

A proposal of Collegial Expertise



**The mercury problem in the Amazonian area
Influence of anthropic activity on the contamination of man and its
environment**

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I - INTRODUCTION

The Minamata catastrophe, which occurred in Japan in the fifties and produced severe neurological - and often irreversible-disorder due to regular consumption of fish contaminated by methyl mercury, comes back to memory whenever the use of mercury in gold mining activities in the Amazonian area and its spreading in the environment are evoked.

Can new « Minamata » sources be feared in the Amazon ? Are there already any? Is there a real mercury problem in the area and how must it be formulated?

At present, no accurate answer can be offered these different questions in spite of numerous previous studies. Yet quite a number of results presented at the Vth Congress, held in Rio de Janeiro in the end of may, have allowed the mercury problem to be put into new terms as far as environment and human health are concerned.

The three following facts have been put forward:

- (1) the Amazonian soils contain natural reserves of mercury that widely exceed those usually attributed to gold-mining activities and these reserves also originate the production of methyl mercury, especially in flood-plains
- (2) man's intervention furthers the mobilization of these mercury reserves (deforestation, fires) and the creation of methylation sites (deforestation itself, dam lakes)
- (3) the health of populations that eat contaminated fish is altered at far lower contamination levels than those that entail clinical signs, specific to mercury poisoning.

Now it is a matter of reconsidering the mercury problem by gathering all available knowledge not only of man's contamination and its physical and biological environment, but also the anthropic modifications of the mercury biogeochemical cycle. Hence, the need to approach the different socio-economic aspects linked to man's activities that alter this cycle by destroying the soil and its vegetal cover and, as far as gold-miners are concerned, by the direct introduction of mercury in the environment.

In essence, Collegial Expertise, which consists in gathering a college of the best experts, corresponds exactly to this type of exercise. The expected result is a synthesis to be used to formulate the gestion of decisions about environment and health. The Collegial Expertise should also lead a debate to be established among the different protagonists, at various scales ranging from local level to Amazonian Basin.

II - THE PROJECT CONTENT

The expertise may be conducted about three great interdependent themes:

- (1) activities altering the mercury cycle in the environment, especially gold-mining and the socio-economic effects of these activities, as considered in a historical perspective
- (2) mercury spreading into the biological and physical environment, environmental conditions transforming it into an active polluting agent and the impact of its toxicity on biocenoses
- (3) mercury levels in man, the impact of its toxicity and control standards.

1 - Activities altering the mercury cycle in the environment, their socio-economic effects as considered in a historical perspective

Gold mining in the Amazon is not a recent phenomenon. The search for gold and silver developed in the XVIth, XVIIth and XVIIIth centuries, following the Spanish colonization, especially in Bolivia and Peru. Since the start of the XIXth century plenty of discoveries have followed, ore exploitation and processing have changed, according to technical progress. The only permanent feature has been the use of mercury to enrich gold-ore, thanks to its amalgamation propriety. Yet social, economic and political contexts have directly influenced the amount of mercury disseminated all the while. They have imposed restraint on the number and size of exploitations and the way of using mercury, depending itself on the size of these exploitations. Consequently, the story of gold-mining and the evolution of techniques, as well as the analysis of the main socio-politico-economic factors which have accompanied this activity, seem unavoidable in the establishment of an exhaustive expertise of the matter.

The colonization of the Brazilian Amazon has been increasing since the early seventies and has entailed a bloom of mining activities including gold-mining, deforestation and clearing, road building and damming with hydroelectric views.

At this level, the expert evaluation aims at realizing:

- a review of the different mining activities (gold-mining and other) and deforestation, as well as the important road building and hydroelectric development to get a more complete view on the colonization of the environment over the time. The various economic and political contexts which have succeed one another will be simultaneously analyzed and the links established with the local populations will be taken into account.

