

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

**Chapter 10**

1. According to Buchwald, Fresnel does not describe the polarization of a beam of light as involving a decomposition of it into two orthogonal components, each one also normal to the plane of polarization. How, then does Fresnel describe polarization?
2. What is the significance of "the general factor to use in multiplying the number that functions as an index into Newton's table of tints"? Why did Biot feel it was necessary to determine this factor?
3. According to Brewster, why did Biot's particular form of the factor in #2 fail?
4. According to Buchwald, although Brewster's analysis was written entirely from a selectionist viewpoint, how did it seek to go beyond selectionism proper?
5. According to Buchwald, what was the greatest problem a selectionist had in grasping Fresnel's work on polarization?
6. How did Brewster propose to alter the usual selectionist understanding of "common light" as a mixture of rays with random asymmetries?
7. What were the two questions that Brewster posed?
8. How did Brewster interpret Fresnel's reflection formulas?
9. According to Buchwald, what was the core of Brewster's theory of "elliptical" polarization?
10. According to Buchwald, why did Brewster believe that if Fresnel had developed formulas that seem to work, then the elements that enter into them had necessarily to be construed in terms of groups of rays?

**Chapter 11.**

1. What did Fresnel claim in 1821 about crystals with two optic axes ("biaxial" crystals)?
2. What was Fresnel's dynamical explanation of transverse waves?
3. In Fresnel's experiment to test his claim in #1, what is the significance of glueing together two pieces of topaz with different internal orientations?
4. Why was Fresnel strongly convinced that the direction of oscillation (and so that of polarization) must immediately determine the velocity of propagation?
5. In a uniaxial crystal, what is the relation between the plane of polarization of O rays, and the optic axis? How is the plane of polarization of E rays related to the plane of polarization of O rays?
6. According to Fresnel's dynamical explanation of transverse waves, what is the relation between the direction of O ray oscillations, and the plane of polarization of O rays? What is the relation between the direction of E ray oscillations, and the plane of polarization of O rays?
7. What is the relation between the velocity of a transverse wave and the direction of its oscillations?
8. What is the "conjugate ellipse"? What is the "ellipsoid of elasticity"?
9. How can the ellipsoid of elasticity be used to calculate the velocity of a ray in a given direction?
10. According to Buchwald, what is the problem with Fresnel's initial use of his ellipsoid of elasticity method?
11. Why does the problem identified in #10 require the ellipsoid of elasticity to be replaced with a more general surface (the "surface of elasticity")?
12. Instead of ray speeds, what does the surface of elasticity give?
13. What is the "wave surface" that is required in order to determine ray speeds?
14. What is Fresnel's "normal surface"?
15. How did Fresnel define a ray?
16. How is a ray speed different from a wave-front speed?

**Chapter 12.**

1. According to Buchwald, how was Herschel's (1828) account of Fresnel's theory incoherent?
2. According to Buchwald, how does Whewell's (1837) account of theories of light fail to make the distinction between selectionist theories and emissionist theories?
3. How does Buchwald explain the fact that the years of transition to the wave theory were also a period in which optical activity, and productivity, actually decreased?
4. According to Buchwald what were the two functions of the ether for Fresnel?
5. What optical phenomenon investigated by Fresnel involved an appeal to mechanical effects of the ether?
6. How does Buchwald characterize the three main trends in research on the ether during 1830-1880?