DE
BAROMETRI MOTU
A
VENTI DIRECTIONE PENDENTE,
EX
OBSERVATIONIBUS XII ANNORUM MDCCCXXVIII USQUE AD MDCCCXXXIX WETZLARIAE MERIDIE MEDIO INSTITUTIS DERIVATO.

SCRIPSIT

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§. 1.

Inde ab anno MDCCCXXVIII novies per diem observationes meteorologicas institui atque ita observata serie continua litteris mandavi. Ex parte harum observationum, quae anno primo factae sunt barometri variationes diurnae a me sunt derivatae et lectoribus propositae *). Investigationes phaenomeni hujus perscrutatione sane dignissimi a me sunt continuatae nec tamen ad scopum illum jam perductae, quem attingere velim. Rem inchoatam, si Deo O. M. placuerit annis aliquot exactis ad finem perducam. Nunc scribendi occasione iterum oblata mutationes barometri considerare lubet ex venti directione pendentes.

§. 2.

Hunc ad finem observationes omnes adhibendas esse censuissem, si cum barometro simul anemoscopium semper observare licuisset. Quum vero ob diei aut lunae lucis inopiam et anemoscopii constructionem horis quibusdam singulis matutinis et vespertinis hoc fieri non potuisset, ex magno illo observationum penu (quo quidem 39447 observationes barometri ad 0° R. reductae continentur) illae tandummodo erant eligendae, quae ad rem pertractandam essent aptissimae, observationes dico meridie vero institutae, quia hoc tempore, uti inter omnes constat barometrum medium, quem dicunt statum obtinet **) et atmosphaera causis cosmicis saltem unoquoque die aequali fere modo afficitur.

§. 3.

Observationes igitur ipso meridie institutas annorum XII inde ab anno MDCCCXXVIII usque ad MDCCCXXXIX in tabulas redegi secundum menses et annos inscriptas, quae ita sunt compositae, ut status barometri singulo quoque sedecim ventorum flante observati columnam unam eandemque verticulem expleant, medio cujusvis columnae observationum venti numerum, quem pondus medii voco, apposui. Ceterum, quum nomina sedecim ventorum apud nos usitatorum veteribus desint ***), signa eorum cuilibet nota eaque a

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*) De variationibus barometri regularibus unoquoque die revertentibus. Scripsit Jac. Guil. Lambert. Gissae, Typis Heyeri MDCCCXXIX.

**) l. l. §. 38.

***) cf. die Windrose der Griechen und Römer von Carl. v. Raumer. Rhein. Museum V. pag. 497.

geographis et nautis nostri temporis usitata adhibui. Statum barometri signo B notavi ejusque ventum infra apposui; sic e. g. B_N statum significat barometri flante vento N. i. e. Aquilone s. Borea veterum. Quae hoc modo ex observationibus 4383 annorum illorum XII calculo haud exiguo (nam tabularum liber paginas L. fol. complectitur) a me sunt inventa, infra §. 19. cum lectoribus communicantur; nunc ipsae formulae sunt inveniendae ad investigationem nostram necessariae.

§. 4.

Numerentur venti octo, sive numero generali n indicati, horizontis N, NO, O SO, S, SW, W, NW ita ut a Borea (N) incipiatur et Boreae N tribuatur numerus O, vento NO numerus I, vento O numerus II, et sic porro ut ad ventum NW tandem referatur numerus VII et designetur unusquisque horum ventorum signo generali v, sit porro B_v altitudo barometri vento v flante observata, b altitudo barometri media et π arcus 180 graduum, sint tandem α et β numeri coefficientes, φ et ψ anguli auxiliares ex ipsis observationibus determinandi, formula saepius usitata generalis

$$A_x = a \sin (\alpha + x\varphi) + b \sin (\beta + x\vartheta) \ldots .$$

signis nostris exstructa erit:

$$B_v = b + \alpha \sin \left(\frac{v \cdot 2\pi}{n} + \varphi\right) + \beta \sin \left(\frac{v \cdot 4\pi}{n} + \psi\right).$$

Si venti sedecim respiciuntur erit $n = 16$, si, ut nobis propositum est, octo tantum venti calculo subjiciuntur, erit $n = 8$. Positis valoribus $n = 8$ et $\pi = 180°$ formula prodit

$$B_v = b + \alpha \sin (v \cdot 45° + \varphi) + \beta \sin (v \cdot 90° + \psi).$$

§. 5.

