$$\begin{Bmatrix} a_1 b_1 c_1 d_1 e_1 f_1 \\ a_2 b_2 c_2 d_2 e_2 f_2 \\ a_3 b_3 c_3 d_3 e_3 f_3 \\ a_4 b_4 c_4 d_4 e_4 f_4 \end{Bmatrix} \quad \begin{Bmatrix} a_1 & -b_1 & c_1 & -d_1 & e_1 & -f_1 \\ a_2 & -b_2 & c_2 & -d_2 & e_2 & -f_2 \\ a_3 & -b_3 & c_3 & -d_3 & e_3 & -f_3 \\ a_4 & -b_4 & c_4 & -d_4 & e_4 & -f_4 \end{Bmatrix}$$

and is developed into

$$\triangle \equiv (a)^2 - \binom{d}{e}^2 + \binom{d}{f}^2 + \binom{a}{e}^2 - \binom{a}{f}^2 + \binom{b}{c}^2 + \binom{b}{f}^2 + \binom{c}{e}^2 - \binom{c}{f}^2$$

$$+ (a_1 b_2 e_3 f_4)^2 - (a_1 c_2 e_3 f_4)^2 + (a_1 d_2 e_3 f_4)^2 + b_1 c_2 e_3 f_4)^2 - (b_1 d_2 e_3 f_4)^2 + (c_1 d_2 e_3 f_4)^2$$

The first row is the same as the coefficient of $(a)^2$ in Φ, and from determinants,

$$(a)^2{}_1 (c_1 d_2 e_3 f_4)^2 = \left[\binom{a}{e}\binom{b}{f} - \binom{a}{f}\binom{b}{e}\right]^2,$$ and similarly for

the other terms, then $\triangle \equiv (a)^2 \Phi$. *The two lines common to four linear complexes are real, coincident or imaginary according as the combinant of the complexes is positive, zero or negative.* This criterion may be used to find the reality of the lines cutting four given ones, by making the principal diagonal of $\triangle$ vanish, and for A_{ik}, the polar of the lines i, k.

CORNELL UNIVERSITY,
January 8, 1897.

THE CUBIC RESOLVENT OF A BINARY QUARTIC DERIVED BY INVARIANT DEFINITION AND PROCESS.

BY PROFESSOR H. S. WHITE.

(Read before the Conference at Chicago, January 1, 1897.)

In the usual discussion of a binary quartic the cubic resolvent first arises as an auxiliary in factoring the quantic, or what is the same thing, in reducing it to a determinate normal form. The coefficients of this cubic, when found, prove to be rational invariants of the original quartic. Such a fact appears as a surprise, since the invariant character of the roots of the cubic is rarely made prominent at