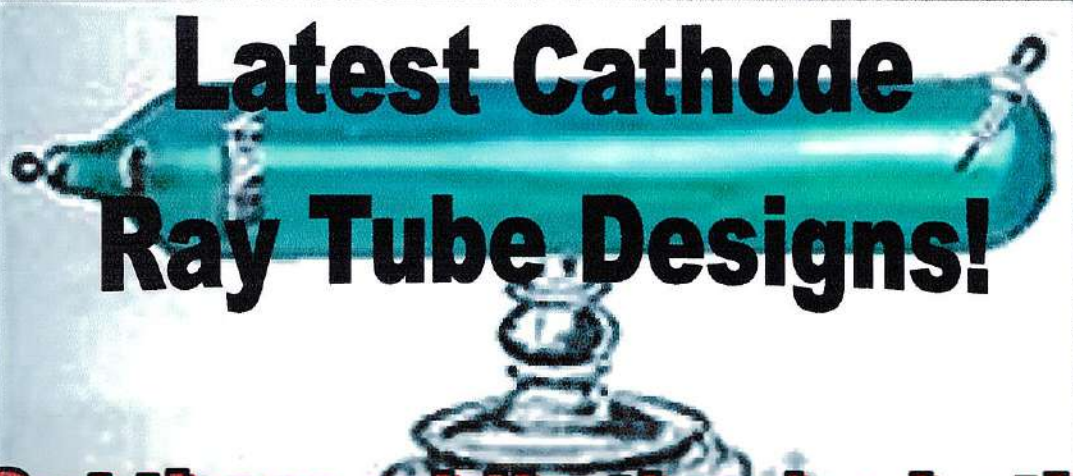
Science Wizards' Weekly

Exclusive interview with "the man who split the atom"

7 WAYS TO WEAR YOUR MUSTACHE



Latest Cathode Ray Tube Designs!

Get them while they're hot!

Imagine exploring something never known to man. You are the first to take a brave step into the unknown.

I am sitting with physicist Joseph John Thomson (more commonly known as J.J.). Being curious in the field of science myself, I thought it would be interesting to interview one of the men who helped to start it all. Here's his story!

Kylee German: When you were young, did you have any plans for the future?
JJ Thomson: Well my future plans we really my dad's plans for me. He wanted me to get an apprenticeship so I could become and engineer. My family could not raise enough money to cover the fee of an apprenticeship. Instead I went to Owens College.

KG: So obviously your father was a little ashamed and disappointed about not raising enough money, but did anything good come out of going to Owens College?
JJ: Certainly. Every college has its positives. Owens ended up having one of the best science faculties. It provided me with some courses in experimental physics.

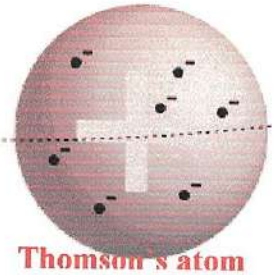
KG: So you started one path of engineering and then took a whole new path to physics. What happened after Owens?
JJ: Well while I was at Owens, a teacher recommended me to apply for a scholarship to go to Trinity College in Cambridge. I ended up winning that scholarship and moved away to Trinity. This is where my life began to take an extraordinary turn into the world of science. At Trinity I got my B.A. degree in mathematics. I finished second in my class only under Joseph Larmor.

KG: So now was your college life over? What happened after you got your degree?
JJ: My life as a college student ended but I never left Trinity. My curiosity led me to the Cavendish Laboratory. There I became the third Cavendish Professorship of Experimental Physics, or more simply a professor. This was a very new territory to me. Prior to this, I had done very little lab work and experimenting. It also did not help that I was very clumsy with my hands.

"J.J. was very awkward with his fingers, and I found it necessary not to encourage him to handle the instruments"
-H.F. Newall (one time assistant to Thomson)

KG: Now you said that becoming a teacher was very new for you. Why did you decide to take such a drastic step?
JJ: That is a complicated questioned, but I would say that one reason I took on the challenge was because it was a challenge. I love conquering difficult tasks and this was one of my more difficult ones placed before me. But the main reason I accepted the offer was because I was interested in helping young researches discover their own ideas of the atom.

KG: So while they were discovering their own ideas, what were some of your ideas on the atom?
JJ: Well I personally believe that the atom consists of thousands of tiny, negatively charged corpuscles distributed by electrostatic forces inside a positive, spherical, massless cloud of matter. It is often called the "plum pudding" model. I do not, however, force my ideas upon my students. I allow them to think for themselves.


Thomson's atom

KG: So what experiments led you to the "plum pudding" model and corpuscles?
JJ: Well when I was first given the assignment of proving cathode rays are small particles, I decided to try and measure the particles mass and electrical charge, assuming they were particles. I did this through the deflection of the particles in a magnetic field. This deflection depends not only on their mass and charge

but also on velocity. From my findings I derived the equation mv/e. From measuring the deflection and combining results with another combination of the same quantities, mv^2/e, I could find separately the particles' velocity and their charge to mass ratio, e/m.

