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Reactions...

Again, Big Science has pushed forward scientific progress, as it has with Atomic Physics and others. This time it was George Ellery Hale who was the great builder.

Hale started building instruments as a child with the support of his rich father. His father decided that once George made a working device, he would buy his son the best of that kind of instrument. This gave George much experience building delicate scientific instruments, while at the same time giving him example of the best workmanship and design available at that time. This pattern was to develop George into a master craftsman of telescopes.

He started with a 40 inch telescope funded by Yerkes in Chicago; it was to be the largest refracting telescope at that time. He went on to build a 60 inch reflecting telescope in 1908, a 100 inch in 1917, and finally he started work on a 200 inch reflecting telescope in 1928, which was not finished until after his death.

The large 200 inch telescope provided data that lead to theories about the shape and extent of the universe. Hubble found that distant galaxies are receeding from the earth at a speed proportional to the distance they are away. The recession speed can be calculated by assuming the composition of a star, or matching the spacing of the spectral lines of its light. Next, notice that the lines are shifted from their normal positions towards the red end of the spectrum, but the relative spacing is still the same. By using the calucations for red shift, one can calculate the speed of recession:

$$f = f_o \frac{\sqrt{1 - v^2/c^2}}{1 + v/c}$$

where f is the observed frequency of the red shifted spectral lines, and f_o is the frequency of the lines when observed with no motion.

It is arguably more interesting to note the manic streak in both Hale and Lawrence. Each was obsessed with creating the next bigger device, even starting the next before the last was finished, sometimes starting work on something even bigger even when it won't work, as Lawrence almost did with his last cyclotron, which would have been foiled by the relativistic effects of mass increase. Perhaps they had this mania for the same reason a sorcerer wears a sword.