in their use, do not well-informed and conscientious manufacturers require protection against such competition, and are they not entitled to it?

The cases of poisoning by a variety of fabrics in domestic use, when fully investigated, will be found so clear, and the mischief arising so great, that Parliamentary action and legal restraint are evidently demanded for the protection of the public, under circumstances where the vast majority, especially the

poor, have no means whatever of protecting themselves.

It is a fortunate circumstance that arsenic—the poisonous material most generally employed—can be easily detected by means of proper tests. Such careful tests should always be obtained by those whose attention has been called to the subject. The poorer classes, however, never do, and, clearly, they never could, take such precautions. Even where a certain amount of care is taken, there is no security without testing the actual paper delivered. For instance, a paper marked “non-arsenical” having been selected by the writer from a sample-book of one of the first firms in London, the paper delivered was found to be “*highly arsenical*,” and the manufacturer replaced the paper without charge.

In the case of wall-papers, some greens, it is true, do contain more arsenic than other colours; but colour, whether in papers or other fabrics, is no guarantee of freedom from arsenic. It is quite a mistake to suppose that if green be avoided, there is no danger from arsenic, for arsenic in various combinations more or less dangerous is used in a great variety of colours, even in French white.

In all probability arsenic, in pigments, was first used for green, and this may have given rise to the erroneous impression that it is green alone that is injurious, whereas colour is no guide whatever to the

purchaser ; the danger is simply in proportion to the quantity of arsenic contained in the colour and in proportion to the facility with which it may be removed from the fabric, either as dust or as gas. The public is, to a considerable extent, already alive to the danger of bright emerald green papers, but by no means so to the dangerous quality of dull greens and other colours. It is, therefore, against these that a caution is more especially needful. The expression very commonly used, "*This is not an arsenical green,*" proves that the public are not aware of the true facts of the case, and are, through ignorance, liable to surround themselves with materials highly dangerous to health.

There are two forms in which arsenic may be introduced into the lungs—the one as dust, the other as gas. As regards dust, we have valuable information from the late Dr. Alfred S. Taylor, F.R.S., Professor of Chemistry and Medical Jurisprudence at Guy's Hospital, as follows :—

"The pigment of arsenicated wall-papers contains a large proportion of arsenic, and from some of these papers in the unglazed state the noxious material may be easily scraped or removed by slight friction : thus arsenic is liable to be distributed through the air of the room in a state of fine dust." One gentleman, as stated by Dr. Taylor, who had his library papered with an arsenicated wall paper, suffered from symptoms of arsenical poisoning, which came on after he

had been occupied in dusting his books, and on examination a well-marked quantity of arsenic was found in the dust. Arsenical dust may be, and frequently is, collected from picture-frames, furniture, and projecting cornices of rooms thus papered. The workmen who hang these papers or strip them off the walls are well known to suffer from symptoms referable only to the action of arsenic.

With regard to the gaseous combinations of arsenic, we have the authority of Dr. H. Fleck, of Dresden, who thus reports on his experiments: "Unmistakable cases of poisoning have arisen from inhabiting rooms hung with arsenical wall-papers, where, on account of the character of the paper, or for other reasons, it was impossible to ascribe the poisonous effects to portions of the colouring matter mechanically detached. For this reason, and because in certain cases the odour of garlic had been noticed in rooms thus papered, it was long suspected that there was actually generated, under some circumstance, arseniuretted hydrogen.

"Experiments were made on a paper coloured with Schweinfurt-green, an aceto-arsenite of copper. Starch paste was used to fix the colouring matter on the paper, and also to fasten the paper to the inside of a large tubulated bell-glass.

"The bell-glass thus lined, and while the paste was still moist, was placed upon a well-ground glass plate; the bell-glass was hermetically closed, and the appa-

ratus was left to itself for three weeks. A growth of mould appeared between the paper and the glass sides, and the air within the jar acquired a musty odour. At the expiration of the three weeks, a slow stream of air was passed through the jar, and the presence of arsenic was shown conclusively in the air, as it issued from the apparatus. The arsenical compound thus present in the air, gave, with a solution of salt of silver, the ordinary reaction of arseniuretted hydrogen. A similar experiment, in which was employed a flask, coated on the inside with a mixture of gelatine and Schweinfurt-green, gave a similar result. It was found that a mixture of arsenious acid and starch paste gave rise to the formation of arseniuretted hydrogen ; but no arsenic could be detected in air which had been in contact with a mixture of arsenious acid and water without the presence of any organic material."

From these and confirmatory experiments, Dr. Fleck concludes that there can no longer be any doubt of the possible presence of arseniuretted hydrogen in the air of a room hung with paper which is coloured with Schweinfurt-green ; that the evolution of this gas takes place on account of the joint action of moisture and of organic matters (especially such substances as are used in fixing the paper to the walls) ; and that wherever free arsenious acid is in contact with organic substances, the evolution of the gas is possible. The danger, then, is by no means confined to Schweinfurt-

green, but may arise from any colour which contains arsenic.

Professors Roscoe and Schorlemmer express a confirmatory opinion, as follows, in their "Treatise on Chemistry," Vol. I, p. 518:—

"Hydrogen is evolved during the growth of mould and certain fungi, and it is possible that if arsenic compounds are present where such growths are going on, arseniuretted hydrogen may be evolved. This may perhaps explain the evil effects noticed when arsenical wall-papers are employed. At the same time, it must be remembered that in those cases arsenic doubtless finds its way into the system in the form of dust, which in such rooms invariably contains it."

The following again, from Roscoe and Schorlemmer, p. 541, is to the point:—

"The employment of arsenical wall-papers is much to be deprecated; still more is the employment of the insoluble arsenical green for colouring light cotton fabrics, such as gauze, muslin, or calico, to be condemned. The colour is merely pasted on with size, and rubs off with the slightest friction."

There is an impression abroad that by distempering walls, instead of papering them, all danger from arsenic may be avoided. This, however, cannot be relied upon; for there is frequently arsenic in distemper, which is always mixed with size to make it adhere: thus forming a direct combination of arsenic and

organic matter, ready for the development of arseniuretted hydrogen.

Professor Bamberg, of Stockholm,* observes, that “the injurious effects of arsenical pigments, as applied to the walls of apartments, have been observed by physicians in almost every civilized country.” He made a very important and successful experiment himself, detecting arsenic in a gaseous form in the atmosphere of a room that had been papered for twenty-five or thirty years.

The question whether one is poisoned by dust or by gas is a matter of interest to scientific men, but is of little consequence to the public; the practical fact for their consideration is this, that great numbers do suffer more or less, many most severely, from poisoning by arsenical fabrics, and that, when the mischief has not gone too far, they do recover on removal of the arsenical paper or other fabric—thus demonstrating the origin of the malady.

Attention should be particularly drawn to the green arsenious lamp-shades, so universally employed and so frequently found to produce injurious effects. The headaches, irritation of the eyes, and other symptoms are generally attributed to the use of coal gas; but the mischief in most cases is no doubt due to the arsenic in the shades. Indeed, the same complaints

* *The Pharmaceutical Journal*, August 1, 1874, where a very full description of this experiment will be found.

are made where oil is used, especially with the powerful new burners, which develop great heat as well as strong light.

Dr. Bartlett remarks respecting aniline dyes:—"I should class with preventible dangers the aniline-dyed taffeta gloves and silk handkerchiefs, of which I have had a large number of specimens submitted to me for analysis. Severe irritation of the hands of delicate women and children has accompanied the wearing of gloves dyed with aniline salts, arsenic, and vanadium, and in some instances a considerable vesication of the skin has marked the urticating nature of these poisonous dyes. Even more distinct is the simulation of the so-called hay-fever, by the violent irritation of the mucous membrane of the nose occasioned by the application of silk handkerchiefs dyed with antimonial-salts of aniline. All diffusive poisonous matters ought to be prohibited from use in painting or papering the interior of domestic habitations; and I am sure that no article of clothing should be permitted to be sold when it can be proved to be dyed with materials which are liable to exert any poisonous influence."

