Acid Rain: U.S.–Canadian Negotiations

Eliot Marshall's article on air pollution (News and Comment, 17 Sept., p. 1118) needs a little correction.

Strictly speaking the Canadian government did not accept the advice of the joint committee of the National Academy of Sciences and the Royal Society of Canada, although it has supported the joint venture strongly (with money as well as good wishes). When it became apparent that the two governments would not use the joint committee for the peer reviews of the Memorandum of Intent documents, the Canadian Minister of the Environment asked the Royal Society to carry out a Canadian review. The Society appointed the expert panel to which Marshall refers. It has only one member in common with the joint committee, although it does have the same Canadian chairman, myself, and the same scientific officer, Andrew Forester. This panel's reviews will be referred to the joint committee for comment.

A little Byzantine? Certainly; but needs must if nothing more straightforward will work.

I am the provost of Trinity College in the University of Toronto, not of the university itself. And the Royal Society of Canada is a freestanding body of scholars that is not really the counterpart of the National Academy of Sciences. It was the nearest thing, and the Academy generously assumed that we had as much experience in such matters as they had.

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Trauma Research

The organization of the National Institutes of Health and the creation of additional institutional divisions are indeed subjects that merit discussion (News and Comment, 13 Aug., p. 610). I would like to call attention to a major health problem that has yet to be addressed in an effective, nationally coordinated manner.

Trauma and injury are the leading cause of death after heart disease, cancer, and stroke and represent the major cause of death and disability in individuals below the age of 40. Monetary costs exceed $20 billion yearly plus the loss to society of young individuals in the prime of life. The funding of trauma research, especially accident prevention and injury minimization, is miniscule, estimated at less than 0.04 percent of the annual cost of injury. Existing organizations have not obtained significant increased funding or been able to muster public or congressional support for important preventive measures.

For those reasons, it seems timely to urge consideration of a National Institute of Trauma. Our modern society exacts a high price in injury, disability, and death. The public and those who care for trauma victims must unite to confront this health problem.

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Damascus Steel-Making

In a recent letter (16 Apr., p. 242), Cyril Stanley Smith discusses an article by Thomas H. Maugh II (Research News, 8 Jan., p. 153) about our work on ultrahigh carbon (UHC) steel and on Damascus steel. It was a pleasure to read Smith's review of the history of Damascus steel. We disagree, however, when he states, "The secret of Damascus steel was well known in the 19th century." We believe this statement is incorrect because none of the 19th-century metallurgists (for example, Bréant, Anossoff, or Faraday) ever documented a procedure that would allow ready reproduction of the damask (surface markings) characteristic of Damascus steels. In our work (*1*, *2*), a precise procedure for making the damask has been described. We demonstrate here the inadequate detail of previous descriptions (*3*, *4*) in the work of 19th-century metallurgists.

It has been generally accepted that the methods of manufacture of Damascus swords are insufficiently understood. In our initial research into their history, we came to the same conclusion. In fact, in American patent law it is stated (*5*) that the swords of Damascus are among a number of ancient arts which remain to be rediscovered and are a prime example of a patentable discovery. Smith credits the French metallurgist, Bréant (*6*) as having been the first to unravel the secret of Damascus swords. To support the claim that Damascus sword-making is well understood, Smith states in his letter, "He [Bréant] saw that a good structure originated in the very coarse duplex crystals formed by slow solidification from the liquid state, and this was contorted by subsequently forging the blade at a low temperature" (*7*). No further detail can be found in Smith's other works (*3*, *4*). We suggest that the brief procedural statement given by Smith is quite insufficient, even for one knowledgeable in the art, to manufacture Damascus steel. For example, the statement "the very coarse duplex crystals formed by slow solidification," in addition to being questionable (*7*), neglects the influence of cooling rate after solidification, a factor that is of paramount importance in developing the desired damask. In UHC steels, only by slow cooling from high temperatures (for example 10°C per hour) will the required precipitation of proeutectoid cementite, in the form of thick plates, occur at the grain boundaries of the coarse-grained austenite. This condition is required in order that the final damask be visible to the naked eye. Furthermore, the statement "forging the blade at a low temperature" has no meaning unless the temperature of forging and the strain imparted during forging are specified. Our own experience (*2*) has shown that a deformation, typically a 5 to 1 reduction, imparted by forging in a narrow range of temperatures—from 750°C (cherry color) to 800°C (bright cherry color)—will lead to the desired damask observed in Damascus swords. This damask consists of stringers of spheroidized proeutectoid carbides in a matrix of eutectoid composition steel. A further important factor not discussed by Smith or Bréant is the heat treatment of the final product. In order to obtain the desired strength and toughness while retaining the damask, it is necessary to heat the forged sword in a narrow temperature range (that is, to a cherry color) followed by appropriate quenching (*1*, *2*).

In our reviews on Damascus steel (*1*, *2*), we carried out the above specified procedure and described it for a 1.7 percent carbon steel in the manufacture of a damask. This damask is identical in appearance to those in the photomicrographs taken by Zschokke (*8*) and others (*3*, *9*) of original Damascus swords.

There is no doubt that Bréant and his colleagues made swords having a pattern. Since a Damascus-type blade was made, it is necessary to ask, Why did he not describe its processing in the necessary detail? The answer may, in fact, lie in Smith's own description of Bréant's activities in Damascus steel-making (*4*). "Bréant's success raised a difficult question. The Society [sponsoring his work] was dedicated to the dissemination of information to help the nation's industry, yet it realized that publishing Bréant's process would help foreign competition.