Valores numerorum α et β nec non angulorum auxiliarium φ et ψ methodo sequente ex observationibus deduci possunt. Sint E_0, E_I, E_{II} etc. errores, quibus observationes barometri ventis flantibus O, (i. e. N, I (i. e. NO) II, (i. e. O) etc. implicitae sunt, aequationes omnium errorum, secundum ordinem erunt:

$$b + \alpha \sin \varphi + \beta \sin \psi - B_N = E_0$$
$$b + \alpha \sin (45° + \varphi) + \beta \sin (90° + \psi) - B_{NO} = E_{I.}$$
$$b + \alpha \sin (90° + \varphi) + \beta \sin (180° + \psi) - B_O = E_{II.}$$
$$b + \alpha \sin (135° + \psi) + \beta \sin (270° + \psi) - B_{SO} = E_{III.}$$
$$b + \alpha \sin (180° + \varphi) + \beta \sin (360° + \psi) - B_S = E_{IV.}$$
$$b + \alpha \sin (225° + \varphi) + \beta \sin (450° + \psi) - B_{SW} + E_{V.}$$
$$b + \alpha \sin (270° + \varphi) + \beta \sin (540° + \psi) - B_W = E_{VI.}$$
$$b + \alpha \sin (315° + \varphi) + \beta \sin (630° + \psi) - B_{NW} = E_{VII.}$$

Quae aequationes errorum modo simpliciore exprimi possunt si reputamus esse

$$\sin (90° + \psi) = \cos \psi;\ \sin (180° + \psi) = - \sin \sin \psi;$$
$$\sin (135° + \varphi) = \cos (45° + \varphi);\ \sin (270° + \psi) = - \cos \psi;$$
$$\sin (360° + \psi) = \sin \psi;\ \sin (225° + \varphi) = - \sin (45° + \varphi);$$
$$\sin (450° + \psi) = \cos \psi;\ \sin (540° + \psi) = - \sin \psi;$$
$$\sin (315° + \varphi) = - \cos (45° + \varphi);\ \sin (630° + \psi) = - \cos \psi.$$

His enim valoribus in illis substitutis evadunt:

$$b + \alpha \sin \varphi + \beta \sin \psi - B_N = E_0$$
$$b + \alpha \sin (45° + \varphi) + \beta \cos \psi - B_{NO} = E_{I.}$$
$$b + \alpha \cos \varphi - \beta \sin \psi - B_O = E_{II.}$$
$$b + \alpha \cos (45° + \varphi) - \beta \cos \psi - B_{SO} = E_{III.}$$
$$b - \alpha \sin \varphi + \beta \sin \psi - B_S = E_{IV.}$$
$$b - \alpha \sin (45° + \varphi) + \beta \cos \psi - B_{SW} = E_{V.}$$
$$b - \alpha \cos \varphi - \beta \sin \psi - B_W = E_{VI.}$$
$$b - \alpha \cos (45° + \varphi) - \beta \cos \psi - B_{NW} = E_{VII.}$$

§. 6.

Habemus ergo aequationes octo, quarum opera quatuor tantum quantitates incognitae determinandae sunt. Hae aequationes, uti dicuntur plus quam determinantae, optime erunt resolutae si summa quadratorum errorum omnium, qui existere possunt, est minima, quae fieri potest. Differentientur ergo illae aequationes respectu habito quantitatum α, β, φ, ψ unde prodit:

$$\begin{aligned}
&\alpha \cos\varphi\, d\varphi + \sin\varphi\, d\alpha + \beta \cos\psi\, d\psi + \sin\psi\, d\beta = dE_0.\\
&\alpha \cos(45^\circ+\varphi)\, d\varphi + \sin(45^\circ+\varphi)\, d\alpha - \beta \sin\psi\, d\psi + \cos\psi\, d\beta = DE_{I}.\\
-&\alpha \sin\varphi\, d\varphi + \cos\varphi\, d\alpha - \beta \cos\psi\, d\psi - \sin\psi\, d\beta = dE_{II}.\\
-&\alpha \sin(45^\circ+\varphi)\, d\varphi + \cos(45^\circ+\varphi)\, d\alpha + \beta \sin\psi\, d\psi - \cos\psi\, d\beta = dE_{III}.\\
-&\alpha \cos\varphi\, d\varphi - \sin\varphi\, d\alpha + \beta \cos\psi\, d\psi + \sin\psi\, d\beta = dE_{IV}.\\
-&\alpha \cos(45^\circ+\varphi)\, d\varphi - \sin(45^\circ+\varphi)\, d\alpha - \beta \sin\psi\, d\psi + \cos\psi\, d\beta = dE_{V}.\\
&\alpha \sin\varphi\, d\varphi - \cos\varphi\, d\alpha - \beta \cos\psi\, d\psi - \sin\psi\, d\beta = dE_{VI}.\\
&\alpha \sin(45^\circ+\varphi)\, d\varphi - \cos(45^\circ+\psi)\, d\alpha + \beta \sin\psi\, d\psi - \cos\psi\, d\beta = dE_{VII}.
\end{aligned}$$

§. 7.

