13.1 STUDIES EXAMINING EVIDENCE OF ILL HEALTH RELATED TO AMALGAM

An indication of the infrequency of toxic and allergenic reactions to dental treatment is seen in the study by Kallus (1985), who with the participation of 137 dentists monitored 13,325 patients in order to assess the incidence of adverse reactions from dental materials. In 15,820 visits 24 comments by patients were recorded and 22 observations made by dentists concerning assumed side effects. No reactions were proved (4 probable and 3 possible) and none of these caused by materials intended for permanent use. At worst (assuming that the 7 cases were adverse reactions to dental materials) this is a frequency of 0.05%.

An epidemiological study by Ahlqvist, Bengtsson, Furunes, Hollender and Lapidus (1988) of 1024 women found no positive correlations between number of amalgam fillings and number of symptoms, or between number of amalgam fillings and prevalence of specified single symptoms or complaints.

A Danish study by Meurman, Porko and Murtomaa (1990) investigated 20 patients who allegedly had amalgam-related symptoms. While the results showed that the group suffered more medical illnesses and chronic craniofacial pain than controls, there was no difference in any other clinical, allergic responses, salivary chemical or microbiological findings between this group and the control group. In the five patients who gave blood samples, both inorganic and organic mercury levels were below threshold values.

Michel, Norback and Edling (1989) studied whether fatigue was related to the
number of tooth surfaces of amalgam or to other factors in a group of 108 hospital workers. There was a significant positive relationship between symptoms of fatigue and psychosocial factors and the frequency of sick-leave in respiratory diseases. A positive relation was found between the number of surfaces of amalgam and age as well as smoking habits. The authors conclude that factors such as respiratory infections and psychosocial factors could explain the symptoms of fatigue other than the release of mercury from dental amalgam.

Hietanen et al (1987) found no evidence of hypersensitivity to amalgam or mercury in a group of 29 patients with suspected dental restorative metal allergy.

Lothigius, Smedberg, Angmar-Mansson and Nilner (1989) studied 80 patients for complaints related to dental restorative materials or for supposed adverse effects from mercury released from dental amalgams. A correlation was found between symptoms and lowered pH values in stimulated saliva. It is postulated that, for example, smoking and medications may reduce salivary pH and predispose to oral symptoms, although this study failed to show any demonstrable cause for the reported symptoms.

Lavsted and Sundberg (1989) found no significant increase in the percentage of individuals with symptoms in groups with increased numbers of amalgam fillings after controlling for confounding factors such as gender, social group and smoking habits.
13.2 ANTI-AMALGAM LITERATURE

This literature can generally be distinguished from scientific research and reviews because it tends to support a dogmatic and rigid view of the deleterious effects of amalgam restorations on health as an overriding premise and propounds this view in an almost obsessive, even hysterical, manner. There is a general condemnation of the dental profession and an almost religious deference to obscure tests and authorities. It is unfortunate that the anti-amalgamists suffer to an even greater degree from the blinkered view which they (with some justification) attribute to the dental and medical scientific establishments.

There are a number of organizations which support the concept of mercury toxicity from amalgam and actively produce and distribute printed, audio and video material.

The two major groups are:

- The Toxic Element Research Foundation directed by Dr Hal Huggins, a Colorado Springs Dentist and

- Bio-Probe Inc which circulates the material of Sam and Dr Michael Ziff (the latter a dentist).

Other groups in the USA include:
- American Academy of Biological Dentistry
- National Centre for Homeopathy
- International Centre for Preventive Medicine
- International College of Applied Nutrition
- American Academy of Environmental Medicine
- American Holistic Medical Association
- International Academy of Oral Medicine and Toxicology
- Foundation for Toxic Free Dentistry

In England:
- The British Dental Society for Clinical Nutrition
- The Allergy & Environmental Medicine Department of the Nightingale Hospital
In Australia:
-The Australian Society of Biological Dentistry

These groups promote the concepts of mercury toxicity and direct people to dentists in "mercury free dental practices" who will replace amalgams on the basis of mercury poisoning. Additionally they promote nutritional, supplemental and drug detoxification treatments.

Much of the published material can be found in handouts, leaflets, booklets and texts (Hanson 1983; Lohyn 1983; Huggins 1983; Ziff & Ziff 1988a,b; Black 1990) made available to dentists promoting amalgam removal and distributed through fringe or alternative health oriented societies, bookshops and book publishers. Quite often in general books on alternative health there are chapters or sections repeating the claims of mercury poisoning from amalgam (Horne 1985; Graham 1987).

The titles of these books, monographs and chapters are generally all strident and emotive, denouncing the amalgam restoration with grandiose claims of mercury poisoning causing a multiplicity of afflictions. For example:

-"SILVER DENTAL FILLINGS, THE TOXIC TIME BOMB" (Ziff 1984);
-"ARE YOUR DENTAL FILLINGS HURTING YOU? THE HAZARDS OF HAVING MERCURY IN YOUR MOUTH" (Fasciana c1986);
-"MERCURY: A FACTOR IN MENTAL DISEASE? CAN MERCURY-SILVER FILLINGS CAUSE PSYCHIATRIC SYMPTOMS?"(Huggins 1983);
-"MERCURY AMALGAM TOXICITY - A MAJOR COMMON DENOMINATOR OF DEGENERATIVE DISEASE" (Kupsinel 1984);
"INFERTILITY AND BIRTH DEFECTS. IS MERCURY FROM SILVER DENTAL FILLINGS AN UNSUSPECTED CAUSE?" (Ziff & Ziff 1987).

It must be said that some of these books are produced in a proper scientific style, well documented and with copious references (e.g. "Infertility and Birth Defects" 1987). However, it is the prejudiced and selective utilisation of data to formulate unfounded and speculative conclusions which ultimately consigns these manuals to become mere footnotes in the scientific literature.

In 'THE HEALTH REVOLUTION' by Horne (1985) there is a section on "Mercury Poisoning from Teeth Fillings". As is common in these types of books there is a presumption that mercury poisoning from amalgams is known to produce various chronic disease conditions. On this basis and quoting the names of various clinicians and authors, numerous cases are referred to in a general sense for whom health has been restored with the replacement of amalgams. A Dr Sowharzkopf is reputed to have eliminated 'cancer, erratic heart beats, pancreas weakness, erratic menstruation, headaches, thyrotoxicosis, endocarditis, hyperthyroidism, neuralgia, muscular pains and rheumatism' by amalgam replacement therapy. In a more specific vein the author himself cites a case of Mrs Gun Thoresson of Burea, Sweden, who had been gradually going blind, but after removal of amalgam regained 90% of her vision within 6 months. In this style of publication these cases and those who report them are accepted without query - they support the basic thesis and are, as such, given an unwarranted and unproven status.
A comical, but extremely illuminating, example of nonsense in the guise of science is seen in the book "HOW TO BE YOUR OWN NUTRITIONIST". (Berger 1989) The author asks 'Do you have silver fillings in your mouth? It has been shown that these can leach lead and mercury into the body over a long period. A few experts believe that a quarter of the people with serious lead poisoning get it from dental fillings.'

This epistle exposes the vacuous nature of the oft used phrase 'it has been shown' and the meaningless value of reference to 'experts' without substance. In reality lead is never a constituent of amalgam and thus it cannot be shown that lead leaches into the mouth from dental fillings. Even less compelling is the reference to the experts who contend that 25% of serious cases of lead poisoning come from dental fillings which do not contain lead.

The scientific style articles are published in journals which are either in an esoteric professional category: e.g. Journal of Orthomolecular Psychiatry (Huggins 1982; Pleva 1983; Hanson 1983) and Journal of the International Academy of Preventive Medicine (Pinto & Huggins 1976) or lay publications which promote anti-establishment or alternative approaches to health; e.g. "AUSTRALASIAN HEALTH AND HEALING...A HOLISTIC APPROACH TO ALTERNATIVES IN LIVING." (1990)

As an example of this genre an article by Siblerud (1989) in the American Journal of Psychotherapy claims that mercury poisoning from dental amalgams
may play a role in the aetiology of mental illness. The author notes initially that
the study was designed to prove a preconceived thesis: 'The strong evidence
linking dental amalgam with mercury poisoning and associated psychological
disorders led us to design a study that evaluated the mental health of subjects with
and without dental amalgams.' It is difficult then not to be cynical about the
results and findings thus obtained. Two separate studies were carried out, the
first with 100 college students (50 without amalgams and 50 with amalgams) who
completed two mental health questionnaires and had hair and urine samples
assessed for mercury. In keeping with the expected results the amalgam subjects
reported being significantly less happy, having less peace of mind, rated their
reading comprehension as lower, had more emotional distress symptoms with
significantly more episodes of sudden anger, depression and irritability as well
as suicidal tendencies and anxiety. The amalgam group had higher mercury
levels in urine and hair. The urine mercury concentration of the amalgam group
was 3.7 ppb as against 1.23 ppb for the non-amalgam group. The standard
deviation in the amalgam group was 3.78 ppb implying a significant variation
such that a proportion of this group had levels which would have approximated
those of the non-amalgam group. There are narrow theoretical considerations
in this study highlighted by the fact that, in assessing the results of both clinical
tests (hair and urine), sources of mercury intake other than from amalgams have
been scrupulously ignored. There are also questions as to whether the group
with amalgams were blinded to the object of the questionnaire - it is hard to
envisage a question which would allow the individuals in the amalgam group to
rate their own reading comprehension that would have any objective reality
when compared with the amalgam free group.

The second study reflects a questionnaire response from 86 out of 300 patients who had undergone amalgam removal at a specific dental practice. The results of this survey are almost entirely invalid...people who have their amalgams replaced constitute a specific group with preconceived ideas about their health status, the role of amalgam as a source of mercury poisoning and assorted health symptoms, and the benefits of amalgam removal. In this study there is no control group and the placebo effect is unknown. Additionally, the respondents constitute a further select group within those who have had amalgams replaced (86/300) which should be factored into any assessment of their subjective opinions.

Thus the result that 80% felt better since removal, 86% were glad they had undergone the procedure and 88% would undergo the procedure again is to be expected given the source of the information. In order to further clarify the 14% response of those who were 'feeling worse' after amalgam removal, the following is offered: 'Of the 11 subjects who said they felt worse, 9 said they also felt better after removal. Some said they felt worse immediately after removal, then felt better. Only 3 felt worse after amalgam removal than before. On a scale of 0%-100%, the 11 subjects that felt worse said they felt 21% worse, but said they felt 47% better on the 'feeling better' question.'

The studies overall suffer from a prejudgmental attitude on the part of the author and the second study is additionally weakened by the choice of subjects. The author improperly attempts to relate the two studies assuming that the positive response in the second study to the removal of amalgam supports the
findings in the first that mental symptoms are a result of mercury toxicity from amalgam. The author further postulates that the studies support that mercury via amalgam is responsible for stress, fatigue, memory loss, premenstrual syndrome and poorer lifestyle. This article will be quoted by the anti-amalgam lobby as support for their contentions, but the results are not satisfactorily proved by impartial, objective and scientific methodology.

Siblerud in other related articles makes further postulations regarding the effects of amalgam on health. He contends that mercury from amalgam causes diseases of the mouth (Siblerud 1990a) and that mercury poisoning from dental amalgam may play a role in the aetiology of cardiovascular disorders (Siblerud 1990b). In this latter report the author claims that amalgam bearing subjects had significantly higher blood pressure, lower heart rate, lower haemoglobin and lower haematocrit. The amalgam subjects had a greater incidence of chest pains, tachycardia, anaemia, fatigue, tiring easily and being tired in the morning.

There is no equivalent research in the literature to support these findings. It is essential that the results of these studies by Siblerud be duplicated by independent researchers with proper controls and methodology.

In many instances the amalgam/mercury toxicity question is but one of a multiplicity of contentions regarding disease and ill-health emanating from current dental therapy. For example in the Feb-April 1990 Issue of the aforementioned Australasian Health and Healing which is a special issue on "Hidden Dental Health Hazards" there are, in addition to the mercury related material, articles and commentary on:
The carcinogenic effects of devitalised teeth...root canal-cancer link...why is a root-filled tooth a major health hazard?'

Wisdom teeth - heart link...heart disease linked to tooth decay'

Neural therapy...interference fields cause chronic inflammation and osteitis in the jawbone'

Recommendations to alleviate these problems include removal of bone around current and previous extraction sites, particularly those involving amalgam restorations, root canal therapies and wisdom teeth. Additionally, these publications contain numerous testimonials from individuals attesting to the success of one or more of the recommended alternative dental treatments.

e.g" A cure for my aching heart" and "The miracle that saved my eye" (Australasian Health and Healing 1990 p24-25).

13.3 THE MEDIA

The role of the media is a potent factor in the dissemination and propagation of the anti-amalgam point of view. While espousing a philosophy of public knowledge and professional accountability there is a tendency for the media to sensationalise and simplify complicated issues. This may be, in the first place, because the journalists do not really understand the issues and secondly, because the object is to sell papers and satisfy the public's taste for shock and horror. This is highlighted in the continued oversimplified regurgitation of the thesis that there is a proven relationship between amalgam restorations and mercury poisoning and thence extended to an association with other diseases.
The New York Times (Dec 1990) is guilty of the grossest distortion and simplification when it states in an article "Debate flares over the safety of dental fillings": 'It has long been known that exposure to large doses of mercury can cause symptoms ranging from arthritis to depression, as well as a variety of neurological problems and autoimmune disorders, like multiple sclerosis.' The use of 'It has long been known' is simply a fallacious argument (Fearnside & Holther 1959) in that it is an appeal to authority and tradition which tends to legitimise the statement which follows and forestalls disagreement, but in no way indicates the basis or the authenticity of the authority alluded to. The remaining statement is a classic example of faulty causal generalization. Arthritis is erroneously described as a symptom of mercury exposure when it is a distinct disease state with no direct relationship to mercury and definitely not caused by mercury. Depression is a common symptom which is manifested in a multitude of disease states and is hardly specific for mercury poisoning.

Excessive mercury exposure can cause neurological damage which results in symptoms and problems of sensory and motor dysfunction. Neurological damage is also evident in other disease states including Multiple Sclerosis, Alzheimer's disease, stroke etc. Though overt neurological symptoms may be similar (e.g. tremor) there is no justification for a causal relationship between mercury and Multiple Sclerosis to be implied. There is use here of faulty analogy and post hoc (assuming the cause) reasoning. Multiple Sclerosis has been described as an auto-immune disease, although this not entirely a definite description as the cause of Multiple Sclerosis is as yet unknown. There is a widely held opinion
that mercury poisoning produces damage to the immune system. To make the statement that mercury causes autoimmune diseases such as MS is again an illogical, unproved and fallacious associative argument.

Titles such as "Heavy metal in your mouth - Hidden dangers at the dentist" (Simply Living 1990); "A Mouthful of Trouble" (Geddes 1983); "The mercury starts to rise over filling debate...But can it really cause poisoning in the mouth?" (Daily Mail 1990); "Drilling for Danger?" (Newsweek October 1990) and "Mercury in Teeth. No silver linings" (Economist February 1991), appear to prejudge the issue.

