THE LASER: FOR EXCELLENCE IN ATOMIC PHYSICS.

The laser (an acronym of "Light Amplification by the Stimulated Emission of Radiation") is a machine capable of producing intense monochromatic light which is spatially coherent and emerges in a well-defined beam. This instrument followed on the heels of the maser (acronym for "Microwave Amplification by the Stimulated Emission of Radiation") which can emit radiation of wavelengths from one millimeter to 30 centimeters.

The laser, useful in a hundred ways, its utility increasing daily, has now become a household word. It has profited medicine, dentistry, communications, surveying, welding, interferometry (the science of measuring distance using light), photography, biology, and basic research on atoms and molecules. It aids the blind to detect obstacles, yet produces temperatures that vaporize matter. It can help obtain information from space satellites or serve as a burglar alarm for the home.

The laser's development through discoveries and advances in the fields of microwaves, electronics, atomic physics, quantum mechanics and optics has added the word "maser", "laser", "to lase" and "lasing" to the English language. But although the laser has now revolutionized areas of science and technology, its birth was a difficult one: the laser needed nearly half a century of experimentation in addition to the insight and imagination of four Nobel prize winners in Physics, Max Planck (1918), Albert Einstein (1921), Niels Bohr (1922) and Charles Townes (jointly with Bassov and Prokhorov in 1964) before the world first saw laser light.

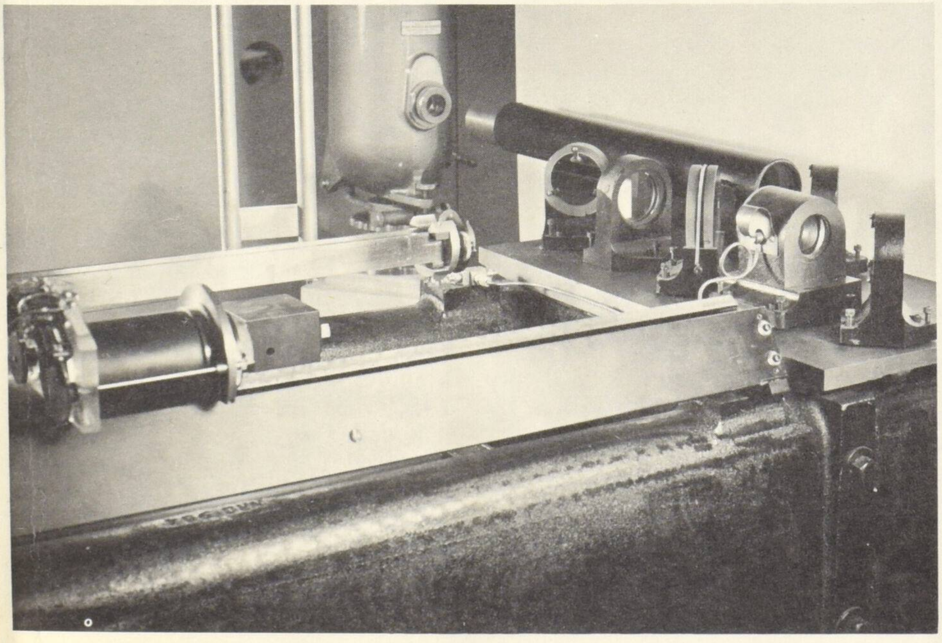
It all began with Max Planck, Physics Professor at the University of Berlin. His fertile mind enriched the study of physics in numerous ways but one of his theories stands out as the basis of modern physics. It is this same theory, called by Planck the "Quantum Theory", which served as the first clue in the intricate puzzle whose solution was the laser.

In 1900, Planck was engaged in the study of the radiation emitted from a "black body", a body which would ideally absorb all, and reflect none of the radiation falling on it. He was particularly interested in the range of energy emitted by the black body at a given temperature – seemingly a straightforward experiment. But Planck was startled by the results, for where a continuous range of values was expected, (as the old proverb has it: "natura non facit saltum, – nature does not make a leap) none was found.

Confronted with these results, Planck lashed out at the pillars of classical physics. With the deft iconoclasm of an intuitive genius, he hypothesized that the energy transfers associated with electromagnetic radiations must occur discontinuously, in definite steps, by means of small bundles of energy. Furthermore, he theorized that each packet of energy (given the name quantum, or, in the case of light, photon) so transferred, had the value of the frequency of the radiation with which it was associated, multiplied by a certain number, which came to be called, not surprisingly, Planck's constant.

But what did this theory mean for the atom?

This query was answered in 1913 by Niels Bohr, the Danish physicist who was to become the head of Copenhagen's Institute of Theoretical Physics. He conceived of the atom as having a positively charged central core (nucleus) around which are orbiting smaller negatively charged particles (electrons). Each orbiting electron is able to jump from one defined stable orbit around the nucleus to another. However if it does change its orbit, the electron will either gain energy by absorbing a photon or lose energy by emitting a photon. Thus the defined orbits may be considered as energy levels. This was succinctly represented by Bohr in the following formula: $E_2 - E_1 = hn$, where "E_1" and "E_2" are the energies of two stable orbits,



Interference comparator for the calibration of scales up to one metre length directly in terms of wavelengths.

Le comparateur interférométrique permet d'étalonner directement en longueurs d'ondes les longueurs allant jusqu'à un mètre.