Excerpts, Recommendations,

& Index

From the ASOMAT Main Submission Parts A & B,
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INTRODUCTION and DISCUSSION

ASOMAT was formed in order to create awareness of research, hitherto ignored, which supports the view that amalgams are not harmless. This was done out of necessity because of the regrettable one sided portrayal and widespread misrepresentation of this issue by the dental associations.

There have been a number of reviews in the past few years. None of these reviews have confirmed the safety of amalgams, merely that there is insufficient evidence of harm. In its assessments of these reviews, a number of which are critical of Richardson's Risk Assessment Study, the Working Party needs to be aware of the intensely political nature of this controversy. It is noteworthy that Richardson's study is the only serious risk assessment study performed on dental amalgams using standard and accepted risk assessment methodology. It was extensively peer reviewed by others expert in this field and was done by an investigator with no vested interest in the outcome. Based on the published data which he examined and which was deemed to be appropriate by the peer reviewers, he showed that the number of amalgams which could be placed without exceeding the calculated safe levels were 4 for adults, 3 for teenagers and 1 for young children and toddlers. This was without making any allowance for mercury from the diet or the environment so the figures are, in fact, quite conservative. This report created intense opposition from the Canadian Dental Association which convened a 'Panel of Experts' (CDAEP) to review it. The panel report was compiled by Dr. Derek Jones, a professor in the faculty of dentistry at Dalhousie University in Canada. Unsurprisingly the panel disagreed with Richardson's research. To determine the validity of the panel's expertise, an assessment was made of each panel member's research activity and their published works. Significantly, not one of the members had published any articles employing risk assessment protocols similar to that used in the Health Canada Report. A summary of the panel's expertise is included (Part A, Appendix 2) and clearly demonstrates, based on their areas of academic expertise and published research, a severe lack of credibility as well as an obvious bias towards the pro-amalgam position. Another assessment, (Part A, Appendix 1) was carried out on the expertise and academic credibility of Canadian Dental Schools. This report, which has not been contradicted by any of the Dental Schools, reveals a decided lack of expertise in the Schools' abilities to assess and comment on this issue. A similar assessment of Australian Dental Schools has not yet been done.

The main opposition to this report has been from the USA and Canadian Dental Associations, and derives from the Derek Jones report mentioned in the previous paragraph. It also needs to be stated, as Dr. Richardson has in his letter (Part B, pg 40) that Dr. Mackert, another active and published critic of the anti-amalgam position, was at that time, and may possibly still be, a paid consultant for Sybron Corp, a major USA amalgam manufacturer. A review which is being cited currently as supporting the safety of amalgams is the Eley article *(Eley, B.M. The future of dental amalgam parts 1-7 British Dental Journal 182 247-459 & 183 11-14)*. ASOMAT has already expressed some concerns about Eley's review in Part B (page ii). Eley raises a number of issues, derived essentially from the report by the CDA Panel, of which he was a member. In so doing Eley has made a number of mistakes and shown a lack of familiarity with the material and the risk assessment methodology, which Dr. Richardson has detailed in his response (Part B page 40,). It is pertinent, as ASOMAT has already noted, that Eley's review was not submitted to an appropriate journal where knowledgeable reviewers could assess the merits of Eley's criticism. Rather it was submitted to one whose reviewers have no understanding of the subject. It bears repeating that Richardson's report was peer reviewed by 16 national and international scientists, regulators and risk assessment specialists before submission to Health Canada and another 3 anonymous peer reviewers before being published in the journal ' Human and Ecological Risk Assessment'. The unquestioning acceptance, by those who should know better, of Eley's observations about the validity of

Richardson's work is therefore quite perplexing. A comprehensive rebuttal of part of the Jones report is also included in the document (Part A, Appendix 10).

ASOMAT trusts that after evaluating the Richardson report, the reviews criticising the report and the rebuttal of those criticisms, that the Working Party will accept the Richardson report as a valuable contribution to our understanding of this issue.

Another frequently cited report, *'Potential Biological Consequences of Mercury released from dental Amalgam, Proceedings from a State of the Art Conference in Stockholm April 1992 '* is another example of political manouevering to achieve a biased and preconceived outcome. I refer the Working Party to the letter (Part A, Appendix 3) by Dr. Murray Vimy, a participant, expressing his disgust at the conduct of the conference. Included in the Appendices are two further critiques of reports which support the use of dental amalgams (Part A, Appendices 4, 9)

Why are these comments important?

They are important because when the amalgam issue is discussed the above studies are cited as 'evidence' of safety and are referred to by other reviewers in their own publications. By the sheer process of repetition they achieve a credibility which is undeserved when their efforts are analysed in an objective manner. This uninformed acceptance of poor science demeans the scientific process and it is therefore important that these studies are recognised as the amateurish, ill-informed and politically motivated works which they really are.

Another review often approvingly cited by amalgam supporters is the USA Health and Human Services Jan 1993 report. It was asserted in the April '95 ADA News Bulletin, page 5, that this report concluded that there was no evidence to support the discontinuation of amalgam as a safe and effective filling material. A closer reading of the report itself would have revealed many statements in conflict with the official conclusion. To list just a few...

> *"This report is not intended to serve as the authoritative source on dental amalgam safety, but rather as a planning tool to assist policy makers in deciding on appropriate risk management actions."*
>
> *"In the absence of adequate human studies, the subcommittee on risk assessment could not conclude with certainty whether or not the mercury in amalgam might pose a public health risk".*
>
> *" Available data are not sufficient to indicate that health hazards can be identified in non-occupationally exposed persons. Health hazards, however, cannot be dismissed."*
>
> *"The margin of safety may, however, be lower because body burdens of mercury are already high as a result of exposure to other sources: some persons may perhaps respond adversely to the incremental exposure to mercury derived from dental amalgams."*

"The potential for effects at levels of exposure produced by dental amalgam restorations has not been adequately studied."

"The available research evidence is not specific enough or strong enough to make sound pronouncements about human health risks from dental amalgam."

There are other similar statements. The above statements from the various work groups are clearly much more cautious than the official conclusion would suggest and it is inappropriate to cite this study as proving that amalgams are safe.

