Birkbeck College Crystallography Laboratory,
21, Torrington Square,
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January 7th, 1956

Dear Dr Fraenkel Conrat,

You may remember that you told me, in Brussels, that you found it difficult to get mercury on to all the sulphur atoms in TMV. The first specimen you sent me had one mercury per 20,000 molecular weight. For the second you did not state the quantity. Is it possible that there may be, in both specimens as little as one in 23,000? The reason why I ask this is that I now have quite a lot of evidence that there are neither 31 nor 37, but 46 structural sub-units in three turns of the helix. The simplest way of reconciling this with the chemical data is to suppose that every third structural sub-unit has an extra S and an extra end-group associated with it. This extra S ($\frac{1}{4}$ of the total) might perhaps be that which is inaccessible to mercury.

I think I gave you, in an earlier letter, a preliminary estimate of 57 A for the radius of the mercury. From a quantitative comparison of the scattering curves of TMV and Hg-TMV we now find the radius to be 56·0 ± 0·5 A. It is the comparison of Hg-TMV with TMV which has provided nearly all the evidence for the existance of 46 units in a repeat. I no longer believe that there is any evidence that the chemical sub-units are related in pairs by diad axes in the structural units. On the contrary the Hg-TMV data provide evidence that such diads cannot be present. (We were originally led to consider the existance of diads on account of the apparent frequency of zeros of intensity, but improved X-ray photographs now show that true zeros of intensity are, in fact, very rare.) It therefore seems that structural and chemical sub-units are the same thing, but that they are probably not all strictly identical. The molecular weight of each comes out to be around 23,000.

I should be very interested to hear from you whether you know of any other evidence that the S or the end-groups are not all equally accessible, or are otherwise non-equivalent.

The iodinated TMV-Hg and TMV-I which you sent me are orientating very slowly, but w. I think, be good quite soon now. The Hg - A protein was much more troublesome, and I have left only one capillary in which the birefringence has not entirely disappeared. In this, orientation is proceeding extremely slowly, but I am still hoping that it will be good enough to be useful one day.

Best wishes,

Yours sincerely