Multiplicatione valorum E_0, E_I, E_{II}, etc. . . . . etc. cum valoribus differentialium eorum dE_0, dE_I, dE_{II}, ... facile derivantur quantitates $E_0\, dE_0$, $E_I\, dE_I$, $E_{II}\, dE_{II}$ . . . . $E_{VI}\, dE_{VI}$, $E_{VII}\, dE_{VII}$. Itaque invenimus:

$$\left\{\begin{aligned}
&b\alpha \cos\varphi\, d\varphi + \alpha^2 \sin\varphi \cos\varphi\, d\varphi + \alpha\beta \cos\varphi \sin\varphi\, d\varphi - B_N\, \alpha \cos\varphi\, d\varphi +\\
+&b \sin\varphi\, d\alpha + \alpha \sin\varphi^2\, d\alpha + \beta \sin\varphi \sin\psi\, d\alpha - B_N \sin\varphi\, d\alpha +\\
+&b\beta \cos\psi\, d\psi + \alpha\beta \sin\varphi \cos\psi\, d\psi + \beta^2 \sin\psi \cos\psi\, d\psi - B_N\, \beta \cos\psi\, d\psi +\\
+&b \sin\psi\, d\beta + \alpha \sin\varphi \sin\psi\, d\beta + \beta \sin\psi^2\, d\beta - B_N \sin\psi\, d\beta.
\end{aligned}\right\} = E_0\, dE_0.$$

$$\left\{\begin{aligned}
&b\alpha \cos(45^\circ+\varphi)\, d\varphi + \alpha^2 \sin(45^\circ+\varphi) \cos(45^\circ+\varphi)\, d\varphi + \alpha\beta \cos(45^\circ+\varphi) \cos\psi\, d\varphi - B_{NO}\alpha \cos(45^\circ+\varphi)\, d\varphi +\\
+&b \sin(45^\circ+\varphi)\, d\alpha + \alpha \sin(45^\circ+\varphi)^2\, d\alpha + \beta \sin(45^\circ+\varphi) \cos\psi\, d\alpha - B_{NO} \sin(45^\circ+\varphi)\, d\alpha -\\
-&b\beta \sin\psi\, d\psi - \alpha\beta \sin(45^\circ+\varphi) \sin\psi\, d\psi - \beta^2 \sin\psi \cos\psi\, d\psi + B_{NO}\, \beta \sin\psi\, d\psi +\\
+&b \cos\psi\, d\beta + \alpha \sin(45^\circ+\varphi) \cos\psi\, d\beta + \beta \cos\psi^2\, d\beta - B_{NO} \cos\psi\, d\beta.
\end{aligned}\right\} = E_I\, dE_I.$$

$$\left\{\begin{aligned}
-&b\alpha \sin\varphi\, d\varphi - \alpha^2 \sin\varphi \cos\varphi\, d\varphi + \alpha\beta \sin\varphi \sin\psi\, d\varphi - B_0\, \alpha \sin\varphi\, d\varphi +\\
+&b \cos\varphi\, d\alpha + \alpha \cos\varphi^2\, d\alpha - \beta \cos\varphi \sin\psi\, d\alpha - B_0 \cos\varphi\, d\alpha -\\
-&b\beta \cos\psi\, d\psi - \alpha\beta \cos\varphi \cos\psi\, d\psi + \beta^2 \sin\psi \cos\psi\, d\psi + B_0\, \beta \cos\psi\, d\psi -\\
-&b \sin\psi\, d\beta - \alpha \cos\varphi \sin\psi\, d\beta = \beta \sin\psi^2\, d\beta + B_0 \sin\psi\, d\beta.
\end{aligned}\right\} = E_{II}\, dE_{II}.$$