Another factor which ASOMAT feels is important and which the Working Party should consider is the persistent misrepresentation of the research by the various Dental Associations. In support of this statement ASOMAT includes (Part A, Appendices 5, 6), a copy of a fax and a transcript of that fax (to enhance legibility), in which the Director of Health Canada was forced to castigate the Canadian Dental Association for misleading its members and the general public with its printed matter. The American Dental Association also misrepresents the amalgam issue in general and, in particular, despite being informed that it is factually incorrect in so doing, persists in stating the Richardson report was rejected by Canada Health. To his credit, Dr. Butler, Executive Director of the Australian Dental Association has acknowledged the error of this statement and has not repeated it to Australian dentists. ASOMAT attaches a printout of the relevant AmDA Internet page (Part A, Appendix 7) and a copy of the letter sent to Dr. Richardson confirming that Health Canada not only accepted his report but deemed it properly done (Part A, Appendix 8). The significance of this is that dentists almost universally accept that what they are told by their Associations is accurate. Combined with a very selective reporting by the Associations of the relevant literature, the end result is that the dentists are particularly ignorant about even the existence of research which does not support the orthodox view. This also leaves them predisposed to dismiss alternative viewpoints with contempt and unwilling to even consider the possibility that there could be problems. The difficulties, from a medical, dental, financial and emotional point of view, which this creates for those patients who do have amalgam related problems and who are seeking some help, are enormous.

The original NHMRC brochure, prepared by the dental subcommittee, was withdrawn because the conclusions misquoted the only reference listed, a study by Alhqwist, which was cited as supporting them. Even if the correct Ahlqwist study had been cited there are serious deficiencies in both the Ahlqwist studies which preclude them from being a key study on which to base Australian Government health advice. The deficiencies arise from the fact that the women were divided into two groups; one with an estimated 20 or more surfaces of amalgam and the other, a "low amalgam" group with an estimated 0-4 surfaces of amalgam. There was no control group WITHOUT amalgam fillings, which would seem to be a desirable requirement if one is looking for differences between amalgam bearers and non-amalgam bearers. Not only was there no control group without any amalgams but many of the "low-amalgam" group probably have gold crowns with amalgam underneath (the researchers ignore the fact that amalgams are usually present under crowns, *counted as a non amalgam in this study*, which are not counted as amalgam surfaces). Theoretically, their mercury exposure could be higher than the "high-amalgam" group. Health status was determined by an unsupervised, self-administered questionnaire of symptom complaints. The researchers also forget that extracted teeth were probably amalgam bearing teeth providing mercury exposure before extraction (*spaces do not count as possible amalgam sites in this study*) The accuracy

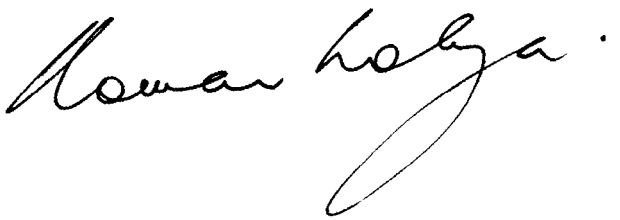
of the count of amalgams in the mouths is suspect and the numbers of participants do not add up. The 1988 abstract says that 1024 dentulous women were studied but the table 2 on following page lists only 653 in total. Clearly, the use of the Ahlqwist study is inappropriate in assessing the effects of amalgams in health.

ASOMAT would also like to bring to the attention of the Working Party the fact that in April 1998 the British Health Ministry sent over 50,000 letters to doctors and dentists advising them that amalgam fillings should not be placed or removed during pregnancy.

This is another indication, after the recommendations of Health Canada, the German Health Ministry and the Norwegian Government that the results of research in recent years are clearly showing that the use of dental amalgams needs to be limited, especially in vulnerable groups.

The ASOMAT recommendations which follow are a reasonable response to this issue and build on investigations already carried out by other governments which have accepted that dental amalgams are a significant source of heavy metal exposure. They are also preventive in nature. There is no call to have existing amalgams removed, just an acknowledgment of the fact that alternative, safer, materials are available and that a policy of preventing unnecessary exposure to mercury from dental treatment is not only feasible and reasonable, but justified by the growing scientific evidence of health problems in a small subgroup of the population. Implementation of the recommendations would be no different in nature and intent than the initiatives which removed mercury and lead from paints, and which are reducing lead from petrol.

Prevention is always better than cure,
- heavy metal toxicity is no exception !



Dr. Roman Lohyn
President ASOMAT
June 1998

ASOMAT Recommendations

The costs of setting up an entirely new inquiry probably cannot be justified when much of the hard work has already been done. ASOMAT would welcome such an inquiry but we suggest that a more reasonable approach might be to adopt a policy which combines the recommendations of the various Government bodies (discussed in Part A) which have already looked at this issue. To that end ASOMAT offers the following recommendations for NHAC's consideration.

- ❑ Amalgams should NOT be used in

  - pregnant women
  - breastfeeding women
  - children under the age of 6
  - people with kidney problems
  - people with neurological problems
  - in retrograde root-canal fillings
  - as cores underneath metal based crowns
  - in conjunction with other metals in the mouth
  - in people with diagnosed lichen planus
  - in people with compromised immune systems

- ❑ Amalgams should be phased out over a 3-5 year period and a concentrated retraining of the dental profession and a change in emphasis in clinical teaching institutions be implemented as soon as possible.

- ❑ Extensive revisions should be made to the NHMRC brochure in order to accurately reflect current research. It is also clear that the results of the Richardson report should be incorporated into such a document. ASOMAT would welcome involvement in the preparation of the revised brochure.

- ❑ TDI exposure values need to be determined as a guide to assessing acceptable mercury vapour exposure levels. ASOMAT does not recommend any particular values but believes that the Richardson report is an appropriate starting point from which to derive such values. ASOMAT would like to bring to the Working party's attention that Dr. Mark Richardson will be visiting Australia in September 1998 and has indicated a willingness to meet and work with NHMRC. ASOMAT encourages NHMRC to consider meeting with Dr. Richardson to discuss the development of TDI levels for Australia.

- ❑ Research should be undertaken to determine the amount of mercury released into the sewerage systems by dental surgeries and consider requiring mandatory amalgam traps. A Pilot study in Seattle which looked at this found significant improvements in waste water quality after traps were installed in dental surgeries.

- ❑ Monitoring facilities should be established to enable dentists to have their offices checked for mercury vapour levels. Currently it is very difficult for this to be done, An Australia wide survey of mercury vapour levels in dental offices would be a very important step in gathering data which is presently not available.