Mr. Bernard Dyer makes the following remarks with regard to aniline dyes:—

"Most unpleasant consequences not uncommonly arise from the improper use of the aniline colours. It is well known that arsenic is largely used in their pre-

paration, but under proper management none of the arsenic passes into the 'finished' dye. The painfully irritant effects which have been frequently observed from stockings, gloves, &c., dyed with aniline colours cannot, therefore, be attributed to any other source than the dyes themselves, the secret of the mischief probably being that the colours have not been thoroughly 'fixed.' Aniline itself taken internally is a strong narcotic poison, and its external action is that of a local irritant. It is not difficult, therefore, to understand that in its numerous chemical derivatives the aniline dyes may partake of its irritant properties. Aniline colours are now largely used in artificial-flower-making, not merely for brilliant colours, but on sombre leaves, bunches of berries and dyed grasses. It is thus an unquestionable fact that our house furniture, decorations, and dress materials are, to a great extent, charged with deleterious poisons."

The cases of decided illness arising from these causes, although far more frequent than is generally supposed, by no means comprise the whole of the mischief. The insidious and unsuspected action of the arsenic, which is diffused through the air, exerts a lowering influence on the general health, more especially in the case of children, undermining the constitution and ending ultimately, in many cases, in a break-down of health. Symptoms of chronic arsenical poisoning so often simulate other complaints, that those who are not alive

to the real cause of the mischief are very liable to be misled.

SYMPTOMS.

The following symptoms, indicating chronic arsenical poisoning, have been kindly abstracted from a large number of reports of medical men by Mr. Malcolm Morris, Honorary Secretary to the "Committee of the Medical Society of London on 'Arsenical Poisoning by means of Wall Papers, Paints, etc.,'" and have been tabulated by him according to the various parts affected, and according to frequency of occurrence:—

1. *The Stomach and Bowels :*

Diarrhoea and dysentery, pain in abdomen, nausea and vomiting, loss of appetite, thirst.

2. *The Eyes :*

Conjunctivitis and sore lids.

3. *The Nervous System :*

Depression of spirits, restlessness, sleeplessness, nightmare, headache.

4. *The Throat, Nose, and Respiratory Organs :*

Soreness of throat, ulceration and dryness, bronchial catarrh, asthma, symptoms like ordinary cold in head with much running of tears.

The symptoms in these four groups may all occur in one individual, or some in one group may occur with some in another. They are put in this form to show the important organs of the body that are affected by this poison.

ILLUSTRATIVE CASES.

As to the injurious effects on those employed in factories, see the Report of the Medical Officer of the Privy Council, 1862, p. 10-13, and 126-132.

“In an establishment employing about one hundred young women in the manufacture of artificial leaves, Dr. Guy found more or less suffering was almost universal amongst the workpeople. The skin affection, which hardly any of them escaped, and which sometimes would begin even after so little as one day’s working, occurred in different degrees, sometimes as mere erythema, sometimes as an eruption of clustered papules, vesicles, or pustules; sometimes as more or less destruction of the skin by process of ulceration or sloughing. The fingers, which (often with accidental chops or scratches on them) are the immediate agents in the industry; the face; the neck, especially about the roots of the hair; the flexure of the arms; the axilla; these were the parts where the skin disease had most shown itself,—parts, namely, to which the arsenical dust is most largely applied, and parts where it is most likely to be retained, and parts where the cuticle is most thin and penetrable. The suffering from these skin affections had been in many cases very considerable; for instance, in several cases the affection had been such that the sufferer could not bear to sit down.

“ But the skin affection was only a minor part of the suffering. Of twenty-five of the sufferers whom Dr. Guy examined, nearly all showed signs, often highly developed, of chronic arsenical poisoning; excessive thirst; nausea and loss of appetite; sickness and vomiting, often with pain in the stomach; palpitation and shortness of breath; debility, fever, headache, drowsiness, dimness of sight and tremblings, nervous twitchings or convulsions. Of the whole group of twenty-five females (says Dr. Guy), four only did not complain of weakness; and of the remaining twenty-one, there were again only four who did not describe the weakness as extreme. Febrile symptoms were present in no less than twenty cases, in five of which they amounted to feverishness, while in the remainder they were described as fever. Headache was an almost universal symptom. It was absent in two cases only, and was described as not severe in only three cases. Dimness of sight was complained of in two-thirds of the cases. In one the eyes were very sore, in another the sight was greatly impaired. Drowsiness was present as a marked symptom in every instance but one, and in two cases only was it spoken of as a trivial circumstance. Tremblings and convulsive twitchings were present in seven cases out of the twenty-five, and in one other instance well marked convulsions were present.”

One case of death is described, the symptoms of

which are given in detail in the report, but need not be repeated here. The concluding sentence, by John Simon, C.B., F.R.S., late Medical Officer to the Privy Council, is, however, to the point at the present moment :—"The tortures which that poor girl must have endured will not have been in vain, if, as may be hoped, the public knowledge of them leads to the amendment of a system under which others are still, day by day, enduring in different proportions the progress of a similar fate."

The unhealthiness of an employment, it is well known, will not deter those who are seeking daily bread, the wages being somewhat in proportion to the risk run.

Such, then, is the fate which attends hundreds of young women and children, who, as artificial florists, suffer in the most terrible manner from handling and inhaling the poisonous arsenical green.

A few cases in private practice will best illustrate the importance of this subject. The three first instances are condensed from a paper read at a meeting of the National Health Society, June 18, 1874, by George Johnson, M.D., F.R.S., Senior Physician to King's College Hospital.

Dr. Hinds,* of Birmingham, papered his own study with green paper. Suffered from severe depression,

* The cases of Dr. Hinds and Dr. Halley occurred upwards of twenty years ago, and were much discussed at the time. They show how long

nausea, pains in the abdomen, faintness, &c. Same occurred every evening when door closed and gas lighted: tested the paper, found it arsenical; paper removed: no return of the symptoms.

Another case in Birmingham: two rooms, papered with arsenical paper. Gentleman and his wife, who were in perfect health, in less than a week suffered from weakness, headache, fever, thirst, loss of appetite, inflammation of the surface of the eyes, heat and dryness of throat. The gentleman went to Ramsgate, and recovered in a week; the lady remained at home and got no better. In two days after his return the gentleman was again ill. The paper was removed, and both recovered in a week.

Dr. Halley, describing his own case, tells us his study was papered with an arsenical paper, one of the worst character. Five or six hours after commencing work, the room being lighted with gas, he suffered from headache, dryness of throat and tongue, and internal irritation; previously in excellent health; after three weeks was completely prostrated, almost losing the use of the left side; recovered during absence from the study. The same symptoms on return to the room. The arsenical paper was removed and health regained.

the question of chronic arsenical poisoning has been before the public. Dr. Hinds was one of the first to appreciate the injurious effects of arsenic in domestic fabrics and to draw public attention to the subject.

The case of T. Lauder Brunton, M.D., F.R.C.P., F.R.S., Physician and Lecturer on *Materia Medica* at St. Bartholomew's Hospital, will carry weight as giving the result of his own personal experience. His remarks have also another important bearing respecting the effects of arsenic in wall-papers, as contrasted with arsenic given medicinally :—

“I believe that colour is no guarantee of freedom from arsenic. The paper which caused so much injury to my own health was a dull green, such as one would hardly suspect to contain arsenic—arsenical greens being generally thought to be bright greens only. Arsenic when present in wall-papers as a pigment of any kind will do mischief, the injurious action being due to a combination of arsenic with the paste by which they are fixed to the wall. An organic compound of arsenic is thus formed which is exceedingly poisonous, much more so apparently than arsenic itself. For a long time I did not believe in the injurious effects of arsenical wall-papers, because I knew that patients could take as a medicine, without any bad result, more arsenic than they were likely to get from the paper of their room ; and it was only after I had learned, to my cost, how very powerful for evil arsenical wall-papers are, that I became acquainted with the explanation. The most marked symptoms in my own case were severe griping, followed by

dysentery, although running from the nose and dry cough were not absent."