The articles in the lay press generally accept unquestioningly the anecdotal claims of cures subsequent to the removal of amalgam restorations. For example: 'The strong denials from conventional dentists and the NHMRC (National Health and Medical Research Council) also do not account for the large numbers of testimonials from people who were sick, had their amalgams removed and now feel much better...Further testimonials range from cured face aches, improved digestion, relief from chest and ear pain, to one person claiming a radical improvement in her advanced and severe muscular sclerosis.' (Simply Living 1990);

'Instances abound of patients making amazing recoveries once their mercury amalgams are replaced with non-toxic fillings, according to Lohyn.' (Geddes 1989);
'I noticed an immediate improvement in my health after the worst amalgam filling was replaced. I had a big increase in energy.' (Daily Mail 1990).

It is difficult for the public (and particularly those in ill-health and looking for therapy), reading scientific material within a journalistic context, to apply objective criteria to assess;

a. hypotheses and opinions which are dogmatically avowed as if universally proven and accepted and

b. unsubstantiated assertions (both generalised and specific) of improvement in health states following amalgam removal;

In America in December 1990 the CBS-TV's "60 MINUTES" news programme posed the rhetorical question: "Is there poison in your mouth?" The answer was sought through a series of interviews, chiefly with opponents of amalgam usage. The programme gave the impression that amalgam restorations contribute toxic levels of mercury to the body. Using anecdotal accounts the programme also suggested that removal of these fillings can cure a variety of medical diseases, including arthritis and Multiple Sclerosis.

The bias as well as factual errors in the 60 Minutes programme has been detailed in a "Special Report" sent with the January 1991 issue of the Journal of the American Dental Association (ADA 1991) and the link with Multiple Sclerosis refuted by the National Multiple Sclerosis Society (Reingold 1990).
A symposium was carried out by the British Dental Society for Clinical Nutrition in 1986 titled "Hazards in Dentistry: The Mercury Debate." and which resulted in a number of stories appearing in the media about the 'dreadful harm' that amalgam fillings were capable of causing. The editor of Dental Update commented: 'The handling of this story in the media is a stark example of the worst type of so-called "investigative" reporting. Sensationalism sells newspapers and frightening the masses appears to be considered fair game. Like many such stories, it disappears into nothingness when examined in an objective and scientific fashion.' (Dental Update 1986). The fact that the sponsors of this meeting were ICI, the makers of the tooth coloured composite material "Occlusin" seems to undermine the objectivity of the proceedings.

13.4 CHRONIC FATIGUE SYNDROME AND CANDIDIASIS

Chronic Fatigue Syndrome (previously known as Myalgic Encephalitis [ME] and also Post Viral Fatigue Syndrome) is a controversial disease entity which has been linked with mercury toxicity from amalgam restorations. Chronic Fatigue Syndrome is characterised by chronic variable and fluctuating symptoms particularly muscle fatigue and may be caused by viral infection (Ramsay 1988).

In "TOXIC CHEMICAL-FREE LIVING" (Whitmore 1990) the author recounts the history of 'an acquaintance' whose long term ME and head pain had improved radically since having her amalgam fillings systematically removed.
Candidiasis (Thrush) is a proliferation of the fungus candida albicans which can occur when normal bacterial flora are diminished by the use of antibiotics. Additionally it is suggested that with an altered immune status and/or chemical and food allergies, candida can proliferate. In "CANDIDA: A TWENTIETH CENTURY DISEASE" (Lorenzani 1986) in a section on "Causes of Candidiasis", the author implicates mercury toxicity (specifically from dental restorations) by suggesting that if the activities of the major organ systems are continuously compromised by toxic metals slowly and steadily entering the blood stream, foreign organisms, such as Candida, may find it easy to proliferate.

Crook in "THE YEAST CONNECTION"(1989) in the section "Could your dental fillings be hazardous to your health?" discusses in much detail the effective adjunctive value of dental amalgam removal as anti-candida albicans therapy. In conclusion the author states: 'Should you have your dental fillings removed? I don't know. Yet, if you suffer from chronic health disorders which haven't improved in spite of all your efforts and those of your physicians, I feel a silver/mercury-illness relationship should be considered.'

Crook quotes a monograph by Zamm (1986) titled "Anticandida Albicans Therapy: Is There Ever An End To It? Dental Mercury Removal: An Effective Adjunct"

The aetiology of both Chronic Fatigue Syndrome and candidiasis are often related to the effects of food and chemical allergies causing immunosuppression. In the case of Chronic Fatigue Syndrome a general multi-allergic base is implied whereas with candidiasis, yeast intolerance is quoted as a major factor (Griffiths
1990). In both these diseases mercury (in a general environmental sense and specifically from amalgam restorations) is often mentioned as an underlying element in the allergic/immunosuppressive/toxic background.

Occasionally a direct interrelation between Chronic Fatigue Syndrome, candidiasis and mercury from amalgam restorations is claimed and this is evidenced in an article in Interaction, the Journal of Myalgic Encephalitis Action (Viewpoint 1989) where the "Case Against Dental Amalgam" is put forward by Mr Jack Levenson, a dentist and President of the British Dental Society for Clinical Nutrition. The article relates that Dr Victor Penzer of Boston University stated: 'It appears that mercury leaking from amalgam fillings, when ingested and converted to methylmercury, can disturb the intestinal flora of saprophytes, and can encourage the growth of fungus'. This is followed by two typically vague statements: 'Reports from physicians indicate that patients who did not get well on anti-fungal therapy alone recovered after the source of mercury intoxication was also eliminated.' and 'Reports from Europe indicate that intestinal dysbiosis is often related to amalgam fillings', which are classic examples of unsubstantiated assertions. The article continues: 'Mr Levenson explained the process in simple terms. When you chew food with teeth that have amalgam fillings, the mercury is released into your saliva. When this toxic saliva is swallowed it kills off the 'good' flora in the gut, allowing the 'bad' such as candida, to proliferate.'

Mr Levenson's description may seem plausible to the person with Chronic Fatigue Syndrome who is considering candidiasis as a contributing factor in the disease, but several questions can be raised as to the scientific legitimacy of the
facts and sequences offered. Of the small amounts of mercury released from amalgam during chewing, most concern focuses on mercury vapour, some of which will be inhaled. The inorganic mercury compounds in saliva are composed of some proportion of the vapour which dissolves in saliva and perhaps actual particles of amalgam (corrosion products) which contain inorganic mercury compounds. The inorganic compounds of mercury that would exist in saliva and be ingested are minimal in quantity and also the least toxic form of mercury. Even assuming some mercury from amalgam was dissolved in saliva, there is no evidence that, after ingestion and during passage through the gut, there is any alteration in intestinal flora sufficient to depress normal bacteria and promote fungal growth. Dr Penzer’s assumption that inorganic mercury is converted to the organic methylmercury is a very tenuous and speculative hypothesis, the conversion only based on an \textit{in vitro} experiment and never having been established in humans. [see Sections 4.1.3 and 11.6]

\textit{Two definite facts can be accepted:}

\begin{itemize}
\item[a.] mercury is released from amalgam restorations during chewing and \\
\item[b.] changes in intestinal flora can cause candidiasis....
\end{itemize}

The subsequent inferences drawn are incorrect as well as hypothetical. The remote possibility that these assertions may be true should not be allowed to undermine the broad and major scientific body of knowledge which rejects the extended assumptions regardless of the conviction with which they are held.
Although strongly implied in the article there is actually NO evidence for the following contentions:

i. the amount of mercury released and then absorbed is significant to the body burden of mercury;

ii. mercury from amalgams can produce any degree of mercury poisoning or toxicity;

iii. all mercury released from amalgam is dissolved in saliva and swallowed;

iv. mercury in saliva ingested can affect intestinal flora and specifically reduce certain flora allowing candida to proliferate;

v. inorganic mercury or mercury vapour is converted to the extremely toxic organic methylmercury in the gut;

vi. mercury has any role in the aetiology of either Chronic Fatigue Syndrome or candidiasis;

vii. removal of amalgam restorations has any affect on candidiasis and by extension Chronic Fatigue Syndrome.

13.5 METHODS OF ANALYSIS

A number of screening measures are often employed to ostensibly assess mercury levels and provide evidence of toxicity. Some of the tests (e.g. blood, urine, hair) are potentially valid indicators if carried out by appropriate trained personnel and utilising sophisticated technical analysis. In general the testing carried out for mercury sensitivity and mercury poisoning from amalgam restorations is extremely questionable and quite often unacceptable, inappropriate and invalid. The mercury sensitivity allegedly revealed by these
tests is used as justification for the recommendation for amalgam removal.

1. Symptom Questionnaire
2. Electrical Reading of Restorations
3. Skin Patch Testing
4. Urine Mercury Analysis
5. Blood Tests
6. Hair Analysis
7. Oral Mercury Vapour Tests
8. Food and Chemical Allergy Tests

[adapted from Dodes 1988]

13.5.1 Symptom Questionnaires

Hundreds of questions elicit information on all health aspects, including areas such as cardiac, pulmonary, nervous, skin, digestive, blood, urine, emotional etc. The questions are general even when assessing specific problems and the list is so inclusive that any healthy person would find it hard not to confirm the presence of some of the symptoms or conditions.

13.5.2 Electrical Reading of Restorations and Sequential Removal of Amalgams.

A quasi-scientific metering device assesses the electrical status of the amalgam restorations and the "negative" restorations are accorded pre-eminence in the sequence of removal. Ostensibly this device is recording electric potentials which is presumed to be a measure of corrosion rate and thus the release of mercury, but in the first place the device does not accurately measure this parameter and in the second there is no scientific evidence that corrosion of amalgams is a significant factor in the body burden of mercury. The sequence of removal of amalgams is claimed to be important in the release of mercury from the tissues. Electrical potential testing and sequential removal of amalgam restorations is
even criticised by one of the major patrons of mercury toxicity from amalgam restorations. Ziff and Ziff (1988b) state: *'There is no scientific data to support the use of sequential removal. More importantly, there is absolutely no scientific data to support the statements being made by the proponents of sequential removal that 'if your dentist doesn’t use sequential removal it will cause the mercury to remain locked in the tissues’. Moreover, it has been well established scientifically that precise measurements of these electrical potentials is not possible.’*

[See also Section 13.6 Electrogalvanic Effect and Oral Galvanism]

### 13.5.3 Skin Patch Testing

Skin patch testing can be used to determine allergic and hypersensitivity responses to materials such as mercury but they are not able to test for mercury poisoning (toxicity), micromercurialism or non-allergic hypersensitivity. Skin tests are not valid to assess for relationships between general symptoms of ill health and amalgam restorations.

Fisher (1985) notes that: *'Patch tests with mercury chloride are notoriously unreliable because even dilute solutions, such as 0.01% aqueous solutions, may show 'irritant' patch test reactions in many normal controls. The North American Contact Dermatitis Research Group has determined that the proper test for allergic mercury hypersensitivity is 5% ammoniated mercury. Even a positive patch test with 5% ammoniated mercury is meaningless as far as mercury "poisoning" is concerned. Hence the removal of a mercury amalgam dental filling because of a positive patch test is irrational in suspected cases of mercury "poisoning".'*
The "Merc-Kit", a mercury patch test kit which is marketed for dentists to test for mercury hypersensitivity and toxicity, suffers from a number of flaws which virtually invalidate its use:

- use of 0.02% mercuric chloride...an inappropriate and irritant allergen;
- Unfounded extrapolation of interpretive factors to include systemic as well as cutaneous responses. Minor changes in blood pressure, pulse and body temperature, as well as indigestion, fatigue, depression, redness of eyes etc are considered as significant sequelae of the patch test;
- the adhesive bandage may also act as an irritant

The large percentage of positive responses (20-25%) reported with the use of the "Merc Kit" has been one of bases on which diagnosis of mercury poisoning is made and the removal of amalgams promoted and justified (Mackert 1985).

Results of skin patch testing are inconsistent, with many false positive and negative reactions. Patch testing must be performed by professionals (dermatologists and immunologists), and interpretation is complex and requires expertise. Additionally the reaction of skin and oral mucosa may differ.

[Also see Section 10. Allergy to amalgam and mercury]

13.5.4 Urine Mercury Analysis and

13.5.5 Blood Tests

These tests are only accurate when performed by medical personnel and assessed in proper pathology laboratories. Urine and blood tests are significant for group analysis on a linear long-term basis, but highly variable for individuals. Serial
monitoring of blood and urine may allow for assessment of exposure by individuals, with urinary levels reflecting steady-state exposure and blood levels indicating recent exposure. The inorganic component of the blood concentration of mercury (which in part would reflect mercury vapour from amalgam) should be differentiated from the organic component (which would generally reflect methylmercury exposure through fish consumption).

Home urine testing with ultra-violet light is advocate by some clinical ecologists as a test for food and chemical allergies. This involves taking a urine sample some three hours after eating a particular substance. 'If the urine is pink or red this is said to indicate porphyria (mercury toxicity) which is also linked to an allergic reaction' (Griffiths 1990). There seems to be no medical or biochemical basis for these assumptions.

13.5.6 Hair Analysis

The legitimate use of hair analysis by qualified researchers should not be confused with the misuse of hair analysis to assess nutritional status or diagnose toxicity to various trace elements (Langan, Fan & Hoos p873 1987). Hair samples from two healthy teenagers were sent to 13 commercial laboratories performing multimineral hair analysis. Laboratories had contradictory normal values for the minerals and 'most reports contained computerised interpretations that were voluminous, bizarre and potentially frightening to patients. Literature from most of the laboratories suggested their reports were useful in managing a wide variety of diseases and supposed nutrient imbalances. However commercial use of
hair analysis in this manner is unscientific, economically wasteful and probably illegal' (Barrett 1985).

Sherertz (1985) questions the usefulness of hair analysis on the variability in environmental effects (hair care, occupational exposure and geographic location), differing growth rates (health, drug effect, age, gender) and lack of standardisation in analysis techniques. She concludes: 'Little has changed in this regard since the editorial in 1974 in JAMA, in which Lazar, reflecting the opinion of the American Medical Association’s Committee on Cutaneous health and Cosmetics, stated “present scientific knowledge does not support the use of metal levels in hair for broad sophisticated, subtle diagnostic purposes...and certainly, hair analysis is not desirable for routine use.”'

Hair is recognised as an indicator medium for exposure to methylmercury, but is not suitable to indicate exposure to inorganic mercury and mercury vapour.

13.5.7 Oral Mercury Vapour Tests

A probe inserted in the mouth after mastication or stimulation measures mercury vapour levels. The mercury vapour levels thus measured do not reflect a continuous pattern of exposure and are highly variable. Carried out in dental surgeries, where ambient mercury vapour levels may be above normal, the results may not specifically reflect mercury vapour emanating from the patient’s amalgams.

The "Jerome Mercury Vapor Analyzer" (Jerome Instruments, Jerome, AZ, USA) is an instrument commonly used to estimate mercury vapour levels released from
amalgams and additionally estimate potential body burden of mercury. It is based on the absorption of mercury by a thin gold film. The accuracy of the Jerome Analyzer is, at best, +/-15%, with repeats agreeing to +/-5 μg/m³ (Akers 1991).