$$\left\{\begin{aligned}
-&b\alpha \sin(45^\circ+\varphi)\, d\varphi - \alpha^2 \sin(45^\circ+\varphi) \cos(45^\circ+\varphi)\, d\varphi + \alpha\beta \sin(45^\circ+\varphi) \cos\psi\, d\varphi + B_{SO}\alpha \sin(45^\circ+\varphi)\, d\varphi +\\
+&b \cos(45^\circ+\varphi)\, d\alpha + \alpha \cos(45^\circ+\varphi)^2\, d\alpha - \beta \cos(45^\circ+\varphi) \cos\psi\, d\alpha - B_{SO} \cos(45^\circ+\varphi)\, d\alpha +\\
+&b\beta \sin\psi\, d\psi + \alpha\beta \cos(45^\circ+\varphi) \sin\psi\, d\psi - \beta^2 \sin\psi \cos\psi\, d\psi - B_{SO}\, \beta \sin\psi\, d\psi -\\
-&b \cos\psi\, d\beta - \alpha \cos(45^\circ+\varphi) \cos\psi\, d\beta + \beta \cos\psi^2\, d\beta + B_{SO} \cos\psi\, d\beta.
\end{aligned}\right\} = E_{III}\, dE_{III}.$$

$$\left\{\begin{aligned}
-&b\alpha \cos\varphi\, d\varphi + \alpha^2 \sin\varphi \cos\varphi\, d\varphi - \alpha\beta \cos\varphi \sin\psi\, d\varphi + B_S\, \alpha \cos\varphi\, d\varphi -\\
-&b \sin\varphi\, d\alpha + \alpha \sin\varphi^2\, d\alpha - \beta \sin\varphi \sin\psi\, d\alpha + B_S \sin\varphi\, d\alpha +\\
+&b\beta \cos\psi\, d\psi - \alpha\beta \sin\varphi \cos\psi\, d\psi + \beta^2 \sin\psi \cos\psi\, d\psi - B_S\, \beta \cos\psi\, d\psi +\\
+&b \sin\psi\, d\beta - \alpha \sin\varphi \sin\psi\, d\beta + \beta \sin\psi^2\, d\beta - B_S \sin\psi\, d\beta.
\end{aligned}\right\} = E_{IV}\, dE_{IV}.$$

$$\left\{\begin{aligned}
-&b\alpha \cos(45^\circ+\varphi)\, d\varphi + \alpha^2 \sin(45^\circ+\varphi) \cos(45^\circ+\varphi)\, d\varphi - \alpha\beta \cos(45^\circ+\varphi) \cos\psi\, d\varphi + B_{SW}\alpha \cos(45^\circ+\varphi)\, d\varphi -\\
-&b \sin(45^\circ+\varphi)\, d\alpha + \alpha \sin(45^\circ+\varphi)^2\, d\alpha - \beta \sin(45^\circ+\varphi) \cos\psi\, d\alpha + B_{SW} \sin(45^\circ+\varphi)\, d\alpha -\\
-&b\beta \sin\psi\, d\psi + \alpha\beta \sin(45^\circ+\varphi) \sin\psi\, d\psi - \beta^2 \sin\psi \cos\psi\, d\psi + B_{SW}\, \beta \sin\psi\, d\psi +\\
+&b \cos\psi\, d\beta - \alpha \sin(45^\circ+\varphi) \cos\psi\, d\beta + \beta \cos\psi^2\, d\beta - B_{SW} \cos\psi\, d\beta.
\end{aligned}\right\} = E_V\, dE_V.$$

$$\left\{\begin{aligned}
&b\alpha \sin\varphi\, d\varphi - \alpha^2 \sin\varphi \cos\varphi\, d\varphi - \alpha\beta \sin\varphi \sin\psi\, d\varphi - B_W\, \alpha \sin\varphi\, d\varphi -\\
-&b \cos\varphi\, d\alpha + \alpha \cos\varphi^2\, d\alpha + \beta \cos\varphi \sin\psi\, d\alpha + B_W \cos\varphi\, d\alpha -\\
-&b\beta \cos\psi\, d\psi + \alpha\beta \cos\psi\, d\psi + \beta^2 \sin\psi \cos\psi + B_W\, \beta \cos\psi\, d\psi -\\
-&\sin\psi\, d\beta + \alpha \cos\varphi \sin\psi\, d\beta + \beta \sin\psi^2\, d\beta + B_W \sin\psi\, d\beta.
\end{aligned}\right\} = E_{VI}\, dE_{VI}$$