The following case is forwarded by Dr. Hodges, of Belfast, Professor of Chemistry to the Chemico-Agricultural Society of Ulster, who has given great attention to this subject:—

"I beg to give you the following particulars in reference to the effects produced by the green wall-papers which you so kindly analyzed for me a few months ago. I bought them last November to paper the walls of the children's day and night nurseries from a shop in Belfast. I got a paper-hanger to put them up, and he got sick before he had half finished the job, and left his son to finish it out. He has since told me that some green papers always affect him in this way. The paper had not been on ten days before two of the children (there were three in all) began to lose their vigour and animation. They had all been particularly healthy before. One little boy of three and a half years old was the first to show it. His throat became much ulcerated, and he got languid and weak. He was put to sleep in another room for about a fortnight, and his strength and vigour came back again; whereas our eldest little girl, who was still in the nursery, remained as she had been. We had no suspicion at the time that the paper had anything to do with it. On the little boy returning to sleep in the room with the green paper, he again fell back into the

state he had been in before, and grew gradually worse and worse every week. We called in the local doctor, but he was quite at a loss to understand the apparent epidemic. The children had by this time become all more or less affected in the same way, also the nurse and Mrs. — ; whereas all others in the house, who were not in the habit of being in the nurseries, were quite free. From fine healthy children they became weak and fretful ; their necks became swelled and knotted, and their throats very much ulcerated. Ultimately it was suggested that the paper was the cause, and on getting your report, we at once had it taken off. In a very short time all became well, with the exception of the little boy and eldest girl. The health of the former was so completely undermined, that at one time it appeared as if he would not recover.”

The following is from Dr. Leonard W. Sedgwick, who suffered himself from arsenical poisoning :—

“ I suffered from sore throat and irritable eyes from a *blue* arsenical paper in my bedroom. One of the most singular cases of poisoning from arsenic in wall-paper was that of three children who had been unaccountably suffering for several weeks ; when I saw them I suspected arsenic, but was told that no new paper had been put up for several years. This seemed conclusive against it ; but in the course of conversation the lady spoke of a country girl she had taken

as a nursery-maid, and of her industrious habits, mentioning in illustration that she was not satisfied with washing the floor, but that she brushed the walls. I immediately requested that any dust that might be out of her reach, as on the top of a wardrobe, should be sent to me, and on examination found arsenic. I ordered the children to be taken from home and no medicine given them. They got well in ten days. The paper was fairly safe, I doubt not, until the colouring matter was rubbed off by the diligence of the nursemaid."

Dr. Alfred S. Taylor's case, a member of his own family:—

"I was subject to a troublesome eruption of the skin, continual boils, frequent ulcerated sore-throats, and any accidental graze or crack of the skin remained a sore for a long time.

"Numerous doctors were consulted and various remedies tried, but all without success. All said it was blood-poisoning, but the cause, viz., the paper, was not thought of at first. Absence from home invariably benefited me.

"On removing to London, where there were no hurtful papers, by slow degrees I became better and lost the eruption, but it took some years to accomplish the cure. In fact, it was not until seven years after leaving the house where the arsenical paper was, and after a still further residence at Dieppe of three years,

that I quite lost the tendency to eruptions of the skin.

Another case occurred in the family of a relative of the writer. The statement of symptoms given in this pamphlet were accidentally brought under his notice. He sent his nursery paper, one with pictures of green fields, trees, &c., for analysis. It was found to be highly arsenical. "What we have ourselves observed is that before the nursery was re-papered, the children were healthy and strong; immediately after, they became pale and sickly and suffered from loss of appetite, peeling of the skin, short dry cough, blinking of the eyes, and in one case ulceration of the leg. When taken from home they got well, but each time on returning the same symptoms recurred. We have grave reasons for thinking that our little boy, lately deceased, was seriously affected by the paper, as nearly every symptom you mention was noticed by us at one time or another previous to his last illness."

Here, then, we have marked symptoms of chronic arsenical poisoning going on for a great length of time, the cause unsuspected till the father became accidentally acquainted with the facts stated in the first edition of this pamphlet. The injurious paper was removed, and the children are now perfectly well and free from the peculiar symptoms of arsenical poisoning.

Some persons are not readily susceptible of arsenical

atmospheric poisoning; others again are highly so, and soon made seriously ill, there being every possible grade between. It should be observed that those in robust health are liable to be affected as well as the delicate. Irritation about the eyes, nose, and throat, and a general feeling of depression seem to be the first and most usual forms of slight affection.

The foregoing are typical examples of injury from wall-papers; the instances which follow relate to textile fabrics of different kinds, articles of dress more especially.

Various instances of poisoning are given in a paper read by Dr. Hardwicke, the late Coroner for Middlesex, at the Social Science Congress, 1875.

That of a young woman, a cutter-out of dyed goods; of others poisoned by gloves, shirts, socks, shoe-lining, &c. The evil effects of the socks are especially well-known to the public.

A young lady, lately suffering in her feet, came under the care of Dr. Myrtle, of Harrogate. Her case is reported as follows:—

She had for some time been wearing stockings of a deep red colour, and suffered from large inflamed blisters. She was under medical treatment for several weeks, but the blisters remained, notwithstanding that the stockings were discarded. Dr. Myrtle then discovered that she was wearing slippers lined with magenta flannel, which kept up the irritation. When this lining also was removed, she soon recovered.

Dr. Myrtle remarks that "he has had several cases where mauve dyed articles of clothing have produced great local irritation, which, in one or two cases, has proved not only painful, but most difficult of cure. Neckties and socks have furnished obstinate forms of an eruption of an herpetic character, the base of each vesicle being painful and greatly inflamed. The eruption has, in appearance and nature, resembled shingles more than anything else, although it is, as far as my observation goes, a distinct form of cutaneous disease."

Case of dark bronze gloves, under Dr. Robert Blair, of Goole :—

"A short time since, my sister bought a pair of 'bronze green' silk gloves. After wearing them a day or two she was attacked with a peculiar blistering and swelling of both hands, which increased to such an extent that for three weeks she was compelled to carry her hands in a sling, suffering acute pain, and being unable to feed or dress herself. At the present time her hands are still swollen to double their natural size."

The following, by George Owen Rees, M.D., F.R.C.P., Consulting Physician to Guy's Hospital, appeared in *The Times* :—

"I have had occasion more than once to bring cases before the notice of the medical profession, in which severe symptoms were experienced by patients who

were being slowly poisoned with arsenic. This slow poisoning is going on at present very extensively. I have described a sad instance of poisoning by an arsenical colouring matter contained in the green calico lining of some bed-curtains. For months and months this source of poison was not discovered, and the symptoms were treated as those of natural disease. On the removal of the curtains the patients at once recovered their health. This poisonous lining has been sold, and I believe is still selling freely, and is doubtless producing severe suffering."

From Samuel O. Habershon, M.D., F.R.C.P. :—

"I was called to see in consultation several children with bronchitis, resident in this neighbourhood; there was no apparent cause for the bronchial irritation, but the nursery which they occupied had an arsenical paper. The friends were urged to remove the children from the room, but did not do so till the death of the youngest child. On removal from that room the survivors soon lost the symptoms of bronchial irritation."

From Henry C. March, M.D. :—

"The following is an interesting case. A gentleman was subject to erysipelas of the nose. About every two months he would have a bad attack which kept him in bed for a week. He had a slight chronic eczema or soreness along the *alæ nasi*, and I noticed that the erysipelas always began there. His bed-room paper was submitted to 'Marsh's Test' and found

to be highly arsenical. This paper was removed, and replaced by one ascertained to be harmless. The eczema got well, and for eighteen months he continued in good health ; at the end of that time he sent for me as his nose was swelling up. I said, ' Well, we cannot blame the paper this time ; ' after some conversation, however, I found that for a fortnight while workmen were in his own bed-room he had occupied another, and the paper of this was found to be highly arsenical. He got back at once to his own room, and for two years he has had no eczema and no erysipelas."