WHO (1991) notes a standard deviation of 3-10% for the Jerome Analyzer but notes that: "at higher mercury concentrations, the films become saturated with mercury and precision decreases. There is no data on the accuracy of the method when used in actual field studies by Svare et al (1981) or Vimy & Lorscheider (1985a,b)."

Ziff & Ziff (1988b) in the booklet "THE HAZARDS OF SILVER/MERCURY DENTAL FILLINGS", in the discussion on mercury vapor analyzers (and specifically the much touted Jerome Mercury Analyzer) admit: "Again unfortunately, the degree of validity of these equations is still controversial, as is the very use of these analyzers for dental mercury exposures."

Another type of direct reading mercury vapour detector is the "Bacharach Mercury Sniffer" (Bacharach Instrument Co., Pittsburgh, PA, USA) which is based on the use of ultraviolet light. Correct readings can be distorted by organic acids, dust, cigarette smoke and water vapour. The machine should not be used for sampling in the mouth (Cooley & Young 1984).

To properly detect vapour from the amalgam the tooth must be dry and this does not reflect the normal status in the mouth where the teeth are coated with saliva. Perhaps this fact may account, at least in part, for the disparity between
some of the high readings of intra-oral mercury release and the subsequent poor correlation with indicator media levels and clinical effects.

13.5.8 Food and Chemical Allergy Tests

Food and chemical allergy tests are often used to determine a hypersensitivity to mercury and other heavy metals.

i. Vega Test - 'works on the principles of Bio-Energetic Medicine. It looks at the body from an electrical (bio-energetic) sense. It combines aspects of both acupuncture and homeopathy.' (Graham 1987). Glass phials containing foods and chemical are placed in a machine and an electric current applied to the finger or toe of the subject. The sound from the machine occurs when there is a drop in measured resistance and indicates the substance as sensitive or toxic. The relationship of skin impedance to food and chemical sensitivity is not scientifically validated nor is there any indication that the measurements produced have any meaningful connotation.

ii. Applied Kinesiology - 'also works on the principles of Bio-Energetic Regulatory Medicine. It tests the reaction of muscles as a way of detecting food allergies and nutrient imbalances.' (Graham 1987). The subject holds a glass phial containing a particular substance and tries to raise his arm. The tester, by putting pressure on the muscles of the raised arm, is able to identify (by relative strength and weakness of the arm) those foods and substances to which the patient is allergic.
This test is also conducted by placing the substance to be tested under the tongue after chewing (Griffiths 1990).

The Vega and Applied Kinesiology tests are the epitome of quasi-science and would be comical were it not for the fact that they are presented as authentic and proper and the public cannot distinguish legitimate medicine from fraudulent quackery. This is highlighted in the letter referred to in Section 17.2 relating to removal of amalgams for Multiple Sclerosis.

13.6 ELECTROGALVANIC EFFECT AND ORAL GALVANISM

A related claim to mercury toxicity from amalgam restorations is that a combination of dental metals (e.g. gold and silver fillings) in combination with saliva can create an electrogalvanic effect which adversely affects the cells of the body, causing neurological dysfunction. Oral galvanism was previously thought to be induced by a short circuit resulting from contact between metal restorations, but more recently has been attributed to a flow of ions or to the "battery effect" of metal restorations.

It is common for a minor galvanic reaction to occur in the mouth initially when a mixture of metals, or a new metal, is utilised. This applies to gold, amalgam, non-precious alloys (used as an economical alternative to gold) and the chrome cobalt alloys used in partial dentures. These minor "electric shocks" occur while the new material has an active surface and until a passive (oxide or sulphide) layer forms. It is caused when contact occurs with a dissimilar metal in the
mouth, but is of short-term duration and inconvenience. Beryllium, which is used in non-precious alloys, has been alleged to be released into the mouth from dental restorations and implicated in disease states, but there are no substantive clinical reports in the literature verifying this thesis. On the other hand there are extremely large numbers of people with a mixture of dental metals in their mouths and there have been no reports of general and consistent adverse effects.

An example of the claims of oral galvanism related to ill-health is seen in "TOXIC CHEMICAL-FREE LIVING" Whitmore (1990) where the author relates that an acquaintance whose 'bizarre symptoms of head pain' had improved radically after the systematic removal of her amalgam restorations was also of the opinion that: 'the metal fillings affected the electrical charges in her body and contributed to dizziness and pain'.

Muller, Van Loon and Davidson (1990) studied 28 patients without oral complaints (galvanism, leukoplakia, oral lichen planus, toxic or allergic reactions to restorations) and measured the electrical potentials of 183 amalgams and 11 precious metal restorations. In most subjects potential differences of more than 50 mV were present between restorations. The authors thus conclude that this phenomenon is common in healthy populations.

Hampf, Ekholm, Salo et al (1987) conclude that: 'oral galvanism is primarily a psychosomatic disorder'. In this study there was no statistical difference in electrical currents, potential or energy capacity in the dental metallic restorations
between patients and controls. The frequency of allergies and candida infection was similar to the normal population, and the mercury exposure was excluded. Of the 38 patients with signs and symptoms of oral galvanism, 68% exhibited signs of mental disturbance. Of the 20 patients referred for psychiatric investigation, 5 refused consultation, 2 were mentally healthy and the remaining 13 had varying problems ranging from neurosis to severe psychiatric disturbance.

Molin, Marklund, Bergman, Bergman and Stenman (1987) investigated 12 patients with subjective symptoms, ascribed by the patients themselves to mercury released from dental restorations. There were higher intra-oral currents in the patient group related to a control group, although no differences could be seen in the amount of selenium, glutathione peroxidase and mercury in the blood of the two groups. There was a positive correlation between total number of amalgam surfaces and plasma mercury levels for all participants.

A study by Ortendahl, Holland and Rockert (1989) analyzed levels of mercury and copper in blood, blood plasma, urine and saliva of navy divers working under water with electrical cutting equipment in order to assess any changes in the presence and level of oral galvanism and the potential for occupational health risk. They concluded that the risk of increased intra-oral electrical activity during welding or cutting activities was small.

The addition of a small amount of palladium to a high copper spherical amalgam showed less electrochemical activity (Mahler, Engle & Adley 1990).
14. HOW SAFE IS AMALGAM?

14.1 REVIEWS OF THE LITERATURE

A number of authors have, in recent years, reviewed the literature and the evidence for mercury toxicity from amalgam restorations.

Reinhardt (1988) in a risk assessment analysis of mercury exposure from dental amalgams concludes that: 'the margin of safety for mercury toxicity in humans is approximately 8-30 fold.' The author's figures are calculated using as a basis a daily dosage range of 8-29 μg of mercury which are taken from the works of Brune and Evje (1985) and Vimy & Lorscheider (1985). Current opinion is that these figures are an overestimate and that the daily dosage from amalgams is more in the region of 1-3 μg. Thus the margin of safety is actually 80-240 fold. Additionally, the use of 50 μg/m³ as an occupational TLV in the calculations may need to be reduced by a factor of 2 [See Section 8]. This then would alter the safety margin to 40-240. The author notes that in deriving estimates of acceptable daily intakes of noncarcinogens a tenfold safety factor is an arbitrary margin established to protect sensitive members of the human population. Thus from this analysis the mercury from amalgam does not constitute a risk for mercury toxicity.

Langan, Fan and Hoos (1987) conclude that: 'There is no evidence in the scientific literature that the minute amounts of mercury vapour that may be released from amalgam restorations cause mercury poisoning. Allergic reactions to mercury and
other constituents of amalgam have been documented, but are exceedingly rare. Finally, dental amalgam, which has been used extensively for more than 100 years, has an exemplary record of safety and benefit to the dental patient.

The conclusions of Ely and Cox (1988) were that: 'At the present time, it must be concluded that there is insufficient evidence to justify claims that mercury from amalgam restorations has an adverse effect on the health of the vast majority of patients, excepting allergic reactions in a few individuals sensitive to amalgam constituents.'

Ironside (1988) comments on the fact that: 'The studies conducted by well credentialed researchers and published in well credentialed journals with unbiased editorial review panels present overall a picture where the role of mercury from dental amalgam as a potent neuro-toxin to the patients carrying such restorations is not near as harmful as some would want us to believe.'

Dodes (1988) makes the judgement that: 'In critically evaluating some of the theories, diagnostic tests, and treatments promoted by the anti-amalgam fringe, I have found a lack of any valid scientifically sound data to support the contention that amalgam is dangerous, much less that it causes serious disease.'

Enwonwu (1987) states that: 'The potentially serious health risks of mercury notwithstanding, there are as yet no unequivocally convincing published data linking any specific major human health problem to mercury vapour derived mainly from dental amalgam restorations which are prepared and inserted according to
recommended standard procedures.'

Gettleman (1986) notes that: 'although the increases in mercury vapour in the oral cavity have been shown to be statistically significant, disease or pathology has not been demonstrated as a result of mercury toxicity.'

Akers (1989) asserts that: 'There is no statistically reliable scientific study which links amalgam restorations with specific disease states. This excludes the well documented but rare cases of allergy to mercury. The current 'conflict' is not due to a problem with amalgam, but rather to the perception of a problem by extreme minority 'scientific' opinion and the media. The mercurophobes have, on occasions, been exposed as fraudulent, scientifically inaccurate and philosophically paradoxical. This is a social, not scientific, "debate".'

Smart (1985) concludes that: 'the dangers to the patient would seem to be negligible'.

Balevi (1988) notes that: 'It appears that any risk of mercury in amalgam to the dental health team and the general public is acceptably low. Until such time as low levels of mercury are definitively linked to ill-health, we must assume that the use of mercury amalgam is safe. However we should be diligent in protecting our patients and ourselves from mercury in our working environment, especially in light of the percentage of offices where mercury levels exceed the recommended levels.'
Clinical Research Associates reported on "Silver amalgam and its alternatives - 1991" (Clinical Research Associates 1991) and concludes: 'Empirical evidence and minimal scientific research support silver amalgam use. Increasing research and highly vocal antagonists discourage its use. Replacement for mercury in dental restorative materials should be sought. Currently most viable alternatives to silver amalgam appear to be cast gold and composite resins. Unfortunately, a low cost, easily placed, well researched replacement for silver amalgam does not exist in 1991. Worldwide dentistry needs less emotion and politics and more sound research on this subject.'

Eggleston (1989) considers that the belief that amalgam has over 100 years of exemplary record of safety and benefit to the dental patient does not reflect the concern generated by recent additions to the literature on dental amalgam. This review highlights the author's concerns regarding the risk of toxic accumulation of inorganic mercury and hypersensitivity in dental patients and dental personnel, and the hazardous waste disposal of mercury. This review does not support the general acceptance of amalgam and its safety and the author concludes: 'By necessity, the use of amalgam will continue until a true substitute is available. When dental amalgam is recommended, dental patients and personnel have the right to informed consent regarding the hazards of dental amalgam as well as the benefits.'
14.2 NATIONAL, INTERNATIONAL RECOMMENDATIONS, DENTAL PUBLICATIONS

Support for the safety of amalgam has been underwritten by the vast majority of national and international dental bodies:

- **Federation Dentaire Internationale (1988)** In their "Recommendations on dental mercury Hygiene" (Federation Dentaire Internationale 1988) the FDI state: 'Mercury is a potential health hazard in dental practice. Available evidence suggests that the presence of amalgam restorations does not constitute a significant hazard to the patient, except in rare cases of hypersensitivity.'

- **Federation Dentaire International (1989)** In the FDI's "Safety of dental Amalgam" (Federation Dentaire Internationale 1989) they conclude: 'There is no documented scientific evidence to show adverse affects from mercury in dental amalgam restorations, except in rare cases of mercury hypersensitivity. Therefore, except for individuals sensitive to mercury, there is no reason why a person would seek at this time to have amalgam restorations replaced. Indeed, the effect of such a procedure and further restorative operations could be detrimental to a patient's oral health and cannot be justified. There is no alternative to dental amalgam which has been proved to give durable restorations at a comparable cost, and the routine use of composite as an amalgam substitute cannot be endorsed.'
- National Health and Medical Research Council of Australia. (Statements in 1984, 1986, 1989) The 1986 "Recommendations in Dental Mercury Hygiene" state that: 'Mercury is a potential health hazard in dental practice. Available evidence does not suggest that the presence of amalgam restorations constitutes a significant hazard to the patient, except in the rare cases of hypersensitivity.'


In summary they found that:

-no data had been published in scientific journals which supported claims that dental restorations are a source of mercury poisoning;

-a small proportion of the population may have an allergy to mercury;

-replacement of amalgam restorations is only justified when the restoration has failed.

The authors also recommended that: 'patients should be tested for allergy or hypersensitivity to alternative dental materials used to replace silver amalgam restorations before these materials are inserted.' This recommendation needs to be clarified further as it should really only apply to those who are having amalgams replaced for reasons of true hypersensitivity and for whom it would be sensible to make prior assessment of the allergic potential of the replacement material. As a broad and general application, allergy testing is impractical and unnecessary.
This review was also the core of the feature article in the April 1991 issue of the Asia Pacific Dental News (Asia Pacific Dental News 1991).

- The American Dental Association has recently (American Dental Association April 1990) published an overview of the subject in "When your patients ask about mercury in amalgam" which aims at educating the dental profession such that they can accurately advise patients about mercury in amalgam. The American Dental Association maintains that amalgam restorations are safe and that except in individuals sensitive to mercury there is no reason why a patient should have his amalgam restorations removed and replaced by composite fillings. The ADA warns that any dentist who advocates the removal of amalgam fillings for the alleged purpose of removing toxic substances or for health reasons is acting unethically and violating principles of ethics and codes of professional conduct.

The American Dental Association in January 1991 in response to a "60 Minutes" television programme provided a supplement to the Journal of the American Dental Association. In this is outlined "What '60 Minutes' didn't tell you" concluding with: 'The American Dental Association continues to believe that dental amalgam is a safe and effective restorative material.' (American Dental Association 1991).

- The Canadian Dental Association There are no definitive studies or case reports published in refereed scientific journals supporting the statements that dental amalgams are the cause of mercury toxicity. There is no data to suggest that the removal of amalgam restorations should be performed in an attempt to treat

- The American National Institute of Dental Research. 'Based on the available research, the NIDR concludes that dental amalgams pose no known health risk to individuals who are not sensitive to the materials. At this time, there is no reason for recommending either the discontinuation of dental amalgam from patients who have no demonstrated hypersensitivity to mercury or other components of amalgam.' (National Institute of Dental Research 1991).

- Stamm (Dean of the School of Dentistry & Chief of the Dental Research Centre, University of North Carolina, USA) (American Dental Association 1991) states: 'The contribution of mercury from amalgam to the overall mercury level in the body has never been demonstrated to be sufficient to cause or contribute to toxicity reactions.' One might however question this author's toxicological hierarchy of mercury wherein he claims that elemental mercury is the least toxic of the states of mercury and the implication that dental amalgam fillings containing elemental mercury are thus safe. There seems here an unfortunate choice of terminology and simplified conclusions which do not adequately express the particular toxicity of mercury vapour released from amalgam and the degree of uptake which inhalation provokes.

