
Concluding Remarks

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Concluding remarks

BY E. J. UNDERWOOD, F.R.S.

There is a story told of Lord Birkenhead when he was a young barrister which has some relevance to the discussions of the last two days. After he had spoken in court for some five hours the Judge leant forward and said, ‘Young man, you have spoken for five hours and I am afraid we are none the wiser!’ To which the young barrister replied, ‘My Lord, you may not be any wiser but you should be much better informed’. After listening to 16 formal papers and several discussion periods I have no doubt that we are all better informed. Whether we are also wiser depends on the use we make of this information in our own future endeavours and on the extent to which we understand that progress in the problems of environmental geochemistry and health must come from interdisciplinary efforts, not only involving a wide range of disciplines and expertise but also a wide range of environments.

The most satisfactory and, to me, certainly the most rewarding aspect of this Discussion Meeting has been the way it has brought together so many individuals of such varying backgrounds, all revealing a basic commonality of interest. Chemists, geologists, nutritionists, epidemiologists, physicians and others have contributed their specialized interests to an area which is vast, complex and above all challenging. They must have gained immeasurably from the contributions of others with whom they would not normally communicate in their professional life.

The complexity of the relations between man’s long-term health and wellbeing and his geochemical environment is apparent from many of the papers presented. This complexity begins with the rocks and soils and the plants that grow on these soils, as Dr Mitchell and Dr Plant pointed out in their papers. The levels of trace elements, and of the major elements with which they interact, in crop plants consumed by man and in crops and pastures consumed by animals, vary with the soils on which the plants depend, with the way these soils are modified by the use of soil amendments and fertilizers and with the plant species and even varieties that are present in any particular area. Geochemical aspects of soils as agents of natural selection by plants and the remarkably high concentrations of such elements as Ni, Cr, As and Se that can occur in some species were highlighted in the paper by Professor Peterson.

The complexity of which I have spoken is apparent further from the fact that the physical and chemical forms of essential and potentially toxic elements in the soils, foods, water supplies and atmosphere also vary widely. Relatively little is yet known about the nature of these different physical and chemical forms and even less of the relation of these forms to physiological availability to plants and animals and therefore to potential deficiency and excess in man. Several speakers stressed the need for more work in this area of chemical speciation in rocks, soils, waters and plant materials. There is already ample evidence that physical and chemical form profoundly affects the biological effectiveness of many mineral elements in experimental animals.

Similarly, although a good deal is now known about the marked metabolic interactions that occur among the trace elements and the major mineral elements in experimental animals, especially under conditions of severe imbalance as was evident from Dr Mills’s paper, we need

to know much more of their quantitative significance in human health particularly at the more modest imbalances most likely to occur in the natural human environment. From the work presented by Dr Barltrop with the potentially toxic element Pb, it appears that even moderate dietary imbalances can affect absorption and retention, at least in children with their particular sensitivity to Pb toxicity. It is probable that a similar situation exists in respect to environmental intakes of Fe and Cd, if we can extrapolate from the results of experiments with laboratory species. After all, subclinical conditions *are* accompanied by significant enzyme changes in the tissues, as we were told by Dr Mills, but their significance to long-term health and wellbeing remains to be determined.

The differences in chemical and physical forms in sources of the trace elements and the metabolic interactions among them indicate clearly that geochemical mapping confined to total amounts or concentrations of single elements can be misleading. Several of the papers presented on this topic made it clear that this point is now well appreciated. However, regional geochemical mapping still varies widely in scope and intensity and in the methods being employed. More international collaboration in this area was stressed by Professor Webb so that more uniform and therefore more comparable data are obtained. Dr Tourtelot raised the important point that geochemists and health specialists need to plan jointly, rather than simply get together *after* separate studies have been undertaken. Professor Shaper also stressed the need for geochemists and epidemiologists to be doing more together. Maps, he bravely pointed out, are only a beginning; the real and urgent need is for more analytical studies of the data already available by geochemists and epidemiologists working together. This need for *combined* interdisciplinary effort became, indeed, the principal theme of the meeting. Professor Shaper also told us of research developments in this country in relation to water quality and cardiovascular disease incidence in which this joint approach is already in progress and which I found extremely hopeful and encouraging. At this point may I be permitted to make a suggestion of my own in this area of environmental geochemistry and health. In my view there is an urgent need for more combined epidemiological and geochemical studies in the developing countries. There are parts of the world which, because they are not yet highly industrialized, motorized and urbanized, would be expected to reveal a more direct relation between human health and the geochemical environment, less complicated by the technological modifications of the environment characteristic of the Western world. I realize that such investigations present formidable difficulties and costs but they could provide valuable base-line data which in a few years' time will have disappeared for ever. I thought that the papers by Mrs Cannon and Dr Thornton describing the extensive studies of aspects of geochemistry and health being carried out in the United States and the United Kingdom were extremely informative and it was encouraging to us all to hear of the great volume of research now under way in those countries.

In conclusion I wish to record on behalf of the participants, our appreciation of the organizers of the meeting, Professor Bowie and Professor Webb, for their skill and initiative in bringing us together in this way and to the staff of the Royal Society for their courtesy and assistance. My own personal thanks go also to the International Association of Geochemistry and Cosmochemistry for generous financial assistance. Whatever our specialty or wherever we are located, the interchange of facts and ideas, of convictions and speculations, must make us all better informed *and* wiser – better able therefore to achieve our common aim, which if I can put it without sounding too pretentious, is the improvement of the health and welfare of mankind.