II. "On the Great Storm of December 3, 1863, as recorded by the Self-registering Instruments at the Liverpool Observatory." By JOHN HARTNUP, F.R.A.S., Director of the Observatory. Communicated by General SABINE, P.R.S. Received January 21, 1864.

[This Paper is accompanied by a diagram, which is deposited, for reference, in the Archives of the Royal Society, and of which the author gives the following explanation.]

The accompanying diagram exhibits the strength and direction of the wind, the height of the barometer, and the rain-fall for three days preceding, two days following, and during the great storm of December 3, 1863, as recorded by the self-registering instruments at the Liverpool Observatory. The barometer-tracing is a *facsimile* of the original record produced by King's self-registering barometer; the force and direction of the wind and the rain-fall have been taken from the sheets of Osler's anemometer and rain-gauge; the time-scale for the anemometer has been slightly increased to adapt it to that of the barometer, and the scale of wind-pressure for each five pounds has been made uniform, instead of leaving the spaces greater or less according to the strength of the springs as in the original record. The tracings of the recording-pencils for the direction of the wind and the rain-fall are faithfully represented, but it is scarcely possible to copy the delicate shadings and every gust recorded on the original sheets by the pencil which registers the force of the wind; all the heavy pressures are, however, correctly represented, and may be taken from the diagram as accurately as from the original sheets. The figures at the bottom of the diagram show the readings of the dry- and wet-bulb thermometers and the maximum and minimum thermometers as recorded at the Observatory during the six days; the wet- and dry-bulb thermometers were read each day at 8 and 9 A.M. and at 1, 3 and 9 P.M.; the registering dry thermometers were read and readjusted each day at 1 P.M. The time marked on the diagram for all the instruments is Greenwich mean time.

For four days previous to the 30th of November the barometer had been high and steady, the readings ranging from 30·13 in. to 30·33 in., the latter at noon on the 29th being the highest; from this time to midnight the fall was slow and pretty uniform; from midnight November 29 to midnight December 5 the changes of barometric pressure, the strength and direction of the wind, and the rain-fall are shown on the diagram. The fall of the barometer on the day of the great storm was rapid from midnight to 6 A.M.; heavy rain and hail fell from $3^h\ 30^m$ to $7^h\ 20^m$; and from $5^h\ 50^m$ to $6^h\ 45^m$ it was nearly calm, during which time the wind shifted from E. through S. to W. Between $6^h\ 45^m$ and $8^h\ 15^m$ the pressure of the wind increased from 0 to 16 lbs. on the square foot, and at about twenty-five

minutes past eight it increased from 16 to 43 lbs. in the short space of two or three minutes; the barometer, being at its minimum, suddenly rose about three-hundredths of an inch, and during the heaviest part of the storm it continued to rise at the rate of about one-tenth of an inch an hour. The oscillations in the mercurial column, as will be seen by the diagram, were large and frequent during the storm, one of the most remarkable being immediately after 10^h A.M. and nearly coincident with two of the heaviest gusts of wind; the depression in this case amounted to between four and five hundredths of an inch, the rise following the fall so quickly that the clock moved the recording-cylinder only through just sufficient space to cause a double line to be traced by the pencil.

III. "On the Criterion of Resolubility in Integral Numbers of the Indeterminate Equation

$$f=ax^2+a'x'^2+a''x''^2+2bx'x''+2b'xx''+2b''x'x=0.$$"

By H. J. Stephen Smith, M.A., F.R.S., Savilian Professor of Geometry in the University of Oxford. Received January 20, 1864.

It is sufficient to consider the case in which f is an indefinite form of a determinant different from zero. We may also suppose that f is primitive, *i. e.* that the six numbers a, a', a'', b, b', b'' do not admit of any common divisor. We represent by Ω the greatest common divisor of the minors of the matrix of f, by $\Delta\Omega^2$ the determinant of f, and by $\Omega\mathrm{F}$ the contravariant of f, *i. e.* the form

$$(b^2-a'a'')x^2+\ldots;$$

$\Omega\Delta^2$ will then be the determinant of F, and Δf its contravariant. By $\overline{\Omega}$, $\overline{\Delta}$, and $\overline{\Omega\Delta}$ we denote the quotients obtained by dividing Ω, Δ, and $\Omega\Delta$ by the greatest squares contained in them respectively; ω is any uneven prime dividing $\overline{\Omega}$, but not $\overline{\Delta}$; δ is any uneven prime dividing $\overline{\Delta}$, but not $\overline{\Omega}$; and θ is any uneven prime dividing both $\overline{\Omega}$ and $\overline{\Delta}$, and consequently not dividing $\overline{\Omega\Delta}$. We may then enunciate the theorem—

"The equation $f=0$ will or will not be resoluble in integral numbers different from zero according as the equations included in the formulæ

$$\left(\frac{\overline{\Omega}}{\delta}\right)=\left(\frac{\mathrm{F}}{\delta}\right),\qquad \left(\frac{\overline{\Delta}}{\omega}\right)=\left(\frac{f}{\omega}\right),\qquad \left(\frac{-\overline{\Omega\Delta}}{\theta}\right)=\left(\frac{f}{\theta}\right)\left(\frac{\mathrm{F}}{\theta}\right)$$

are or are not satisfied."

The symbols $\left(\frac{\overline{\Omega}}{\delta}\right)$, $\left(\frac{\overline{\Delta}}{\omega}\right)$, and $\left(\frac{-\overline{\Omega\Delta}}{\theta}\right)$ are the quadratic symbols of Legendre; the symbols $\left(\frac{\mathrm{F}}{\delta}\right)$, $\left(\frac{\mathrm{F}}{\theta}\right)$, $\left(\frac{f}{\omega}\right)$, $\left(\frac{f}{\theta}\right)$ are generic characters of f (see the Memoir of Eisenstein, "Neue Theoreme der höheren Arithmetik," in his 'Mathematische Abhandlungen,' p. 185, or in Crelle's Journal, vol. xxxv. p. 125).

The theorem includes those of Legendre and Gauss on the resolubility