Page 98, equation (3.113)

From equation (3.107) follows:

$$Q = \rho\dot{u} + \mathrm{div}\mathbf{q} - \mathrm{tr}(\mathbf{TD})$$

and equation (3.109) can be then modified:

$$-T\sigma = -T\rho\dot{s} - T\,\mathrm{div}(\mathbf{q}/T) + \rho\dot{u} + \mathrm{div}\mathbf{q} - \mathrm{tr}(\mathbf{TD})$$

From the definition (3.111) it follows that $\dot{f} = \dot{u} - T\dot{s} - s\dot{T}$; thus

$$-T\rho\dot{s} + \rho\dot{u} = \rho\dot{f} + \rho s\dot{T} \tag{1}$$

Further:

$$\begin{aligned}\mathrm{div}(\mathbf{q}/T) &= \sum_j \frac{\partial}{\partial x^j}\left(\frac{q^j}{T}\right) = \sum_j \left[\frac{1}{T}\frac{\partial q^j}{\partial x^j} + q^j \frac{\partial}{\partial x^j}\left(\frac{1}{T}\right)\right] \\ &= \frac{1}{T}\sum_j \frac{\partial q^j}{\partial x^j} + \sum_j q^j \left(\mathrm{grad}\frac{1}{T}\right)^j = \frac{1}{T}\mathrm{div}\mathbf{q} + \mathbf{q}.\mathrm{grad}\frac{1}{T} \end{aligned} \tag{2}$$

and

$$\left(\mathrm{grad}\frac{1}{T}\right)^i = \frac{\partial}{\partial x^i}\left(\frac{1}{T}\right) = -\frac{1}{T^2}\frac{\partial T}{\partial x^i} = -\frac{1}{T^2}\left(\mathrm{grad}T\right)^i \equiv -\frac{1}{T^2}g^i \tag{3}$$

where the definition (3.112) was used in the last identity.

Taking into account (1) to (3) we obtain:

$$\begin{aligned}-T\sigma &= \rho\dot{f} + \rho s\dot{T} - T\left(\frac{1}{T}\,\mathrm{div}\mathbf{q} - \frac{1}{T^2}\,\mathbf{q}.\mathbf{g}\right) + \mathrm{div}\mathbf{q} - \mathrm{tr}\left(\mathbf{TD}\right) \\ &= \rho\dot{f} + \rho s\dot{T} + T^{-1}\mathbf{q}.\mathbf{g} - \mathrm{tr}\left(\mathbf{TD}\right)\end{aligned}$$

which is as in (3.113).