SUMMARY OF RELEVANT FACTS

1: Dental amalgam is NOT a true alloy. It is made up of 50% mercury, which is NOT locked into a set filling but escapes continuously during the entire life of the filling in the form of vapour, ions and abraded particles.

2: The absorption rate of inhaled mercury vapour is extremely high, approximately 80% of the inhaled dose, reaching the brain tissue within one blood circulation cycle.

3: The extreme toxicity of mercury is well documented. Current research clearly demonstrates that inorganic mercury is just as toxic as organic mercury under various physiological conditions.

4: The toxic threshold for mercury vapour has never been found.

5: Controlled, broad-scale scientific studies investigating the effects on the health of patients of mercury released from dental amalgam fillings have NEVER been conducted.

6: The brain is the critical target organ for mercury vapour and methylmercury and is most significant in cases of chronic low level exposure to mercury vapour

7: Mercury from dental amalgam will be transported across the breast milk of lactating women.

8: The halftime for the elimination of a single dose of mercury is extremely long, certainly at least 30 days for the whole body, and perhaps as long as 10,000 days for the brain. Multiple small doses result in accumulation.

9: Sheep and monkey studies have confirmed that the mercury from dental amalgams enters and accumulates in the patient throughout the body, including the brain.

10: Human autopsy studies have shown that the concentration of mercury in the brain is directly related to the number, size and age of amalgam fillings in the mouth.

11: Mercury has been shown to interfere with tubulin synthesis resulting in "neurofibril tangles" in the brain. Mercury, specifically from dental amalgam, placed in rats' teeth, has been shown to affect tubulin synthesis.

12: Mercury from dental amalgams has been shown to be related to antibiotic resistance in the gut and oral cavity.

13: Both Health Canada (1996a) and WHO (1991)consider dental amalgam to be the single largest source of mercury exposure for the general public, contributing up to 84% (WHO, 1991) of total daily intake.

14: Amalgam fillings have been associated, in the scientific literature, with a variety of problems such as periodontal problems (pyorrhea), allergic reactions, oral lichen planus, interference with the immune system, multiple sclerosis, fatigue, cardiovascular problems, skin rashes, endocrine disorders, eye problems.

15: Claims by the Australian and American Dental Associations that the incidence of mercury allergy is less than 1% have never cited any references. Such claims are totally refuted by the scientific literature.

16: The earliest symptoms of long term, low level mercury poisoning are sub-clinical and neurological. Consequently, due to their subtlety, these symptoms are easily mis-diagnosed.

17: Some recent studies show that at least 50% of dentists with elevated mercury levels had peripheral nervous disorders and that dentists have twice the rate of Glioblastomas than non-dentists.

18: Research shows female dental personnel have twice the rate of infertility, miscarriage and spontaneous abortion than the rest of the population.

19: Wolff et al in 1983 stated, “It is generally agreed that if amalgam was introduced today as a restorative material, it would never pass FDA approval".

RELEVANT FACTS in DETAIL

1: Dental amalgam is NOT a true alloy. It is made up of 50% mercury, which is NOT locked into a set filling but escapes continuously during the entire life of the filling in the form of vapour, ions and abraded particles.

This release is stimulated by chewing, brushing and hot fluids. One study reported that mercury vapour levels in the mouth 54 times higher in the mouth of a patient with amalgams, than levels in the mouth of a patient without amalgams, after chewing.

Bioavailability is related ONLY to absorption. It is well documented in the literature that mercury is stored in tissues. The concept of retention toxicity is accepted and research using DMPS has demonstrated this clearly (2,3,4,5,6,7,8,9,10,11,12,13). In 1991 The World Health Organization (WHO) published a report showing that the mercury retained in the body from dental amalgam exceeds the combined amount from all other environmental sources, including seafood (14).

Mercury vapour levels in the human mouth have been recorded in many studies. These studies indicate that stimulation by chewing or increase in temperature will lead to an elevation of the mercury vapour levels. These levels remain elevated for about 90 minutes. Thus, during the course of a day, the stimulation of regular chewing and grinding could lead to a permanently elevated level of mercury vapour. A recently published study gives an indication of the amount of mercury released from dental amalgam (35). Other studies (40,42,47,48,49,51) indicate levels as high as 87mcg/m3, and in some individuals this may go as high as 100mcg/m3 (37). Even a level of only 10mcg/m3 would be 714 times higher than the ATSDR MRL for chronic inhalation exposure to metallic mercury vapour.

2: The absorption rate of inhaled mercury vapour is extremely high, approximately 80% of the inhaled dose, reaching the brain tissue within one blood circulation cycle.

Apart from its effects on neurological tissues, mercury vapour in the oral cavity will rapidly react with methyl mercaptan or by its other name methyl-thiol, producing methylthiol-mercury or di(methylthiol)mercury. Methylthiol is produced in the mouth by anaerobic bacteria in periodontal disease or infected root canal filled teeth. These compounds are extremely cytotoxic, due primarily to their hydrophobic nature, similar to methyl-mercury and dimethyl mercury. This is simple, irrefutable chemistry and would certainly explain why periodontal disease is a major contributing factor to stroke, cardiovascular disease, low birth weight babies and other diseases (268,269,270, 271, 272,273).

It is often asserted by the dental associations that methyl mercury is not an issue in relation to dental amalgams, the fact is that many studies have demonstrated the methylation of inorganic mercury to methyl mercury. (15,16,17,18,19,20,21,22,23,25,26,27,28,29).

It should also be noted that elemental Hg and Hg vapour from dental amalgam can be methylated in the body to form methyl mercury (98,99,120169,185,192,195, 197,198, 208, 213). This form of mercury is readily transported across the placenta, and via the breast milk.

3: The extreme toxicity of mercury is well documented. Current research clearly demonstrates that inorganic mercury is just as toxic as organic mercury under various physiological conditions.

The synergistic effects of mercury combined with various other substances is also an area of significant concern which has been under-researched to date. The toxic effects of mercury are further enhanced when mercury is in combination with other metals such as zinc and lead.