- a statement of the evolution of gold-mining techniques. The amount of mercury disseminated in the environment (atmosphere, soils, sediments, surface and underground waters) is more or less important depending on the processing used. So, it seems quite judicious, especially as concerns French Guiana, to draw up a typology of old and recent processing modes. This will *in fine* permit to describe the different categories of mining development of today and the corresponding means used, as well as to precise the importance of the pollution ensuing the mode of processing.

All the data required in this section should contribute to a better definition of the norms relative to the control of mining activities.

2 - Mercury spreading in the physical and biological environment, its transformation into an active polluting agent and the impact of its toxicity on biocenoses

The biogeochemical cycle of mercury is in many ways more complex than that of any other heavy metal, equally toxic. It is the only one (with lead) to include an atmospheric phase, because of its high volatility. Its dissemination from a given source into the environment is difficult to outline and to delimit. It is more the result of atmospheric than fluvial transport. Secondary mercury emissions, such as mercury that has been laid down, transported by rivers or coming from atmospheric fallout, can be added to atmospheric, anthropic and natural primary emissions. Consequently, the mercury mobilization/demobilization is continuous and its spreading out can go on because of both old and recent stocks, be they anthropic or natural. Under certain environmental circumstances, mercury changes to methylated form which can get into cells easily and accumulate there (bioaccumulation). What is more any prey acts as a mercury «pre-concentrator» for any predator (biomagnification). The interaction of these two multiplying

phenomenons makes that the methyl mercury concentration in man (located at the end of the food chain as a fish eater) is of the order of 10^5 to 10^7 times as high as in the environment. Methyl mercury destroys or damages, according to the amount absorbed, the central nervous system of superior organisms.

According to these few considerations, it seems that this section of the evaluation must give as much importance to the natural stocks of mercury contained in the soils, if not more, as to the direct supply of mercury due to gold-mining. The question is also, not only of listing down the levels of contamination in the physical and biological environment, but also of assessing our knowledge of the process controlling its spreading and toxicity. What are the environmental circumstances that favor the remobilization of mercury in the soils and in old and recent deposits due to gold-mining? What are the environmental circumstances that favor mercury methylation/demethylation. Two fundamental questions which developers need accurate answers to.

As concerns this section, the collegial expertise proposes to establish the following assessments :

- the mercury emissions in the environment,
- the distribution and speciation of mercury in aquatic environment,
- the distribution of mercury in biocenoses, especially in fish,
- the ecosystems magnifying mercury toxicity for man (sites of mercury methylation such as dams, flood-plains, wet lands, deforested areas...),

The conclusions of these various assessments are fundamental to anticipate the evolution of the toxic impact of mercury depending on various ways of developing and exploiting the environment. Unfortunate measures can rouse mercury toxicity, or at least, increase it.

indicators (plants, animals).

As a conclusion, this section of the evaluation will review the possibilities of following through processes and interactions linked to the existence and diffusion of mercury in the environment. They may concern networks of measures, observatories, or biological

3 - Mercury levels in man, the impact of its toxicity and control standards

There are two « target-groups ». The populations who rely on fish for a great part of their food are exposed to methyl mercury toxicity. The workers, exposed to the fumes of the metal mercury, some on the mining sites when they destroy the gold/mercury amalgam under heat, others, on the selling spots during the last process of gold purification .

The amount of mercury found in man does not only depend on the amount of mercury entering the organism but on its chemical methylated or metallic form as well. It also depends on age, sex and diet, so that important interindividual variations are to be observed.

The mercury level is measured by biological samples, mostly of hair and blood. The measuring out in hair is well adapted to the study of chronic accumulation in the population in general. The measuring out in blood, which often shows more recent expositions, is to be favored among people professionally exposed. The contents, however, greatly vary with time.

The consequences of methyl mercury poisoning among adults cannot be compared either quantitatively or qualitatively with the consequences on prenatal life or on children. There is a phenomenon of some 20 to 30% concentration of methyl mercury in the red blood

corpuscles of the newborn baby as compared with the mother's. Thus, the notion of risk differs according to the people's ages.