Arsenical Conjunctivitis and Tonsillitis, communicated by ARTHUR GAMGEE, M.D., F.R.S., of Owen's College, Manchester.

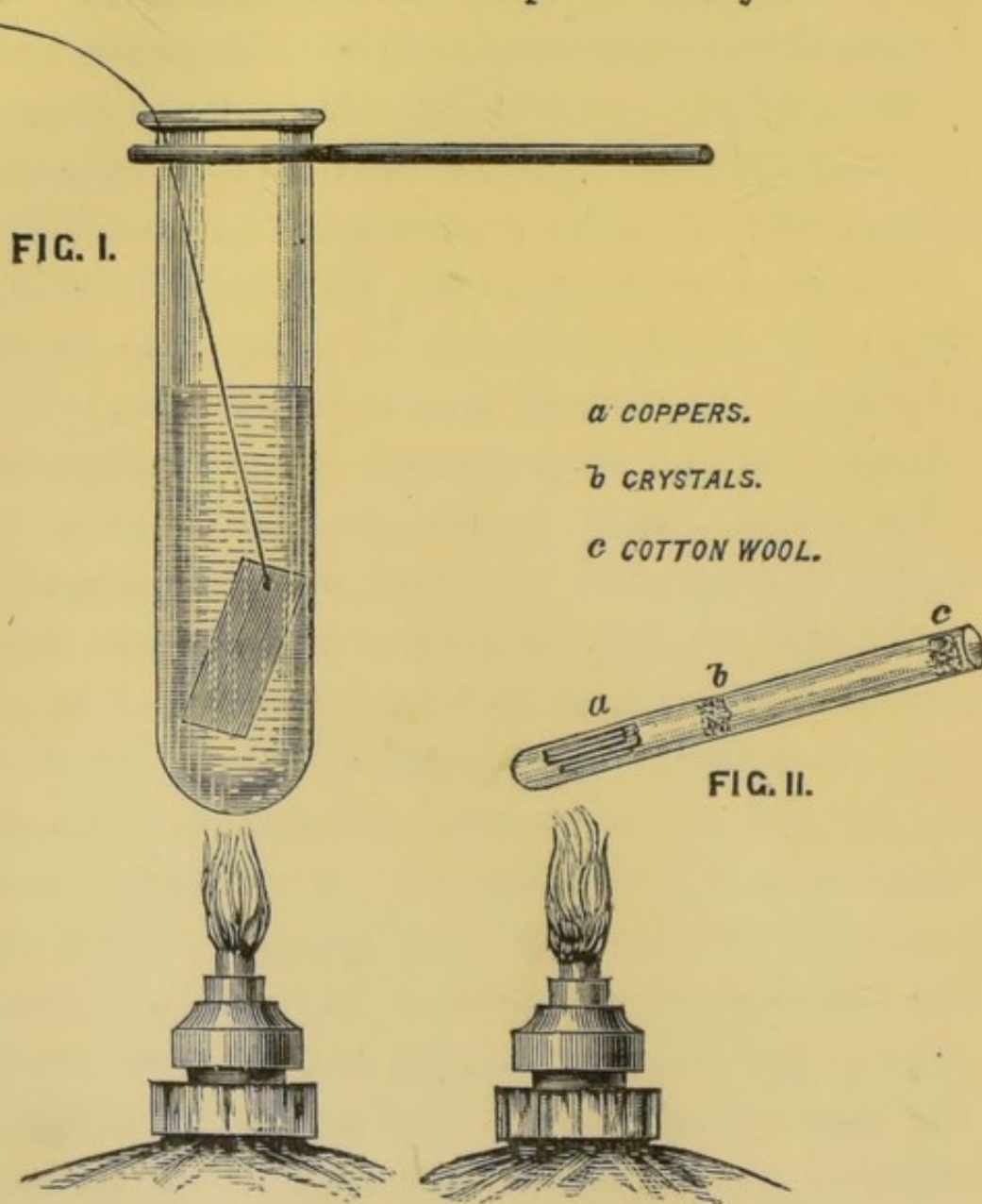
Some months ago nearly the whole of the ballet-girls at the Alhambra were found to be simultaneously suffering from conjunctivitis and tonsillitis of a severe character. On instituting a careful enquiry as to the probable cause of the outbreak, it was found that at a particular period of the evening there appeared to be a decided increase in all the symptoms. The gossamer dresses of the girls, which were green tarlatan, were suspected, and on being submitted to analysis were found to be loaded with arsenic. This immediately explained the cause of the illness, and also led to a change in the colour of the material. The health of the girls was soon restored.

TESTING FOR ARSENIC.

The desire to have wall-papers, furniture, dress materials, etc., free from arsenic, now influences the public to a great extent, and when making purchases, especially of wall-papers, the question is asked, Is this free from arsenic?—the assurance that it is so being given too much as a matter of course. The difficulty felt by the general purchaser is how to ascertain the fact in a manner to be relied upon, and at a moderate cost. The National Health Society has brought out a valuable report on the question of the tests to be used, but their attention has been given more to those suitable for legal proceedings, for the settlement of disputes, and for standard tests to be introduced into Acts of Parliament, rather than to what may be called a popular test, available for those merely selecting fabrics for their own use. A test for general use must be one which does not require special or expensive apparatus. There must be no danger from explosion, and there must be no generation of poisonous gases; and no special scientific skill should be required, if the test is to be made available to a large extent throughout the country. Reinsch's test meets these requirements, but a modification of Marsh's test is recommended as the standard to be introduced into the proposed Act of Parliament. In some very rare cases Reinsch's may not be so exhaustive a test as Marsh's, but it must be borne in mind that testing for

arsenic, for the selection of a wall-paper, is a very different thing from testing in a case of suspected poisoning. The mode of testing by Reinsch's process, as given below, corresponds with Marsh's more complicated test, as described in the Appendix. That is to say, if minute definite quantities of arsenic be introduced and then tested for, the octahedral crystals of arsenious acid obtained will be identical, whether obtained by Reinsch's process or by the modification of Marsh's. The report of the National Health Society as to the mode of testing for arsenic, to be recommended for all cases of special importance, is founded upon a long and most valuable series of experiments. This report ought to be in the hands of every public analyst and of every scientific chemist, in order that all may be able to refer to one common standard of what is to be permitted as "*accidental and unavoidable contamination*," and what is to be condemned as "*arsenical*." If any question should arise as to the accuracy of the Reinsch test above recommended, it will be a very simple matter to refer the question to a scientific chemist—the party in error to pay the fee; in such cases it is essential that the portions of paper tested be cut from the same identical piece, and that the report be written on the back of a part of it. The writer had a dispute with a public analyst in the country as to whether a certain drawing-room paper was arsenical or not. It turned

out at last that a second printing had been required to make up the quantity needed. The flower in one printing was arsenical, in the other it was free; a sample of one kind was sent to the writer, a sample from the other was sent to the public analyst.



Mode of testing by Reinsch's process.—From the*

* Suitable materials may be obtained from Messrs. Townson and Mercer, 89, Bishopsgate Street Within, E.C., either direct or through any druggist. Price 8s 6d.

paper to be tested cut a piece 4 in. by 4 in. or 16 in. area ; all colours must be included or, if any particular colour be suspected, cut out this colour in sufficient quantity to cover the same area ; let the portion to be tested be cut up into small pieces. Place the test tube in the ring support, insert the paper, add dilute hydrochloric acid (one of acid to four of water) half filling the tube, light the spirit lamp with a moderate flame and place it underneath the test tube.

Take a piece of copper-foil 1 in. by $\frac{1}{2}$ in., brighten it with a piece of emery or glass paper, pass a fine platinum wire through a small hole in the copper foil, and as soon as the contents of test tube boil, insert the copper, noting the exact time, and lowering the flame of the lamp so as to maintain a gentle simmering only. By means of the platinum wire, the copper can be drawn out and examined from time to time as the test proceeds. (Fig. I.)

