

Historical Review

Of garlic, mice and Gmelin: the odor of trimethylarsine

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In the 19th century, rooms were frequently decorated with wallpaper containing arsenical pigments; illness and fatalities often resulted. In 1839, Leopold Gmelin described a mouse-like odor under those conditions. Much later, it was recognized that the problem was the formation of toxic and volatile trimethylarsine by fungal action. Gmelin's observation was misreported as a garlic-like odor that is characteristic of trimethylarsine. Gmelin's original article in German and an English translation are included, and possible explanations for the incorrect reporting and for the original observation are described. Copyright © 2002 John Wiley & Sons, Ltd.

KEYWORDS: arsenical pigments; poisoning; arsenical gas odor; trimethylarsine; Gosio Gas; Gmelin

INTRODUCTION

In the 19th century, green arsenical pigments such as Scheele's Green (copper arsenite, CuHAsO_3) and Schweinfurt Green (copper acetoarsenite, $3\text{CuO} \cdot \text{As}_2\text{O}_3 \cdot \text{Cu} [\text{OOC} \cdot \text{CH}_3]$) had many decorative uses, even including coloration of food.¹ When the manufacture of continuous rolls of wallpaper became possible in 1785, the use of wallpaper increased significantly. Green was a popular color and, beginning in about 1800, large amounts of the arsenical pigments were used. It became clear that individuals living in rooms decorated with such papers were liable to illness and death, especially if the rooms were damp. One possible cause of illness was inhalation or ingestion of arsenic-containing particles mechanically removed from the papers. However, an Italian physician, Bartolomeo Gosio, discovered that some fungi would grow in the presence of inorganic arsenic compounds to form a very toxic, volatile compound of arsenic.^{2,3} Gosio, in a Preliminary Communication in English,³ stated that the gas had a 'strong smell of garlic'. In full publications, he wrote '... ed in capo ad una settimana comincio a svilupparsi un intenso odore di aglio, indizio di emanazioni arsenicali gassose'² and '... au bout d'une semaine, commença à se développer une forte odeur

d'ail, indice d'emanations arsenicales gazeuses'.⁴ This volatile material with a garlic odor became known as Gosio Gas; it was also produced when the green arsenical pigments were used as fungal substrates.

The public health problem in rooms containing wallpapers with arsenical pigments was greatest under damp conditions, where fungal growth was favored. Gosio isolated a fungus that was particularly active in volatilizing arsenic from a piece of carrot exposed to air. This organism, originally termed *Penicillium brevicaulis*, was later reclassified as *Scopulariopsis brevicaulis*. The garlic odor produced by *S. brevicaulis*, grown in the presence of inorganic arsenic, formed the basis for a very sensitive microbiological test for arsenic; as little as 1 µg of arsenic trioxide could be detected in 1 g of material using smell alone. With his colleague, Biginelli, Gosio performed analyses suggesting that his garlic-odored gas was diethylarsine.^{5,6} However, a re-examination in 1933 conclusively demonstrated that Gosio Gas was trimethylarsine.

This re-examination was carried out at the University of Leeds by Professor Frederick Challenger, together with C. Higginbottom and L. Ellis.⁷ Challenger's 'Leeds School' subsequently became a leader in the study of methylation processes in general and metalloid biomethylation in particular. Challenger had taken up his Leeds position in 1930, retiring in 1953. He remained scientifically active to the end of his long life (1887–1983) and at age 91 sent a written introductory paper to an American Chemical Society

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Symposium focusing on organometals and organometalloids.⁸ In 1945, he wrote a lengthy review of biological methylation⁹ that acts, in many ways, as the foundation of the field. The biomethylation of metals and metalloids is now of considerable importance in areas such as medicine, microbiology and environmental studies, and there is a vast literature.