$$\left.\begin{array}{l} b\alpha\sin(45^\circ+\varphi)d\varphi-\alpha^2\sin(45^\circ+\psi)\cos(45^\circ+\varphi)d\varphi-\alpha\beta\sin(45^\circ+\varphi)\cos\psi d\varphi-B_{NW}\alpha\sin(45^\circ+\varphi)d\varphi- \\ -\cos(45^0+\varphi)\,d\alpha+\alpha\cos(45^\circ+\varphi)^2\,d\alpha+\beta\cos(45^\circ+\varphi)\,\cos\psi+B_{NW}\,\cos(45^\circ+\varphi)\,d\alpha+ \\ +b\beta\,\sin\psi\,d\psi-\alpha\beta\,\cos(45^\circ+\varphi)\,\sin\psi\,d\psi-\beta^2\,\sin\psi\cos\psi\,d\psi-B_{NW}\,\beta\,\sin\psi\,d\psi- \\ -b\,\cos\psi\,d\beta+\alpha\,\cos(45^\circ+\varphi)\,\cos\psi\,d\beta+\beta\,\cos\psi^2\,d\beta+B_{NW}\,\cos\psi\,d\beta. \end{array}\right\}=E_{VII}dE_{VII}.$$

§. 8.

Summa quadratorum errorum omnium $E^2_0 + E^2_I + E^2_{II} + E^2_{III} + E^2_{IV} + E^2_V + E^2_{VI} + E^2_{VII}$ minima erit, si differentiale ejus primum $2\,E_0\,dE_0 + 2\,E_I\,dE_I + 2\,E_{II}\,dE_{II} + 2\,E_{III}\,dE_{III} + 2\,E_{IV}\,dE_{IV} + 2\,E_V\,dE_V + 2\,E_{VI}\,dE_{VI} + 2\,E_{VII}\,dE_{VII} = 0$, sive si $E_0\,dE_0 + E_I\,dE_I + E_{II}\,dE_{II} + E_{III}\,dE_{III} + E_{IV}\,dE_{IV} + E_V\,dE_V + E_{VI}\,dE_{VI} + E_{VII}\,dE_{VII}$, quod brevitatis causa signo $\Sigma E\,dE$ notamus, erit $= 0$. Positis pro $E_0\,dE_0$, $E_I\,dE_I$ .... etc. valoribus supra inventis et terminis singulis secundum differentialia $d\varphi$, $d\alpha$, $d\psi$, $d\beta$ constitutis habemus:

(I.) (II.) (III.) (IV.)

$$\left(\begin{array}{llll} b\,\alpha\,\cos\varphi & +\alpha^2\sin\varphi\cos\varphi & +\alpha\beta\cos\varphi\sin\psi & -B_N\,\alpha\cos\varphi\;+ \\ +b\,\alpha\cos(45^\circ+\varphi) & +\alpha^2\sin(45^\circ+\varphi)\cos(45^\circ+\varphi) & +\alpha\beta\cos(45^\circ+\varphi)\cos\psi & -B_{NO}\,\alpha\cos(45^\circ+\varphi)\;- \\ -b\,\alpha\sin\varphi & -\alpha^2\sin\varphi\cos\varphi & +\alpha\beta\sin\varphi\sin\psi & +B_0\,\alpha\sin\varphi\;- \\ -b\,\alpha\sin(45^\circ+\varphi) & -\alpha^2\sin(45^0+\varphi)\cos(45^0+\varphi) & +\alpha\beta\sin(45^\circ+\varphi)\cos\psi & +B_{SO}\,\alpha\sin(45^\circ+\varphi)\;- \\ -b\,\alpha\cos\varphi & +\alpha^2\sin\varphi\cos\varphi & -\alpha\beta\cos\varphi\sin\psi & +B_S\,\alpha\sin\varphi\;- \\ -b\,\alpha\cos(45^0+\varphi) & +\alpha^2\sin(45^0+\varphi)\cos(45^\circ+\varphi) & -\alpha\beta\cos(45^\circ+\varphi)\cos\psi & +B_{SW}\,\alpha\cos(45^\circ+\varphi)\;+ \\ +b\,\alpha\sin\varphi & -\alpha^2\sin\varphi\cos\varphi & -\alpha\beta\sin\varphi\sin\psi & -B_W\,\alpha\sin\varphi\;+ \\ +b\,\alpha\sin(45^\circ+\varphi) & -\alpha^2\sin(45^\circ+\varphi)\cos(45^\circ+\varphi) & -\alpha\beta\sin(45^\circ+\varphi)\cos\psi & -B_{NW}\,\alpha\sin(45^\circ+\varphi) \end{array}\right)d\varphi\;+$$

