

Nothing New Under the Sun

Experiences with Mercury Poisoning Related by Dr. Alfred Stock and Dr. E. Jaensch in 1926.

The following is a translation by Mats Hanson of an article by Dr. Stock which appeared in 1926 in Zeitschrift für Angewandte Chemie Vol. 39.

When I decide to tell a wider audience everything about personal troubles, which in themselves do not concern others and therefore should not be worth publishing, it is because of an intense wish to spare others, who have anything to do with metallic mercury, the very bad experiences which have destroyed a major part of my life and to very emphatically warn against the volatile metal. I can freely tell about it today since it is fortunately enough in the past and a terminated matter.

The insidious dangers of mercury are not sufficiently known and are too little noticed just in the places where people are especially threatened, that is in the chemical and physical laboratories,

For nearly 25 years I experienced symptoms, in the beginning only weak and occasional, in time increasing up to being unbearable which caused me to doubt if I could continue my scientific work. The cause was not known to me or any of many excellent doctors I visited to ask for advice. It was considered

possible that my problems were caused by an especially narrow nasal passage and an unusual sensitivity of the nasal mucosa. My nose was therefore treated for decades by etching, burning, massage, electricity and bloody operations. Without results! Two years ago something happened — a few of my collaborators fell ill with similar symptoms — and it was revealed that the cause was an insidious mercury intoxication. Because of my chemical work; the study of volatile compounds with vacuum technique using vessels with mercury, mercury-pumps, manometers and valves, I was for 25 years in constant contact with mercury.

It is today not possible to doubt the causal connection since all symptoms, even if not yet completely, have disappeared (and a short time ago clearly reappeared when I for some time worked in mercury-containing air because of a mishap with the ventilation of my laboratory) when I, for two years have protected myself from inhalation of mercury vapor.

I will next give an account of my symptoms and how they developed with time. They agree, even in detail, with all insidious mercury vapor poisonings, something my collaborators and other chemists could confirm. They were and are, largely unknowingly, victims of mercury vapor poisoning and did

not know the source of their troubles. Many essential symptoms have, until now, not been sufficiently described and the insidious mercury vapor poisoning has not received the attention it deserves.

The matter started with me as periodically occurring light headaches and weak dizziness which increased with the years to continuous, nervous unrest and irritability, to a pressure on my head which made thinking difficult, to ever increasing headache, finally almost continuous and tormenting (mostly over the eyes), to intense vertigo which was connected with troubles of vision (dim and double vision). Soon also the upper airways were affected; in the beginning light and occasional nasal catarrh, then permanently tight nose, later almost continuous catarrhs of the olfactory mucosa with often bloody mucus production and crust formation, violent throat inflammations and pains in my ears connected with depression of hearing and smell (for some substances like hydrogen cyanide it remained), distaste for tobacco smoke. In the last few years before the cause was recognized, other symptoms appeared: salivation, sour-stale taste in my mouth, eye inflammation, inflammation of the oral mucosa and vesicles, sensitive and ulcerating spots on my tongue, gums, gingiva, insides of lips and cheeks, redness of gums and slight bleeding during toothbrushing, toothache, withdrawal of gingiva from teeth and the appearance of pockets, occasional loose, single teeth. The mouth and teeth changes occurred late with me (the peak of these symptoms did not occur until months after the poisoning had been discovered) since I from childhood had been careful with my mouth hygiene (for instance every evening prolonged rinsing with 1½ percent hydrogen peroxide solution and then with sodium bicarbonate). If this had not been the case I might have discovered the cause of the symptoms earlier because of the mouth inflammations.

Further symptoms were: intellectual exhaustion and depression, lack of energy and ability for work, especially intellectual work, increased need for sleep, trembling of my stretched fingers, often also my eyelids, pains

in various places, stabbing pains in my back and in limbs, pressure around the liver, sudden need for urination and diarrheas without special reasons. Slight vesicles on the inner sides of my arms and on the upper half of my legs.

The manifestation which was most severe for a person with intellectual work was the loss of memory. My originally very good memory got worse and worse so that I, two years ago, was near total amnesia. Only with the help of extensive notes and with considerable effort was it possible to write a paper or hold a lecture. I would forget the phone number on my way from the telephone directory to the telephone; I would forget almost everything I had learnt by heart, the contents of books and theatre plays I had recently read and seen, the contents of my own papers I had published. It was impossible for me to remember numbers or names. Often I could not remember the names of close friends. Especially the ability to calculate, to do mathematical thinking, also to play chess, was severely affected. The depressed ability to remember and the difficulties in calculating seem to be a special sign of insidious mercury vapor poisoning. This was also evident with my collaborators and with other persons, for a long time exposed to mercury vapors, cases which have now become known to me. Shortly after we had discovered what was wrong, I and two collaborators were trying to finish writing a paper which needed calculations. None of us had the ability to add 10-20 large numbers without errors!