When Challenger *et al.* wrote their ground-breaking paper in 1933⁷ giving the structure of Gosio Gas, they confirmed that it had an odor best described as garlic-like, as already indicated by Gosio. In this paper, they gave a brief historical introduction, the first sentence of which was as follows: 'GMELIN (*Karlsruher Ztg.*, November, 1839) ascribed certain cases of poisoning to a volatile arsenic compound liberated from mouldy wall-paper in damp rooms and mentioned the garlic odour observed under such conditions'. This reference to a newspaper article by Leopold Gmelin and a garlic odor was repeated in Challenger's *Chemical Reviews* article:⁹ 'Gmelin in 1839 noticed that a garlic odor was usually present in rooms where the symptoms had developed'. The citation was there given as *Karlsruhe (sic) Zeitung*, November, 1839. Similar statements occur in two other review articles by Challenger.^{10,11}

Leopold Gmelin, 1788–1853, was a most distinguished chemist, perhaps best known for his text, *Handbook of Chemistry* (1817). Its successor was the famous Gmelin-Kraut, *Handbuch der anorganischen Chemie* and Gmelin's systematization of organic chemistry formed the basis for Beilstein's *Handbuch der organischen Chemie*, 1880–1882.¹² Gmelin's article appeared in the newspaper, *Karlsruher Zeitung*,¹³ a daily paper published from 1758 to 1810 and from 1817 to 1933; the gap in publication occurred during the time of Napoleon (1812, the "gates of Moscow"; 1815 the 'hundred days' and Waterloo). The full name of this paper was *Karlsruher Zeitung: Staatsanzeiger für das Grossherzogtum Baden* (Newspaper of Karlsruhe: Government Gazette of the Grand Duchy of Baden) and it was printed by the 'Braunsche Hofbuchdruckerei'. Gmelin obviously wanted to inform the population of a danger; therefore, he chose the supplement of the Sunday edition of that gazette. He strongly warned against the use of arsenical pigments on wallpaper and described an odor observed in rooms where poisoning had occurred as adverse and mouse-like ('eines widrigen, mäuseartigen Geruchs'). Gmelin stated that there was no doubt that the smell was caused by a trace of arsenic, 'which volatilizes as a special compound (probably alkarsine)'. The latter word was definitely given in the German newspaper text as Alkorsin, but this is almost certainly a typographical error, with Alkarsin (English, alkarsine) being intended. Alkarsine was shown by Bunsen to be the oxide of cacodyl (dimethylarsin oxide), $(\text{CH}_3)_2\text{As}-\text{O}-\text{As}-(\text{CH}_3)_2$, the major component of Cadet's fuming arsenical liquid. Its odor has been described as intolerable;¹⁴ similarly, cacodyl itself, $(\text{CH}_3)_4\text{As}_2$, is 'of a most disgusting garlic odour'.¹⁵ The name 'cacodyl' was coined either by Bunsen or Berzelius and

derives from Greek, *κακωδία*, meaning stench. As can be seen from the original article and the translation below, Gmelin made *no mention* of a garlic odor in such rooms.

Gmelin's article was cited by a Public Health official, Sanitätsrat Dr Karl Adolf von Basedow (1799–1854), Kreisphysikus von Merseburg, in an 1846 paper published in the medical journal *Preuss Medizinisch Zeitung*.¹⁶ This paper was titled 'Arsenik-Dunst in Wohnzimmern', and Gmelin's article was dated as November 1839. A slightly different and somewhat abbreviated version of this paper also appears in *Schmidt's Jahrbuch*.¹⁷ It is there described under the number 680, with the same title and the citation 'Pr. Ver.-Zeit. Nr. 10. 1846'. 'Ver.' is an abbreviation for 'Verein' (meaning Society), and this is certainly a reference to the article in *Preuss Medizinisch Zeitung*. The description comes under the general heading, 'VII. Staatsarzneikunde' (Government Pharmaceuticals) and the citation to Gmelin in *Schmidt's Jahrbuch* is given as 'Carlsr. Zeit. Novbr. 1839'. Von Basedow emphasized that the problem of arsenical poisoning from wallpaper was a matter for the 'Sanitätspolizei' (i.e. the public health/medical service).

Von Basedow also described a volatile arsenic compound with a bad smell produced in damp rooms. However, as the following quotation shows, he gave a different description of the smell: 'Er ist lauchartig, etwas dem Athemgeruche nach Meerrettigenuss, sehr dem des ätherischen Senföls ähnlich u. durch alle andern Dünste hindurch bemerkbar'. (It is leek-like, has some similarity to the smell of breath after eating horseradish, is very similar to that of volatile mustard oil and noticeable 'through' all other fumes.) The description, leek-like, was used several times. Another comparison was with the odor of stuffed birds preserved by arsenic treatment. Nowhere in either version of the von Basedow article is the odor described as mäuseartig (mouse-like) or knoblauchartig (garlic-like).