(V.) (VI.) (VII.) (VIII.)

$$\left(\begin{array}{llll} b\sin\varphi & +\alpha\sin\varphi^2 & +b\sin\varphi\sin\psi & -B_N\sin\varphi\;+ \\ +b\sin(45^\circ+\varphi) & +\alpha\sin(45^\circ+\varphi)^2 & +\beta\sin(45^\circ+\varphi)\cos\psi & -B_{NO}\sin(45^\circ+\varphi)\;+ \\ +b\cos\varphi & +\alpha\cos\varphi^2 & -\beta\cos\varphi\sin\psi & -B_0\cos\varphi\;+ \\ +b\cos(45^0+\varphi) & +\alpha\cos(45^\circ+\varphi)^2 & -\beta\cos(45^\circ+\varphi)\cos\psi & -B_{SO}\cos(45^\circ+\varphi)\;- \\ -b\sin\varphi & +\alpha\sin\varphi^2 & -\beta\sin\varphi\sin\psi & +B_S\sin\varphi\;- \\ -b\sin(45^\circ+\varphi) & +\alpha\sin(45^\circ+\varphi)^2 & -\beta\sin(45^\circ+\varphi)\cos\psi & +B_{SW}\sin(45^\circ+\varphi)\;- \\ -b\cos\varphi & +\alpha\cos\varphi^2 & +\beta\cos\varphi\sin\psi & +B_W\cos\varphi\;- \\ -b\cos(45^\circ+\varphi) & +\alpha\cos(45^\circ+\varphi)^2 & +\beta\cos(45^0+\varphi)\cos\psi & +B_{NW}\cos(45^\circ+\varphi). \end{array}\right)d\alpha\;+$$

(IX.) (X.) (XI.) (XII.)

$$\left(\begin{array}{llll} b\,\beta\cos\psi & +\alpha\beta\sin\varphi\cos\psi & +\beta^2\sin\psi\cos\psi & -B_N\,\beta\cos\psi\;- \\ -b\,\beta\sin\psi & -\alpha\beta\sin(45^\circ+\psi)\sin\varphi & -\beta^2\sin\psi\cos\psi & +B_{NO}\,\beta\sin\psi\;- \\ -b\,\beta\cos\psi & -\alpha\beta\cos\varphi\cos\psi & +\beta^2\sin\psi\cos\psi & +B_0\,\beta\cos\psi\;+ \\ +b\,\beta\sin\psi & +\alpha\beta\cos(45^0+\varphi)\sin\psi & -\beta^2\sin\psi\cos\psi & -B_{SO}\,\beta\sin\psi\;+ \\ +b\,\beta\cos\psi & -\alpha\beta\sin\varphi\cos\psi & +\beta^2\sin\psi\cos\psi & -B_S\,\beta\cos\psi\;- \\ -b\,\beta\sin\psi & +\alpha\beta\sin(45^\circ+\varphi)\sin\psi & -\beta^2\sin\psi\cos\psi & +B_{SW}\,\beta\sin\psi\;- \\ -b\,\beta\cos\psi & +\alpha\beta\cos\varphi\cos\psi & +\beta^2\sin\psi\cos\psi & +B_W\,\beta\cos\psi\;+ \\ +b\,\beta\sin\psi & -\alpha\beta\cos(45^\circ+\varphi)\sin\psi & -\beta^2\sin\psi\cos\psi & -B_{NW}\,\beta\sin\psi. \end{array}\right)d\psi\;+$$

(XIII.) (XIV.) (XV.) (XVI.)

$$\left(\begin{array}{llll} b\sin\psi & +\alpha\sin\varphi\sin\psi & +\beta\sin\psi^2 & -B_N\sin\psi\;+ \\ +b\cos\psi & +\alpha\sin(45^\circ+\psi)\cos\psi & +\beta\cos\psi^2 & -B_{NO}\cos\psi\;- \\ -b\sin\psi & -\alpha\cos\varphi\sin\psi & +\beta\sin\psi^2 & +B_0\sin\psi\;- \\ -b\cos\psi & -\alpha\cos(45^\circ+\varphi)\cos\psi & +\beta\cos\psi^2 & +B_{SO}\cos\psi\;+ \\ +b\sin\psi & -\alpha\sin\varphi\sin\psi & +\beta\sin\psi^2 & -B_S\sin\psi\;+ \\ +b\cos\psi & -\alpha\sin(45^\circ+\varphi)\cos\psi & +\beta\cos\psi^2 & -B_{SW}\cos\psi\;- \\ -b\sin\psi & +\alpha\cos\varphi\sin\psi & +\beta\sin\psi^2 & +B_W\sin\psi\;- \\ -b\cos\psi & +\alpha\cos(45^\circ+\varphi)\cos\psi & +\beta\cos\psi^2 & +B_{NW}\cos\psi \end{array}\right)d\beta = \Sigma E\,dE = 0.$$

§. 9.