A similar problem in terminology occurs in an article by Katz (Associate Dean of McGill University, Faculty of Dentistry, Montreal, Canada) titled "Unwarranted and Unprofessional: the Superfluous Removal of Clinically Acceptable Amalgams" (Katz 1991) which is an impassioned and generally lucid
condemnation of the anti-amalgam point of view. The statement: *The inorganic forms of mercury, particularly the inorganic form used in dentistry, carries the least potential for harm, even if it leaches out from set fillings* seems to imply (incorrectly) that all mercury released from amalgam is in the form of inorganic compounds, ignoring the existence of the high percentage uptake and the potential toxicity of mercury vapour.

- Heydt (1988), Editor of the Journal of the Dental Association of South Africa states: *There is no alternative to dental amalgam which has been proved to give durable restorations at a comparable cost, and the routine use of composite as an amalgam substitute cannot be endorsed.*


The nine members of this scientific advisory committee was unanimous in its recommendation that dental fillings containing mercury are safe for most people. They also recommended that more research be done to allay the fears of the public that the fillings can cause health problems.

Additionally, independent organizations such as the Consumer’s Union of USA in their Consumer Reports of March 1986 have supported the continued use of amalgam.

Within the dental literature the views in the main refute the claims of the anti-amalgam lobby and offer a supporting view for amalgam (Smart 1985; Chase

Graver (1986), while stating that: 'for the majority of patients the benefits of dental amalgam far outweigh the risks' advises dental practitioners to: 'use patients' medical histories to evaluate the possibility of systemic problems; inform patients of the toxic potential of amalgam so that they may be given the opportunity to choose another restorative material; and replace amalgam restorations with other posterior restorative materials only in patients who have a medically justified need for such replacement'. Occasionally an article in a dental journal may present more strident claims as to the dangers of amalgam (Penzer 1986; Bellman 1987; Faguy 1987; Eggleston 1989), but usually these papers and comments are presented in more peripheral literature.

14.2.1 THE LEK INQUIRY (Sweden)

The LEK Inquiry (referred to in some publications as "Socialstyrelsen Redovisar"), was commissioned by the Department of Health and Social Welfare in Stockholm, Sweden in 1985 and the report submitted in 1987 (Lek Inquiry 1987). The group responsible for the inquiry included lay representatives as well as scientific experts. They looked into the possible risks at low dose exposure to mercury and particularly examined the effects of mercury in dentistry. In their conclusions they make a number of statements relating to questions posed in their original brief, but it should be noted that these are recommendations not
laws, and that they represent a cautious and studied concern with unknowns. These proposals have been widely misrepresented as being legitimate support for the anti-amalgam lobby. While the authors acknowledge that alternative materials should be fostered, they present no proof of mercury poisoning from amalgam and advise caution in pregnancy only because of mercury's ability to pass across the placenta, not because of any evidence of foetotoxicity from amalgam. They promote research into amalgam as well as all other dental materials. As regards whether mercury from amalgam could cause mercury poisoning and mercury allergy they point to the possibility that allergic responses such as contact eczemas and oral lichen planus may be associated with amalgam. In respect of mercury poisoning, because of the non-specific nature of the symptoms, the low level of the exposure from amalgam and the few cases occurring, the authors question whether such cases do exist. They mention the possibility of birth defects, but note that: *this hazard is not verified experimentally or epidemiologically*. 

The question of whether there exist any documented case histories proving firstly that mercury from amalgam caused symptoms of mercury poisoning and allergy and secondly verifying the alleviation of symptoms by removal of amalgam fillings, was answered thus: *There are no epidemiological surveys available which permit conclusions regarding the effects of amalgam.* While the authors accept that many people believe their symptoms are caused by amalgam and some studies have described improvement after amalgam replacement, they note that: *The inquiry finds that these studies are not controlled in such a way that any conclusions can be drawn*. 
In setting future guidelines the authors make the following recommendations:

- 'Amalgam is from a toxicological point of view an unsuitable material for tooth fillings. The group of experts because of this would like to suggest to the Department of Health and Social Welfare the following action regarding the use of amalgam;

- The Department is proposed to stimulate the development of new materials for tooth filling which are technically and biologically/toxicologically satisfactory. When such materials are available, the group of experts suggest that the use of amalgam should be discontinued;

- Because of the potentially damaging effects on foetii, it is proposed that the Department should advise against extensive amalgam works during pregnancy. If the treatment of teeth has to take place during the pregnancy, filling materials of the cement type should primarily be used.'

The authors do note that all materials for tooth fillings should go through a biological/toxicological examination, citing gold alloys, titanium and ceramics as satisfactory at the current level of knowledge. Dental cements and 'above all' composite materials should be the subject of further examination.

One of the major recommendations of the Lek Inquiry was to caution against extensive amalgam work during pregnancy. There is little evidence that inorganic mercury is a danger to the foetus, whereas methylmercury is known to cross the placenta and cause adverse affects to the developing foetus. The term "inorganic" is often used to indicate "non-organic" and can include elemental mercury vapour as well as inorganic compounds. However if inhaled mercury vapour follows the same kinetics in crossing the placenta as it does in the blood brain barrier, then
before oxidation in the blood to the mercuric ion there would be a passage of some elemental mercury vapour into the foetal tissues where final oxidation would occur. Thus, though the placenta may be a barrier to inorganic mercury compounds this says nothing of the passage of "inorganic" elemental mercury vapour to the foetus.

The World Health Organization in 1980 recommended that the exposure of women of child-bearing age to mercury vapour should be minimised due to the fact that elemental mercury readily passes the placental barrier.

A recent study by Klemann, Weinhold and Strubelt (1990) gauged the effects of amalgam fillings in the mother on mercury concentrations in amniotic fluid and breast milk. In 95 women there were no correlations between the surface area of dental restorations and the concentrations of inorganic mercury in amniotic fluid and, as well, no correlation between amalgam fillings and total mercury in maternal blood and breast milk. The authors conclude that: 'maternal amalgam fillings are of no importance for the mercury load of the foetus and the neonate.'

Sections of these two reports appear to have been prepared in a less than impartial manner and present an incomplete, unbalanced and overstated view of the extent and danger of mercury exposure from amalgam restorations.

In WHO 1991 Section 1.9 "Effects on Humans" of Section 1 "Summary and Conclusions", the following appears:

'Recently, there has been an intense debate on the safety of dental amalgams and claims have been made that mercury from amalgam may cause severe health hazards. Reports describing different types of symptoms and signs and the results of the few epidemiological studies produced are inconclusive.' This statement implies that no studies have shown that "severe health hazards" are not caused by mercury from dental amalgam. Similarly Section 9.7 (Dental Amalgam and General Health) is incomplete and unconvincing in its attempt to clarify the question of whether amalgam has any effect on general health. There are no reports in the scientific literature where severe health hazards can in any way be attributed to the mercury from amalgam. The studies by Kallus (1985), Ahlquist et al (1988), Meurman et al (1990), Michel et al (1989), Hietanen et al (1987), Lothigius et al (1989), Lavsted and Sundberg (1989) [reviewed in this text Section 13.1] and Hampf et al (1987) [reviewed this text Section 13.6], all failed to show any causal relationship between amalgam restorations and the symptoms
reported. Additionally none of the symptoms studied could in any way be regarded as "severe". It is only in the peripheral literature and health publications that the spectre of "severe" sequelae (such as Multiple Sclerosis, cancer, birth defects) from amalgam is proposed. The use of the word "inconclusive" to describe the reports and results is not only misleading but adds further emphasis to the possible validity of the claims of "severe health hazards".

The approach of WHO 1991 should be contrasted with that of the National Institute of Dental Research (1991) which states: *There is no scientifically sound evidence linking mercury in dental amalgam to multiple sclerosis, arthritis, mental disorders, or other diseases. Despite a number of case reports and anecdotes implicating amalgam in systemic diseases, there have been no controlled studies demonstrating adverse effects of amalgam restorations on human health.*

Reproduced below in Table 11 is Table 2 of the WHO Report 1991, (originally published as Table 4 in WHO Environmental Health Criteria 101 - Methylmercury 1990) which gives estimated daily intake and retention (in parentheses) figures for mercury in the general population not occupationally exposed to mercury.

<table>
<thead>
<tr>
<th>EXPOSURE</th>
<th>ELEMENTAL MERCUry VAPOUR</th>
<th>INORGANIC MERCURY COMPOUNDS</th>
<th>METHYLMERCURY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>0.050 (0.024)</td>
<td>0.002 (0.001)</td>
<td>0.008 (0.0064)</td>
</tr>
<tr>
<td>Food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>0</td>
<td>0.600 (0.042)</td>
<td>2.4 (2.3)</td>
</tr>
<tr>
<td>Non-fish</td>
<td>0</td>
<td>3.6 (0.25)</td>
<td>0</td>
</tr>
<tr>
<td>Drinking Water</td>
<td>0</td>
<td>0.050 (0.0035)</td>
<td>0</td>
</tr>
<tr>
<td>Dental Amalgams</td>
<td>3.8-21 (3-17)</td>
<td>0.0 (0.0039)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>3.9-21 (3.1-17)</td>
<td>4.3 (0.3)</td>
<td>2.41 (2.31)</td>
</tr>
</tbody>
</table>

Table 11 Source: WHO (1990, 1991)
It is interesting that a range is given for mercury vapour from amalgam whereas for methylmercury an average low figure is quoted. Therefore this table gives an unbalanced view of the contribution of the different forms and sources of mercury to the daily dosage of mercury. In each of the categories in Table 2 (elemental mercury vapour, inorganic mercury compounds and methylmercury) the figures quoted can be criticised or at least questioned not only in terms of the amounts cited but the sources used (and ignored) and the selective use, or non-use, of ranges.

14.2.2.1 Elemental Mercury Vapour.

Section 5.1.1.1. in the WHO Report 1991, which discusses human studies on exposure from dental amalgam, ignores the trend in recent studies to lower levels of mercury being recorded as released from amalgam and more importantly the chorus of independent studies which have criticised earlier reports and particularly the measurements of Vimy and Lorscheider as being up to 16 times too high and grossly inaccurate. Even within the WHO 1991 document in 2.4.2. there are questions raised as to the accuracy of the sampling methods of Svare and Vimy & Lorscheider.

It should be noted that this document was originally produced as a draft Internal Technical Report in December, 1988 (WHO 1988) and in that version it was stated: (p10) *In some studies the authors have undoubtedly overestimated the uptake of mercury, as in the papers by Vimy and Lorscheider (1985 a,b) and Vimy et al (1986).* In the current version (WHO 1991) this has been deleted and replaced with a meaningless dilution: *some studies may have overestimated and others underestimated the daily dose of mercury, while others may have
underestimated or overestimated the mercury uptake.' In fact the text seems to reinforce the results of the earlier studies and glosses over or ignores those by Mackert (1987), Berglund (1988, 1990), Olsson and Bergman (1987), Wallis (1986, 1988), Langworth (1988), Snapp (1989) and Derand (1989) all of whom either found the daily dose of mercury from amalgam to be 3 \( \mu g \) or less or criticised the overestimated calculations and conclusions of Vimy & Lorscheider. [See Table 7 Section 11.4 this text]

The estimates of 3.8-21 \( \mu g \) Hg intake per day (3-17 \( \mu g \) Hg retention per day) for mercury vapour from dental amalgams are originally quoted in WHO 1990 Section 5.1.1. and in Table 4, (WHO 1990 p38) with no references or indication as to the basis of the figures.

*It can be deduced that the source of these figures is as follows:*

a. The author of WHO 1990 is Dr T. Clarkson (WHO 1990 p9);


<table>
<thead>
<tr>
<th>Source</th>
<th>Total Daily Uptake ( \mu g ) Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Svare et al 1981</td>
<td>17.5</td>
</tr>
<tr>
<td>Abraham et al 1984</td>
<td>8.0</td>
</tr>
<tr>
<td>Patterson et al 1985</td>
<td>2.5</td>
</tr>
<tr>
<td>Vimy &amp; Lorscheider 1985b</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Table 12 Source: Clarkson, Friberg, Hursh & Nylander (1988)

The range of figures 2.9-17.5 \( \mu g \) Hg/day is almost identical to the range 3-17 \( \mu g \) Hg/day quoted in WHO 1990, 1991 as retention rates. The significant feature
of this data is that it does not incorporate material subsequent to 1985 (referred to above) and is thus grossly out of date. Additionally the figure of 2.9 \( \mu \text{g Hg/day} \) quoted for Vimy & Lorscheider (1985b) is only 10% of that calculated by the original authors as the daily dose for subjects with twelve or more occlusal amalgam surfaces (29 \( \mu \text{g Hg/day} \)). In Clarkson et al (1988) the recalculation of the results of Vimy & Lorscheider parallels the current view of overestimation. However the work of Vimy & Lorscheider is given a high profile in the text of WHO 1991.

It is not mentioned that Svare and Abraham are research collaborators, which could account for the duplicated high release rates in their two studies and which are the basis for the calculation of daily dosage by Clarkson et al (1988). 

c. Further supporting evidence for this publication being used as resource material for WHO 1990,1991 is that Figures 3,4,5,6 and Table 5 are directly reproduced from Clarkson et al 1988 in WHO 1991 

d. The author of the first draft of WHO 1991 is Dr L. Friberg one of the co-authors with Clarkson in Clarkson et al 1988 

e. Table 2. in Clarkson et al 1988 p256 was included in the draft copy WHO 1988 but was not in the final publication WHO 1991 

f. Dr M.J. Vimy was a member of the WHO Task Group involved in the production of WHO 1991.

The animal experiments cited in 5.1.1.2 of the WHO Report 1991, reflect almost exclusively the work of Hahn (1989) and Vimy (1990) and Summers (1990) who are research collaborators. The experiments conducted by this group at the University of Calgary have been widely criticised but the text of WHO 1991
fails to acknowledge this fact.

14.2.2.2 Inorganic Mercury Compounds:
The level of mercury intake from non-fish foods is given as 3.6 μg Hg/day. This level of inorganic mercury compounds is below the normal considered range which is 5-20 μg/day. [See Table 1 in Section 6.3 this text].

Section 5.2.1. of WHO 1990 states: The estimated dietary intake of inorganic mercury of 4.3 μg/day is the least reliable of the estimates in Table 4. Data are not available on the species of mercury in most foodstuffs. In addition, the figures for dietary intake of total mercury come from only two countries, Belgium and the USA.' In fact the two Belgian studies had total mercury intakes from foodstuffs of 13 μg/day and 6.5 μg/day. It is the low USA figure of 3.5 μg/day which is given maximum weighting in the calculations. To achieve a mean figure the two Belgian figures are averaged and then the resultant amount averaged again with the USA figure. This produces a 1.1 μg/day less amount than if the three studies were averaged in a single calculation, which is a 14% difference. In WHO 1990 a Polish study by Szprezinger-Juszkiewicz (1988) giving a figure of 15.8 μg/day is quoted but not incorporated in the calculations used to formulate the final figure of 3.6 μg Hg. Given the admitted unreliability of the figure quoted, the absence of a range of intake figures in this category is curious.