If there be much arsenic present the copper will be coated almost immediately of a *black* or *dark steel* colour ; if less arsenic be present a longer time will be required, varying from half a minute to half an hour, half an hour being the limit of time for boiling ; if in that time the copper be not coated all over of a lamp black or dark steel colour, the paper may be accepted, the cases being very rare in which this process does not detect the arsenic. If the copper be coated all over, the paper is in all probability arsenical,

though the process carried thus far does not *prove* the presence of arsenic, for this coating may arise from sulphur, mercury, or some few other ingredients which may be present in the colouring matter. The completion of the test is as follows:—Well wash the copper by shaking it in clean water, holding it by the wire or by a small pair of pliers—the copper must never be touched by the hand; dry it first between two pieces of blotting paper, finally by laying it on a strip of thin sheet brass and warming it over the flame of the lamp—direct exposure of the copper to the flame must be avoided. Take a reduction tube, about 3 in. in length and $\frac{1}{4}$ in. in diameter, dry it by holding the closed end in the flame till nearly red hot, then slowly pass it forward till the whole is thoroughly heated; taking the copper in the pliers, cut it up with a pair of scissors into such pieces as will pass into the tube; the mouth of the tube should then be closed slightly with cotton wool. Now hold the closed end of the tube containing the copper over the flame of the spirit lamp, gradually increasing the heat; arsenic, if present, will be driven off the copper by the heat, and will be deposited a short distance beyond in the form of octahedral crystals of arsenious acid, which may be examined by a small magnifying glass or in a microscope; if the sublimate consist of octahedral crystals, the discolouration of the copper is due to arsenic. (Fig. II.)

Or the crystals may be sublimed on to a microscope slide in the following manner :—

Take a thin glass tube $\frac{1}{4}$ in. internal diameter, and $1\frac{3}{8}$ in. long, sealed at one end, and lipped like a test tube at the other. Suspend this by dropping it through a hole cut in a piece of stout sheet brass or copper, not less than 4 by 1 inches, so that the lip just supports the tube, and place the brass or copper plate on the ring of a retort stand. Heat the tube nearly to redness, and expel the last trace of moisture, and when cold put the copper strips within, and place over it, resting on the mouth of the tube, a microscopic slide, warmed in a spirit lamp till all the moisture at first deposited has disappeared. Now heat the tube with the spirit lamp, letting the flame play on the under side of the brass plate. In a few seconds a sublimate will appear on the slide. Watch this until it begins to shrink from the edges, and form a patch just the size of the bore of the tube. Remove the lamp, allow the slide to cool, and examine the sublimate with a magnifying power of 220 diameters.

The copper and acid when first obtained, must be tested by boiling alone for an hour ; if the copper then becomes coated at all, either the acid or the copper is not pure, and must be rejected.

APPENDIX.

NATIONAL HEALTH SOCIETY: COMMITTEE ON
ARSENIC IN DOMESTIC FABRICS.

REPORT ON EVIDENCE REGARDING THE INJURIOUS EFFECTS
ON HEALTH ARISING FROM ARSENICAL WALL-PAPERS
AND OTHER ARTICLES. By T. LAUDER BRUNTON, M.D.,
F.R.S.

The evidence on this subject consists partly of articles published in various journals, and partly of answers to a circular on the subject sent out by the Medical Society of London (see *British Medical Journal*, February 21st, 1880). The nature of the evidence is, first, that certain symptoms have occurred in persons exposed to the influence of certain conditions; secondly, that, on attempting to analyze these conditions with the object of finding out the cause of injury, none could be discovered at all likely to produce the symptoms, except arsenic; thirdly, that the symptoms coincided in many respects with those produced by arsenic when administered internally; fourthly, that the symptoms disappeared when the arsenic was removed, although, as far as could be ascertained, the other conditions remained unaltered. The number of cases on which the report of the Committee of the Medical Society of London was based was a little over one hundred; and, besides these, numerous cases have been reported in medical journals. Considering the extensive use of arsenic in wall-papers and articles of clothing and furniture, the number of cases may appear very small, and quite insufficient to prove the necessity for any form of legislative interference. This objection we believe, however, to be invalid. It is exactly the same in kind as that which may be brought against interference with systems of drainage which contaminate drinking water with typhoid excreta, or against the free distribution of milk supplied from dairies where typhoid

or scarlet fever exists. The comparative smallness of the number of cases of poisoning by arsenical wall-papers is, we believe, simply due to ignorance of the injurious action of arsenic in papers, dress, or furniture, and consequent failure to perceive the connection between the illness and its cause. One circumstance which renders this connection more easily overlooked, is the fact that all persons are not equally susceptible to the injurious action of arsenic. It is well known that, in Styria, many persons are accustomed to take quantities of arsenic, which would be fatal to persons unaccustomed to it. It seems possible that the same may occur with arsenical papers, for a family living in a house at Hampstead, where the former occupants had enjoyed good health, shortly after their entrance began to suffer from symptoms of arsenical poisoning. The wall-paper was examined, and found to be arsenical. On its removal all the symptoms ceased. The immunity which the first of these families enjoyed, although exposed to the action of the arsenical paper, may have been due to their having become gradually inured to the presence of arsenic; but it may also have been due to a less degree of sensitiveness; and this is all the more probable, because the second family have suffered three several times in the same way. Should one member of a family be more sensitive than others, he may suffer while the rest escape. In such a case suspicion will be averted from the arsenical paper, as all have been exposed to its influence. In one case reported to the Medical Society, two children of an eminent consulting surgeon died from enteritis, while the nurses escaped. The cause of the illness and death of the children was a mystery until the nursery papers were examined and found to contain arsenic. Another cause of the failure to connect the symptoms due to arsenic with its presence in wall-papers is that the symptoms are those of irritation of the intestinal or respiratory tracts, or of the conjunctiva; and these may frequently be attributed to other causes than the true one, especially if no suspicion be entertained of its presence. Thus, in thirty-five cases reported to the Medical Society, nausea, diarrhœa, and

digestive disturbance occurred; and these symptoms might be ascribed to errors in diet, to chills, to imperfect drainage, or to worry or overwork; or might be vaguely ascribed to constitutional disturbance by those who did not suspect, and therefore failed to discover, the true cause. The same may be said of the cough and asthma which occurred in nine cases, or of the conjunctivitis which occurred in nineteen. In support of this view it may be mentioned that one-fourth of the cases of poisoning reported to the Medical Society had occurred in the persons of the medical men themselves who reported them, or in members of their families; and that a large proportion of the cases reported had been observed by men qualified in an especial way, either by knowledge or by training, to discover the true cause of the symptoms which occurred.

Another reason why arsenic as a cause of disease is overlooked is that, when given as a medicine, it produces no injurious action in quantities which are probably larger than those which affect persons exposed to the action of arsenical papers. The reason of this may be twofold; either it may be that the arsenic given off from the paper is absorbed by the lungs instead of the stomach, or it may be that the arsenic is given off from the paper in a specially poisonous form. The difference between the effect of poisons taken by the mouth or introduced into the body in other ways, is shown by the fact that the venom of vipers, although very poisonous when applied to a wound, is quite innocuous when swallowed. That arsenic, in different combinations, has different poisonous powers, is shown by the fact that, in the form of cacodyl, although exceedingly offensive to the sense of smell, it is not poisonous; while, on the other hand, arsenic, in the form of arsines, appears to be more poisonous than arsenious acid.

At all events, however, a considerable amount of positive evidence has already been obtained of the injurious action of arsenical papers and fabrics; and, whatever may be the reason why it is not greater, it is sufficient to justify vigorous action in the matter.

