PROOF OF FORMULA 3.636.1

$$\int_0^{\pi/2} (\tan x)^{\pm\mu} \, \sin 2x \, dx = \frac{\pi\mu}{2} \, \text{cosec} \, \frac{\pi\mu}{2}$$

Write the integral as

$$\int_0^{\pi/2} (\tan x)^{\pm\mu} \, \sin 2x \, dx = 2 \int_0^{\pi/2} (\sin x)^{\pm\mu+1} \, (\cos x)^{\mp\mu+1} \, dx.$$

The integral representation

$$B(a,b) = 2 \int_0^{\pi/2} (\sin x)^{2a-1} (\cos x)^{2b-1} \, dx$$

shows that

$$\int_0^{\pi/2} (\tan x)^{\pm\mu} \, \sin 2x \, dx = B\left(1 \pm \frac{\mu}{2}, 1 \mp \frac{\mu}{2}\right)$$

and this reduces to the stated answer.