14.2.2.3 Methylmercury
The use of a figure of 2.4 μg/day methylmercury is representative of a low fish consumption and this is conceded in the text of WHO 1990 Section 5.2.1. As well mention is made of communities where fish consumption produces intakes
exceeding 200 μg Hg/day.

Studies have shown that the daily dose of organic mercury (presumably the bulk of which is methylmercury) is in the range of 2.4-80 μg/day depending entirely on fish consumption. [See Table 1 in Section 6.3. this text]. Again the absence of a range to properly indicate the intake of methylmercury skews the significance of the results.

Thus the three categories show inconsistencies in the way figures are presented, giving a false impression that the bulk of mercury intake and retention is a reflection of mercury vapour from amalgam restorations.

It is disturbing that these two documents (WHO 1990, 1991) have actually added to the confusion surrounding the release of mercury from amalgam, its significance as regards body burden and the question of toxic effects on health. The data regarding mercury release from amalgam is dated, the comparison of dental sources of mercury to other dietary sources is misleading and the indecisive conclusions regarding health effects from amalgam reflect poorly on the scientific credibility of such an august body as the World Health Organization.
14.3 The Views of Dentists

In a survey of some 10,000 dentists, Clinical Research Associates Newsletter (1990) reports dentists' attitudes about mercury use in dentistry:

- Highly concerned about mercury use....6%
- Concerned about mercury use..........33%
- Not concerned about mercury use.....16%
- Not concerned: feel anti-amalgam movement is overdue..........45%

Additionally 94% of respondents use amalgam as their major class 2 restorative material. The number of respondents that do not use amalgam at all had increased from 3% in the 1985 survey to 6% in 1990.
15. REMOVAL OF AMALGAM

15.1 REMOVAL OF AMALGAM RESTORATIONS

The removal of amalgam restorations has been recommended as a method of eliminating the source of mercury poisoning which is propounded as the cause of a variety of diseases. The anti-amalgamists are preoccupied with the effects of mercury from one source...amalgam restorations. Both in the studies and hypotheses which implicate mercury from amalgam they make little or no provision for mercury from other sources. The contribution of methylmercury from fish and inorganic mercury from topical medicines, cosmetics etc is generally ignored, both as a source of body burden mercury and as a cause of hypersensitivity to mercury. The removal of amalgam may eliminate one source of low level chronic exposure, but may not pivotally alter the total body burden of mercury.

In assessing the merits of the procedure of amalgam removal to eliminate mercury poisoning there are a number of considerations:

1. There is no evidence of difference in the incidence of diseases nor in longevity between people who have amalgam restorations and those with no amalgam restorations.

2. Edentulous people are in general not healthier than people with amalgam-filled teeth and specifically do not show less evidence of neurological disease
nor improvement thereof.

3. Except for individual anecdotal evidence (which is usually short-term) there are no studies which indicate that people who have amalgam fillings removed experience any lasting improvement in health.

One report from Drouet, Le Sellin, Bonneau and Sabbah (1990) describes a single patient whom the authors observed had improvement from asthma after removal of dental amalgam. The authors suggest that mercury acts in this case as a respiratory tract allergen rather than the normal mucosal or systemic type hypersensitivity. This isolated report and hypothesis would need to be duplicated to validate the claims made. Additionally there would be the need for control groups to monitor placebo effects which might well account for the results.

4. Removal of amalgams would not eliminate mercury in brain tissue.

5. Removal of amalgam produces short-term high levels of mercury vapour.

   Bulk removal of amalgam restorations may possibly create a significant mercury uptake by the body.

Removal of amalgam (or any other restorative material) involves damage to tooth structure and should only be effected if the original restoration is defective or if there is recurrent decay. A study by Qvist, Qvist and Mjor (1990) in Denmark assessed the reasons for placement of 5000 amalgams. 39% of restorations were placed because of primary caries and 61% were replacements of failed restorations. The failed restorations were due to secondary caries (38%), marginal discrepancies and fracture. The age of the restorations replaced ranged from 0 to 46 years and 50% of the failed restorations in permanent teeth were more than 8 years old.
Short-term elevation of mercury vapour levels occur during removal of old amalgams. The resultant replacement restorations (whether amalgam or alternate materials) are always larger and consequently remaining tooth is thinner, weaker and more fragile. The pulpal tissues are traumatised by restorative procedures with increased potential for pulpal injury and possible pulpal death.

Anusavice (Chairman, Department of Biomaterials, University of Florida) and Major (Director, Scandinavian Institute of Dental Materials) are quoted in the American Dental Association’s January, 1991 supplement to the JADA (American Dental Association 1991). They state: 'The removal of serviceable amalgam restorations for the alleged purpose of removing toxic substances from the body is not currently considered acceptable dental practice. Presently the most biocompatible, well-established materials are direct filling gold, gold alloys and ceramics. Compared with amalgams, restorations made from these materials are much more costly and may require the removal of more tooth structure. As a general group, the plastic fillings called composites have failed thus far to demonstrate comparable strength, durability, and resistance to bacterial leakage along the tooth-restoration interface. They also show less resistance to degradation after long-term exposure to saliva and they are associated with significant shrinkage during hardening and higher levels of plaque accumulation compared with amalgam restorations.'
In respect of allergy to amalgam, van Noort and Johns in a letter to the Editor of the British Dental Journal (1985) make the point that indiscriminate replacement of dental amalgams with composites could lead to more problems than those encountered by the very small group of patients with a low tolerance to mercury.

The Chairman of the Dental health and Science Committee of the British Dental Association (Dowell 1985) notes that: 'It is misleading and cruel to suggest to worried patients that their neurological symptoms may be cured by extensive, and probably expensive, dental treatment in the absence of a responsible diagnosis. I would advise any dentist considering the replacement of amalgam fillings under these circumstances not to undertake work without obtaining the advice of a consultant neurologist.'

15.2 SUPPLEMENTAL THERAPIES AND DETOXIFICATION

There is no evidence as to benefits of food supplements, vitamins, minerals and chelating agents advocated as part of the amalgam detoxification process.

15.2.1 LIFESTYLE CHANGES

Lifestyle changes in diet and habits advocated are usually quite reasonable and commensurate with many of the recommendations of Heart Foundations etc.

These include:

- reduction of refined carbohydrates, sugars and saturated fats
- increase in high fibre food consumption
- reduction in stress
- limit alcohol and smoking
15.2.2 Replacement Protocols

Some anti-amalgamists (Ziff & Ziff 1988a) propose amalgam replacement protocols which by the addition of specific nutrients to the diet supposedly assist in a mercury detoxification process. These are initiated two weeks before amalgam replacement and continued subsequently for an additional one to two months.

*Pre Amalgam replacement:* Glutathione, Cysteine, Vitamin C, Zinc, Selenium, Vitamin B1, B complex, Magnesium, Acidophilus capsules.

*Post Amalgam replacement:* Increased glutathione, cysteine and Vitamin C. Additionally Pantothenic Acid, Vitamin E, Amino Acid complex.

There is no evidence to support the claims that any additional mercury is eliminated from the body by the use of these supplements.

The effects of Vitamin C supplements (500 mg and 1000 mg) were tested by Calabrese, Stoddard, Leonard and Dinardi (1987) on 52 adult males. Results indicate that Vitamin C did not significantly effect levels of cadmium, lead or mercury in either hair or blood samples.

15.2.3 Detoxification with Drugs

Dimercaprol and D-Penicillamine have been used as chelating agents for mercury poisoning. Intravenous EDTA is sometimes used in the USA for mercury detoxification although EDTA is not known to have a great binding affinity with mercury.
Currently DMPS (Dimaval), a water soluble derivative of Dimercaprol, is being recommended for "mercury poisoning" from amalgam. DMPS is initially given intravenously and then followed up with oral administration over a period of some months. DMPS has not been approved for use in the USA (Ziff & Ziff 1988a; Daunderer 1989).
16. AMALGAM AND ALTERNATIVE DENTAL MATERIALS

In the interests of informed consent it is important that patients are advised of the benefits, problems, risks, costs and alternatives for any proposed treatment and technique in dentistry. If amalgam restorations are being suggested, the patient should be advised that they contain mercury, with perhaps a brief overview and comment on the mercury debate and the current view of the profession on the longevity and safety of amalgam restorations.

Dental biomaterials which are used to replace damaged or lost oral tissue are in principle intended to be inert. With the exception of unalloyed gold and titanium most dental biomaterials can be expected to release constituents into the complex and highly variable environment of the oral cavity (Bergman, 1990).

16.1 AMALGAM

Amalgam has been used successfully as a restorative material for over 150 years. It was quickly taken up by dentists after its introduction by the Crawcour Brothers, who advertised the material in London in 1831 and in New York in 1833. Amalgam restorations may be serviceable from 5-15 years and are generally used in posterior teeth for strength and where aesthetics is as a secondary consideration. Dental amalgam is still the material of choice for the
repair of most medium-sized areas of decay in premolar and molar teeth. In 1983 nearly 25 million amalgams were placed under the National Health Service in England and Wales (Dental Estimates Board 1985) and it is estimated that in excess of 160 million amalgams are inserted in the USA annually (Moen & Poetsch 1970). In both countries amalgam is used for 75-80% of all posterior restorations.

Amalgam does not support surrounding tooth structure and requires significant tooth removal for proper design and placement. Amalgam is clinically well tolerated and has an established durability, generally regarded as between 5 and 15 years. A recent study showed that medium to large size amalgam restorations have a survival rate of 72% after fifteen years (Smale 1991). Dental amalgam is also successfully used as a retrograde root filling material in which case it is not exposed to the oral cavity and serves as an implant material.

The legitimate concerns surrounding the release of mercury vapour from amalgam restorations suggests that if a viable alternative restorative material to amalgam were available it should be utilised. The speculation that mercury release from amalgam restorations may be effected internally through the tooth to the pulpal and periodontal tissues has yet to be substantiated.

Potential release of mercury during insertion, removal and polishing of amalgam restorations can be reduced markedly by use of water spray and high-volume aspiration. The modern ternary amalgam alloys, which have reduced silver and tin and higher copper content, have improved properties and may reduce mercury loss during function.
16.2 ALTERNATIVE TOOTH-COLOURED MATERIALS

The tooth coloured alternatives comprise plastics, glass ionomer cements, composite materials, ceramics and porcelains. As an alternative to amalgam they offer improved aesthetics, but with significant complications in respect of technique and longevity which should be explained to patients. In most of these techniques the material is bonded to the enamel and dentine of the tooth using an acid-etch system for adhesion. The results are very technique sensitive and the ultimate long-term integrity and quality of the bond is not entirely guaranteed by current methods and technology.

Modern tooth coloured materials (synthetic resins) which are bonded to tooth structure (particularly enamel) effect (at least initially) a measure of support to surrounding tooth. One of the great advantages of bonding technique is that only carious material need be removed and in the case of new cavities, where no previous restoration exists, a small composite restoration could be preferable to a larger amalgam.

Nevertheless the decision to replace an amalgam with a synthetic alternative should only be made at the time of necessary replacement of the existing restoration and cannot be supported on the basis of mercury toxicity.
16.2.1 Synthetic Resins

Modern synthetic resins (tooth-coloured restorations) have been successfully used in the anterior region of the mouth for the past 10-15 years. These restorations used in posterior teeth, which bear great masticatory load, are technically more complicated and more difficult to construct than are amalgams. The cost is greater and the life of the restoration is often much shorter than amalgam. Posterior composites are very technique sensitive and this coupled with polymerisation shrinkage and incomplete curing means there is more likelihood of salivary contamination, post-operative sensitivity, leakage around margins and, as well, recurrent decay is more rapid beneath these restorations. Composite resin may have its own degree of toxicity with a recent report demonstrating the presence of formaldehyde as a byproduct of the polymerisation process (Lind 1988).

The Federation Dentaire Internationale in their Technical Report 33 on the Safety of amalgam (1989) note that: 'at the present time resin-based materials cannot be used unrestrictedly in stress bearing posterior cavities. Such materials are unproved, with deficiencies particularly in abrasion resistance, stiffness and radiopacity, and should only be used in selected cases.'

16.2.2 Porcelain and Ceramic Materials

Porcelain or ceramic materials which are fabricated outside the mouth have significant advantages over the resins in respect of strength, internal integrity and aesthetics. They represent an biocompatible alternative to gold and
porcelain fused to gold crowns and perhaps indicate the future replacement alternative to amalgam. Improved laboratory techniques have created ceramic restorations which fit accurately and are less likely to fracture. In addition to being brittle ceramics can also be highly abrasive to opposing teeth. The covalent bonding of ceramics does not permit the surface mobility which characterises the precious metals.

Another weakness of these materials lies in the bonding arrangement of the restoration to tooth structure, but as marginal accuracy approaches 50-100 μ and bond strength improves, ceramic restorations will be both aesthetic and serviceable.

16.3 NON-PRECIOUS ALLOYS

Nickel is used commonly in metal dental prostheses, both in stainless steel alloy (10%-14%) and alloyed with chromium as chrome cobalt alloy (2.5%) (Burrows 1986). It is now estimated that some 20% of women and 3% of men exhibit allergic responses to Nickel. This is apparently due to ear piercing which is the initial sensitizing exposure. The addition of beryllium to Nickel/Chromium alloys produces an increased rate of corrosion. Noble elements (e.g. gold) are considered far safer than the non-precious alloys.

Intimately related to amalgam is the common use of stainless steel pins containing nickel for additional retention in larger restorations. There is little information regarding possible degradation, corrosion or galvanic reaction of the nickel containing stainless steel pins within tooth substance and amalgam restorations. Stainless steel is strongest, but today many practitioners are avoiding
the use of nickel that is present in stainless steel. Some countries will not allow the use of nickel in humans. Titanium alloy or pure titanium pins are now available from most pin manufacturers.' (CRA 1991).

16.4 GOLD

Cast gold has long been considered the ideal dental material, being inert and biocompatible. Precious metals are ideal for the restoration of natural teeth because of the lubricating effect of the metal atoms during clenching and grinding. Gold has been the most enduring of dental materials but high costs restrict its generalised use and the current fixation by public and dental profession alike with aesthetics has limited its application. The porcelain fused to gold crowns have extended the scope of gold by virtue of the aesthetic benefits of the porcelain coverage.

The procedure whereby large amalgams are covered by cast gold or gold/porcelain restorations may offset the fears of release of mercury vapour from amalgam during function. Some 30% of build-ups for crowns is achieved with amalgam (CRA 1991). This however would also increase the possibility of electrolytic reaction between the contiguous surfaces of gold and amalgam, although no evidence exists that this is significant, continuous, or harmful. The cementation process, whereby a luting cement (e.g. glass ionomer or zinc phosphate) aids in retention of the crown to the tooth and forms a layer between gold and amalgam, may reduce the potential for this process. There appear to be no studies to determine if mercury vapour is released from
amalgam restorations which are covered by other materials such as gold.