CHEMICAL REPORT ON THE TEST TO BE EMPLOYED FOR THE DETECTION OF ARSENIC.—It was found that, on the Continent, Acts or decrees exist, forbidding the sale of wall-papers, curtains, carpets, and textile fabrics generally, if they contain arsenic. We had before us the decrees in force in Germany and Sweden. In the former, the prohibition of the sale of goods containing arsenic is absolute; in Sweden, a concession is made to manufacturers to this extent, that a paper or textile fabric shall be considered practically free from arsenic if an opaque black or brown arsenical mirror cannot be obtained from 68 sq. in. of paper, or 34 in. of a textile fabric, in a tube of 2mm. (.078 in.) internal diameter. In the printed certificates issued by the Government, to be filled up by the chemist making the analysis, it is stated that the method known as the Von Babo Fresenius test should be employed. The process is then minutely described, so as to insure uniformity of results. We ascertained from the Government analyst in Stockholm, that the fact of the mirror being opaque is determined by observing whether or not a black line on a white ground could be seen through it.

The fact that the presence of arsenic in domestic fabrics is injurious to health having been already ascertained by the Committee, the question for our consideration is simply that of the mode of testing. The first point for consideration is whether the prohibition of arsenic must be absolute, extending to the most minute trace, or whether such minute quantities may be allowed as arise from accidental and unavoidable contamination. A very large proportion of fabrics of all kinds are found absolutely free from arsenic, no known test discovering the slightest trace; but, again, with regard to many fabrics, some traces are unavoidable in consequence of the very wide diffusion of small quantities of arsenic in natural products. The consideration consequently arises—First, as to what amount of arsenic it is requisite to allow as unavoidable and accidental contamination, in order that trade may not be hampered or interfered with to any undue extent; and next, whether that allowance

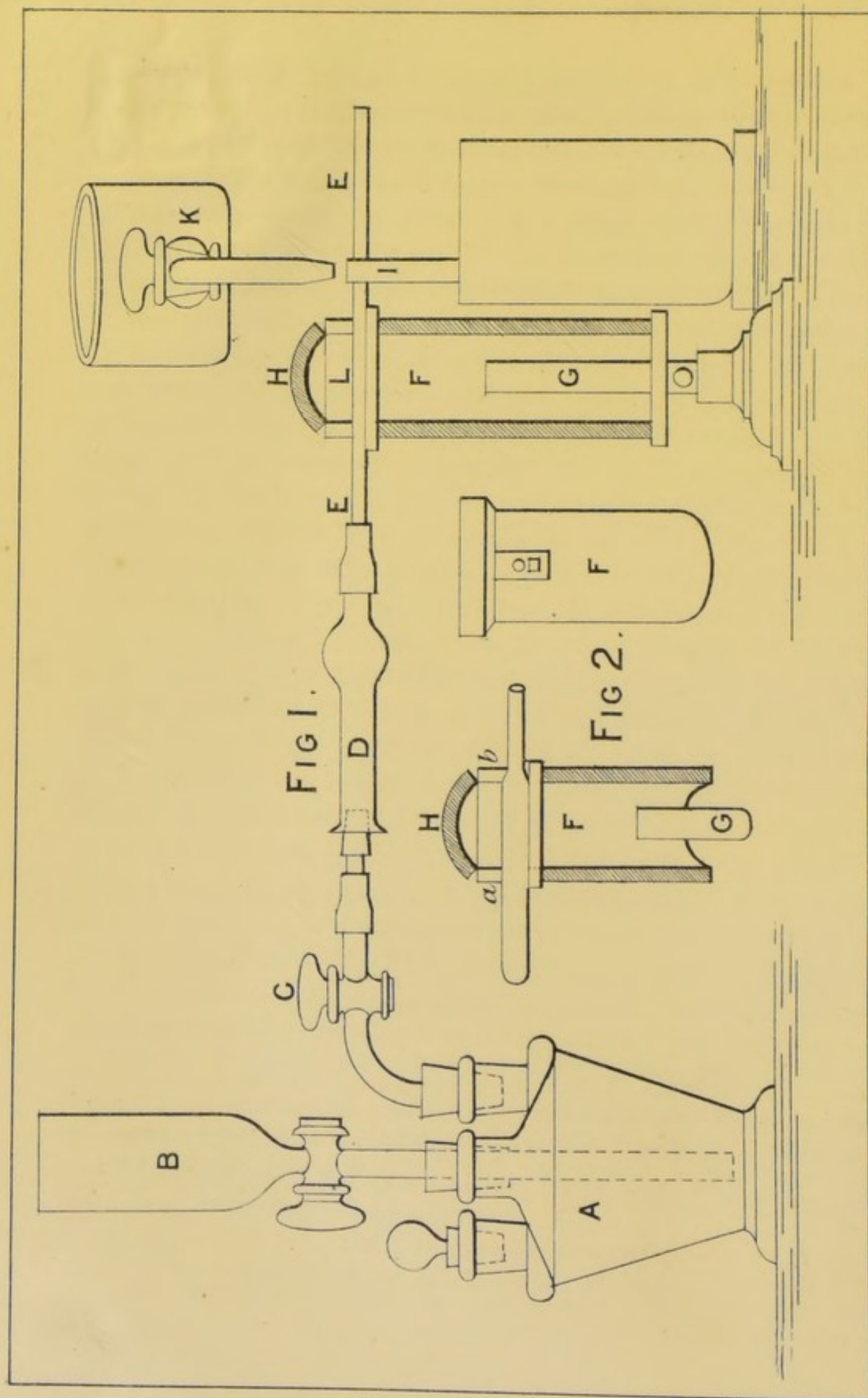
may be permitted with due consideration to health. There are manufacturers of wall-papers (the principal articles in question) who have, on principle, abjured the use of all arsenical colours; the result of their work affords, therefore, an excellent guide for what may be demanded without unreasonable interference with the freedom of trade. An examination of a very large number of papers, supplied by these manufacturers, leads to the conclusion that an allowance of half a grain of arsenic per "piece of paper"—a piece being 12 yds. in length and 21 in. wide—would be ample for accidental and unavoidable contamination; and this quantity it is considered would not be injurious to health. It is found that a suitable size for a sample to be tested is 16 sq. in., to be cut from one part; or, if thought well, from several parts of the pattern so as to include the more arsenical colours. The proposed limit of half a grain per piece gives .001 grain per sample of 16 sq. in. For ordinary uniform materials, a square of 4 in. by 4 in. may, therefore, be taken as the portion to be tested. We may remark, that the quantity of arsenic which we allow to pass by these tests, is more than four times as much as would be permitted by the Swedish decree. A modification of Marsh's test is recommended as the most reliable, and as most suitable for a standard test to be inserted in an Act of Parliament. Detailed instructions are given for both tests, in order that those who still desire to use Reinsch's method may get results comparable with the prescribed test by the modification of Marsh's process where arsenic is found.

The description of Reinsch's test is omitted here, it having been given previously, page 32.

STANDARD TEST.—No paper should be passed as "non-arsenical," unless when treated as hereafter described, it fails to yield a mirror in a tube $\frac{1}{8}$ in. internal diameter, sufficient to cut off at any point a black line on a white ground, technically known as thick rule (eight to pica).

Specimen Line.





"In a three-neck bottle* of the form A, Fig. 1, of about 10 oz. capacity, place 200 grains of pure zinc.† To the centre neck, fit a tube funnel and stop-cock, B, and to one of the side necks a right-angled tube, and stop-cock, C. The third neck should be closed with a ground stopper. Connect with C a chloride of calcium tube, D, and with this a tube of hard glass, E, $\frac{1}{8}$ in. internal diameter, and about .04 in. thick in the glass, if the paper or other material to be tested does not contain sulphur; but if, on being treated with hydrochloric acid, it yields sulphuretted hydrogen, the modification of this tube E, hereafter mentioned, must be adopted. Let this tube traverse a clay chimney, F, $1\frac{1}{4}$ in. diameter, and 6 in. high, in the top edges of which two slots have been filed to admit E, to the depth of 1 in., and let E be supported on a thin bridge of the same material as the chimney, $\frac{1}{4}$ in. wide and a $\frac{1}{8}$ in. thick, slightly notched, to rest on the sides of the chimney. This chimney surrounds a Bunsen burner, G, of $\frac{1}{2}$ in. diameter. Over the top of the chimney, place an arched cover, H. Round E, at $\frac{3}{8}$ in. from the chimney,‡ roll a strip of thick blotting-paper or calico, $\frac{1}{4}$ in. wide, secured by a thread, as at I. This should go at least twice round the tube, and hang down, as shown in Fig 1; on to this, water is dropped from a bottle, K, at the rate of about 120 drops per minute (in very hot weather even faster).