Ex hac aequatione $\Sigma E\, dE = 0$ quatuor alias aequationes deducere possumus, quarum ope valores α, β, φ et ψ quantitatibus ex observationibus notis exprimuntur. Etenim $\Sigma E\, dE$ nullo modo $= 0$ fieri potest, nisi numeri coefficientes differentialium singulorum $d\varphi$, $d\alpha$, $d\psi$, $d\beta$ ipsi sint $= 0$. Ergo si, brevitatis causa, columnas hujus aequationis numeris romanis, quibus inscriptae sunt designamus, habemus:

$$\begin{aligned}
(\mathrm{I.}) + (\mathrm{II.}) + (\mathrm{III.}) + (\mathrm{IV.}) &= 0\\
(\mathrm{V.}) + (\mathrm{VI.}) + (\mathrm{VII.}) + (\mathrm{VIII.}) &= 0\\
(\mathrm{IX.}) + (\mathrm{X.}) + (\mathrm{XI.}) + (\mathrm{XII.}) &= 0\\
(\mathrm{XIII.}) + (\mathrm{XIV.}) + (\mathrm{XV.}) + (\mathrm{XVI.}) &= 0.
\end{aligned}$$

§. 10.

Terminus (I.) i. e. $b\alpha \cos\varphi + b\alpha \cos(45^\circ + \varphi) - b\alpha \sin\varphi - b\alpha \sin(45^\circ + \varphi) - b\alpha \cos(45^\circ + \varphi) + b\alpha \sin\varphi + b\alpha \sin(45^\circ + \varphi)$ etiam hoc ordine scribi potest:

$$\begin{aligned}
&b\alpha \cos\varphi - b\alpha \cos\varphi +\\
&+ b\alpha \cos(45^\circ + \varphi) - b\alpha \cos(45^\circ + \psi) -\\
&- b\alpha \sin\varphi + b\alpha \sin\varphi -\\
&- b\alpha \sin(45^0 + \varphi) + b\alpha \sin(45^\circ + \varphi),
\end{aligned}$$

quo constituto evidenter apparet eum esse $= 0$. Simili modo elucet etiam esse (II.) $= 0$, et (III.) $= 0$; si vero est (I.) $= 0$, (II.) $= 0$, (III.) $= 0$, ex aequatione (I.) + (II.) + (III.) + (IV.) $= 0$ sequitur etiam esse (IV.) $= 0$. Habemus ergo

$$\left.\begin{aligned}
&- B_N\, \alpha \cos\varphi - B_{NO}\, \alpha \cos(45^\circ + \varphi) + B_O\, \alpha \sin\varphi + B_{SO}\, \alpha \sin(45 + \varphi) +\\
&+ B_S\, \alpha \cos\varphi + B_{SW}\, \alpha \cos(45^\circ + \varphi) - B_W\, \alpha \sin\varphi - B_{NW}\, \alpha \sin(45^\circ + \varphi)
\end{aligned}\right\} = (\mathrm{IV.}) = 0.$$

sive omisso factore α, omnibus terminis communi et ordine meliore constituto:

$$(B_S - B_N) \cos\varphi + (B_{SW} - B_{NO}) \cos(45^\circ + \varphi) + (B_O - B_W) \sin\varphi + (B_{SO} - B_{NW}) \sin(45^\circ + \varphi) = (\mathrm{IV.}) = 0,$$

sive adhibitis formulis notissimis $\cos(x + y) = \cos x \cos y - \sin x \sin y$ et $\sin(x + y) = \sin x \cos y + \cos x \sin y$.

$$\left.\begin{aligned}
&(B_S - B_N) \cos\varphi + (B_{SW} - B_{NO}) (\cos 45^\circ \cos\varphi - \sin 45^\circ \sin\varphi) +\\
&+ (B_O - B_W) \sin\varphi + (B_{SO} - B_{NW}) (\sin 45^\circ \cos\varphi + \cos 45^\circ \sin\varphi)
\end{aligned}\right\} = (\mathrm{IV.}) = 0 = (\mathfrak{A}.)$$

§. 11.