However Combe (1986) states that: 'if amalgam comes into contact with a gold restoration, an electrolytic cell may be set up leading to corrosion of the amalgam and incorporation of mercury on the gold restoration.' This process may require saliva and aerobic conditions, neither of which may be present where gold totally covers amalgam.
17. MERCURY AS A FACTOR IN MULTIPLE SCLEROSIS

Mercury poisoning, from whatever source and regardless of whether organic or inorganic, has not been conclusively proven to be associated with, or the cause of, Multiple Sclerosis (MS). Nevertheless Multiple Sclerosis is constantly cited as being a known consequence of, or linked to, mercury poisoning from dental amalgams.

Multiple Sclerosis may briefly and for the lay public be described as: 'An unpredictable neurological disorder with its onset in early adult life, mostly affecting walking, and often with associated urinary problems' (Scheinberg 1987) or more scientifically as: 'a slowly progressive Central Nervous System disease characterised by disseminated patches of demyelination, resulting in multiple and varied neurological signs and symptoms, usually distinguished by exacerbations and remissions.'

Multiple Sclerosis is thought to affect some 70,000 people in the U.K. and perhaps 250,000 in the USA. The disease generally manifests between the ages of twenty and forty and affects more women than men. Multiple Sclerosis is the most common chronic neurological condition affecting young adults, peak of onset being at 22 years of age. Half the known cases begin before the age of 30, three-quarters before 40. Multiple Sclerosis occurs more commonly in the white
races, in cooler climates (further away from the equator) and in areas with high standards of sanitation (National Multiple Sclerosis Society of USA 1978; Multiple Sclerosis Society of Great Britain & Nth Ireland c1985; US Dept Health and Human Services 1985; Waksman, Reingold & Reynolds 1987; National Multiple Sclerosis Society of Australia 1990).

These elements have led some researchers to believe that an environmental factor is responsible for Multiple Sclerosis, but it is entirely possible that migration patterns within certain genetically predisposed groups of people could account for the geographic distribution of the disease.

The disease process is variously referred to as inflammatory, auto-immune, metabolic, vascular, viral and genetic ...all of which attest to the unknown aetiology and permit a variety of hypotheses as to initiating and exacerbating factors, as well as a host of treatment modalities (Russell 1976; Greer 1982; Swank & Dugan 1987; Graham 1987). The enigma that is Multiple Sclerosis permits it to be routinely appended to lists of "caused by" and "could be cured by". In this case those who believe that mercury from amalgam is the font of ill-health include Multiple Sclerosis as caused by mercury from amalgam, and claim that Multiple Sclerosis can be cured by the removal of amalgam. The extraordinary diversity of therapeutic modalities offered for Multiple Sclerosis are comprehensively and objectively assessed in "THERAPEUTIC CLAIMS IN MULTIPLE SCLEROSIS" (Sibley 1988).
17.1 SYMPTOMS OF MULTIPLE SCLEROSIS

Initial Symptoms

The incidence of initial symptoms are approximately as follows: (Matthews et al 1985)

i. Weakness in one or more limbs 40%
ii. Optic neuritis 22%
iii. Paraesthesia 21%
iv. Diplopia 12%
v. Vertigo 5%
vi. Disturbance of micturition 5%

Advanced Symptoms

Certain symptoms and signs are commonly present in advanced cases:

i. Weakness
   This is most commonly seen in the lower limbs. Onset varies but initially presents as fatigue or weakness on exertion, gradually increasing until present constantly.

ii. Spasticity

iii. Ataxia

iv. Sensory loss

v. Loss of bladder control

vi. Pyramidal signs .(depression or absence of superficial abdominal reflexes, increased tendon reflexes and an extensor plantar reflex.)

Lechtenberg (1988) notes that the systems often affected include; vision, coordination, speech, strength, sensation and bladder control and lists the common symptoms in Multiple Sclerosis as:
- Blurred or double vision
- Loss of vision in one eye
- Slurred or slow speech
- Easy fatiguability
- Psychologic changes
- Weakness or paralysis of limbs
- Poor coordination
- Shaking of limb
- Stagerring gait
- Poor balance
- Dragging feet
- Numbness or pins-and-needles
- Poor bladder or bowel control

Note see section 5 re clinical effects of Hg poisoning
17.2 MERCURY, AMALGAM RESTORATIONS AND MULTIPLE SCLEROSIS

The two groups generally responsible for maintaining a causative link between mercury (via amalgam restorations) and neurological disease are clinical ecologists and a very small sub-group of "holistic" dentists and doctors.

Dr Hal Huggins, head of the Toxic Element Research Foundation in Colorado USA makes statements such as: 'It may well be that MS starts in the dentist's office.' (Martin 1987). Martin further quotes Huggins: 'I used to have MS or something near - but I gave it up!' (It is the mercury in his nervous system, however, which makes him unable to draw a straight line today).’ Huggins also claims that an unspecified 'European research group have allocated US $1 million to investigate these techniques in their improvement in Multiple Sclerosis and Leukaemia.' (Australian Society of Biological Dentistry 1988).

Dr M. Daunderer (1989), (a German Internist) is quoted in the anti-amalgam "Bio-Probe Newsletter" claiming that Multiple Sclerosis is an 'immunodeficiency caused by amalgam' and that 'many cases of colitis (ulcerative) and some with Multiple Sclerosis improved considerably after removal of the amalgam fillings and detoxification with DMPS.'
The rationale of those who implicate dental amalgams in Multiple Sclerosis is that:

a. mercury is a neurological poison which serves as a causative or aggravating factor in neurological diseases including Multiple Sclerosis.

Additionally they contend that:

b. mercury leakage from amalgam restorations is of sufficient dosage and toxicity to inflict damage to the body tissues and organs as well as to the immune system, causing a broad range of health problems of which Multiple Sclerosis is one.

c. removal of amalgam restorations will cure Multiple Sclerosis

Over the last 10-15 years the claims of links between Multiple Sclerosis and amalgam restorations have continued to surface periodically, attracting media and public attention. The more recent data establishing release of mercury vapour from amalgam restorations has provided further material for the proponents of this theory and stimulated additional controversy. There are many groups involved in promoting this theory and it is difficult, given the multiplicity of sources, to simply dismiss the claims as outrageous, unsubstantiated and unscientific.

The righteous, dogmatic conviction, which complements these assertions, places limits of credulity on any claim to scientific objectivity and clouds the validity of the data and case histories utilised as substantiation. Much of the research referred to in the copious anti-amalgam literature is published in obscure journals whose impartiality is questionable and the material rarely relates specifically to Multiple Sclerosis. The term Multiple Sclerosis is almost ritually
 appended to lists of diseases or symptoms thought to be initiated by mercury poisoning from dental amalgam. For example a book by Stortebecker is titled "DENTAL CARIES AS A CAUSE OF NERVOUS DISORDERS - EPILEPSY -SCHIZOPHRENIA -MULTIPLE SCLEROSIS - BRAIN CANCER." The continued reckless and unwarranted inclusion of Multiple Sclerosis creates a false and totally unsubstantiated impression of a genuine affiliation with mercury poisoning and amalgam and has become enshrined as a cruel piece of anti-amalgam folklore. The case histories and personal testimonials of dramatic improvement of Multiple Sclerosis after amalgam removal, while emotionally convincing, are uncontrolled and rarely followed for any reasonable period.

Nevertheless, there is legitimate research to demonstrate that mercury and mercury vapour is released from amalgam restorations in the mouth. The anti-amalgam lobby makes a number of strained assumptions leading from this premise, one being that Multiple Sclerosis is a consequence of mercury release from dental amalgams and that their removal will cure the disease. There can be no argument with the call for the ultimate exclusion of mercury from dental techniques based on its inherent bio-incompatibility, nor the call for further research to demonstrate threshold levels and toxic effects of low level chronic exposure to mercury. Notwithstanding these valid considerations, there is no evidence that the dose of mercury which is released from amalgam is toxic or that it causes symptoms of mercury poisoning. There is even less justification for a causal relationship to be attributed to mercury (either by itself or as a product of amalgam) and Multiple Sclerosis.
Again one must criticise those health professionals, who espouse an anti-amalgam viewpoint, for their manipulation of scientific data to convince the gullible public of their claims. Whether well-meaning or simply exploitative, these health professionals ignore their responsibility to ensure that desperate and unhealthy people are fully informed of all the facts before embarking on techniques which, particularly in the case of Multiple Sclerosis, will be expensive, stressful, time-consuming, unnecessary and achieving of no long-term health benefit.

The strands of the amalgam/MS rationale are clearly seen in the following extracts where the author, a person with Multiple Sclerosis, having been recommended amalgam replacement requests communications on the subject. Although the responses concluded no improvement from amalgam removal, there is still maintained a presumptive acceptance of the general mercury toxicity hypothesis as a factor in Multiple Sclerosis.

The following is from a letter published in the Jan/Feb 1990 issue of "Arms Link" [produced by Action and Research for Multiple Sclerosis, London] (p30) (Bowring 1990a) from a person with Multiple Sclerosis: In common with many of your readers I consulted a Clinical Ecologist after MS was diagnosed and was put on a strict diet. I was also advised to have my dental amalgam fillings changed to a non-mercury filling. I would be very interested to hear from anyone who has had their fillings changed, or who knows of anyone, and what they think about this course of action. It would also be of interest to know whether they had a Vega test first, and if they then had their teeth re-filled in the "correct" order.'
In a later issue of "Arms Link" (May/June 1990 p22) (Bowring 1990b) from the same writer: *I heard from many people on this subject, not one of whom reported any notable improvement in their condition after having their fillings changed, and I detected an understandable note of disappointment in several on this account. However most who had consulted clinical ecologists had been found to be sensitive to mercury and one or two proffered the view that mercury poisoning was actually blocking other forms of treatment."

These letters exemplify the confusion that quasi-science can create in a person with Multiple Sclerosis who is both literate and sensible.

The following claims are included in the letters:

- diet and removal of amalgams will alter the course of Multiple Sclerosis;
- the Vega Test (see Section 13.5.8) and the "correct order" of amalgam removal are necessary adjuncts to the amalgam removal procedure;
- some people with Multiple Sclerosis are sensitivity to mercury;
- mercury poisoning blocks other forms of treatment for Multiple Sclerosis;

None of these claims are true, but offered in a "professional" environment and shrouded in, what appears to be, scientific terminology and analysis, they are appealing and reasonable.

Multiple Sclerosis is a disease that is often ignored by the medical profession - there is no cause and only symptomatic therapy. Many (if not the majority) of people with Multiple Sclerosis seek assistance outside the established medical framework. Thus it is not unusual nor unlikely that they will be exposed to peripheral and alternative medicine offering attention and therapies which the medical establishment is unwilling or unable to offer. Fear and frustration tend
to dilute commonsense and even outlandish theories and therapies are tacitly accepted. The clinical ecologists, holistic dentists etc whether sincere or exploitive, capitalize on the abandoned status of the person with Multiple Sclerosis. There is need for the medical profession (both family doctors and neurologists) to support and advise their patients with Multiple Sclerosis on an ongoing basis (particularly in relation to claims of cures and treatment), and guide them to appropriate organizations (e.g. Multiple Sclerosis Societies) where they can seek further information and assistance.

That one individual's Multiple Sclerosis remits after amalgam removal should not be interpreted as proof of a relationship between amalgam and Multiple Sclerosis, nor that others will have similar results. Ms Louise Herbeck claims a 'remarkable recovery' from her Multiple Sclerosis after amalgam removal such that she has founded a group "D.A.M.S." (Dental Amalgam Mercury Syndrome Victims Support Group). The title of her testimonial "Amalgam poisoning and MS - a case history - Or a walk through hell" (Herbeck 1990) conveys her anguish and frustration with the disease and the text her obvious conviction as to the benefits of amalgam removal. In the majority of testimonials, (whether alluding to Multiple Sclerosis or other disease states) there is no supporting medical evidence, either of the state of health prior to amalgam removal or of the reality of altered symptoms subsequent to removal.
There is very little in the scientific literature specifically relating mercury from amalgam to Multiple Sclerosis:

Heavy metal toxicity is often cited as a cause of disease and, in the case of Multiple Sclerosis, lead and mercury are often implicated. Ingalls (1986) discusses clusters of outbreaks of Multiple Sclerosis, in particular 30-40 cases in Key West, Florida, USA in 1983-1985. He concludes that this outbreak was due to environmental pollution of mercury from a local dump pile. Copper deficiency has been implicated in the aetiology of Multiple Sclerosis on the basis of similar demyelinating diseases in sheep (Warren 1989).

An earlier article by Ingalls (1983) associates slow, retrograde seepage of ionic mercury from amalgam restorations over many years with the advent of Multiple Sclerosis in middle age. Ingalls considers that lead may operate interchangeably with mercury. Using rather oblique reasoning he states: 'Possibly cases of unilateral MS derive from mercury-amalgam fillings in ipsilateral teeth, whereas the generalised disease may result from ingestion or inhalation of volatile mercury or exhaust fumes of lead additives to gasoline.'

Craelius (1972) claims that the aetiology of dental caries and Multiple Sclerosis are similar and proposes that dental caries may be just a precursor stage in many cases of Multiple Sclerosis due to mercury toxicity secondary to mercury seepage from amalgam fillings.

This claim can only be regarded as nonsensical. Dental caries is a specific bacterial disease of teeth and one of the most common diseases of modern man.
To equate the aetiologies of dental caries and Multiple Sclerosis is simply bizarre.

Currier (1972) interviewed a series of 87 patients with Multiple Sclerosis for historical factors over a 10 year period and hypothesised that the amount of dental work carried out prior to onset might be unusual and bear further investigation. This idea is based on the fact that 83 of the 87 had diverse forms of dental treatment prior to the onset of Multiple Sclerosis and all of the 83 having had local anaesthetic administered. These statistics are not compared to a control group of 84 patients whose dental experience is not documented. The fact that the remaining 4 Multiple Sclerosis patients had no dental treatment tends to further dilute the basis for this hypothesis. The author sees support for this thesis in the fact that in China and India, where Multiple Sclerosis is virtually unknown, both dental care and dental caries are infrequent, teeth being lost from periodontal disease.

This type of associative hypothesis is purely conjectural and not supported by any factual data. The low incidence of Multiple Sclerosis in China and India may be a reflection of lack of medical facilities such that the disease is not recognised nor documented. On the other hand dietary factors present in the western world and absent in these countries could as easily be substituted for the claim that dentistry is the source of Multiple Sclerosis.

Sibley, Bamford and Clark (1990) studied 170 Multiple Sclerosis patients and 130 healthy controls over an 8 year period to determine possible environmental factors which might be important in the disease. Stress had only a marginal
affect and physical trauma was not a risk factor. Dental treatment was included in the category of physical trauma and there was no evidence of any relationship between dentistry and the exacerbations of Multiple Sclerosis. The authors noted that the only significant risk factor was clinical viral infection and they conclude that Multiple Sclerosis is probably a post-infectious phenomenon.

The research by Eggleston (1984) [See Section 10.4] into alterations in T lymphocyte populations related to the presence and removal of amalgam restorations has been cited by some as evidence of a relationship between amalgam and autoimmune disease. This preliminary study, which has not been duplicated nor confirmed, showed an increase in T cell numbers with the removal of amalgam in 2 patients. Neither of these people exhibited any evidence of allergic response, nor sensitivity to amalgam or mercury, much less any indication of immune suppression. Multiple Sclerosis has been described as an autoimmune disease and it has been established that there is a reduction in the numbers of circulating T lymphocytes during the exacerbation phase of Multiple Sclerosis. Although mercury is known to be able to cause autoimmune responses in rodents, this study does not provide any logical link between amalgam and Multiple Sclerosis, other than a superficial similarity of response mechanisms.