* This form is recommended, as in case of frothing, which frequently occurs, the froth is not driven into the tubes.

† Zinc sufficiently pure for this purpose can only be prepared by dissolving the purest commercial zinc in pure acid, so as to expel any arsenic as arseniuretted hydrogen; precipitating the zinc with pure carbonate of soda, washing the precipitate, and, when dry, reducing it. Messrs. Johnson and Matthey, of Hatton Garden, prepare zinc exactly in this manner, and supply it in bars, guaranteed free from arsenic. This zinc gives off hydrogen so freely, that it is desirable to have the requisite quantity in one piece in the bottle, so as not to expose too great a surface to the action of the acid. Three-necked bottles suitable for the purpose may be obtained of Messrs. Cetti, of Brooke Street, Holborn.

‡ The chimney is conveniently made by cutting the bottom off a Daniel's porous cell, and the cover by cutting a piece $1\frac{1}{4}$ in. long off a similar cell and splitting it into three. The bridge also is best made of the same material.

When the apparatus is thus arranged, pour through B 2 oz. of dilute hydrochloric acid, one part acid to eight water. If any sample of zinc does not yield hydrogen with sufficient rapidity with this acid, slightly stronger must be employed. The hydrogen should be evolved with sufficient rapidity to keep alight at the end of this tube if now fired. Close stop-cock on B, and let hydrogen escape through C, D, E, till all air is expelled. Now light G, and when E is quite red-hot, close C, and introduce through the stoppered neck the 16 sq. in. of paper, cut into strips of 1 in. by 2 in., and rolled up, so as to pass readily through the neck. This must include within the 16 sq. in. of paper, portions of every part of the pattern, so that all the colours may be tested. Replace the stopper, open stop-cock C, and let the action continue for one hour. Now extinguish G, and observe if a brown or black mirror be formed in E, between I and the chimney. If no mirror be formed, the paper is absolutely free from arsenic; if a mirror be formed, which, if the operation be properly conducted, will occupy about $\frac{3}{16}$ in. in the tube, lay E along the black line before spoken of, in front of and pointing towards a window, and observe, with one eye exactly over the tube, whether at any point the mirror be thick enough to obscure the line. Should this not be the case, the paper may be passed as containing no more arsenic than may have got into it from unavoidable causes; should the line be at any point obscured, it only remains to make sure that the mirror is arsenical. If, when sublimed with access of air, the mirror yield octahedral crystals, it is arsenical. This operation is best performed as follows:—The portion of the $\frac{1}{8}$ in. tube containing the mirror being cut out, take a thin hard glass tube, $\frac{1}{4}$ in. internal diameter and $1\frac{3}{8}$ in. long, sealed at one end, and lipped like a test-tube at the other. Suspend this by dropping it through a hole cut in a piece of stout sheet-brass or copper, not less than 4 in. by 2 in., so that the lip just supports the tube, and place the brass or copper plate on the ring of a retort stand. Heat the tube nearly to redness, to expel the last trace of moisture; when cold, insert the portion of the $\frac{1}{8}$ in. tube

containing the mirror, and place, over the mouth of the tube and resting on it, a microscopic slide, warmed in a spirit-lamp till all the moisture at first deposited has disappeared. Now heat the tube with the spirit-lamp, letting the flame play on the under side of the brass plate. In a few seconds, a sublimate will appear on the slide. Watch this till it begins to shrink from the edges, and form a patch just the size of the bore of the tube. Remove the lamp, allow the slide to cool, and examine the sublimate with a magnifying power of not less than 220 diameters. If the sublimate is found to consist of octahedral crystals, it is arsenical. Such crystals are well shown on the photographs taken by Mr. J. H. Jennings, of 14, Beach Avenue, Nottingham.

"If, on being treated with hydrochloric acid, a paper or other substance yield sulphuretted hydrogen, as before mentioned, or if, on being treated as above described, a yellow or whitish-yellow sublimate be found instead of a mirror, the following modification must be adopted.

"Substitute for the tube E a tube of $\frac{1}{4}$ in. diameter, having the $\frac{1}{8}$ tube sealed on to its end (Fig. 2); at *a*, the junction of the two, place a small plug of asbestos, fill the portion which traverses the chimney with a mixture of dry carbonate of soda and charcoal; and behind this, at *b*, place another plug of asbestos. The rest of the arrangement is the same as in Fig. 1. The red-hot carbonate of soda and charcoal retain any sulphur, etc., but permit the arsenic to pass. In this case, a little water is formed, and carried forward with the arsenic, which prevents the mirror having such well-defined limits as when it is perfectly dry; but a few experiments made with known quantities of arsenic will enable the operator to say with accuracy if a paper contain more than the permitted maximum of arsenic. It is remarkable how small a quantity of sulphur will completely mask a considerable amount of arsenic. Thus, sufficient ultramarine, mixed with a white pigment to give it a greyish tint, will quite prevent the formation of an arsenical mirror with four times the maximum quantity of arsenic permitted.

“In the case of textile fabrics to be worn next the skin (as gloves, socks, or vests), experience has shown us that no trace of arsenic, however small, should be permitted. Curtains, carpets, etc., come under the same rule as wall-papers. In the case of carpets, it is better to remove the hempen backing on which they are frequently made up, and only to put the wool into the bottle. Some textile fabrics will not yield up their arsenic without previous maceration in strong acid. It is, therefore, desirable in all cases to submit the material to the action of pure hydrochloric acid, sufficient thoroughly to saturate it for a period of at least twelve hours previous to testing. When commencing to test, water should be added to dilute the acid. Textile fabrics should also be submitted to the action of zinc and acid for a longer time than papers, and it is safer, when the first portion of acid has nearly ceased to act, to add a quarter of an ounce of strong acid through B, and let the action proceed for a second hour.

“The only novelties that are claimed in this process are, first, the chimney of a non-conducting material, which confines the intense heat to one and three quarter inches of the tube; and, secondly, the sharp condensing action of the water passing over the strip of blotting paper or calico. By these means, the arsenical mirror is concentrated, and not permitted to be carried off as arseniuretted hydrogen, as we have found to be the case when these precautions are not insisted on.

“It is an important fact that, though there are at present various methods of testing for arsenic, more or less accurate, well-known to all competent chemists, hitherto there has been no standard test for small quantities which could enable one chemist to say that a material is arsenical beyond the just limits of accidental contamination, with confidence that any other competent chemist would give a corresponding report; and this merely from want of an accepted standard mode of testing, and a standard limit of accidental and unavoidable contamination. It would, of course, be open to any chemist to say that, in his opinion, these standards were too rigid, or not rigid enough;

but it is most important that there should be a common measure by which all might compare their results; this is at present a great desideratum. We therefore recommend the Society to adopt and publish the proposed test, as a standard test according to which wall-papers, and other materials described in Appendix A, may be classed as 'arsenical' or 'non-arsenical,' and their manufacture or importation be regulated accordingly."

APPENDIX A.

Articles in which Arsenical Pigments, Dyes, or Mordants are used within the Knowledge of the Sub-committee.—Paper, fancy and surface, coloured; in sheets; for covering cardboard boxes; for labels of all kinds; for advertisements cards; for playing cards; for wrappers and cases for sweetmeats, cosaques, etc.; for the ornamentation of children's toys; for covering children's and other books; for lamp shades; paperhangings for walls and other purposes; artificial leaves and flowers; wax ornaments for Christmas trees and other purposes; printed or woven fabrics intended for use as garments; printed or woven fabrics intended for use as curtains or coverings for furniture; children's toys, particularly inflated indiarubber balls with dry colour inside, painted indiarubber dolls, stands and rockers of rocking-horses and the like, glass balls (hollow); distemper colour for decorative purposes; oil paint for the same; lithographic colour printing; decorated tin plates, including painted labels used by butchers and others to advertize the price of provisions; japanned goods generally; Venetian and other blinds; American or leather cloth; printed table baizes; carpets; floor-cloth; linoleum; book cloth and fancy bindings.

