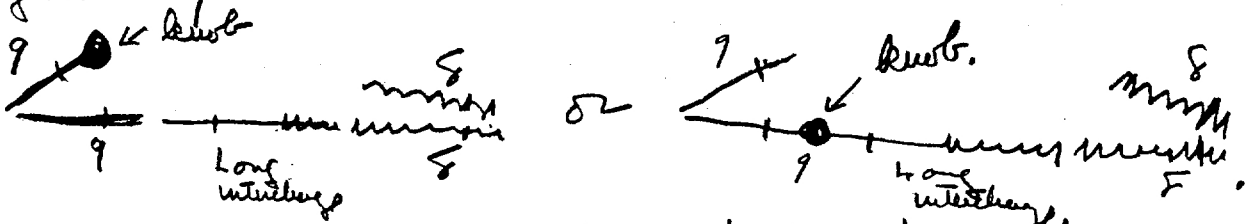
March 12, 1931

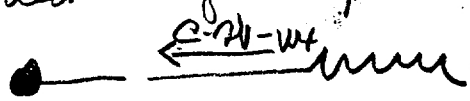
Dear Charlie,

My last letter was just a hasty one. I don't believe I gave you the reasons for my belief in the order of the genes. 1. The c-sh-wx chromosome is the Rubbed chromosome 2. In 2n+1 tertiaries + in your work c-sh-wx are on the same piece 3. The order from the interchange is wx-sh-c. Then these would place the gene letters on the [illegible] upper arm (a) of the rod arm (b) (the bend representing the interchange point of the Rubbed chromosome.)

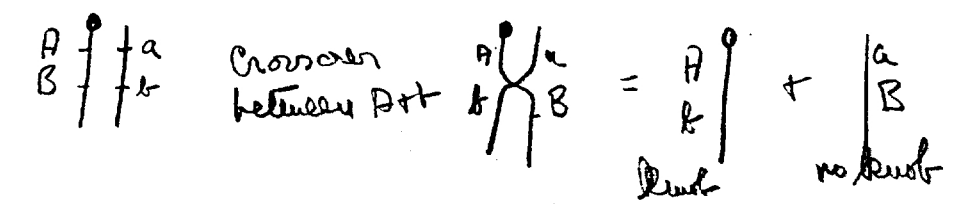
A 30% (2n+1) sterile gave a 2n+1 plant which was 10-12% sterile. The chromosome involved is thought to be the long interchange chromosome. This plant gave a number of 2n+1 individuals all but one of which were 10-12% sterile plants. This latter plant was a 2n+1 (#8 or 3rd smallest). One of the 2n+1 plants showing sterility gave reaction ratios for wx in the pollen 16 wx : 1 wx. The composition of the chromosomes being,

Wx ___ Wx ___ ___ wx wx. This plant was crossed by a plant - homozygous granule. The 2n+1 plant was known to have no granule on the end of the 2nd smallest chromosome. I have examined 3 of the 2n+1 individuals from this cross. 2 of them showed distinctly the 3rd-smallest chromosome in triplicate. The third plant gave the critical evidence, that the interchange chromosome involved was the long interchange chromosome. The following figures only were and ought only to be observed:



The figures are good altho I just started the work today. Tomorrow I am going to hunt for earlier stages. This synaptic evidence was what I was waiting for to prove my hunch, derived from earlier work, that the long interchange chromosome carried the genes for wx - sh + c. This means that we have 

. I believe that sh + wx and possibly c are all on one piece, that is, on the arm of the chromosome next to the interchange. The reason is this: c $\underline{1}$ sh $\underline{2}$ wx When studying crossing over there is a decided interference in crossing over in these regions, a crossover in 1 - seldom in 2 + vice-versa. This probably

indicates that c-sh-wx are all on one piece with respect to the spindle fiber region. I feel convinced that, cytologically, crossing over on one side of the spindle fiber region does not interfere with crossing over on the other side. The spindle fiber regions of the synapsed chromosomes remain close together while the crossing-over is probably going on. Genetically this holds for Drosophila, I believe. The figures look:

(no attempt to show chromatids) It's a hard proposition in corn but I hope we can do it. I tried the Feulgen reaction. I works beautifully but in running up there is a great deal of shrinkage. The Knobs take the Feulgen reaction.) My reason for believing sh + wx are on the arm NEXT to the interchange depends on the fact that wx + the Knob show almost no correlation in crossing over in ♀ × normal from what data we have. To study crossing over with a gene + the Knob we should use genes in the short arm of the c-sh-wx chromosome. If 2 genes are used + the crossover types picked, interference should be so high that there should be an almost perfect correlation between the crossovers + the Knob- providing there is practically but 1 chiasma in this arm.