In contrast to only a small effect on bodily strength, for instance during mountain climbing, the intellectual capacity was also in other ways depressed although not as severely as memory. In addition there was psychic depression, a painful inner unrest, with time also causing disturbed sleep. By nature fond of company and full of enjoyment of life, I withdrew in misery into myself, avoided public relations, people and social contacts, lost the love for art and nature. Humor rusted in. Difficulties which I earlier had cleared with ease (and today again can clear with ease) appeared insurmountable. The scientific work required considerable efforts. I forced myself into my laboratory but could not produce anything of value despite all efforts. My thoughts were heavy and pedantic.

I had to give up participating in matters which were not of immediate importance. The lectures, previously something I liked, became tormenting. The preparation of a lecture, the writing of a paper, even a simple letter, required immense efforts in handling the contents and language. Not seldom it happened that I wrote words wrongly or forgot letters. To be aware of these shortcomings, not to know their cause, to know no way of getting rid of them, to expect further deterioration — that was not nice.

All efforts to improve my condition failed. Several weeks in the mountains was of no use; I did not feel less miserable there than in Berlin. The nasal treatments and operations often gave short, not lasting improvements. It was remarkable that all psychic symptoms disappeared for hours when the doctor treated certain places of the upper nasal mucosa with cocaine; if the correct spot was treated, headache and vertigo disappeared, often within a few minutes. Memory, ability to work and good spirits reappeared, however, only as passing guests. I often used the method to recall my ability before a lecture, an important meeting etc.

As I have already mentioned, also my collaborators in the laboratory; assistants, Ph.D. students, technicians, had various symptoms: depression without apparent cause, bad memory, headaches and dizziness, now and then gastrointestinal troubles, limb pains, slight mouth inflammations, nasal catarrh etc. With one person some symptoms were worse, with another some other symptoms, apparently for each person at his weakest point. All showed tiredness and depression of intellectual capacity. However, nobody got the idea that there could be a common cause for all of us. Not until a happy - unhappy event finally opened our eyes.

In order to save money we had in 1921 disconnected the ventilation aggregates of our Kaiser-Wilhelm Institute of Chemistry; aggregates which consumed much expensive electric current. Since the middle of 1923 two of my collaborators, an assistant and a Spanish guest, were working on density measurements

in a small room. The measurements required constant temperature and therefore windows and doors were kept closed. The work had to be finished before early 1924 since my assistant was to take up a post in industry and the Spanish colleague had to go back to his home country. Therefore the work was rushed and the careful cleanliness we at other times kept, was neglected in this room and scattered mercury was left unattended in cracks and joints in the floor and under laboratory stands. Instead of an insidious mercury poisoning the conditions were given for a more acute and more easily recognizable mercury intoxication. The assistant fell severely ill, not just with headaches and intellectual depression but also with severe bodily deterioration, ulcers in the mouth etc. His brother, a doctor, thought that the condition reminded him of mercury poisoning. The renowned toxicologist, L. Lewin, whom we called for, examined the laboratory personnel and declared, that according to his experiences, we were all with certainty suffering from mercury poisoning.

Mercury was found in the air of the laboratories as well as in the urine of all affected persons. The mercury concentration in the air varied from room to room, from a few thousandths to a few hundredths of a milligram per cubic meter. That is only a small fraction of what air can contain when saturated with mercury vapor (about 12 mg/m³). Since a human being breathes about 1/2 m³ air each hour and the inhaled mercury, as it appears, is largely absorbed in the lungs, only a short visit in mercury saturated air is sufficient to elicit an acute mercury poisoning.

When air containing small amounts of mercury is inhaled, it will take a long time until the poisoning becomes apparent. For one to several years the symptoms can be restricted to tiredness and slow deterioration of the intellectual ability and memory. For instance with the Spanish guest, inflammations in the mouth did not appear until at the end of the year he stayed with us and reached their peak a month after he had left us and was not exposed to mercury any more. The psychic effects he had felt earlier without knowing their cause. "It was as if I became more stupid in Germany." And similar observations I could make on my other collaborators. Almost all Ph.D. students in my laboratory had difficulty qualifying

for the doctor degree. If the students and assistants left the laboratory after a few years, they recovered without knowledge of the mercury poisoning. On myself, the effects of the minimal amounts of mercury developed as I have described.

Especially significant for this type of insidious mercury poisoning are sudden changes in the condition. After a few weeks of better health follows, often quite suddenly, a time of worse conditions. This also holds true for the relapses during recovery. When my disease was at its peak, the general rule was: one or two days of endurable conditions, then increased salivation and nasal catarrh including catarrh in larynx and bronchi, inflammation around teeth, severe weakness and dizziness, tormenting headache, often also joint pains and diarrhea. The headache, dizziness and weakness of memory are connected to the nerves in the upper part of the nose as the effects of the cocaine treatment has shown.

