INTRODUCTION :
Since second class at school, I was fascinated by Nth degree equations, which can't be solbed at present even by the most advanced mthematicians, but for which there exists (It has been demonstrated), n real solutions :
$x_1, x_2, \ldots x_n$

I discovered by chance an unknown theorem whch never appears in any mathematical book. I demonstrate this theorem, for equations of degree 1, 2 et 3, (see below).
This theorem binds the derivatives of fonction :

$$y = a_0 x^n + a_1 x^{n-1} + \ldots a_n$$

To his roots $x_1, x_2, \ldots x_n$
That is to say the values : $y'_1, y'_2, \ldots y'_n$

This theorem can be written as :

THEOREM :
The product of derivatives at the roots of Nth degree equations is equal to the discriminant of this equation :

$$\boxed{y'_1 y'_2 \ldots y'_n = \Delta}$$

And also equal to the product of the roots difference, taken 2 by 2.

Example for a second degree equation :
Let x1 and x2 the equation roots :

$$y = ax^2 + bx + c$$

$$y'_1 = 2ax_1 + b$$

$$y'_2 = 2ax_2 + b$$

$$y'_1 y'_2 = (2ax_1 + b)(2ax_2 + b)$$

$$y'_1 y'_2 = 4a^2 x_1 x_2 + 2ab(x_1 + x_2) + b^2$$

$$y'_1 y'_2 = 4a^2 \frac{c}{a} + 2ab\left(-\frac{b}{a}\right) + b^2$$

$$y'_1 y'_2 = 4ac + 2ab\left(-\frac{b}{a}\right) + b^2$$

$$\boxed{y'_1 y'_2 = 4ac - b^2}$$

$$\boxed{y'_1 y'_2 = (x1 - x2)(x2 - x1) = \Delta}$$

Consequences : It is possible to compute the PI number, knowing that all his root derivatives are equal to + or – 1.

CASE of DEGREE 3 EQUATION :

Let us consider the following équation :

$$y = x^3 + px + q$$

Whose roots are x_1, x_2, x_3 :

$$y' = 3x^2 + p$$

$$y'_1 = 3x_1^{\ 2} + p \qquad y'_2 = 3x_2^{\ 2} + p \qquad y'_3 = 3x_3^{\ 2} + p$$

$$y'_1\, y'_2\, y'_3 = \left(3x_1^{\ 2} + p\right)\left(3x_2^{\ 2} + p\right)\left(3x_3^{\ 2} + p\right)$$

$$y'_1\, y'_2\, y'_3 = 9\left(x_1x_2x_3\right)^2 + 3p^2x_1^{\ 2}x_2^{\ 2}x_3^{\ 2} + 9p\left(x_1^{\ 2}x_2^{\ 2} + x_2^{\ 2}x_3^{\ 2} + x_3^{\ 2}x_1^{\ 2}\right) + p^3$$

After development, and assuming that :

$$x_1 + x_2 + x_3 = 0$$

$$x_1x_2 + x_2x_3 + x_3x_1 = p$$

$$x_1x_2x_3 = -q$$

$$y'_1\, y'_2\, y'_3 = 27(-q)^2 + 3p^2(-2p) + 9p\left(x_1^{\ 2}x_2^{\ 2} + x_2^{\ 2}x_3^{\ 2} + x_3^{\ 2}x_1^{\ 2}\right) + p^3$$

When developped :

$$\left(x_1x_2 + x_2x_3 + x_3x_1\right)^2$$

One can deduce :

$$\left(x_1x_2 + x_2x_3 + x_3x_1\right)^2 = x_1^{\ 2}x_2^{\ 2} + x_2^{\ 2}x_3^{\ 2} + x_3^{\ 2}x_1^{\ 2} + 2\left(x_1x_2 + x_2x_3 + x_3x_1\right)$$

So :

$$p^2 = x_1^{\ 2}x_2^{\ 2} + x_2^{\ 2}x_3^{\ 2} + x_3^{\ 2}x_1^{\ 2}$$

$$y'_1\, y'_2\, y'_3 = 27q^2 + 3p^2(-2p) + 9p.p^2 + p^3$$

$$\boxed{y'_1\, y'_2\, y'_3 = 4p^3 + 27q^2}$$

NOW LET US GENERALIZE SUCH A RESULT for Nth degree EQUATIONS !