In making an assessment of a possible connection between Multiple Sclerosis and mercury poisoning, there is confusion because, both Multiple Sclerosis and chronic toxic exposure to mercury particularly target central nervous system structures and are manifested as neurological effects. Thus many of the
symptoms of mercury poisoning are similar to those of Multiple Sclerosis including early toxicity signs of weakness and fatigue, and later signs of advanced toxicity such as tremor, memory loss, ataxia and speech disorders. The correspondence of symptoms does not, however, indicate a common aetiology. Thus mercury is the cause of mercury poisoning, but mercury is not the cause of Multiple Sclerosis, the aetiology of which is as yet unknown.

*Factors to be considered in excluding mercury and amalgam restorations as a cause of Multiple Sclerosis:*

1. Although first identified as a distinctive disease in 1868 by Charcot, Multiple Sclerosis predates the invention of dental silver amalgam in c1818 and its general usage in dentistry which developed in the mid 19th century.

2. There is no evidence of an increased incidence of Multiple Sclerosis in those occupationally exposed to elemental mercury vapour and in whom high levels of mercury have been reported. In the dental sphere, dentists and staff have higher mercury levels than both the general unexposed population and those people with extensive amalgams, but not a higher incidence of Multiple Sclerosis.

3. Multiple Sclerosis is not limited to people with amalgam restorations:
   a. Multiple Sclerosis occurs in children and adolescents who have had no amalgam restorations and therefore mercury from dentistry cannot be the initiating factor for Multiple Sclerosis in these cases.
   b. Multiple Sclerosis develops in edentulous people who have no teeth and therefore no amalgam restorations. However, it must be accepted that
the teeth extracted may have been restored with amalgam and that prior exposure to mercury may have occurred. Nevertheless, the fact that edentulous people are not healthier than those with amalgam-filled teeth questions the claims of those who recommend removal of amalgam restorations as a treatment for Multiple Sclerosis.

4. Multiple Sclerosis is a highly unpredictable disease, marked by exacerbations and remissions which vary in degree and frequency. Thus to conclude that the cause of onset or an exacerbation of Multiple Sclerosis is the existence of or the placement of amalgam restorations and that the basis for a remission is the removal of same is highly tenuous. Additionally, the placebo effect is as high as 70% in Multiple Sclerosis patients (National Multiple Sclerosis Society 1983) and thus the assessment of improvement or deterioration requires rigorously controlled studies. None of the cases of Multiple Sclerosis supposedly caused by mercury from amalgam or the anecdotal cures resulting from amalgam removal have been supported by evidence of changes in the characteristic findings in Multiple Sclerosis seen in Magnetic Resonance Imaging (MRI), spinal fluid and evoked potentials.

5. Stress has been considered as a factor in the onset and recurrence of symptoms of Multiple Sclerosis. The possibility (even remote) that increased stress could affect immune response and be a contributory catalyst suggests that unnecessary surgery and anaesthesia should be avoided. The removal and replacement of multiple amalgam restorations is a protracted procedure involving extended periods in the dental chair and the injection of considerable
amounts of local anaesthesia. A large percentage of the population is apprehensive of dental treatment and for the person with Multiple Sclerosis there would be enhanced levels of anxiety and stress associated with these procedures.

6. The consumption of methylmercury in fish increases the body burden of mercury far more than the release of mercury vapour from amalgam restorations. Methymercury is also more toxic than mercury vapour. The daily consumption of fish in many parts of the world produces high levels of mercury in these populations, but no epidemiological evidence of increased incidence of Multiple Sclerosis.

7. There is no pathological or histological evidence that the neurological demyelinating process which is a characteristic of Multiple Sclerosis is in any way similarly produced by mercury poisoning.

Thompson (1986) in his review of dentistry and the Multiple Sclerosis patient concludes that: 'there was no bonafide scientific evidence that either mercury-silver amalgam restorations or correction of occlusal dysfunction has any bearing on the course of Multiple Sclerosis'.

In reviewing the replacement of mercury amalgam fillings as a treatment for Multiple Sclerosis the Therapeutic Claims Committee of the International Federation of Multiple Sclerosis Societies (IFMSS)(1988) concludes that: 'there appears to be no generally accepted scientific basis for use of this therapy. It has
never been tested in a proper controlled trial. It is relatively free of serious adverse side-effects during long-term use. It is very expensive.'

Dr Reingold, Vice President for Research and Medical Programs of the American National Multiple Sclerosis Society notes in a memorandum (November 1990): 'The theory that MS is in some way caused by amalgam fillings, and that their replacement can lead to a remission of the disease, has been present for a number of years. The reality is that there has never been a direct association made between amalgam and MS. Reports of remissions resulting from amalgam removal appear to be anecdotal and cannot be separated from placebo effect or spontaneous changes in the disease. There are many people with MS who do not have such fillings, and others with MS who have had amalgam fillings replaced with no demonstrated benefit. Additionally, MS as a disease existed well before amalgam fillings became commonly used in dental care.

The Medical Advisory Board of the National Multiple Sclerosis Society has concluded that there is no sound epidemiological evidence which relates mercury amalgam fillings to MS, and no sound clinical evidence, gained through controlled clinical trials, which suggests that replacement of dental amalgams leads to any improvement in MS.'

In an editorial in Dental Update (1986) the Editor states: 'The statements, made in the media, that dental amalgam fillings are harmful are both highly misleading and lacking in good scientific evidence to support them. The linking of mercury toxicity with symptoms mimicking Multiple Sclerosis is highly speculative and it is most improbable that the mercury levels from dental amalgam could lead to
neurological symptoms.'

The National Institute of Dental Research (NIDR) (1991) states: 'There is no scientifically sound evidence linking mercury in dental amalgam to multiple sclerosis, arthritis, mental disorders, or other diseases.'

People with Multiple Sclerosis and their loved ones are particularly susceptible to claims of curative treatment. The relationship purported to exist between Multiple Sclerosis and mercury poisoning hinges on a simplistic comparison of similar neurological symptoms with dissimilar aetiologies. For the desperate and afflicted this quasi-scientific thesis is reassuringly reasonable and many people with Multiple Sclerosis have little ability to objectively assess the legitimacy of these claims. It should therefore be clearly communicated to the Multiple Sclerosis community that there is no evidence that Multiple Sclerosis is associated with mercury poisoning from amalgam restorations. Additionally no benefit occurs to the person with Multiple Sclerosis by the removal and replacement of amalgam restorations.
18. DISCUSSION

In assessing the question of mercury toxicity from amalgam there is an interesting analogy within the dental arena of concerns regarding the toxicity of fluoride which might imply a more general social and political dimension to these controversies. This salient point has been emphasised by Akers (1989) and Chenoweth (1985) aptly notes that: "most of the present difficulties in the field of toxicology are not technical but political, psychological and sociological".

In this civilized and technical world there are many health measures imposed by governments, local authorities and health professionals which may appear to impinge on the rights of the individual. The chlorination and fluoridation of water supplies is a classic example, as may be the dental profession's general and optionless usage of amalgam. Notwithstanding society's medical excellence, diseases persist and the modern style of existence creates new symptoms and conditions which are yet to be resolved. There are thus fears within the community, almost archetypal in nature, of bureaucratic health impositions which might in fact be contaminating part or all of the populus.

*These misgivings are the domain of certain groups within the community:*

- the sincere (but unfortunately often obsessive) crusaders who make elaborate claims as to health dangers posed by certain substances. There are very few people who can claim a complete grasp of the specialised fields of knowledge involved in toxins and disease. Nevertheless there are, on the one
hand, experts in a single field making pronouncements in other disciplines and, on the other, lay generalists with a broad understanding of fundamentals making assertions in complex specialist areas. In many respects the arguments presented are as faulty in detail as they are mistaken in principle.

- the healers whose particular therapy offers cures for the multiplicity of symptoms and diseases not satisfactorily catered for by the medical establishment. It is often hard to ascertain whether these are charlatans, their fabrications purely for fame and profit, or genuine believers, they themselves as deluded as their patients as to the basis of their belief and the effects of their therapies. Outside of the holistic dentists who promote mercury toxicity from amalgam and amalgam removal there are a range of para- and pseudo-health professionals who are involved in the concept of disease by mercury poisoning; clinical ecologists, nutritionists, herbalists, homeopaths, chiropractors, naturopaths.

- the media, which in general shows contempt both for the public and for the truth. There is thus a vehicle for the recycling of the revelations of those mentioned above which is exaggerated and simplified for easy and gratuitous consumption;

- some members of the community whose perception and attitude finds satisfaction and credibility in these types of claims. This is particularly so of those who are critical of imposed authority, establishment values, and particularly cynical of the ethics of the healing professions. For some, perhaps,
there is a willingness to personally accept far greater danger than is acceptable to be imposed upon them from another source. While challenging orthodoxy is healthy and valuable, the unquestioned embracing of alternative claims and cures seems more a social posture than a reasoned judgement. In addition to its human effects, mercury is also an environmental pollutant. Thus environmentally oriented individuals and groups become concerned with the ecological impact of mercury which indirectly adds a measure of credence to the anti-amalgam claims;

- the sick, whose search for therapy must encompasses all possible avenues. Unfortunately, irrationalism born of hope never dies - which accounts for the continued existence of those who offer remedies. This also explains the anecdotes recounting miraculous cures which are always paraded as supporting evidence of claims and therapies, but which are usually the result of short-term placebo effects, natural remissions, and psychosomatic considerations.

In discussing the above groups and their contribution to the mercury from amalgam debate it is relatively simplistic to explain the phenomenon as a combination of naivete, gullibility and confused logic, with the lack of scientific expertise and less than objective reasoning producing false conclusions. Perhaps it is just that, as sentient beings, there is an unwillingness to accept that certain configurations of our lives are as yet unknown. There is a need to create patterns out of randomness, and then impart meaning to the pattern.
For the quacks and charlatans it is probably fair to say that when the cited evidence is deficient and yet the conclusions have grave and significant implications, there are perhaps motivations which are other than a concern for the truth.

However, as in the fluoride controversy, there are a few groups of respected researchers within the established scientific community who continually report data which gravely impugns the safety of amalgam. Some of these results have been questioned and even discredited by a larger and diverse number of similarly well respected researchers. Where a scientific impasse exists there is the obvious need for objective and independent research to duplicate and either validate or refute these findings. However, there is also a question as to why these few groups (the prime example being the "University of Calgary Group" comprising researchers Vimy, Lorscheider, Hahn, Summers), having established an anti-amalgam stance, seem to be able to produce data from varied animal and human experiments which repeatedly support this position. Numerous articles printed in diverse publications, with members of teams rotating as primary authors, gives a bulk of literature, apparently of independent source, producing similar results. Katz (1991) criticises the results of the studies at the University of Calgary as not being peer-reviewed and according to the FDA, very flawed.

Perhaps there is in these cases the cardinal fallacy that, once having predetermined the conclusions, both the method of research and the manner of argument become selective and manipulative in order to satisfy and justify the fixed equation. This comment may of course have a wider application and just
as legitimately apply to some members of the scientific and dental establishment (for whom change is an anathema and who seek to preserve the inertia and hierarchy of the status quo) as to the radicals and dissenters (whose desire for change can be an anarchical response to those who have become self-satisfied and sedentary, and so consuming as to become logically inconsistent).

Beyond the emotional and sensational, there is little to substantiate the basic claims made by the hard-core anti-amalgamists such as Huggins and his Toxic Element Research Foundation and the Ziffs and their Bio-Probe Incorporated:

1. Mercury escapes from amalgam in significant amounts;

   There is mercury released from amalgam, but the levels are low and there is simply no evidence that it is either significant in quantity or in effect.

2. WHO Threshold Limit Values are exceeded by the mercury which escapes from amalgam;

   There are no proper general population thresholds for chronic exposure to mercury vapour, but WHO occupational levels are not exceeded.

3. Mercury from amalgam is in sufficient quantities to impair health;

   There is no evidence of ill health being a consequence of mercury release from amalgam. The rare cases of contact allergy to amalgam and oral lichenoid conditions are not confirmation of any widespread community health damage.

   There is no proof that the human immune system is affected by the mercury released from amalgam.
4. Elemental mercury is one of the deadliest poisons known to man;

The elemental mercury vapour released from amalgam is one of the most toxic forms, but less toxic than methylmercury consumed in fish. In negating the claims of the anti-amalgamists, the inherent dangers of mercury in all its forms cannot be ignored.

5. The human body can methylate elemental mercury;

This rather important plank in the mercury toxicity platform is total conjecture and has not been validated. The human body does not methylate inorganic mercury. This assertion had allowed an inclusion of all methylmercury in the body (with its attendant high neurotoxicity and reproductive sequelae) to be inferred as a consequence of inhalation of mercury vapour from amalgam. In this way all the repercussions of methylmercury poisoning (birth defects etc) could be laid at the door of amalgam. The reality is that all methylmercury in the body is from fish consumption.

6. Inorganic Mercury in the body (in the absence of occupational exposure) is mainly due to mercury from amalgam;

A body of recent research, which shows that demethylation of methylmercury contributes to a major proportion of the body's inorganic mercury levels, confounds the claim that the bulk of inorganic mercury in the body must come from amalgam mercury release. This means that the inorganic mercury in the body could be derived from both inorganic and organic
7. Mercury from amalgam is harmful during pregnancy, causes stillbirths and malformations and retardation;

   Only methylmercury has been shown to have these effects. Methylmercury is not a consequence of mercury release from amalgam.

8. Mercury from amalgam accumulates in brain, thyroid and pituitary glands;

   Mercury does target the central nervous system, but the source of the inorganic accumulation is not necessarily and solely amalgam. In spite of this there seem no clinical effects as a consequence of mercury accumulation in the brain which may emanate from amalgam.

9. Oral galvanic impact from dissimilar metals in the mouth (including amalgam) is a serious concern;

   There is no evidence that, if oral galvanism exists, it produces any damage to health.

10. Removal of amalgam improves health;

    Only anecdotal reports make these assertions and no studies have shown any improvement in health states, diseases, or symptoms by the removal of amalgam restorations.
Research in the next few years will clearly identify whether:

a. the dental and scientific community have complacently supported an
enshrined dogma of amalgam safety such that opinion and research has
continually confirmed what was believed to be true or
b. those who claim mercury poisoning from amalgam restorations have
created a grand fiction from modest facts. The presumption of guilt has
allowed misrepresentations and misinterpretations to colour the debate
such that untenable assumptions and conclusions have maligned a long
standing and historically satisfactory dental therapy.

The bulk of evidence currently favours the latter interpretation.

Unlike fluoride (which in large doses is toxic, yet in small doses is safe and has
a profoundly beneficial influence on tooth structure), mercury has no redeeming
biological features for the human body and should be avoided. The therapeutic
margin (the difference between a therapeutic and toxic dose) for fluoride is wide
whereas for mercury there is little therapeutic value (it being a weak
antimicrobial agent) and threshold levels (particularly for mercury vapour) are
not satisfactorily established.

