often magnesium-deficient, and Heggtveit, Herman and Mishra[12] have demonstrated in magnesium-deficient animals myocardial lesions that resemble those found in man.

Chronic alcoholics are particularly susceptible to infection and it has been suggested that the chronic disease of the myocardium represents a burned-out stage of viral myocarditis.[13]

Although there is evidence to suggest that alcohol does have a toxic effect upon the myocardium and can also cause acute myopathy,[14] in our present state of knowledge it is difficult to differentiate the roles played by alcohol *per se* and the associated nutritional and metabolic disorders accompanying chronic alcoholism.

One can speculate that chronic ingestion of large amounts of alcohol renders the myocardium more susceptible to damage by various drugs and viral and chemical agents which in a non-alcoholic would not be harmful to the myocardium. The Quebec study of beer-drinkers' cardiomyopathy provides some support for this thesis, since absorption of cobalt, which is of low myocardial toxicity, produced serious myocardial derangement in these patients, who consumed large quantities of beer containing cobalt. The low incidence of the disease among persons who drank cobalt-containing beer is probably a reflection of the low myocardial toxicity of this substance.

If the "alcoholic myocardium" exhibits increased susceptibility to damage by one agent, it may be similarly susceptible to damage by other chemicals and drugs.

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THE MYSTERY OF THE QUEBEC BEER-DRINKERS' CARDIOMYOPATHY

EVERYONE is attracted by a mystery. A medical mystery—the appearance of a rare, frequently fatal disease, previously unrecognized anywhere in the world—has its own peculiar frightening fascination. Our interest is heightened when we can follow tireless, intelligent investigators as they identify the cause, eliminate it, and thereby eradicate the disease. All these elements are present in the story of the Quebec beer-drinkers' cardiomyopathy.

An epidemic is easily identified as such when a large number of similar cases appear suddenly in a community. But in Quebec City four patients were admitted to hospitals in the first month (August 1965); one patient was admitted in September; eight in October, and then a few patients each month for six months (never more than nine patients in a month). It was not easy to suspect an epidemic, particularly when the patients were admitted to eight different hospitals under different physicians.

Fortunately, in this respect, a majority of the patients were admitted under the care of three Quebec physicians, Drs. Yves Morin, André Têtu and Gaston Mercier. Common factors, both clinical and pathological (from biopsies and autopsies), soon became apparent. The victims were mostly men; all were heavy beer drinkers and had been so for many years; no one under the age of 25 years was affected; the symptoms had been present in some for only one day, in the others rarely more than one month; often the disease killed quickly, killing almost one of every two admitted to hospital (mortality 46.1%). But there were disparate elements to this disease. Other beer drinkers drank the same beer; drank just as much and had been drinking just as many years; ate the same diet, and yet were not affected at all. Those who were stricken usually died or were desperately ill, and recovered only after a struggle for their lives; there were no known mild cases—it was an "all or none" disease.

By early 1966 (January) the victims, their relatives, their friends, shopkeepers and bartenders had been questioned many times by epidemiologists and others. It was apparent that one type of beer had been the only kind consumed by the majority of the diseased or dead victims. It was not until March 1966 that exaggerated reports in the daily press of "hundreds of deaths" brought about organized action. A committee was appointed under the chairmanship of the Deputy Minister of Health for Quebec. It included members of the Department of Forensic Medicine of Quebec's Ministry of Justice, epidemiologists of Quebec's Department of Health, members of the Food and Drug Directorate of Ottawa, a toxicologist and biomedical researcher from a brewery, pathologists from l'Hôtel-Dieu de Québec, and even mem-

bers of the provincial police. The secretary of the committee, who played an important role as liaison officer between the various clinicians, was Dr. Hugues Milon, at that time resident in medicine at l'Hôtel-Dieu de Québec.

The committee's task was formidable: (1) What caused the epidemic? (2) Why did it affect those particular persons? (3) Why was there such a high death rate? (4) Most important, how could it be stopped? Answers to most—but not all—of these questions were uncovered.