KG: Wow, that is amazing! So after you found the equation e/m, where did you take your next experiment?

JJ: From here I decided to take my experimenting in a path that had been traveled before by C. T. R. Wilson. He found out "if the dustless air saturated with water vapor is cooled by expansion, tiny water droplets are formed on any ions present in it. For small expansions, only negative ions serve as condensation centers." When this fog forms it slowly settles onto a disc in the cylinder that is used in the experiment. I can then take the total electric charge and measure it by an electroscope. Now knowing the initial amount of water vapor in the cylinder and the average size of the fog droplets, I could find the total number of droplets, leading to the total number negatively charged particles.

KG: Was it hard to see the droplets and count them?

JJ: Oh yes! The droplets were far too small to see individually. Instead I decided to find their size from the velocity at which the fog settled. You see, the smaller the droplet, the slower it settles. Another physicist, Stokes, derived this. Now, by dividing the total charge received by the electroscope by the number of droplets, I found the electric charge of each droplet to be 4.77×10^{-10}esu. Knowing the electrical charge, e, I could find the mass of the particles from e/m. I found this mass to be 0.9×10^{-29}gm.

KG: Is this number of any significance?

JJ: This was probably one of the biggest discoveries of my time! I had found a particle almost two thousand times smaller than the smallest atom!

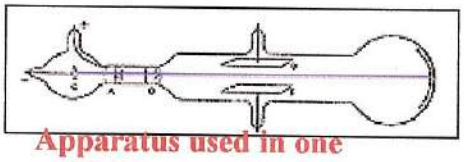
KG: How did other scientists' beliefs of the cathode ray differ from yours?

JJ: Faraday, a fellow physicist, had said that atoms were carrying the electric charge. I had proven that this ray was far to small to be an atom and the cathode ray had to be the electric charge itself.

> *"We have in the cathode rays matter in a new state"*
>
> ~ *J.J. Thomson*

KG: So all of this new information swarming around in your head must have changed your ideas of the atom. How?

JJ: That's a good question. With all this information, we can now go back to our discussion of my "plum pudding" or "static model" of the atom. I developed my own view of the atom as a sphere of positively charged material with corpuscles, now called electrons, within it. The electrons I believe rest at certain equilibrium positions determined by the balance of their charges. As we know, though, Ernest Rutherford disproved my theory.



Apparatus used in one of J.J.'s experiments

KG: This brings to me my next question. Do you know Ernest Rutherford personally? Did you have a lot to do with Rutherford's success as a physicist?

JJ: Rutherford and I go way back! He was a student of mine when I taught at the Cavendish Laboratory. I actually do believe that I did have a lot to do with his success. I gave my young researchers the excitement they needed to go and explore the world around them. Because of this enthusiastic attitude, seven of my students, including Rutherford, went on to become Nobel Prize winners.

KG: You also received a Nobel Prize. But aside from the scientific work, what do you like to do for enjoyment?

JJ: I enjoy watching sports at Cambridge, like the cricket and rugby teams. I also enjoy politics and drama. One of my greatest interests is plants. I love taking long walks in the countryside to search for rare botanical specimen for my garden.

Kylee German

Bibliography

1. "Corpuscles to Electrons." Mar 1997. American Institute of Physics. 9 Feb 2006 <www.aip.org/history/electron/jjelectr.htm>

2. "Mysterious Rays." Mar 1997. American Institute of Physics. 9 Feb 2006 <www.aip.org/history/electron/jjrays.htm>

3. "3 Experiments, 1 Big Idea." Mar 1997.American Institute of Physics. 9 Feb 2006 <www.aip.org/history/electron/jj1897.htm>

4. "J.J. Thomson." Mar 1997. American Institute of Physics. 9 Feb 2006 <www.aip.org/history/electron/jjthomson.htm>

5. "J. J. Thomson." 9 Feb 2006. Wikipedia. 9 Feb 2006 <en.wikipedia.org/wiki/J.J._Thomson>

6. Mary Ellen Bowden. "Joseph John Thomson." 2005. Chemical Herritage Foundation. 9 Feb 2006 <www.chemheritage.org/classroom/chemach/atomic/thomson.html>

7. Sir George Paget Thomson. "Thomson, Sir J.J." 1997. Encyclopedia Britannica. 9 Feb 2006 <www.britannica.com/nobel/micro/591_84.html>

8. "J.J. Thomson-Biography." 29 Aug 2005. Nobel Web AB. 9 Feb 2006 < nobelprize.org/physics/laureates/1906/thomson-bio.html>

9. George Gamow. The Great Physicists From Galileo To Einstein. New York: Dover Publications,Inc., 1961.