In a study (24) which looked at a common amalgam (Dispersalloy), the researchers reported.... "Dispersalloy was severely cytotoxic initially when Zn release was greatest, but was less toxic between 48 and 72 hours as Zn release decreased." Zn, at the amount released from an amalgam, should not reach cytotoxic levels. It does however, potentiate the toxicity of the mercury released by tying up protective mercury chelators due to the fact that Zn and Hg both have a high affinity for sulfhydryls. In experiments investigating this effect, it was found that addition of non-toxic amounts of Zn^{2+} (5-10 micromolar) enhanced the toxicity of mercury about 5-fold. ***(Personal communication: Prof. Boyd Haley. Prof. and Chair, Dept of Chemistry, Univ of Kentucky)***

The effects of mercury and lead combined have also been reported. One study showed that when a lethal dose (LD1) of mercury was combined with 1/20 LD1 of lead, the combination of the two resulted in a LD100 in the test animals (44). This has not been investigated in human subjects but it is clearly reasonable to assume the possibility of similar effects in amalgam-bearing humans.

***4: The toxic threshold for mercury vapour has never been found. Even the US Environmental Protection Agency has so stated* (30,31,32).**

The existing occupational standards are all specifically declared to be estimates only, on the appearance of CLINICALLY OBSERVABLE SIGNS AND SYMPTOMS. Statements by the dental profession that the amount of mercury exposure encountered by patients from dental amalgams is too small to be harmful are contradicted by the scientific literature and are totally indefensible. Dentists receive no training at all which would enable them to even look for symptoms relating to mercury toxicity.

As far back as 1975 the consensus at that time had already concluded there was no level of mercury vapour established where the effects could be considered harmless. *(The International Committee on MAC Values for Mercury 1969, US EPA document on mercury 1973 and 1984, US NIOSH document on mercury 1973)*. More recently WHO endorsed the earlier consensus when its 1991 WHO Criteria 118 publication stated clearly that for mercury vapour "a specific no-observed-effects level (NOEL) cannot be established", meaning that NO level of mercury vapour that can be considered harmless has been found. WHO also stated "There are at present no suitable indicator media that will reflect concentrations of inorganic mercury in the critical organs, the brain or kidneys, under different exposure situations." Various agencies have set various levels for legislative purposes. For example, the U.S OSHA Maximum Allowable Concentration Mercury Vapour (MAC) is 100 mcg / m3 and its Time Weighted Average maximum Mercury Vapour (TWA) is 50 mcg / m3. These are the Mercury Vapour Exposure Levels for occupationally exposed individuals based on a 40 hour per week exposure. They must have regular medical monitoring and medical records must be kept for 30 years after the end of the exposure. (note that people with amalgam fillings are exposed permanently to Hg vapour for 168 hours per week)

The U.S. Environmental Protection Agency sets another level. The US EPA maximum safe level for mercury vapour is only 0.3 mcg /m3. Another US agency, The Agency for Toxic Substances and Disease Registry, is mandated by the US Government to research, and to set MRL's (Minimum Risk Levels) for toxic substances. It's MRL's for Hg vapour exposure are 0.02mcg/m3 for acute exposure, and 0.014 mcg/m3 for chronic exposure. The documented exposure to mercury vapour from dental amalgams, even in the absence of stimulation, have been recorded as up to 200 times higher than the ATSDR levels. (33,34,35,36,37,38,39,40, 41,42).

The dangers of complacently accepting 'guesstimated' safe levels are starkly demonstrated in a recent study (50) which studied 917 children of approximately 7 years of age. Clinical examination and neurophysiological testing did not reveal any clear cut mercury related abnormalities, but mercury related neuropsychological dysfunctions were most pronounced in the domains of language, attention, and memory, and to a lesser extent in visuospatial and motor functions. These associations remained after adjustment for covariates, and after exclusion of children with maternal hair mercury concentrations above 10 micrograms (50 nmol/g). The effects on brain function associated with prenatal methyl mercury exposure appeared to be widespread, and *early dysfunction was detectable at exposure levels currently considered safe.*

5: Controlled, broad-scale scientific studies investigating the effects on the health of patients of mercury released from dental amalgam fillings have NEVER been conducted.

The true nature and full extent of effects are therefore unknown. Several studies have purported to examine large groups but all have suffered from various methodological weaknesses which limit their usefulness. The only study which we are aware of which compared two well controlled groups is the one by Siblerud *(Siblerud R. Relationship between mercury from dental amalgam and health Toxic Substances Journal, 10:425-444. 1990)* which suggested that mercury poisoning from dental amalgam may play a role in the etiology of many health disorders. A comparison of 125 health symptoms was made between a group of subjects with amalgams and a control group without amalgams. The 47 amalgam subjects reported a total of 45% (P - .0001) more health symptoms per subject compared to an age- and sex-matched control group of 48 non-amalgam subjects. Symptoms that were exhibited significantly more by the amalgam group were less happiness, less peace of mind, poorer reading ability, foul breath, tremors, colds and respiratory infections, heart or chest pains, heartburn, menstrual difficulties, sudden anger, depression, irritability, tiring easily, tired in morning, hay fever, trouble with night vision, and a metallic taste in mouth. Most of these symptoms can be explained by the know effects of mercury toxicity.

It has been suggested that if intention tremor is not present there are no health effects to be concerned. It should be noted that this is contrary to the published scientific research, the advice published by the dental associations and the advice published by the manufacturers themselves.

6: ***The brain is the critical target organ for mercury vapour and methylmercury and is most significant in cases of chronic low level exposure to mercury vapour*** *(Sheridan P. 'Amalgam restorations and mercury toxicity' Masters thesis Sydney University 1991).*

Mercury from amalgam fillings is stored principally in the kidneys, liver and central nervous system. This mercury has also been shown to cross the placenta and collect in foetal tissue. Studies show the level of mercury in liver, kidney and brain tissue of

deceased foetuses, newborn and young children is proportional to the number of amalgam fillings in the mother's mouth. One such study concludes that "the elevated concentrations of inorganic mercury found in the tissues of people with amalgam filings, derive mainly from these fillings and not from other theoretically possible sources. (57,58)

Hg vapour passes into the brain easily because while oxidation is quick, it is not instantaneous. There is time for one blood circulation cycle to deliver Hg into the brain. Once in the brain, Hg oxidises and has more difficulty in passing back out. This accounts for the very long estimated half life of mercury in the brain. With continuing exposure, mercury enters the brain more quickly than it is excreted. This has been clearly shown in autopsy studies where the level of mercury in the brain tissue was related to the number and size of the amalgam fillings (91) Research (46) has shown differences in Hg vapour accumulation compared with accumulation from Hg^{2+} in water. It was found that there was 400ng Hg/g wet tissue weight in rat brain after two weeks exposure to Hg vapour but after having rats drink Hg^{2+} in their water the researchers could only measure about 200 ng Hg/g wet weight after one year.

