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A Tragedy of Errors Compounded

The case history is a prime means of communication among the professions. Carefully read, a medical case history tells a great deal about the patient, the disease – and the physician. What can we learn from the following example? It appeared in an article, "An Acneform Dermatergosis," by Drs. Jack W. Jones and Herbert S. Alden of Atlanta, Ga., in 1936 (*Arch. Dermatol. Syphil.* 33, 1022):

> O.D., a Negro aged 26, began work in the distillation of chlorinated diphenyl in April 1930 and worked regularly until the latter part of the year 1933. About May of 1933, he noticed the appearance of blackheads on his face, neck, arms and legs. These areas itched slightly. In a short time blackheads began to appear on the chest, back and lower part of the abdomen, around the navel and on the scrotum and penis. Many of these blackheads swelled and became infected, discharging thick pus. The areas healed with difficulty and often left scars . . . When seen in December 1933 the patient complained of lassitude, loss of appetite and loss of libido and said that his cutaneous condition seemed to be improving . . . On examination he seemed in good general health. His complaint of lassitude was not borne out by anything more than the usual temperament of the Negro toward work.

As to the patient, we learn from this case history (and from the accompanying text) that he was among the first workers in the first, clearly unhygienic, plant constructed to produce a then new industrial chemical now known as polychlorbiphenyl (PCB). PCB has since become very widely used – and biologically notorious. We also learn that the patient was black. The two facts are not unrelated, for given the economic discrimination against blacks in the U.S. they have frequently been forced to work in the most hazardous and disagreeable places. A classical study of workplace-related disease among steel workers showed that the incidence of cancer among black workers was considerably higher than among white workers because the blacks were more frequently assigned to jobs in the noxious, carcinogenic environment of the coke ovens. (See J. W. Lloyd et al, *J. Occup. Med.* 13: 53, 1971.)

On the positive side, the case history (and the paper as a whole) tells us that the physicians were sensitive to the effect of the patient's work history on his condition; and – as subsequent studies have confirmed – they were able to pinpoint polychlorbiphenyls as the causative agent. On the negative side is their conclusion that the patient's complaint of lassitude represented only "the usual temperament of the Negro toward work," and that his disease was only skin-deep. As things have turned out, this statement is just as scientifically incorrect as it is morally repugnant.

It is now firmly established that PCB's, along with other chlorinated hydrocarbons, have serious systemic effects, including atrophy of the liver, digestive disturbances, hematuria, impotence – not to speak of "lassitude." Had the original observers been less blinded by racial prejudice we might have more quickly learned to appreciate these hazards.

In retrospect, this initial report on PCB toxicity looms as the start of what has turned out to be a scientific tragedy of errors. Consider the following.

First there is the long lapse in time between the discovery of toxic hazards in industrial experience with chlorinated hydrocarbons (1930-33) and appre-

ciation of their environmental hazards (1960-66). In the post–World War II boom of synthetic industrial chemicals many thousands of tons of two of the worst offenders – DDT and PCBs – were produced and disseminated into the environment. At the time two important things were already known about such substances – that they are extraordinarily stable and (a number of them) extraordinarily toxic. Twenty years later it became evident that DDT and PCB's were accumulating in the tissues of most living organisms, including human beings, and in a number of instances had sufficiently interfered with liver function to threaten a number of species of wildlife. These environmental hazards, which have recently led to the banning of DDT and a sharp curtailment in the use of PCB's should have been obvious from the known properties of the substances two decades ago.

Another example. In the early industrial experience it became evident that the toxicity of certain chlorinated hydrocarbon preparations was often due not to the main constituent but to very small amounts of impurities that were likely to occur in the relatively complex chlorination processes. Yet it was not until the 1970's and the intensive studies of the toxicity of 2,4,5-T set off by the massive use of this herbicide in Vietnam, that very much attention was paid to the possible roles of such impurities. Now it has become clear that the toxicity of 2,4,5-T is associated with the presence of extremely small amounts of 2,3,7,8 tetrachlorodibenzo-*p*-dioxin (TCDD), a substance that has just achieved dubious distinction as the most toxic known compound.

A final irony is that when the importance of TCDD was discovered, Baughman and Meselson made an intensive effort to develop an analytic method sufficiently sensitive to detect the material at the low levels (less than 1 ppb) that are significant in environmental samples (*Environ Health Perspect*, 5:27, 1973). They were interested in evaluating the possible teratogenic and other hazards to the Vietnamese resulting from U.S. herbicidal warfare and based their analyses largely on samples of fish and crustaceans from Vietnam. They succeeded in showing that 18 to 810 parts per trillion of TCDD could be unambiguously detected in these samples. The irony is this: that when the same method was applied to a range of U.S. samples – where, in contrast to Vietnam, PCB has been in widespread industrial use – it was found that the latter was so ubiquitously present as to interfere with the detection of TCDD. Because of the failure of the method with U.S. samples, the Environmental Protection Agency was recently forced to cancel hearings on the issue of banning the use of 2,4,5-T.

In each of these instances what was lacking was timely communication among the relevant scientific groups: physicians, toxicologists, chemists, and ecologists. With the introduction of new laws regarding workplace conditions and the control of industrial chemicals – and their effective enforcement – some of the faults revealed in this account can be remedied. But this will depend on the efficiency of scientific communication. The problems thrust upon us by modern industrial technology do not readily conform to the arbitrary lines between scientific disciplines. It is useful to bridge these boundaries through the communication achieved by interdisciplinary research. It would be even more useful to erase them entirely through *adisciplinary* research – research designed around the problem rather than the disciplines.

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