Von Basedow also followed Gmelin in suggesting that the odor was caused by cacodyl or its oxide, alkarsine. The odor was comparable to that obtained by boiling arsenious oxide with 'Liquor kali acetici', the original process for producing Cadet's fuming arsenical liquid. The cacodyl odor was also described as 'stechend-stinkend' (pungent/stinging-stinking). He also reported that occupants of the rooms did not notice an odor; however, for people who had just entered it was really remarkable for some moments. Even he himself noticed a peculiar leek-like odor only each time upon entering. So, it is possible that occupants became thoroughly insensitive to it. In a case of arsenic poisoning (not from wallpaper) von Basedow was able to smell the special odor very close to the sternum of the patient, and he asked his colleagues to report further observations, especially by checking for the characteristic odor.

As a conscientious health official, von Basedow expressed concern that although the sale of arsenic was carefully monitored, and although officials had clearly warned of misuse of this most dangerous poison, anyone could scrape

enough arsenic from wallpaper for evil purposes. Many houses in Merseburg and the surrounding area essentially contained an arsenic stockpile. He described a number of clinical examples of affected persons (to give to his colleagues an overview of possible harmful effects). He even referred to technical solutions, i.e. green copper colors without arsenic. Action was necessary. If officials were unable to regulate the wallpaper industry directly, the public should at least be informed of the disadvantages.

In an 1865 text concerning the theory and science of harmful and poisonous gases, Eulenberg referred to Gmelin in section 151, under the heading of 'Sanitätspolizei'.¹⁸ He did not mention a mouse-like odor but gave von Basedow's description as 'ein eigenthümlicher lauchartiger Geruch', i.e. as leek-like, and repeated the 'stechend-stinken' appellation. Von Basedow's paper was there cited as 'Preuss. Medicinal-Zeit. Nro. 10, 1846'. Eulenberg also noted odors derived from chemical reactions of arsenic: 'Wollte man aber auch annehmen, dass metallische Arsen auf diese Weise sich verflüchtigen könne, so ist dadurch noch nicht die Entstehung des eigenthümlichen lauchartigen Geruchs erklärt, da bekanntlich metallisches Arsen nur bei Glühhitze einen farblosen, durchdringend nach Knoblauch riechenden Dampf abgiebt'. (Even if one assumes that metallic arsenic can volatilize in such a way, this would not explain the leek-like odor, since metallic arsenic only releases a colorless, penetrating garlic-like fume when heated to glowing [as everybody knows].)

In a long review of Gosio's biological method for arsenic detection and the microbial formation of volatile compounds of arsenic, selenium and tellurium, Maassen, in 1902, also quoted the Gmelin article, giving the title correctly, and the citation 'Carlsruher Zeitung, November, 1839'.¹⁹ He stated that Gmelin observed a peculiar, garlic-like smell ('eigenthümlichen, knoblauchartigen Geruch') making no mention of neither the adverse, mouse-like description actually given by Gmelin or of the leek-like description of von Basedow. Much later, Gosio cited Gmelin but without mentioning any detail; his citation reads simply: 'Karlsruhe (sic), Zeitung. 1839'.²⁰

Probably the first citation of the Gmelin article in English was in an 1893 paper by C. R. Sanger working at Washington University Chemical Laboratory in Saint Louis.²¹ He referred to Gmelin only indirectly by quoting Eulenberg,¹⁸ so presumably he had not actually seen the newspaper article. He did not, however, give the Gmelin characterization of the odor as mouse-like. Instead, Sanger noted von Basedow's publication and stated that the latter 'lays stress on the peculiar garlic odor which he notices'. This is clearly a misrepresentation, since, as already noted, von Basedow never referred to a garlic odor but repeatedly used the term leek-like. In a second paper, Sanger reviewed German cases of poisoning from arsenical wallpaper prior to 1886 in which analytical evidence indicated the presence of arsenic in the urine.²² In a few cases, he stated that a garlic odor had been recorded as present in rooms where poisoning occurred and in one case in the patient's urine. It has to be kept in mind

that in 1893 Sanger had, in fact, received a culture of '*P. brevicaulis*' from Gosio and he confirmed that growth of this organism in the presence of arsenic did produce the garlic-odored Gosio Gas.