The adults' symptoms are essentially neurological with damage to the nervous system, partial blindness, auditive loss, loss of muscle strength. The most frequent signs among newly born babies are microencephalitis, uncontrollable shaking, paralysis, fits and deformities.

The symptoms linked to professional exposure to mercury fumes during gold-mining activities are as follows: irritated respiratory tract, mouth ulcers, kidney disease for severe poisoning, headaches, loss of appetite, changes of personality, fits of shaking, intellectual damages, allergic rashes for chronic poisoning.

A great number of studies have been carried out so as to establish the link between methyl mercury supplied in food, some biological exposure indicators and the appearance of early clinical signs of poisoning. Some doubts remain as to the dose that may originate subclinical troubles especially among high-risk groups such as pregnant women and foetuses that are especially sensitive to methyl mercury as previously evoked. The tolerable weekly dose fixed by the W.H.O. (200 µg methyl mercury) does not take these intergroup variations into account. What is worse, this dose based on a western world diet cannot apply to an Amazonian diet that includes a daily intake of fish. New surveys show that in these high-risk groups the thresholds of tolerance have to be revised and lowered.

The expert evaluation is intended to propose:

- a review of the mercury impregnation in man distinguishing two great groups : fishing communities eating their catch poisoned by methyl mercury and the populations that inhale mercury fumes during gold-mining activities or during the ultimate gold purification. The notion of early symptoms must not be ignored. The clinical alteration which lead to Minamata disease are just the tip of the iceberg
 - an exhaustive inventory of the methyl mercury toxic effects on the former population and those of the gaseous metal mercury on the latter group
 - a review of data relative to a dose-effect relationship distinguishing these two modes of poisoning and taking into account the intra-population variations
 - a revision of the thresholds of toxicity accepted today (weekly doses for example) by fitting them according to the forms of assimilated mercury (methyl mercury, mercury fumes), to contamination duration, to age, sex and high risk-groups (such as those of pregnant women)
 - propositions of new differentiated tolerance norms. This part of the evaluation which will provide an objective estimation of the impregnation of various endangered populations and of the sub-clinical signs they show will be a precious auxiliary for the development of a general policy of surveillance and sanitary treatment. Recommendations and preventive measures (protection against the inhalation of mercury fumes, modification of eating habits), effective in the short run may also be deduced. Other measures will have to be taken in the long run so as to solve the problem of the environmental contamination.

III - EXECUTION STRATEGY

The first stage will consist in acquiring data in the three considered sets of themes (anthropic activities and their socio-economic dimensions, passive and active pollution of the environment due to mercury, human contamination by mercury and derived health problems). The effort will focus less on the elaboration of an exhaustive inventory of the

Amazon as a whole, than on the identification of the actual problems and their formulation within the decision-makers' reach. Therefore the data research will essentially focus on Brazil, Surinam and French Guiana. The handicap due to this geographic limitation is of minor importance since most of the problems are set in similar terms in the different Amazonian areas.

The expertise, organized according to themes and countries, will be realized by 12-15 experts.

Five steps are programmed:

1 - An initial three-days workshop in Cayenne, intended to go deeper into the question, collectively, to adjust the documentary research and to divide it into individual contribution.

2 - A first four-month phase devoted to the bibliographic research of data followed by a second three day-workshop in Cayenne with a view to confronting the various contributions, to harmonizing the contents of a single theme or the interlocking of distinct themes and to planning further bibliographical research.

3 - A phase concluding individual two-month contributions closed by a third three-day workshop to carry out the synthesis and write the final report.

4 - A seminar in Cayenne, in order to reconstitute the expertise, gathering three experts and about fifteen decision-makers and operators coming from border countries. This meeting will be used to analyze the various interpretations of the document according to responsibilities and commitment. A cross analysis of the different stakes should allow to graduate the problem and to bring first aid to the decision process.

5 - The production of a final document, within the three months following the seminar, recording its results as short term recommendation and long term suggestions of concerted actions as well.