With the help of laboratories both in Quebec City and Montreal, a viral etiology was ruled out. There had been arsenic poisoning of beer drinkers in Manchester in 1900—was arsenic now killing Quebec citizens? A search for arsenic was started. This sounds easy to do until one remembers that, in the chemical search for arsenic, nail and hair clippings are needed—not easy to obtain, when most of the people from whom specimens were required spent all their days in various taverns, their nights anywhere and everywhere—they had no fixed addresses. Nevertheless, this was done; no arsenic was found! One by one, other toxic agents were eliminated by examinations of the beer and/or of the patients or specimens from them: pesticides, insecticides, alpha toxins, ergot alkaloids, papain, bromine, various metals such as magnesium, phosphorus, copper, iron, manganese, zinc, aluminum, platinum, silver, bismuth, cadmium and radium. All were sought; none were found. "Goof balls" and other drugs were similarly excluded; evidence from survivors or their relatives did not suggest the use of these menaces. But there must be something else! Uncomplicated alcoholic cardiomyopathy has not been known to produce a sudden epidemic of this magnitude. Those affected had not suddenly increased the amounts of alcohol they originally consumed; they had not, as far as could be ascertained by intensive investigation, changed their diet or any other of their living habits. What was it then that was different?

Suspicion of cobalt as the toxic agent was aroused after examination of the thyroid glands removed at autopsy showed changes similar to those found in cobalt intoxication. Had cobalt been added to the beer? Yes! But it had also been added to the beer in Montreal and there were no cases in Montreal. Why just in Quebec? Further painstaking investigations proved that in Montreal cobalt had been added to the same brand of beer, but only to the draft beer, and not to the bottled beer, whereas in Quebec City it had been added to both draft and bottled beer. Then, too, the amount added in Montreal was 0.075 parts of cobalt per million, whereas in Quebec it was 1.2 parts per million. Yet how could it be cobalt when these amounts were much smaller than those taken in occasionally prescribed medicines? This same conundrum had troubled the Manchester Commission concerning arsenic; and yet the Commission had concluded that something happened to the hearts of alcoholics which made them unexpectedly susceptible to serious damage by much smaller doses of arsenic. Was it likely that the same was true of cobalt? It was!

Within one month of the time that cobalt had been added the cases appeared—within one month of its withdrawal from the beer, no new cases were seen. In May 1966 it was decided to hold a conference in Quebec City for critical assessment of the findings; interested pathologists, cardiologists and toxicologists from Canada and the U.S.A. attended.

But the story does not end here. Similar cases had been seen in Omaha and also apparently in Minneapolis.[1]

McDermott *et al.*,[2] describing the experience in Omaha, reported: "The presence of additives in the brewing process as described in the Quebec symposium has not yet been studied by our group. An oral communication, July 15, 1966 from Steven B. Carson, M.D. of the Food and Drug Research Laboratories, Inc., indicates that one of the beers marketed in Nebraska also contained cobalt." In the Omaha outbreak the first cases were encountered in June 1964. A similar pattern was followed: a slowly emerging epidemic—64 cases over a period of two years—with a mortality of about 50%. Here too, the first patient became ill within one month of the addition of cobalt to the beer—the last patient within one month of withdrawal of cobalt, as advised by the Canadian doctors. (Dr. Morin and some colleagues had flown to Omaha.)

From Louvain, Belgium, a similar epidemic was reported in 1966[3]—cobalt was used in some Belgian beers.

But no one has yet explained why just *some* heavy drinkers are affected while others who consumed the same beer escaped the disease. Both in Quebec and in Omaha, heavy beer drinkers, working for years in the breweries which had added cobalt, had not been affected. "A riddle wrapped in a mystery inside an enigma." Having solved the riddle and unwrapped the mystery, Dr. Morin and his researchers are now trying to fathom the enigma.

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