Some of the semantic confusion may derive from the fact that in the German language different types of onion plant (Zwiebeln) often contain the word 'Lauch'. Among culinary plants, there is leek itself (Lauch), garlic (Knoblauch), chive (Schittlauch), pearl onion (Schlangenslauch) and shallot (Eschlauch, Jakobslauch, etc.). Less well-known edible wild plants are garlic leek or cabbage garlic (Kohllauch) and ramsons (Bärenlauch) or ramps. In some (US) Appalachian areas, ramps (*Allium tricoccum*) are a special treat, with several towns holding Spring-time festivals during which large quantities of them are consumed.²³ The very strong taste, modified somewhat on cooking, causes the unpleasant condition 'halitosis horribilis'.

A TWO-COMPONENT MYSTERY

The first mystery

It is particularly mysterious that Gmelin's precise description of a mouse-like odor has been consistently ignored. Perhaps part of the problem is that the article in question was not readily available. Of most interest is the question of why writers such as Sanger, Maassen and Challenger specifically reported that Gmelin said the odor was garlic-like and ignored von Basedow's use of leek-like. It seems most likely that Maassen had actually seen the newspaper article in 1902, since he correctly quoted the title. He was an assistant (technischer Hilfsarbeiter) in the Imperial Health Ministry (Kaiserlichen Gesundheitsamte) in Berlin and was thoroughly familiar with the Gosio microbiological test for arsenic relying on the garlic smell for its success and on other descriptions of garlic odor produced by microorganisms. He also knew that the Gosio fungus in the presence of inorganic selenium compounds produced a different, mercaptan-like odor ('merkaptanähnlich'), whereas with tellurium the odor was definitely garlic-like ('ausgeprägt knoblauchartig'). With that said, organo-selenide and -telluride odors have variously been described as mercaptan-like, garlic-like, or just plain malodorous. Some people detect a similarity in all metalloid hydride odors. Mixed organo-sulfides and -selenides figure prominently in the odor of fresh garlic and onions, but in very low concentrations,²⁴ and the odor of organo-metalloids changes with gas-phase concentrations.

Maassen also referred to a further report by Gmelin in 1844 to the Grand Duchy of Baden²⁵ (Grossherzogth. Regierung des Mittelrheinkreises). In that report, Gmelin eliminated the possibility of arsine itself, since it had a weak odor, and again suggested alkarsine with a very intense odor ('sehr heftigem Geruch')—there was apparently no mention of a garlic odor in Gmelin's report. Maassen did not refer to the work by von Basedow. One can only conclude that Maassen's own experience with Gosio Gas led him to

attribute a garlic-like odor to Gmelin despite the clear evidence that Gmelin did not so describe the odor.

It appears most likely that Frederick Challenger had not actually seen the November issue of the *Karlsruher Zeitung*, but had relied on secondary sources such as Maassen and other references noted in his 1933 paper. The Maassen paper was, in fact, cited by Challenger in both the 1933 paper identifying Gosio Gas⁷ and in his *Chemical Reviews* article.⁹ In the 1930s, with less well-developed library loan systems, it would not have been easy to obtain from England—where Challenger was at Leeds—a copy of a German newspaper almost 100 years old (it is still difficult today!!). A further factor is that any competent organic chemist of Challenger's time would have had to acquire a working knowledge of German, since much of the chemical literature was then published in that language. In addition, Challenger had spent 2 years in Göttingen, 1910–1912, and was certainly fluent in the German language, writing his Ph.D. thesis in German. His knowledge of German is also indicated by the fact that he noted two incorrect citations of Maassen's work.²⁶ There can be no doubt that, had Challenger actually read the Gmelin article, he could not possibly have confused a mouse with any member of the genus *Allium* in the family *Liliaceae*.

Only a single unifying feature can be found in the misrepresentations by Sanger, Maassen and Challenger: all three of these individuals had actual working experiences with the garlic odor of trimethylarsine (Gosio Gas). This working knowledge may have led them to assume that the odor in rooms where poisoning had occurred *must* have been that of garlic.

