Reflection of Light from a Moving Mirror. Let us suppose that light of wave-length λ and velocity V is incident at an angle θ on a plane mirror, and that the mirror is moving forward in the direction of its normal with velocity v. The component of the velocity of the mirror in the direction of the ray is $v \cos \theta$, the velocity with which the waves arrive at the mirror is consequently $V + v \cos \theta$, and the number of waves received per second is increased in the ratio of V to $V + v \cos \theta$. In the same way the reflected ray is only leaving the mirror with a velocity of $V - v \cos \theta$, the waves emitted by the mirror in a second are spread over a distance $V - v \cos \theta$ instead of a distance V, and the number of waves per unit length of the ray is increased in the ratio of $V - v \cos \theta$ to V. Combining both effects we find therefore that the effect of the reflection has been to diminish the wave-length in the ratio

$$\frac{V}{V + v \cos \theta} \quad \frac{V - v \cos \theta}{V}.$$

Since v is small compared with V this reduces to

$$\frac{1}{\left(1 + \frac{v \cos \theta}{V}\right)}\left(1 - \frac{v \cos \theta}{V}\right)$$

$$= \left(1 - \frac{v \cos \theta}{V}\right)^2 = 1 - \frac{2v \cos \theta}{V}.$$

It can be shown by Huygens' principle that owing to the motion of the mirror the angle of reflection is not exactly equal to the angle of incidence, but the difference is very small, and its effect on the change in the wave-length can be neglected.

If instead of a mirror we have a rough surface, which diffuses the incident light in all directions, then the wave-length of the light scattered in a direction making an $\angle \phi$ with the normal can obviously be obtained by the above reasoning, if we substitute ϕ for θ in the expression for the velocity with which the ray leaves the mirror.

The above theory has been employed by Wien in deriving what is known as the Wien displacement law in the theory of complete radiation. It has been verified experimentally by Galitzin and Wilip and has been applied in astrophysics to determine the angular velocity of the planets. As Doppler's principle is assumed in the above theory of the moving mirror, the verification of the latter is at the same time a verification of the former.

Experimental Verification of Doppler's Principle. Doppler's principle was first verified experimentally in the laboratory by Bélopolsky. He used multiple reflection from mirrors mounted on the rims of wheels which were revolved at a high speed. The verification was repeated in 1907 by Prince Galitzin and J. Wilip with the same apparatus but with the substitution of an echelon spectroscope in place of Bélopolsky's spectroscope. The echelon spectroscope gave a much