It is important that amalgam restorations be seen as a therapeutic modality in
the same light as medical applications which contain mercury (e.g. skin
lightening creams, topical antiseptics etc). There has been a tendency for the
dental profession to view amalgam as a static prosthetic implant in solid tooth
rather than as a form of medication. However, amalgam is not inert and the site
is human tissue, and thus consideration of the use of amalgam in humans should
be approached in the same way as medical applications containing mercury. The health considerations by which medications containing mercury are being selectively excised from medical practice should also be applied to dental applications containing mercury. There appears to be a paradox in comparing the therapeutic value of the amalgam restoration in the dental field with the lack of therapeutic value (and potential toxicity) of the mercury which it contains.

Avoidance of mercury altogether is not possible.... natural as well as polluted sources in soil, air and water ensure that a background level exists. Additionally it is impossible to avoid some level of intake from foods. The inorganic mercury in non-fish foods is poorly absorbed and is thus less consequential than fish foods which constitute the major source of retained dietary mercury, almost all of which is the highly toxic methylmercury.

It must be acknowledged that from current data available some mercury vapour is regularly entering the body from dental amalgam restorations by the respiratory route when mouth breathing occurs. The important considerations which stem from this fact are whether the levels of mercury taken into the body from this source are significant, add measurably to the body burden of mercury, are toxic to the extent of causing mercury poisoning and the cause of disease states.
Compared to mercury intake from other sources the quantities are small, but must be weighted due to the repetitive nature of the exposure and the toxicity of mercury vapour. Nevertheless, many people and populations regularly consume fish containing methylmercury in far higher concentrations than that of mercury vapour released from amalgam restorations and, in the case of the methylmercury, more is retained and it is far more toxic than mercury vapour. The possibility of further increased community methylmercury exposure exists because there is a worldwide trend to more regular fish consumption because of health benefits accruing from the Omega-3 essential fatty acids which are at high levels in fish. Many National Heart Foundations and official health organizations recommend increased fish meals per week as part of a balanced diet, with the aim of a reduction in saturated fats and an increase in marine unsaturated oils.

Symptoms of mercury toxicity may reflect organic or inorganic exposure or a combination of both. Both methylmercury and inorganic mercury vapour have a specificity for the Central Nervous System. There are subtle differences in symptoms [See Section 5.1 & 5.2] but, because of ultimate demethylation of much of the methylmercury in the body to inorganic mercury, the final clinical effects may represent a combination of the effects of inorganic and organic forms of mercury. The various symptoms reported as being a consequence of mercury released from amalgam do not fit any recognised pattern or progression of mercury toxicity. Many of the non-specific symptoms may reflect a vast panorama of alternative disease processes, psychological manifestations and, as
well, mirror toxicities from other elements and heavy metals. Clarkson (1987)
states: 'Inorganic compounds of aluminium, lead, lithium, manganese, mercury and
thallium are well known for their neurological and behavioural effects in humans.
The alkyl derivatives of certain metals - lead, mercury and tin - are specially
neurotoxic. The most severe damage (to the nervous system) is produced by organo-
metallic forms such as methylmercury.'

Huggins claims that 67% of the population (presumably a figure representing all
those with amalgam restorations) show symptoms of systemic mercury toxicity.
Yet, in the descriptions of "mercury toxicity" and the cases cited, there is little
mention of classic mercurial tremor, a symptom which would be prevalent if such
a vast proportion of the population exhibited the toxic effects of mercury
exposure.

One major area of concern in regard to alleged symptoms from mercury
poisoning from amalgam relates to mild neurological effects. Although it is
accepted that a proportion of mercury, from whatever source, targets the brain
and is retained for many years, little is known as to how neurological symptoms
are produced and what level of tissue or cellular concentration can be accepted
without neurological deficit. The efficiency of the body's cellular defence
mechanisms is characterised by the fact that even though the pituitary and
thyroid glands have been shown to retain remarkably high concentrations of
mercury there is no evidence that their function has been compromised.
The relationship between mercury release from amalgams and uptake by the body is obscured by uncertainties about analytical quality control, sampling methodology, breathing patterns and dilution with inhaled air. There is controversy as to the actual amount of mercury vapour released from amalgamrestorations on a daily basis, and the relationship of this to physical indicators such as blood, and urine, which are traditionally more indicative of the degree and extent of exposure to mercury vapour. The effects of mercury poisoning are reasonably explicit where large doses are involved, but the vague and non-specific symptoms which are equated with lower levels of mercury exposure are neither distinct nor exclusively characteristic of mercury poisoning.

If amalgam restorations contribute to mercury poisoning, it can only be in terms of the uptake of mercury vapour thus released. The effects of inorganic mercury ingested in saliva are negligible in comparison with that from mercury vapour, only a fraction being absorbed and being less toxic.

Perhaps the most telling evidence for the relatively innocuous nature of the mercury vapour from amalgam is found in studies done on dental personnel who can be exposed to significant amounts of mercury vapour in the surgery (to which must be added the mercury from their own amalgam restorations). Despite having urine mercury levels 3-5 times higher than the average population, blood levels 2-3 times the normal and mercury levels in surgery air up to the maximum accepted threshold occupational level of 50 μg/m³, dentists and their assistants exhibit no elevated levels of morbidity and mortality.
As an example of provisional tolerable weekly intake, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) [See Section 6.4] established a Provisional Tolerable Weekly Intake (PTWI) which allows 43 μg of total mercury consumption per day of which no more than 28 μg should be methylmercury. Given the toxicity of methylmercury, the probable 1-3 μg/day of mercury vapour released from amalgam restorations presents little threat. This contribution of amalgam restorations to the body burden of mercury is probably equivalent to approximately 10-20 μg from general foods but minimal in relation to the consumption of methylmercury via fish which is often in the range of 20-30 μg/day. The comparison with methylmercury is particularly significant because of the similar uptake factors (mercury vapour 80% and methylmercury 95%), whereas only 7% of inorganic mercury compounds (found in non-fish foods) is absorbed into the body. There is grave doubt that the mercury released from amalgam could actually cause symptoms of micromercuralism or mercury toxicity. There is simply no scientific evidence which identifies any symptom of ill health, or particular disease state which can be causally related to the effects of mercury released from amalgam.

Berlin (1986), in discussing the consumption of 10 μg/day of inorganic mercury in non occupationally exposed populations, states: 'Some contribution may result from the release of mercury vapour from dental fillings if these are present. This figure is low in relation to the possible intake of methylmercury.'
It is an important global health consideration that human mercury consumption be qualified and quantified. Mercury poisoning should be a legitimate concern of all health authorities... examples of pollution and occupational excesses indicate clearly that threshold levels do exist and toxic levels of mercury can be reached, producing overt disease symptoms. The inherent dangers both to the environment and to people that can accrue from the industrial use of mercury may result in actions by governments limiting or completely restricting its use. As an example there is currently a proposal in Denmark to ban the use of amalgam from 1999 as part of an environmental prohibition on Mercury.

Research indicating dosage which produces preclinical changes in neuropsychology and neurophysiology confirms the urgency for threshold levels to be reassessed. Caution should be applied in the case of treatment of pregnant women with amalgam, but this should not be seen as proof of mercury poisoning, but as a sensible health measure undertaken as a precaution until better data is available and threshold levels are clearly enunciated. The concerns with the effects of mercury on the foetus may well relate only to organic mercury.

There are complexities in evaluating the sources and forms of mercury which contribute to the body burden of mercury. There is transformation of organic mercury into inorganic mercury within the body and the reverse process in the environment. Not all mercury in fish is methylmercury, the contribution of industrial pollution adding inorganic mercury to the calculations. Thus inorganic mercury levels in brain, blood and urine may arise from fish sources as well as
from demethylation. It is simplistic and erroneous to apportion the bulk of body inorganic mercury to the release of mercury vapour from amalgam. All sources of mercury must be identified and incorporated into the assessment of the body burden of mercury and only at that time will we know the real contribution of dental amalgam. At this stage it appears mercury from dental amalgam is a minor contributor to the levels of mercury which many people are currently routinely exposed to, and which fortunately appears to cause little evidence of mercury poisoning or ill-health.

There is only an unproven and speculative relationship between mercury exposure due to amalgam restorations and the generalised and non-specific syndromes which claim mercury from amalgams and subsequent mercury poisoning as the cause. In the absence of objective data showing a direct and sequential relationship between amalgam restorations, mercury toxicity and disease states, there currently exists no need to restrict the use of amalgam as a routine dental restorative material. There appears no justification for gross replacement of amalgam restorations. Claims of improvement after replacement of amalgam fillings are usually anecdotal and with no control for potential placebo effects and observer bias.

Nevertheless there is validity in the premise that mercury (as with many chemicals) is inherently dangerous to the human system and exposure should be minimised. Even though the levels of mercury vapour taken up after release
from amalgams are low, it is of concern that there are no precise and accepted safe levels of mercury consumption for the general population and particularly for pregnant females, young children, the aged and the infirm. Therefore, without detracting from the usefulness of amalgam in dentistry, suitable alternative materials and treatment modalities should also be considered when amalgam restorations fail and require replacement. Again, in the case where a new restoration is required, informed consent is obligatory where amalgam is the restoration of choice.

The future for amalgam is pleasantly bleak in a number of respects. In the first place it will in time be superseded by materials which are more biocompatible and have adequate function and longevity, as well as improved aesthetics. In the second place in countries where fluoridation of water supplies has been instituted the affected population show minimal caries and require far less restorative treatment. Thirdly, a better educated and health conscious population will maintain a higher standard of oral health. Fluoridation of water supplies plus appropriate regular preventive care (both professionally in the dental surgery and personally at home) should create a community for whom dental caries and the ensuing restorative process is a rarity. The routine need for restorations only exists if the prevention of caries fails.
The great value in the current controversy is that it alerts the dental profession to a possible problem with mercury as a constituent of amalgam restorations. It is the responsibility of the dental profession to ensure that any treatment provided to the public is beneficial and safe. Rigorous legitimate scientific research coupled with objective clinical assessment will eventually resolve the questions surrounding mercury release from amalgam. We need to know exactly how much mercury is released from amalgam restorations in humans, the uptake dosage, the effect this has on the body burden and the clinical significance as an element in mercury toxicity and disease states. At this stage we only know that mercury is inherently toxic and that small doses of mercury are released from amalgam. All else is supposition and speculative association. Nonetheless, the long and successful use of amalgam as a restorative material does not permit rank dismissal of valid inquiry, nor should it encourage professional complacency. In refuting the gross assertions of the anti-amalgamists there is the lesson that "rigid" and "inert" are not satisfactory characteristics to describe amalgam and nor should these qualities portray the professional approach to the health service provided to the dental patient.
19. RECOMMENDATIONS AND CONCLUSIONS

1. Although there is measurable mercury released from amalgam restorations, no evidence of mercury poisoning has been established as a consequence of this. Additionally, no causal link can be substantiated between the mercury released from amalgam restorations and diverse symptoms of ill health and disease states. There is no substance to the claim that Multiple Sclerosis is related to mercury release from amalgam restorations.

2. Dental personnel constitute a select group whose mercury vapour exposure is significantly higher than the general population and yet who show no particular evidence of mercury poisoning or unusual levels of ill-health.

3. There is need for further research to establish not only the exact amount of mercury released from amalgam restorations into the oral environment, but to what degree this is taken up and incorporated into the body and its ultimate distribution and fate. There is need for the development of accurate measuring and analytical tools to measure low levels of mercury and for speciation of the different forms of mercury.
4. The release of mercury from amalgam must be considered in the broader panorama of mercury as it impacts on humanity. The contribution of methylmercury from fish sources constitutes a far greater factor (both in terms of quantity and toxicity) in the human burden of mercury than does mercury from amalgam.

5. There is a requirement, given the varied sources of human mercury intake, to clearly distinguish at what level of mercury exposure (particularly in respect of mercury vapour) the earliest evidence of toxicity occurs. Testing for subtle neurobehavioural effects should particularly target those occupationally exposed with special attention to the occupationally exposed dental fraternity and their offspring. There needs to be verification of the results of animal studies which have reported widespread dissemination of mercury throughout the body from amalgam implants and the possibility of auto-immune reactions to mercury. There is need for further research to assess the prevalence of true hypersensitivity and allergic responses to the constituents of dental amalgam.

6. Authentic allergy or hypersensitivity to the constituents of amalgam is a rare occurrence and only affects a very small group within the population. Contact allergic reactions are not evidence of mercury poisoning (micromercurialism, mercury sensitivity) which involve systemic parameters. There is consistent data indicating that oral lichenoid lesions may be causally related to the components or the roughness of amalgam restorations. It should be noted that there is a far greater incidence of hypersensitivity to nickel in dentistry than there is to mercury.
7. There is no therapeutic value in the removal of amalgams except in the rare cases of true allergy or hypersensitivity to the constituents of amalgam. No disease states or symptoms of ill-health are improved by the removal of amalgams. In general, amalgam restorations should only be removed when they fail.

8. There is no justification for the exclusion of amalgam from the repertoire of dental materials offered to patients. The benefits and disadvantages of both amalgam and alternative materials should be discussed as part of the treatment plan where restorative dentistry is intended. Informed consent is important in respect of planned amalgam restorations as with all forms of dental therapy.

9. Accurate threshold levels for mercury exposure need to be established for the general population and for the vulnerable members of the community - children, the foetus, the aged and the sick. While there is no evidence at all that mercury vapour from amalgam restorations causes any adverse effects on the developing foetus, a more cautious and restricted approach should be taken by the dental profession to the removal or insertion of amalgam restorations in pregnant women and in young children until such time as proper exposure standards for all forms of mercury for these sub-groups have been determined.

10. Preventive dental health measures should be reinforced in order to minimise the need for all dental restorative procedures.
11. The health professions should aim to exclude mercury from all therapeutic treatments. In the light of current knowledge the mercury released from dental amalgam does not constitute a threat to human health. Nevertheless, mercury has no biologic benefit and efforts should be made to provide alternative and more biocompatible dental materials to ultimately offer a genuine replacement for amalgam in dentistry.

12. The dental, medical and scientific communities should be more aware of the vigour and diversity of anti-amalgam sentiment and the accompanying substantial bulk of aggressive literature promoting the danger in dental amalgam. This perspective is regularly highlighted and even legitimised by sections of the media who readily sacrifice scholarship for sensation. These claims of symptoms and diseases being caused by mercury poisoning from amalgam restorations impact, not only upon those who are ill, but upon a very large percentage of the general public who have amalgam restorations. Within this larger group there are normal concerns regarding health and, because most people have periods of less than optimum well-being, the safety of amalgam may be questioned. The dental and medical professions, particularly, must address the fear and confusion that surrounds this subject, and ensure that their patients, and indeed the whole community, receive a balanced and educated overview of the matter.

13. Continued rigorous, objective scientific research should be fostered to clarify the role of mercury in human health. Within these broad parameters, there will ultimately be precise attribution of the contribution of that mercury which is contained in dental amalgam.
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