The second mystery

The second component of the mystery is why did Gmelin describe a mouse-like and not a garlic or leek odor? The odor he observed was most prominent in unheated, north-facing rooms where 'the warm vapor of the adjoining room can enter, the moisture settling on the walls causes a slow decomposition process of the paper and the paste...'. Such rooms, even in the absence of green wallpaper, would almost certainly have had a musty smell; several microorganisms that might also have been present, in fact, produce the earthy smelling product geosmin (1,10-*trans*-dimethyl-*trans*-(9)-decalol). Hence, Gmelin and, indeed, other observers were probably observing a very mixed population of odorants. In the belief that the major volatile material was alkarsine, Gmelin had to find an appropriate description of the odor for a newspaper article. Perhaps mouse-like was the best he could do. In any case he was looking for a chemical solution; trimethylarsine with its garlic-like odor was not described until 1854, so for Gmelin, alkarsine was a reasonable, volatile compound. Moreover, in 1839 Gosio's microbiological work was yet to come.

A further factor is that other metalloids, particularly selenium, may have been present as contaminants in the arsenical pigments. Selenium is also methylated by *S. brevicau-*

lis to the volatile selenium compound dimethyl selenide. As already noted, dimethyl selenide can have a mercaptan-like odor. One observer has compared its very disagreeable odor to that of skatole (written as skatol), 3-methylindole²⁷ and Challenger and North say that with selenium 'the odour is faecal or leek-like'.²⁸ Moreover, arsenic in the presence of selenium produces a 'pronounced faecal odour different from that produced by arsenic alone'.²⁷ Another author states that in the Gosio test for arsenic 'if sulphur or phosphorus be present, the garlic odour is masked'.²⁹

It is very likely that there was considerable variation in the composition of the various green pigments used early in the 19th century. The primitive and highly dangerous technology used to obtain arsenious oxide relied on roasting of arsenical ores, and was described thus in 1911:³⁰ 'the vapours of the oxide which are given off are now condensed in long passages or chambers called in Silesia poison-chambers (Giftkanäle), formerly in towers termed poison-towers (Giftthürme), in the form of crude flowers of arsenic or poison-flour (Giftmehl)'. Further purification required one or two sublimations. It is most unlikely that highly purified forms of arsenic were used in the preparation of the green pigments, so that contamination of them, e.g. with small amounts of selenium or other metalloids, would have been inevitable. Another source for introducing contaminants such as selenium would have been the copper component of the pigments. Other materials, such as baryta or gypsum, were sometimes deliberately introduced to modify the color (or perhaps to increase the profit).³¹ It is quite possible that the characteristic garlic odor of pure Gosio Gas was modified in many circumstances by these contaminations or additions, so that the overall result was influenced by the more fecal-like odor of dimethyl selenide. The final smell may have been musty and mouse-like. The extent of contamination would vary from district to district, depending on the manufacturer; so, it is not surprising that odor variations were noted.

That there must, in fact, have been much variation in the pigments produced at various factories is suggested by the large number of names under which Schweinfurt Green was known. In addition to variants on the place name, Schweinfurt, such as Schweinfurth, Schweinfürth, Schweinfurter, Schweinfürther, the Merck Index provides the following synonyms:³² Emerald Green, French Green, Imperial Green, Mineral Green, Mitis Green, Parrot Green, and Vienna Green. Other 'Greens' that we have encountered are Paris Green (probably a variant on French Green) and Neuwieder Green. Scheele's Green, however, does not appear to have synonyms.

THE GMELIN ARTICLE

Leopold Gmelin's article appeared as a supplement to a Sunday edition of the *Karlsruher Zeitung*. He clearly desired wide publicity among the general population for what he

may have seen as a major problem. At the end of his article, he asked rhetorically if the green pigments should be prohibited totally for wallpapers and paintings (except in oil). Had this been done, beginning in 1839, lives would have been saved and illnesses avoided.

