Page 186, equation (4.200)

From (4.193) it follows that $P_\alpha = \rho_\alpha g_\alpha - \rho_\alpha f_\alpha \, (\alpha = 1, \ldots, n)$. The first product can be developed using the definition of g_α, (4.161); at first, the product in the numerator in (4.161) is transformed into the "component form" using definitions of f, (4.92), and of w_α, (4.22):

$$\rho \hat{f} = \rho \sum_{\alpha=1}^{n} w_\alpha \hat{f}_\alpha = \sum_{\alpha=1}^{n} \rho w_\alpha \hat{f}_\alpha = \sum_{\alpha=1}^{n} \rho_\alpha \hat{f}_\alpha. \tag{1}$$

Upon substitution from (1) into (4.161) we obtain:

$$\frac{\partial \rho \hat{f}}{\partial \rho_\alpha} = \frac{\partial}{\partial \rho_\alpha} \sum_{\gamma=1}^{n} \rho_\gamma \hat{f}_\gamma = \sum_{\gamma=1}^{n} \frac{\partial \rho_\gamma \hat{f}_\gamma}{\partial \rho_\alpha} = \sum_{\gamma=1}^{n} \left(\rho_\gamma \frac{\partial \hat{f}_\gamma}{\partial \rho_\alpha} \right) + f_\alpha. \tag{2}$$

Substituting (2) into the above expression for P_α, (4.200) results:

$$P_\alpha = \rho_\alpha \sum_{\gamma=1}^{n} \left(\rho_\gamma \frac{\partial \hat{f}_\gamma}{\partial \rho_\alpha} \right) + \rho_\alpha f_\alpha - \rho_\alpha f_\alpha = \sum_{\gamma=1}^{n} \rho_\alpha \rho_\gamma \frac{\partial \hat{f}_\gamma}{\partial \rho_\alpha}.$$