The peer reviewed published literature clearly shows that neurological damage is one of the most reported effects of long term, low level mercury poisoning (61,62,63,64,65,66,67). Mercury also inhibits sodium/potassium transport, creatine kinase activity, and tubulin polymerization as well as numerous other enzymes leading to more toxic effects.

7: Mercury from dental amalgam will also be transported across the breast milk of lactating women.

In fact it has been demonstrated that breast milk increases the bioavailability of mercury to the newborn. Negative developmental effects have been shown (in animal models) in relation to these sources and concentrations of mercury.

It has been well documented for some time now, that mercury from dental amalgams not only enters the breast milk but that it also crosses the breast and enters the neonate.(68). Several studies have already established the transfer of dental amalgam mercury into the tissues of unborn babies, in both animals and humans (236). The study on humans by Drasch et al (57) concluded: "Future discussion on the pros and cons of dental amalgam should not be limited to adults or children with their own amalgam fillings, but also include foetal exposure. The unrestricted application of amalgam for dental restorations in women before and during the child bearing age should be reconsidered." Vimy et al.,(89) studied lactating women with aged amalgam fillings and found that increased Hg excretion in breast milk correlated with the number of fillings or Hg vapour concentration levels in the mouth air.

The publication of these studies has already resulted in the issuing of government advisories against the use of mercury amalgam dental fillings in pregnant females (Germany, Sweden and Canada).

It is also now documented (50) that mercury in the developing infant and foetus can lead to permanent and irreversible brain damage. Further relevant research is cited (69,221,235,237,245).

As far back as 1984 the USEPA stated that “Women chronically exposed to mercury vapour experienced increased frequencies of menstrual disturbances and spontaneous abortions”, and ... “A high mortality rate was observed among infants born to women who displayed symptoms of mercury poisoning” (240). Many other studies also support these findings (151,241,242,243,244).

8: The halftime for the elimination of a single dose of mercury is extremely long, certainly at least 30 days for the whole body, and perhaps as long as 10,000 days for the brain.

Multiple small doses will therefore result in body accumulation. Chronic exposure to mercury vapour produces neurological effects which include excitation, tremors, insomnia, vasomotor disturbances, gingivitis and kidney dysfunction. Toxicity of inorganic mercury includes inflammation of mucosal surface of the mouth, gingivitis with swelling, and kidney dysfunction (nephrotic syndrome) (71,72,73,74,75,76).

Neurological damage is sustained by chronic exposure to mercury vapour. This is relevant not only for the patients receiving amalgam fillings but also for the future children of women with amalgam fillings. It is also relevant to dentists who place it. Many studies have demonstrated neurological damage to dental personnel (12,77,78,79,80,81,82,83,84,85) Many other studies have also showed the harmful effects of mercury in the brain (65,66,67,64,62,70).

In another recent study (5), the authors included a significant comment:

"We once stated that our experimental results can not be used to support either side of the controversy dealing with whether mercury vapour liberated from dental amalgam is harmful or involved in the etiology of disease(s). In the present study, however, in which dental technicians were exposed to mercury vapour as a result of their working with amalgams, the mean urinary mercury level after the DMPS challenge was adversely and statistically associated with functions related to complex attention, a psychomotor task, mood and symptoms in a linear dose-effect manner. Of singular importance, this investigation establishes a firm protocol for the evaluation of dental personnel regarding potential adverse neurological effects from occupational exposure to amalgam mercury"

The toxicity of this material was tragically demonstrated with the recent death of Prof. Karen Wetterhahn, (The Scientist 11 (21) October 1997, front page). Prof. Wetterhahn died from exposure to two drops of dimethyl mercury that penetrated her latex gloves. She first lost her balance, then her hearing and eyesight, went into a coma and died 10 months after exposure, despite valiant attempts to save her life. Dimethyl mercury is less reactive than Hg^{2+} but is definitely more lethal due to the fact that it concentrates in the central nervous system.

9: Sheep and monkey studies (57,87,88,89). have confirmed that the mercury from dental amalgams enters and accumulates in the patient throughout the body, including the brain.

Mercury’s well known and scientifically documented affinity for thiols is particularly significant in light of the above studies as they provide a pathway for the widespread distribution of mercury throughout the body. Thiols are ubiquitous throughout the body and are involved in all of the following pathways... amino acids, tissue cell receptor sites,

hormones and enzymes, erythrocytes, glutathione and glutathione peroxidase, coenzyme 'a' and succinyl coenzyme 'a', myosin, heart muscle, factor xiii and thioredoxin. Mercury competes for the -SH sites in all of the pathways listed.

The continuing and chronic release of mercury from dental amalgams ensures that the mercury levels build up in tissues throughout the body over many years, interfering with a variety of body functions. It is this chronic long term heavy metal poisoning which is the problem, not the one-off brief and acute exposure.

10: Human autopsy studies have shown that the concentration of mercury in the brain is directly related to the number, size and age of amalgam fillings in the mouth. **(93,95)**

11: Mercury has been shown to interfere with tubulin synthesis resulting in "neurofibril tangles" in the brain. Mercury, specifically from dental amalgam, placed in rats' teeth, has been shown to affect tubulin synthesis.

The relationship of mercury in this matter is still not fully determined. There is however, a body of evidence which is strongly suggestive of a connection in Alzheimer's disease. In Alzheimer's diseased brain the tubulin is present in normal levels, so synthesis is not the problem. However, tubulin in Alzheimer's diseased brain is inactive and unable to bind its natural substrate, GTP, and this can be mimicked by addition of mercury (as the cation or vapour) to get Hg into the brain tissue. Also, tubulin in Alzheimer's disease is not in the correct place (the cytosol, where it is found in normal brain). Instead it is found in the particulate fraction where the neurofibrillary tangles are found. Adding Hg^{2+} to normal brain tissues causes tubulin to not bind GTP, and to partition into the particulate fraction as is observed in Alzheimer's disease brain (274).

ASOMAT does NOT assert that mercury causes Alzheimer's. ASOMAT does believe however, in the light of recent research (10,90,100,101,102,103), that it is quite possible that low levels of mercury present in the brain could cause normal cell death, and that in susceptible people this could lead to dementia which would be similar to Alzheimer's disease. This would be entirely consistent with what is known in the literature about mercury's neurotoxicity.