The extent of the problem of volatile arsenic toxicity cannot be rigorously defined. Most evidence concerns the situation in Victorian Britain, and it has been noted that 'Owing to the virtual absence of hard evidence on morbidity and mortality rates associated with arsenic poisoning, production figures for arsenical compounds, and sales of arsenical goods, historical examination of arsenical poisoning in the domestic environment is necessarily impressionistic and anecdotal ... there can be no precise appreciation of the extent to which arsenic posed a public health threat in Victorian society'.¹ The anecdotal evidence, however, is extensive, with many examples where illness was alleviated by provision of an environment free from the arsenical pigments.^{1,9,21,22,31,33} There is no evidence that materials other than the arsenical pigments in the wallpapers were responsible for the illnesses.

We have previously noted a paradoxical situation,³⁴ viz. the LD₅₀ for trimethylarsine in mice has been reported³⁵ as 7.87 g kg⁻¹. Though this implies that trimethylarsine is relatively non-toxic, it has to be kept in mind that the result refers only to oral administration of single doses of trimethylarsine dissolved in olive oil (concentrations not stated). It is likely that volatile arsine gases are, as implied, highly toxic under inhalation conditions—a fact already observed with animals by Gosio.⁴ For arsine itself (AsH₃, with LD₅₀ of about 3 mg kg⁻¹) the extreme hazard arises from the fact that 'being gaseous, a lethal dose may be received in a very short period'.³⁶ Some 2 years after the report of the LD₅₀ for oral administration, it was stated that 'further tests are needed to determine the toxicity of dimethylarsine and trimethylarsine with inhalation studies to test animals'.³⁷ To the best of our knowledge such tests have not been performed.

A copy of the Gmelin article was obtained as follows. Working at the University of Stuttgart Vaihingen, one of us (MW) only had the following information: topic—poisoning by arsenic in houses in Germany; author—Gmelin; journal—*Karlsruher Zeitung* (newspaper of Karlsruhe); date—November 1839. Since the task seemed quite difficult, he asked help from a librarian in the reading room of the library in Stuttgart Vaihingen, well aware of the fact that most periodicals available there dated back only until the start of that branch of the University, some 30 years ago. He was advised to contact the University of Heidelberg, the University of Freiburg—where the access to originals would be limited—or the Archive of Newspapers at the Institute of Newspaper Research in Dortmund. In a phone call to the University of Heidelberg, MW was redirected to the catalog room, where he described the problem to Mrs A. Philipp. She knew Gmelin, even his christian name, Leopold, and told

MW that he was a famous professor of chemistry in Heidelberg. Only a few days later MW received a letter from Mrs Philipp, one of her colleagues having found the article.

None of the citations with which we are familiar has provided all of the data given earlier and in Ref. 13. The full German text of this important and historic note and a translation by one of us (MW) follow.

Beilage zur Karlsruher Zeitung Nr. 326

Sonntag, den 24. November 1839.

Warnung vor gewissen grünen Tapeten und Anstrichen.

