$$a_1 = b_0 Q + a_0 Q + a_0 P$$
$$b_1 = b_0 P + a_0 Q$$

$$a_2 = b_1 Q + a_1 Q + a_1 P$$
$$b_2 = b_1 P + a_1 Q$$

$$a_2 = [b_0 P + a_0 Q]Q + [b_0 Q + a_0 Q + a_0 P]Q + [b_0 Q + a_0 Q + a_0 P]P$$
$$b_2 = [b_0 P + a_0 Q]P + [b_0 Q + a_0 Q + a_0 P]Q$$

$$a_2 = b_0 PQ + a_o QQ + b_0 QQ + a_0 QQ + a_0 PQ + b_0 QP + a_0 QP + a_0 PP$$
$$b_2 = b_0 PP + a_0 QP + b_0 QQ + a_0 QQ + a_0 PQ$$

$$a_2 = b_0[PQ + QQ + QP] + a_0[QQ + PQ + PQ] + a_0[QQ + PP]$$
$$b_2 = b_0[PP + QQ] + a_0[QQ + PQ + PQ]$$

We can then infer that:

$$a_2 = b_0 Q' + a_0 Q' + a_0 P'$$
$$b_2 = b_0 P' + a_0 Q'$$

With $Q' = [QQ + 2QP]$ and $P' = [QQ + PP]$