12: Mercury from dental amalgams has been shown to be related to antibiotic resistance in the gut and oral cavity.

The continued use of penicillin (and other antibiotics) has led to penicillin resistance, one of modern medicine's greatest problems. Published research (104,105,106,107) now demonstrates that mercury from dental amalgam may be a significant factor in antibiotic resistance. The experiments also demonstrated that when the amalgam fillings were removed there was a rapid return of non-antibiotic resistant organisms in the gut and the mouth. This issue is not yet resolved beyond dispute, but given the serious nature of the medical consequences of antibiotic resistance, this subject deserves serious examination.

13: Both Health Canada (1996a) and the World Health Organization (1991) (14) consider dental amalgam to be the single largest source of mercury exposure for the general public, with amalgam potentially contributing up to 84% (WHO, 1991) of total daily intake of all forms of mercury from all sources.

Therefore, the level of exposure resulting from amalgam is not an issue of contention. The WHO also noted that for mercury vapour "a specific no-observed-effects level (NOEL) cannot be established, (14) ie. NO level of Mercury Vapour has been found that can be considered harmless.

The levels of exposure are small. We point out however, that in toxicological terms, 'small' needs to be relative to the threshold for effects. Where no threshold has been defined (as with Hg vapour) it must be compared to a regulatory reference dose. The total dose may be small but where the reference dose is smaller, then the exposure can still be detrimental. Current research, using solid biochemical data, shows that 'small' as it is, it is still enough to compromise body health. We refer the working party to the ATSDR 1994 recommended safe levels of 0.014 mcgms/m3 for chronic exposure to mercury vapour.

14: Amalgam fillings have been associated, in the scientific literature, with a variety of problems such as periodontal problems (pyorrhea), allergic reactions, oral lichen planus, interference with the immune system, as measured by the T-lymphocyte count, (123,124,125,126, 127,128, 129,130,131,132,133), multiple sclerosis (134,135,136,137, 138,139), fatigue, (142,143,144,145,146,147,148,149,150,151) cardiovascular problems (142,152, 153, 154,155,156,157,158, 159,160,161,162,163,164,165,166,167,168), skin rashes (119,170,171,172,173,174,175,176,177,178, 179,180,181, 182,183, 184,186,187,188,189), endocrine disorders (190,191), eye problems (60,74,80,193,194,196,199).

In 13 studies (251,252,253,254,255,256,257,258,259,260,261,262,263) 65%-100% of patients suffering from Oral lichenoid reactions experienced an improvement or total remission of their symptoms after their amalgams were removed. In 9 of those studies they tested for allergic reactions to mercury. In 3 of them the researchers reported 100% of the participants as testing allergic to mercury and the others reported 19%-62% of the subjects showing allergic responses. Blood mercury levels, significantly higher in amalgam patients than in non-amalgam patients, correlate with the number and size of the fillings but return to normal when the fillings are replaced (200,201,202). In one study (203), the daily intake of mercury from amalgams in the subjects was estimated to be at least 1.5ug. Scientific research has clearly established that mercury vapour passes very rapidly from blood to tissue and that levels of mercury in blood or urine are not reflective of the mercury in the body (204,205,206).

Periodontal disease begins as gingivitis, a symptom acknowledged by even pro-amalgam advocates as one of the effects of mercury exposure. It is inconsistent to then deny, or at least ignore the possibility of a connection between periodontal disease and mercury exposure from amalgams. .

There are several published studies linking the presence of amalgam fillings and periodontal problems. Catsakis and Sulica, (108) from the Georgetown University School of Dentistry in Washington D.C. reported a case of persistent periodontitis which did not clear up, despite constant periodontal therapy up to and including periodontal surgery, until all the amalgams were removed. The periodontal problem had persisted for seven years but after the amalgams were removed, the periodontal condition healed quickly

and the tissues remained healthy for a period of more than two years up to the time of publication of that report.

Fisher et al. (247) reported a study where 54 amalgams were placed in 43 patients and followed up, for up to four years. Yearly measurements were made between the alveolar crest and the apical margin of the fillings in the experimental group and the cementoenamel junction and the alveolar crest in the control group. They found that in the experimental group the level of alveolar crest resorption was almost twice that of the control group, i.e. 0.8 mm vs 0.45 mm. This study needs to be considered in the light of the work of Freden in 1974 (248). He measured the amount of mercury in tissues in contact with amalgams and found average levels 49 times higher than control tissues from the same mouth. Is it reasonable to postulate, in light of our knowledge of the extreme toxicity of mercury, that some deleterious effect could be expected in tissues that have 49 times more mercury compared with tissues which have no mercury? Is it even more reasonable when one considers research has shown that mercury in a concentration as low as 20 parts per billion (ppb) was sufficient to stop osteoblastic activity. ***(Personal communication in Oct 1985 regarding preliminary studies at the Department of Biology, University of Colorado, Colorado Springs)***. Ellender et al (246) reported that nickel needed a concentration of 200 ppb to achieve the same result. Finally, consider the findings of Koivumma & Makila (249) who reported that, of a variety of materials, amalgam, in a human mouth, attracted more plaque than any other material.

15: Claims by the Australian and American Dental Associations that the incidence of mercury allergy is less than 1% have never cited any references.

Such claims are totally refuted by the scientific literature. Peer reviewed published research has reported allergy levels of 5%-8% ***(Rudner)*** 27% ***(Djerrasi & Berova)***, 2%-10.8 % ***(White & Brandt),*** 31%, 27%, 32%, 39% ***(Miller et al)***, 11.3% ***(Brun)***, 9.6 % ***(Nebenfuher et al)***, 13% ***(Sato et al)*** (119, 275,276, 278,279,280). Despite this research, the dental associations, including the Australian Dental Association, have, without offering any supporting evidence, falsely stated, and continued to maintain, that the true incidence of mercury allergy is much less than 1% ***(Dr. Sheldon Newman "Amalgam best material, Expert Reports" AmDA News September1, 1986)***. They continue to publicly claim that amalgam is only dangerous to those 'rare individuals' who are allergic to amalgam. Such comments are blatantly false and misleading. (Even Caulk Co., the manufacturers of the Dispersalloy brand of amalgam warn: ***"Allergic reactions that may occur in previously exposed persons include dermatitis, encephalitis, and death").***

As cited above, the research shows allergy levels of up to 39%. Hg allergy is VERY relevant in the context of health effects and mercury exposure. It is relevant because mercury allergies are caused by mercury binding to a host protein, forming a P-S-Hg-X complex that the body's immune system recognizes as a foreign protein and which it attacks. Low level chronic exposure would sensitize the immune system of anyone with the genetic make-up predisposing them to having this problem. It is similar to the penicillin sensitivity that many individuals have. The sensitivity is not to penicillin but to host proteins that are covalently modified by penicillin and appear as foreign proteins to the immune system. Assuming half of the Australian population have amalgam fillings and 13% (119) of them showed symptoms caused by true allergy to mercury, this would mean that over 1,700,000 people have had their immune system compromised to some

extent, either minor or significant, by a toxic substance, the most common source of which is unequivocally dental amalgams!

