ASTRONOMY

Spectral Lines Measured

Research helping to reveal composition of steel, stars and stockings reported to astronomers in Rome. Relative brightness of 30,000 spectral lines measured.

➤ THE COMPLETION of a research that will help reveal the composition of steel, stars and stockings, and will be of wide interest and high importance to the industrial manufacturer as well as to the academic astrophysicist, was reported by Dr. William F. Meggers, chairman of the International Commission on Standard Wave Lengths, at a meeting of the International Astronomical Union in Rome.

The relative brightness of 30,000 spectral lines in the spectra of 70 different chemical elements has been measured in the course of this work, in progress for 15 years. Dr. Meggers, in charge of the spectroscopic laboratories of the National Bureau of Standards in Washington, is one of the leading spectroscopists of the world.

In many industrial processes, it is important to know what impurities are present in a critical material and in what amounts. The impurities are frequently so minute that they cannot be detected or measured by ordinary chemical methods.

The spectroscope and the arc, however, are exceedingly sensitive. The slightest trace of an impurity is revealed by the appearance of characteristic lines in the spectrum, if the electrodes for the arc are made in part of the material under examination.

The spectrum differs conspicuously from element to element, because of the varied organization of the electrons in the outer part of the atoms. For example, sodium has one, chlorine, seven, etc.

With the aid of the new tables (soon to be published) of the intensities of spectrum lines, the composition of materials as well as the traces of impurities can be determined and the relative amounts accurately measured.

Astrophysicist Also Aided

The astrophysicist analyzing the planetary atmospheres or the gaseous composition of stars, nebulae and galaxies is similarly aided by the new work from the Bureau of Standards. Often spectral lines appear that have not yet been identified with any element.

Such lines in the spectrum of a star may indicate that the atomic composition is chemically unusual, or that the pressure and temperature conditions on the star's surface are peculiar. The way atoms of any element vibrate and radiate their spectrum lines depends on the pressure, temperature and abundance of those atoms.

Dr. Meggers' intensity measurements, all made by him personally on a uniform basis referred to a superposed line spectrum of copper, will also be of astrophysical use in determining for many spectra certain fundamental atomic constants known as "f values," and through them in contributing directly to basic theories of atomic structure. Heretofore, such values have been determined laboriously by other methods and for only a limited number of spectra.

The textile, chemical, metallurgical and pharmaceutical industries will be most benefited by the completion of the new tables of line intensities. In all such establishments, the spectroscope and spectrograph are important analytical tools.

The provision of standards of weights, lengths and material qualities for industry is one of the functions of the National Bureau of Standards and much basic research is a necessary part of the work.

The 70 elements studied by Dr. Meggers are all of those that show spectrum lines in the direct current arc that are suitable for intensity (brightness) measurement. The 28 elements omitted from the tabulation include the six new, artificially-created radioactive elements, like plutonium, that have atomic numbers greater than 92, the number for uranium.

Also omitted are the five halogens (chlorine, iodine, etc.), the six noble gases (neon, argon, etc.), and oxygen and nitrogen. But all the common metals, the alkalies and alkaline earths are in the list.

For some of the elements missing from the tables, the spectral lines do not occur in the interval of wavelength from 2,000 Angstroms to 9,000 Angstroms, where Dr. Meggers has worked and where industrial scientists and astrophysicists do most of their investigations. Less than half of the measured 30,000 lines fall in the visual range from violet to red.

The number of measurable lines varies greatly from element to element. Scarcely a dozen lines can be listed for elements of simple electronic structure like sodium and potassium. The "rare earths" elements, such as lanthanum and cerium, have each more than a thousand lines in the tables. Also iron, nickel and manganese are rich in measurable lines, and the now famous radioactive uranium has many thousands of

RIPPLE TANK—Oceanographer Wilbur Marks indicates the wave pattern created by a typical obstruction in the ripple tank, an instrument designed and constructed at New York University for the study of ocean surface waves. The effect of wave patterns on beach erosion is being investigated by the newly-formed department of meteorology and oceanography.