The recovery from insidious mercury poisoning, after elimination of the poison source, is extremely slow and there are often relapses. Professor Lewin told us so and the development of our conditions has proved him right. The necessary time apparently depends on the length of poisoning, maybe also on the person's age. My collaborators who left the laboratory fortunately recovered within one or two years from all symptoms and have recovered their powers of thinking and memory to the full extent. But also these persons had to endure relapses of psychical and physical character (especially mouth inflammations). Some of the assistants and technicians continue working here and we can unfortunately not avoid using mercury. They have now, nearly two years after the poisoning, clear but ever weaker symptoms. I was exposed to the damaging effects for more than 20 years and the complete recovery apparently takes the longest time; the capacity for work is almost back, only occasional relapses (headaches, dizziness and mouth inflammations) affect me slightly. Judging from the development of recovery so far, I do not doubt that all of my collaborators and myself will completely recover from all symptoms. It is likely that it

takes years to excrete the mercury which has been taken up by the body for years.

It appears that from a mercury poisoning follows a special sensitivity towards a new exposure for mercury vapor. Some of us, who because of work or faults in the ventilation system, were again exposed to mercury, felt it immediately as an increasing number of relapses. That seems understandable since the long time for development of the disease shows that a certain threshold must be reached before symptoms appear. The threshold will certainly easily be reached again during recovery and any additional amount of mercury will worsen the condition.

We tried in various ways to enhance the recovery on advice from doctors; using diuretics and substances to promote fecal excretion, taking hot baths, eating small amounts of sodium iodide. I have not the impression that the recovery was substantially enhanced through these measures. Iodine is supposed to bring the metal into solution from insoluble organic mercury compounds, the form in which mercury probably is bound in the body. I could not demonstrate on myself that significantly higher amounts of mercury were excreted in the urine after iodine intake. We did not expect the diuretics to have any effect since we had shown that mercury excretion in the urine soon stopped. The art of medicine unfortunately has no substance which can detoxify the body from mercury.

To be in the fresh air seems to be most useful for making subjective symptoms less felt. Novalgin has some effect on lighter headache and dizziness. In general one has to let time take away the disturbing influences on the body. Some weeks visit in the mountains and a voyage at southern latitudes brought me hardly any faster recovery than at home, although the psychic rest had a positive effect on my nerves.

Why was our disease not recognized as mercury poisoning earlier? I have often asked myself this question, not without reproach. The first symptoms of the slow mercury intoxication, before any oral symptoms appear, are hardly known to the medical world. They are tiredness, depression of thinking and memory, light headache and dizziness, occasional diarrhea. Neither was it known that the nose and the upper airways

were affected. Just this started myself and my doctors on the false track and has also fooled others I know of. One of my assistants was for a long time treated for sinusitis until the true cause was found. Also the difficulties in thinking make it difficult for the affected person to make a correct diagnosis of his troubles: Quern Mercurius perdere vult, dementat prius!

It is appropriate in this context, to warn of another source of insidious mercury intoxication; dental amalgam fillings. Prof. Lewin advised me immediately he had diagnosed the mercury poisoning, to exchange for other materials the amalgam fillings I had in considerable numbers since early youth. He called attention to a case he knew of, a university colleague (Prof. Jaensch, Univ. of Marburg) who was on the border of psychical and physical collapse when the cause, in the nick of time, was found to be the numerous amalgam fillings he had since youth. After their removal he slowly recovered.

The dentists formerly preferred copper and cadmium amalgam and today use silver amalgam for filling teeth since these amalgams are easy to manipulate and fill the cavities well. Silver amalgam is better than the other amalgams which corrode considerably with time. However, also silver amalgam gives off mercury vapor at oral temperatures, which the following experiments proved.

We sealed silver amalgam pieces in glass tubes, bent into right angles, evacuated them and heated the horizontal part with the amalgam to 30-35°C, cooled the other part in ice or liquid air and determined the amount of mercury which distilled over.

1. Amalgam piece, carefully prepared by a dentist from metal powder and mercury for this experiment. Weight 0.801 g, sealed into the glass tube 24 h after preparation, heated for 23 days, ice cooling. Amount distilled over: 11.2 mg mercury.
2. Similar, weight 0.810 g. Three weeks after preparation to obtain as complete hardening as possible and then sealed in a glass tube. Heated for 12 days, cooling with liquid air. Distilled over: 15.3 mg.
3. A piece of amalgam, carefully prepared with as little mercury as possible. Weight

1.000 g, three weeks hardening, 9 days heating, cooling with ice: 8.2 mg mercury.