True allergy is only one of the possible immune reactions to mercury. General sensitivity to the metals in amalgams also exist. Mercury from amalgams has been implicated in immune disease. Lindquist &Mornstad (250) concluded that ***"It thus seems that mercury released from amalgam fillings may initiate or support an ongoing immune disease"*** and called for further research.

16: The earliest symptoms of long term, low level mercury poisoning are sub-clinical and neurological.

Consequently, due to their subtlety, these symptoms are easily mis-diagnosed. This is a challenge to our approach to health care and requires a different awareness of prevention. If all symptoms were totally reversible, with no enduring damage to the patient, then the problem would be relatively straightforward. Unfortunately, by the time chronic mercury toxicity is accurately recognised, the damage is done and often NOT totally reversible, even though significant improvements can be achieved with appropriate treatment. A contemporary example of this is Pink's disease where those patients affected by exposure to mercury as children are still being affected, even though the original source of exposure is now absent.

The fact that such potential irreversibility exists is the reason that prevention and caution must be the dominant sentiments in national health policy, and why the onus of proof of safe levels MUST be on those who advocate the use of this material and not on those in whose mouths it is placed. The consequences of getting it wrong (most recently demonstrated by the Faroe Islands study (50) in which neurological damage by methyl mercury was shown at levels previously considered safe) are too debilitating and too long lasting. We must begin to think in terms of potential and pre-symptomatic effects. In studies in which rats were exposed to mercury vapour, it was found that they showed few clinical symptoms, even though 41% to 75% of their brain tubulin was dysfunctional. In amyotrophic lateral sclerosis (ALS), over one half of the neurons were destroyed before the patients showed signs of clinical distress.

What constitutes clinical versus sub-clinical health impairment? In the case of lead exposure in children for example, no clinical measurement or test can be applied to the individual children to measure impairment of IQ due to lead exposure. However, groups of children exposed to lead have a slightly lower average IQ than do children with no lead exposure. Is the effect clinical or sub-clinical? Does this make low level lead exposure less biologically (or societally) significant? The answer must surely be NO. Similar results have already been reported with low levels of mercury exposure (50,52).

There is obviously a lot of neural redundancy in the body but is it really appropriate to cavalierly take known and universally acknowledged toxins into our body just because we can withstand a certain amount before obvious, but often irreversible, symptoms become apparent? Is such a position morally and ethically justified when safer alternatives have been available for many years? It is widely acknowledged within the dental profession that the main obstacle to universal use of the alternatives in Australia is the inadequate skill levels of the majority of practising dentists. The response must be more concentrated training of the dental profession, not a resigned acceptance that toxic contamination of the population is an acceptable trade-off for more 'easy to use' materials.

17: Some recent studies show that at least 50% of dentists with elevated mercury levels had peripheral nervous disorders and that dentists have twice the rate of Glioblastomas than non-dentists. **(222,281)**

Ahlbom (281) made no observations about the cause of the tumours other than saying that there must be some factor in the practice of dentistry which was responsible. A possible clue that mercury is responsible comes from research by Arrhenius 1971 (282), who hypothesised that methyl mercury might enhance the tumour inducing effect of certain amines, in vivo, by inhibition of enzymes involved in detoxification, thereby leading to an accumulation of carcinogenic intermediates. Neither the tissue mercury levels, nor the dental state of the subjects are known. Only conjecture is possible, but if their own mouths were filled with amalgams then their exposure to mercury could have been significant, with all the attendant biochemical disruption. Nevertheless, while the Ahlbom report is clearly not an unequivocal example of mercury induced problems, it clearly disproves the assertion that dental personnel are as healthy, if not healthier, than the general population, which was the main reason it was cited. On the other hand, Shapiro's report (222) is more definite. He wrote, "298 dentists, 30% of the high mercury dentists had polyneuropathies. No polyneuropathies were detected in the control group. The high mercury group had mild visuographic dysfunction; they also had more symptom-distress than did the control group. These findings suggest that the use of mercury as a restorative material is a health risk for dentists."

18: Research shows female dental personnel have twice the rate of infertility, miscarriage and spontaneous abortion than the rest of the population.

ASOMAT does NOT contend that these problems are solely caused by mercury but the point is made to demonstrate the inaccuracy of constant assertions that the health of dentists and dental personnel is as good as, if not better, than the general population. The studies referred to (283, 284, 285, 286) in the above point clearly show that such assertions are not factually based. Further, as far back as 1984 the USEPA stated that "Women chronically exposed to mercury vapour experienced increased frequencies of menstrual disturbances and spontaneous abortions", and ... "A high mortality rate was observed among infants born to women who displayed symptoms of mercury poisoning" (240). Many other studies also support these findings (151,241,242,243,244).

