I am reading Maxwell's "a treatise on electricity and magnetism, Volume 2, page 156" about "Ampere's Force Law". I have some confusion in the following pages:

The coordinates of points on either current are functions of s or of s'.

If F is any function of the position of a point, then we shall use the subscript $_{(s,0)}$ to denote the excess of its value at P over that at A, thus
$$F_{(s,0)} = F_P - F_A.$$
Such functions necessarily disappear when the circuit is closed.

Let the components of the total force with which $A'P'$ acts on AA be $ii'X$, $ii'Y$, and $ii'Z$. Then the component parallel to X of the force with which ds' acts on ds will be $ii'\frac{d^2X}{ds\,ds'}ds\,ds'$.

Hence
$$\frac{d^2X}{ds\,ds'} = R\frac{\xi}{r} + Sl + S'l'. \tag{13}$$

Substituting the values of R, S, and S' from (12), remembering that
$$l'\xi + m'\eta + n'\zeta = r\frac{dr}{ds'}, \tag{14}$$
and arranging the terms with respect to l, m, n, we find
$$\begin{aligned}\frac{d^2X}{ds\,ds'} = {} & l\left\{-(A+B)\frac{1}{r^2}\frac{dr}{ds'}\xi^2 + C\frac{dr}{ds'} + (B+C)\frac{l'\xi}{r}\right\},\\ & + m\left\{-(A+B)\frac{1}{r^2}\frac{dr}{ds'}\xi\eta + C\frac{l'\eta}{r} + B\frac{m'\xi}{r}\right\},\\ & + n\left\{-(A+B)\frac{1}{r^2}\frac{dr}{ds'}\xi\zeta + C\frac{l'\zeta}{r} + B\frac{n'\xi}{r}\right\}.\end{aligned} \tag{15}$$

Since A, B, and C are functions of r, we may write
$$P = \int_r^\infty (A+B)\frac{1}{r^2}dr, \qquad Q = \int_r^\infty C\,dr, \tag{16}$$
the integration being taken between r and ∞ because A, B, C vanish when $r = \infty$.

Hence
$$(A+B)\frac{1}{r^2} = -\frac{dP}{dr}, \quad \text{and} \quad C = -\frac{dQ}{dr}. \tag{17}$$

516.] Now we know, by Ampère's third case of equilibrium, that when s' is a closed circuit, the force acting on ds is perpendicular to the direction of ds, or, in other words, the component of the force in the direction of ds itself is zero. Let us therefore assume the direction of the axis of x so as to be parallel to ds by making $l = 1$, $m = 0$, $n = 0$. Equation (15) then becomes
$$\frac{d^2X}{ds\,ds'} = \frac{dP}{ds'}\xi^2 - \frac{dQ}{ds'} + (B+C)\frac{l'\xi}{r}. \tag{18}$$

To find $\frac{dX}{ds}$, the force on ds referred to unit of length, we must integrate this expression with respect to s'. Integrating the first term by parts, we find

$$\frac{dX}{ds} = (P\xi^2 - Q)_{(s',0)} - \int_0^{s'} (2Pr - B - C)\frac{l'\xi}{r}\, ds'. \tag{19}$$

When s' is a closed circuit this expression must be zero. The first term will disappear of itself. The second term, however, will not in general disappear in the case of a closed circuit unless the quantity under the sign of integration is always zero. Hence, to satisfy Ampère's condition,

$$P = \frac{1}{2r}(B+C). \tag{20}$$

517.] We can now eliminate P, and find the general value of $\frac{dX}{ds}$,

$$\frac{dX}{ds} = \left\{\frac{B+C}{2}\frac{\xi}{r}(l\xi + m\eta + n\zeta) + Q\right\}_{(s',0)}$$
$$+ m\int_0^{s'} \frac{B-C}{2}\frac{m'\xi - l'\eta}{r}\, ds' - n\int_0^{s'} \frac{B-C}{2}\frac{l'\zeta - n'\xi}{r}\, ds'. \tag{21}$$

When s' is a closed circuit the first term of this expression vanishes, and if we make

$$\left.\begin{aligned} \alpha' &= \int_0^{s'} \frac{B-C}{2}\frac{n'\eta - m'\zeta}{r}\, ds', \\ \beta' &= \int_0^{s'} \frac{B-C}{2}\frac{l'\zeta - n'\xi}{r}\, ds', \\ \gamma' &= \int_0^{s'} \frac{B-C}{2}\frac{m'\xi - l'\eta}{r}\, ds', \end{aligned}\right\} \tag{22}$$

where the integration is extended round the closed circuit s', we may write

$$\left.\begin{aligned} \frac{dX}{ds} &= m\gamma' - n\beta'. \\ \text{Similarly} \qquad \frac{dY}{ds} &= n\alpha' - l\gamma', \\ \frac{dZ}{ds} &= l\beta' - m\alpha'. \end{aligned}\right\} \tag{23}$$

The quantities α', β', γ' are sometimes called the determinants of the circuit s' referred to the point P. Their resultant is called by Ampère the directrix of the electrodynamic action.

It is evident from the equation, that the force whose components are $\frac{dX}{ds}$, $\frac{dY}{ds}$, and $\frac{dZ}{ds}$ is perpendicular both to ds and to this directrix, and is represented numerically by the area of the parallelogram whose sides are ds and the directrix.

My question is of two parts:

1. Equation 20, i.e. $P = \dfrac{B+C}{2r}$ is the outcome of special case (i.e. l=1, m=0, n=0)

But in Page 156, Article 517, Maxwell says: "We can now eliminate P, and find the general value of $\dfrac{dX}{ds}$" and uses this formula (i.e. $P = \dfrac{B+C}{2r}$) in the general case.

However in the general case, where 0<l, m, n<1, and hence

$$\frac{d^2X}{dsds'} = l\left(\frac{dP}{ds'}\xi^2 - \frac{dQ}{ds'} + (B+C)\frac{l'\xi}{r}\right) + m(...) + n(...) \neq 0$$

(since direction of X is not in the direction of ds)

therefore,

$$\frac{dX}{ds} = l\left[(P\xi^2 - Q)_{(s',0)} - \int_0^{s'}(2Pr - B - C)\frac{l'\xi}{r}ds'\right] + m\int_0^{s'}(...)ds' + n\int_0^{s'}(...)ds'$$

Now in this general case, how can we get $P = \dfrac{B+C}{2r}$.

If $P \neq \dfrac{B+C}{2r}$ in general case, what does Maxwell mean by "We can now eliminate P, and find the general value of $\dfrac{dX}{ds}$"

2. How can one get equation 21 from equation 15. Please give a lengthy derivation.