Study Questions for Buchwald (1989) *The Rise of the Wave Theory of Light*.

Chapter 6

1. What problem did Fresnel pose and solve using Huygens's principle combined with the principle of interference?
2. According to Fresnel a single wave with arbitrary phase can be rewritten in terms of the interaction between two other waves with particular properties. What is this interaction, and what are the properties that characterize the other two waves?
3. What is the "inclination factor" that Buchwald associates with Fresnel's new view of oblique radiation?
4. According to Fresnel's new way of thinking, where is the physically important point (the "pole") that determines a region that can produce effective oblique radiation?
5. What is the significance of the edge of a diffracting object according to Fresnel's new way of thinking?
6. In what sense is Fresnel's new understanding of fringe patterns a combination of Huygens's principle and the principle of interference?
7. How does the combination of Huygens's principle and the principle of interference solve the major problem that had been posed by the efficacious ray (namely, to retrieve the original formula for the external fringes in obstacle diffraction)?
8. How does Fresnel characterize the differences between the wave theory and emission theories in his Prize Essay on diffraction?
9. In what sense is Arago's report on Fresnel's essay "a selectionist account of Fresnel's integral method".
10. According to Buchwald, why can diffraction be given a selectionist description in terms of rays? Why is it more problematic to give a selectionist description of partial reflection?
11. What was Young's objection to Fresnel's use of Huygens's principle? What was Fresnel's response?
12. What was Poisson's objection to Fresnel's use of Huygens's principle? What was Fresnel's response?

Chapter 7.

1. In order for two beams of light to interfere, how must they be polarized?
2. How did Fresnel initially explain the answer to #1 above?
3. According to Fresnel's initial view, was unpolarized light purely longitudinal, purely transverse, or a combination of the two?
4. Fresnel initially thought polarized light could not be purely transverse. According to Buchwald, what was the dynamical reason for this? What was the kinematical reason?
5. According to Fresnel, why can't the ordinary and extraordinary beams interfere in a doubly refracting lamina?
6. Why can interference occur when the two beams from #5 are subsequently passed through a doubly refracting analyzing crystal?
7. How did Fresnel use the results from #6 to give an account of chromatic polarization in terms of interference?
8. According to Fresnel, how was his account of chromatic polarization superior to Biot's account?
9. What happens to polarized light when it is reflected by transparent bodies, according to Fresnel? According to Malus?
10. How was Fresnel's concept of the general state of polarization as a mixture of longitudinal and transverse oscillations different from selectionist accounts?

Chapter 8.

1. According to Buchwald, what is the difference between wave mixtures and combinations of state?
2. Up until 1819-21, how did Fresnel view a partially polarized wave? How did he view an unpolarized wave?
3. In Fresnel's new view, in what sense is light always polarized?
4. How does this entail that light waves are always completely transverse?
5. Why does Buchwald refer to Fresnel's new view as a "kinetic" understanding of polarization?
6. In the old view, what characterizes the difference between the states of unpolarized light, polarized light, and partially polarized light? What characterizes this difference in Fresnel's new view?
7. According to selectionism, what determines whether a beam is unpolarized or partially polarized?
8. According to Fresnel before 1821, what determines whether a beam is unpolarized or partially polarized?
9. According to Fresnel's new view after 1821, what is polarization?
10. In what sense do the accounts in #7 and #8 above view polarization as an approximate property, whereas the account in #9 views polarization as an absolute property?

Chapter 9.

1. What instigated the nasty confrontation between Arago and Biot in 1821.
2. What did Biot see as the only serious challenge to his account of chromatic polarization raised by Arago?
3. What was Biot's response?
4. According to Buchwald, how were Fresnel's formulas for chromatic polarization conceptually different from Biot's?
5. What was Fresnel's attitude towards Biot's account?
6. According to Buchwald, how did Fresnel's view of Biot conflate emissionist views with selectionist views?