4. Amalgam filling which had been in tooth for a year and had fallen out.

Weight 0.894 g, 14 days heating, liquid air cooling: 29.4 mg mercury. Undoubtedly fillings like these will also slowly give off mercury in the mouth and give the inhaled air a low level of mercury which must be harmful in the long run. The old copper and cadmium amalgams should be even more dangerous.

Dentistry should completely avoid the use of amalgam for fillings or at least not use it whenever that is possible. There is no doubt that many symptoms: tiredness, depression, irritability, vertigo, weak memory, mouth • inflammations, diarrhea, loss of appetite, chronic catarrh often are caused by mercury which the body is exposed to from amalgam fillings, in small amounts but continuously. Doctors should give this fact their serious consideration. It will then likely be found that the thoughtless introduction of amalgam as a filling material for teeth was a severe sin against humanity.

Letter from E. Jaensch, professor in psychology in Marburg to A. Stock, professor in chemistry at the Kaiser-Wilhelm inst. for Chemistry, Berlin. The letter was published in Zeitschrift für Angewandte Chemie 39, 461-488, 1926, in a paper by A. Stock: Die Gefahrlichkeit des Quecksilberdampfes und der Amalgame (The Hazards of Mercury Vapor and Amalgam).

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You do humanity a favour when you take up the question about amalgam. At about the age of 15 my teeth were, as the saying is, put into order. I had fillings in a large number. Gradually persistent troubles appeared which at first restricted themselves to the nervous system. The condition was diagnosed as hypochondriac neurasthenia since the symptoms were only of a nervous character and since I in general appeared to be in good health.

At the end of my student time I had again distinct nervous and also bodily symptoms. The troubles increased year by year. The beginning of the deterioration was clearly associated with an unusually large and especially unskillful dental treatment. I had mostly so called contour fillings and a distinguished dentist now told me that "to prevent anything

more from happening" he had to connect the adjacent fillings in the molars and he made these solid connections.

From 1909 my condition deteriorated ... chronic, worse and worse diarrheas and I lost much weight. In addition intense pains in all parts of my body, my sleep worse and worse, inflammations in my mouth with increased salivation ... worse inflammations in the upper airways, especially in my throat ... painful asthmatic condition, intense anxiety and deterioration of my physique so I could only leave my bed for short times. Complete impairment of my intellectual ability.

I was on sick-leave for a year and my life was a futile wandering around to medical specialists in Baden-Baden, in hopeless resignation, when in the summer of 1916 I met my former acquaintance Professor Sommer from Giessen. I told him about my condition and also of a recent thought. I had suffered from toothache and had, in front of the mirror, contemplated my set of teeth with its in part very large amalgam fillings (18 silver amalgam fillings). Then I had recalled a remark which I had heard from one of my doctors. I had wondered if I could have contracted lead poisoning since I had worked with accumulators and had the answer, "It is certainly not lead poisoning, it rather looks like mercury poisoning. But that's an impossibility — where should that have come from?"

When I now contemplated my large number of amalgam fillings in my mouth I got the idea that might it not after all be mercury poisoning. Sommer told me that he had a significant number of similar cases which, by closer examination, had proved to be toxic polyneuropathy.

My urine and saliva were tested for mercury. The clinical and chemical examination gave the results which are written in the records of Prof. Sommer. (In these records from 1916 one can read: In the urine was mercury in considerable

amounts. In the saliva mercury could not be detected with certainty. The source of the mercury seemed to be the many amalgam fillings the patient had in his mouth for many years. The previous history fits completely the assumption that it is a toxic disease caused by mercury.)

Now we faced the almost impossible task of finding a dentist who could be persuaded to take out and replace the fillings. Again and again I was dismissed. Everywhere the dentists pointed out that the harmlessness of amalgam fillings was proved, that Sommer's records could not be believed and that no dentist could take the responsibility for such a large and "unnecessary" operation. Prof. X at the emperors court, told me: "You can send me reports from all the medical specialists in the world — I don't believe it."

And all that only because Witzel apparently had "proved" the harmlessness of amalgam fillings, partly against a considerable resistance among the older dentists. (Witzel: *Das fullen der Zahne mit Amalgam*, 1899). (Translator's note: Witzel in Germany played the same role as Black in the USA.) When I had obtained Witzel's book I was shocked by the shallowness of these proofs.

It might not have been possible to find a dentist who could exchange the fillings if Prof. Binswanger had not explicitly asked a relative of his who was a professor in dentistry. When the fillings were drilled out I had increased troubles. When we sucked away the amalgam dust during the rest of the work the troubles did not appear.

Immediately after the removal of the amalgam fillings a considerable improvement, compared to the previous condition, started. Even if the rest of the recovery was slow, the time of the removal of the fillings constituted the turning point after which all the troubles in the digestive and respiratory organs as well as those in the nervous system, steadily decreased so that I now, for the first time really know what it is to live.

How many people suffer in the same way, even if it is to a lesser degree and how many such cases remain forever undiscovered?