In neuerer Zeit wird für grüne Tapeten und Zimmeranstriche gewöhnlich ein Farbmaterial angewandt, welches unter dem Namen des schweinfurter Grüns, wiener Grüns u.s.w. vorkommt, und allerdings durch die Lebhaftigkeit seiner Farbe besticht, aber wegen seines bedeutenden Arsenikgehaltes der Gesundheit Gefahr droht. Nur in ganz trockenen Zimmern ist nichts zu befürchten, namentlich in solchen, die gegen Süden und nicht zu ebener Erde liegen, und welche regelmässig geheizt und gelüftet werden. In Zimmern dagegen, die zu ebener Erde oder gegen Norden liegen, und in solchen, die nicht selbst geheizt werden, in welche aber der warme Dunst des Nebenzimmers dringt, veranlasst die sich an die Wände setzende Feuchtigkeit einen langsamen Zersetzungsprozess von Papier und Kleister, in welchen die grüne Farbe mit hineingezogen wird. Das Resultat hiervon ist die Entwicklung eines widrigen, mäuseartigen Geruchs, den man vorzüglich beim Eintreten in das einige Zeit nicht gelüftete Zimmer bemerkt. Es ist nicht zu bezweifeln, dass dieser Geruch von einer Spur Arsenik herrührt, welche sich in einer besondern Verbindung (vielleicht als Alkorsin) verflüchtigt. Kurzes Einathmen einer solchen Luft ist gefahrlos; aber tägliches anhaltendes Verweilen in solchen Räumen kann Schaden bringen; Kopfweh und unbestimmtes Uebelbefinden wurden bereits als Folge hiervon beobachtet; aber bei noch länger fortgesetzter Einwirkung dieser giftigen Atmosphäre möchte endlich selbst eine chronische Arsenikvergiftung eintreten. Zimmer, welche, wiewohl mit derselben Farbe versehen, aus den oben angeführten Gründen diesen übeln Geruch nicht entwickeln, kann man unbesorgt bewohnen. Dieser Geruch kann sich auch aus Tapeten von einer andern Farbe entwickeln, wenn sie nur hier und da grüne Stellen haben. Bei manchen Tapeten kommt der Geruch erst einige Jahre nach ihrem Aufkleben zum Vorschein; dass er sich mit der Zeit wieder verlieren werde, ist nicht zu hoffen; er wird, je nach der Feuchtigkeit der Wände und der Temperatur bald zu-, bald abnehmen, aber wahrscheinlich erst dann aufhören, wenn alle grüne Farbe zerstört ist. Um diesen übeln Geruch und die Vergiftungsgefahr zu beseitigen, ist es nöthig, die Tapete auf das Sorgfältigste abzureissen; das Ueberkleben derselben mit einer andern würde durchaus nichts helfen. Dieses sind die Erfahrungen, welche ich seit einigen Jahren, und vorzüglich in diesem Herbste vielfache

Gelegenheit hatte, in hiesiger Stadt zu machen, und zu deren Veröffentlichung ich mich verpflichtet fühle. Es drängt sich die Frage auf, ob nicht dieses Farbmateriale für Tapeten und Anstrich, ausser in Oel, ganz verboten werden sollte? Heidelberg, im Nov. 1839.
L. Gmelin.

Supplement to the newspaper of Karlsruhe Nr. 326

Sunday, 24th November 1839.

Warning of certain green wallpapers and paints.

In newer times, for green wallpapers and room paintings, there is usually used a color material, which is named Green of Schweinsfurt, of Vienna etc., and which impresses by the vividness of its color, but which threatens the health due to its considerable content of arsenic. Only in very dry rooms is there nothing to be afraid of, especially those facing to south and which are not on the ground (translator's note: American first) floor and are regularly heated and aired. On the other hand, in rooms facing to north and being on the ground floor, and in those which are not heated itself, but where the warm vapor of the adjoining room can enter, the moisture settling on the walls causes a slow decomposition process of the paper and the paste, in which the green color is dragged in. The result of this is the development of an adverse, mouse-like odor, which is easily noticed by entering a room which was not aired for some time. There is no doubt that this smell is caused by a trace of arsenic, which volatilizes as a special compound (probably alcorsine). Brief inhalation of such air is without danger; but longer daily stays in such rooms can cause harm; headache and undefined indisposition were noticed as a consequence of it; but even longer effect of this poisonous atmosphere can cause chronic poisoning by arsenic. Rooms which do not produce this bad odor due to the reasons cited above, in spite of carrying this color, can be inhabited without concern. This smell can also stem from wallpapers of another color, if there are only some green spots. Some wallpapers take years after pasting until the odor appears; it should not be hoped that it disappears again after a while; it can increase and decrease due to the moisture of the walls and the temperature, but most likely will only stop when all of the green color is destroyed. To get rid of the bad odor and the danger of poisoning, it is necessary to carefully tear off the wallpaper; to overpaste it would not help at all. These are the experiences which I have made over several years, especially numerous during this autumn, in this town, and about which I feel obliged to publish. The question obtrudes if this color material should not be prohibited totally for wallpapers and paintings, except in oil?

Heidelberg, November, 1839.

L. Gmelin

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in obtaining a copy of Gmelin's article in the *Karlsruher Zeitung*. Much help in obtaining many citations was kindly provided by Drynda Johnston and Ann Rogers, Langley Library, University of Pittsburgh, Pittsburgh, PA, USA. RB thanks Peter Bentley for help on backpacking trips in West Virginia, when ramps were located and sampled. TGC was supported by a departmental grant from the Robert A. Welch Foundation.

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