Major scientific bodies and institutions throughout the world have long ago agreed that there is no known safe level of mercury in the body. Animal studies demonstrate potential neurobehavioural deficits in offspring due to exposure of pregnant animals to mercury vapour. This was one of the major concerns of Professor Mats Berlin in his recent review of the literature for the Swedish Government's Council for Planning and Coordinating Research. In the absence of proper investigation, absence of proof cannot be seen as proof of absence. Mercury is known to cause genetic damage in animals. How can we assume that similar results will NOT occur in humans, particularly when there is already some evidence that similar effects are present in humans (50)

19: Wolff et al in 1983 stated, "It is generally agreed that if amalgam was introduced today as a restorative material, it would never pass FDA approval"*. (Wolff.M. et al Mercury toxicity from dental amalgam. Neurotoxicology (4) pp 203 1983)*

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** In proximal or occlusal contact to dissimilar metal restorations.*
** In patients with severe renal deficiency.*
** In patients with known allergies to amalgam.*
** For retrograde or endodontic filling.*
** As a filling material for cast crown.*
** In children 6 and under.*
** In expectant mothers.*

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EXECUTIVE SUMMARY OF RICHARDSON REPORT

ASSESSMENT OF MERCURY EXPOSURE AND RISKS FROM DENTAL AMALGAM by G. Mark Richardson, PhD., Medical Devices Bureau, Environmental Health Directorate, Health Canada, August 18, 1995, Final Report (released November 27, 1995, in Toronto, at the stakeholders' meeting)

Executive Summary For Canadians with amalgam-filled teeth, it was estimated that total mercury (Hg) exposure averages: 3.3 ug Hg/day in toddlers (aged 3 to 4 years); 5.6 ug Hg/day in children (aged 5 to 11 years); 6.7 ug Hg/day in teens (aged 12 to 19 years); 9.4 ug Hg/day adults (aged 20 to 59 years; and 6.8 ug Hg/day in seniors (aged 60+ years). Of this exposure, amalgam was estimated to contribute 50% to total Hg exposure in adults, and 32 to 42% for other age groups. Estimates, based on two independent models, of exposure from amalgam alone were: 0.8 - 1.4 ug Hg/day in toddlers; 1.1 - 1.7 ug Hg/day in children; 1.9 -2.5 ug Hg/day in teens; 3.4- 3.7 ug Hg/day in adults and 2.1 - 2.8 ug Hg/day in seniors.

There are insufficient published data on the potential health effects of dental amalgam specifically to support or refute the diverse variety of health effects attributed to it. Numerous studies constantly report effects on the central nervous system (CNS) in persons occupationally exposed to Hg. Virtually all studies failed to detect a threshold for the effects CNS measured. A tolerable daily intake (TDI) of 0.014 ug Hg/kg body weight/day was proposed for mercury vapour, the principal form of mercury to which bearers of amalgam fillings are exposed. This TDI was based on a published account of sub-clinical (i.e. not resulting in overt symptoms or medical care) CNS effects in occupationally exposed men, expressed as a slight tremor of the forearm. An uncertainty factor of 100 was applied to these data, to derive a reference dose (TDI) which should, in all probability, prevent the occurrence of CNS effects in non-occupationally- exposed individuals bearing amalgam fillings.

The number of amalgam-filled teeth, for each age group, estimated to cause exposure equivalent to the TDI were: 1 filling in toddlers; 1 filling in children; 3 fillings in teens; and 4 fillings in adults and seniors. It was recognized that filling size and location (occlusal versus lingual or buccal) may also contribute to exposure. However, data suggest that no improvement in prediction of exposure is offered by any particular measure of amalgam load. Therefore, the estimates of exposure derived from the number of filled teeth were considered as reliable as those that might be based on size and position of amalgam fillings, were such data available for the Canadian population.

Effects caused by allergic hypersensitivity to amalgam or mercury, including possible auto- immune reactions, can not be adequately addressed by any proposed tolerable daily intake. Individuals suspecting possible allergic or auto-immune reactions should avoid the use of amalgam selecting suitable alternate materials in consultation with dental care (and possibly health care) professionals.

Preface This report has been prepared in response to concerns that exposure to mercury from dental amalgam may adversely impact on health. Recent reviews (USDHHS 1993, Swedish National Board of Health, 1994) have concluded that there is no evidence to suggest that dental amalgam, specifically, is injurious to health. However, the data base relating health impacts in humans or animals to amalgam specifically is small and weak. This suggests that indirect evidence relating mercury vapour exposure (the predominant form of mercury released by dental amalgam) to human health effects (for which a large data base exists) is a necessary basis for an evaluation of the possible health risks of dental amalgam. In the reports previously mentioned, exposure to mercury arising from amalgam was not adequately quantified, and a level of mercury vapour exposure which is, in all probability, tolerable to the vast majority of persons bearing amalgam fillings, was not defined. This report attempts to address these previous deficiencies.

This report is not exhaustive. Recent reviews on mercury (WHO 1990, 1991; IARC 1993; ATSDR 1994) adequately review many aspects of mercury toxicity and exposure. Instead, this report focuses on studies which report on health effects in dental care practitioners and other occupational groups exposed to relatively low levels of mercury. This report also examines recent research which hypothesizes a link between mercury exposure, and thereby dental amalgam, and Alzheimers' Disease. This report concentrates on effects associated with long term mercury vapour exposure (via inhalation) in humans. Other reviews (WHO 1990, 1991; IARC 1993; ATSDR 1994) examined acute and sub-chronic exposure in animals, and all aspects of the toxicology of exposure to other forms of mercury via other routes of exposure (ingestion, dermal absorption), in extensive and adequate detail such that this is not repeated here.

Any medical or dental material, such as amalgam, will have associated with it some degree of health risk. The purpose of this report is to attempt some determination of what that risk is (i.e. what effect(s) it may cause), how significant it is (i.e. what level of exposure should be free from effect), and what proportion of the population might be at some degree of risk (i.e. how many exceed the level considered to be free from effect)

Health Canada's Recommendations Concerning the Use of Dental Amalgam

(Health Canada, 1996a)

1. Non-mercury filling material should be considered for restoring the primary teeth of children where the mechanical properties of the material are suitable.

2. Whenever possible, amalgam fillings should not be placed in or removed from the teeth of pregnant women.

3. Amalgam should not be placed in patients with impaired kidney function.

4. In placing and removing amalgam fillings, dentists should use techniques and equipment to minimize the exposure of the patient and the dentist to mercury vapour, and to prevent amalgam waste from being flushed into municipal sewage systems.

5. Dentists should advise individuals who may have allergic hypersensitivity to mercury to avoid the use of amalgam. In patients who have developed hypersensitivity to amalgam, existing amalgam restorations should be replaced with another material where this is recommended by a physician.

6. New amalgam fillings should not be placed in contact with existing metal devices in the mouth, such as braces.

7. Dentists should provide their patients with sufficient information to make an informed choice regarding the material used to fill their teeth, including information on the risks and benefits of the material and suitable alternatives.

8. Dentists should acknowledge the patient's right to decline treatment with any dental material.

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