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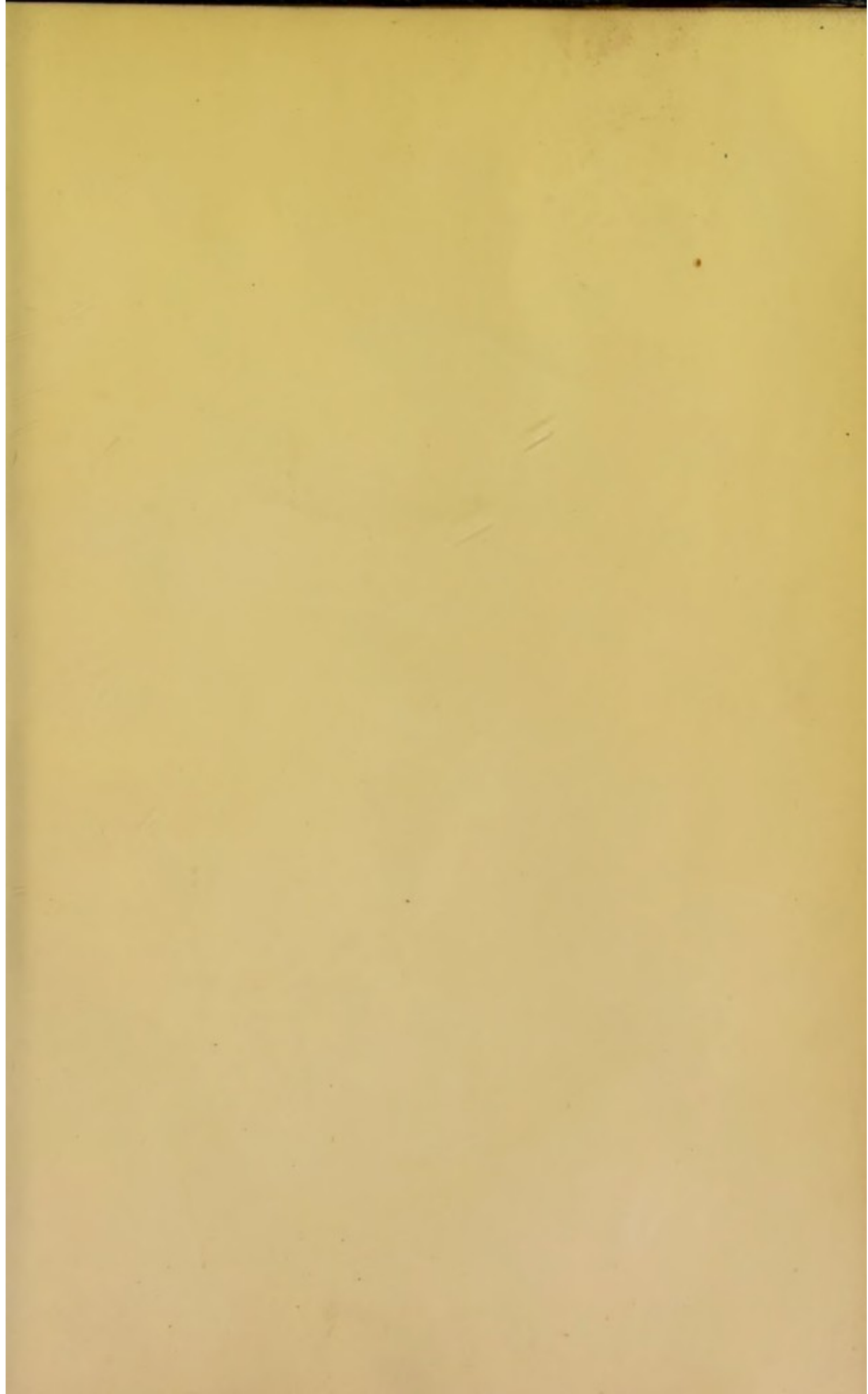
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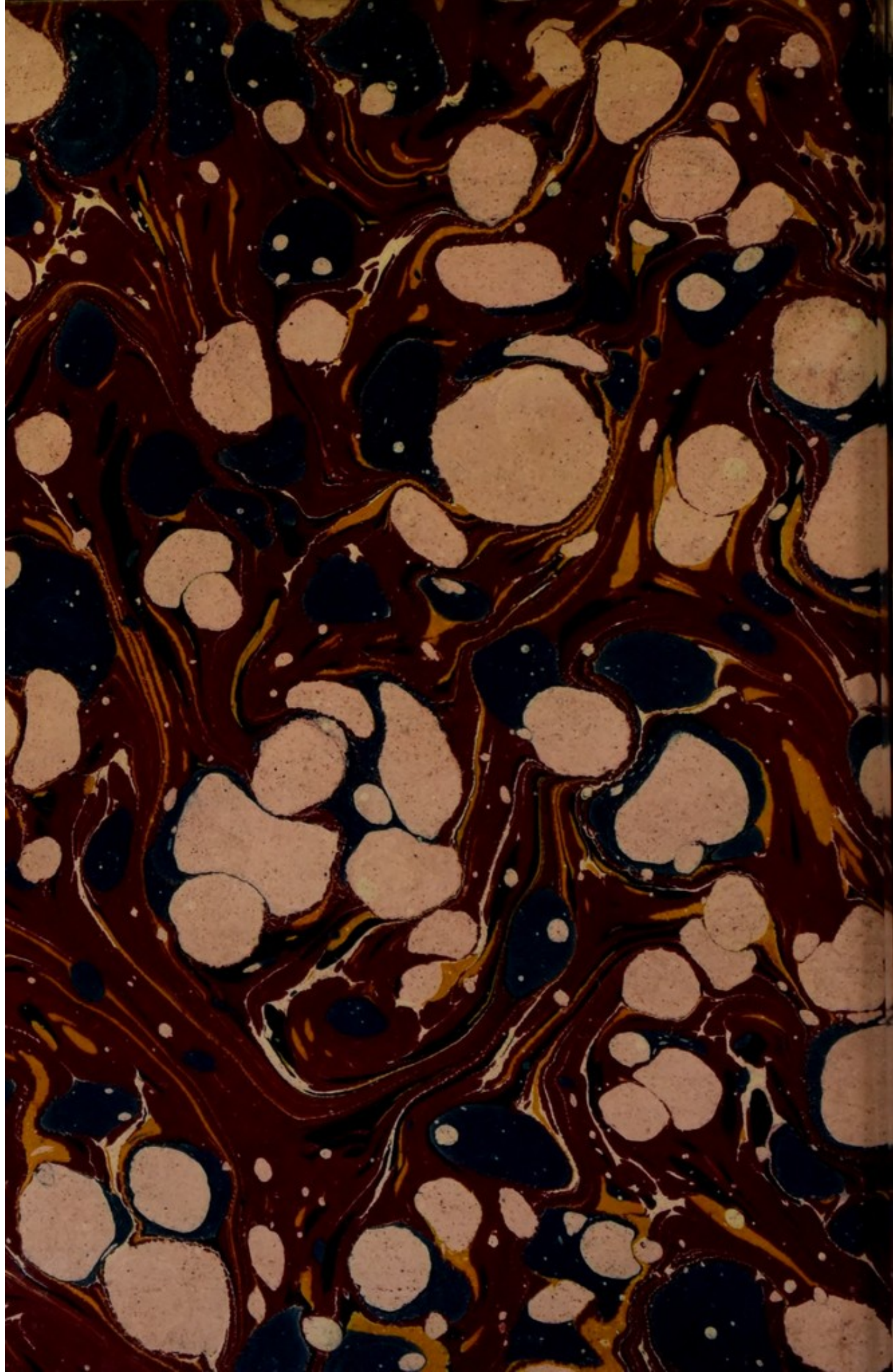
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