Pergamus ad disquisitionem accuratiorem aequationis (§. 9.) secundae

$$(\mathrm{V.}) + (\mathrm{VI.}) + (\mathrm{VII.}) + (\mathrm{VIII.}) = 0.$$

Facillime elucet esse (V.) $= 0$ nec non (VII.) $= 0$, quibus valoribus positis in aequatione data prodit (VI.) + (VIII.) $= 0$.

Est vero

$$\left.\begin{aligned}
&\alpha (\sin\varphi^2 + \cos\varphi^2) + \alpha [\sin(45^\circ + \varphi)^2 + \cos(45^\circ + \varphi)^2] +\\
&\alpha (\sin\varphi^2 + \cos\varphi^2) + \alpha [\sin 45^\circ + \varphi)^2 + \cos(45^\circ + \varphi)^2]
\end{aligned}\right\} = (\mathrm{VI.})$$

id est $\alpha + \alpha + \alpha + \alpha = 4\alpha = (\mathrm{VI.})$.

Invenimus porro

$$\left.\begin{aligned}
&(B_S - B_N) \sin\varphi + (B_{SW} - B_{NO}) \sin(45^\circ + \varphi) + (B_W - B_O) \cos\varphi\\
&+ (B_{NW} - B_{SO}) \cos(45^\circ + \varphi).
\end{aligned}\right\} = (\mathrm{VIII.})$$

sive

$$\left.\begin{aligned}
&(B_S - B_N) \sin\varphi + (B_{SW} - B_{NO}) \sin 45^\circ \cos\varphi + \cos 45^\circ \sin\varphi) +\\
&+ (B_W - B_O) \cos\varphi + (B_{NW} - B_{SO}) \cos 45^\circ \cos\varphi - \sin 45^\circ \sin\varphi)
\end{aligned}\right\} = (\mathrm{VIII.})$$

quam ob rem sequitur:

$$4\,\alpha + \left\{\begin{array}{l}(B_s - B_N)\sin\varphi + (B_{sw} - B_{No})\sin 45^\circ \cos\varphi + \cos(45^\circ \sin\varphi) + \\ + (B_w - B_o)\cos\varphi + (B_{Nw} - B_{so})\cos 45^\circ \cos\varphi - \sin 45^\circ \sin\varphi)\end{array}\right\} = (VI.) + (VIII.) = 0 \ldots (\mathfrak{B}.)$$

§. 12.

Si haec aequatio $\mathfrak{B}$ multiplicatur quantitate $\sin\varphi$ habemus:

$$4\,\alpha \sin\varphi + \left\{\begin{array}{l}(B_s - B_N)\sin\varphi^2 + (B_{sw} - B_{No})(\sin 45^\circ \sin\varphi\cos\varphi + \cos 45^\circ \sin\varphi^2) + \\ + (B_w - B_o)\sin\varphi\cos\varphi + (B_{Nw} - B_{so})(\cos 45^\circ \cos\varphi\sin\varphi - \sin 45^\circ \sin\varphi^2)\end{array}\right\} = 0.$$

Eodem modo si aequatio $(\mathfrak{A})$ supra (§. 10.) inventa multiplicatur quantitate $\cos\varphi$ invenies:

$$\left\{\begin{array}{l}(B_s - B_N)\cos\varphi^2 + (B_{sw} - B_{No})\cos 45^\circ \cos\varphi^2 - \sin 45^\circ \sin\varphi\cos\varphi) + \\ + (B_o - B_w)\sin\varphi\cos\varphi + (B_{so} - B_{Nw})\sin 45^\circ \cos\varphi^2 + \cos 45^\circ \sin\varphi\cos\varphi.\end{array}\right\} = 0$$

utrisque aequationibus addendo junctis jam nobis offertur

$$4\,\alpha\sin\varphi + B_s - B_N + (B_{sw} - B_{No})\cos 45^0 - (B_{Nw} - B_{so})\sin 45^0 = 0.$$

unde prodit

$$4\,\alpha\sin\varphi = B_N - B_s + (B_{No} - B_{sw})\cos 45^0 + (B_{Nw} - B_{so})\sin 45^0$$

sive cum $\sin 45^0 = \cos 45^0$.

$$4\,\alpha\sin\varphi = B_N - B_s + (B_{No} + B_{Nw} - B_{so} - B_{sw})\cos 45^0 \ldots\ldots (A.)$$

§. 13.

At vero si aequatio $(\mathfrak{B})$ multiplicatur quantitate $\cos\varphi$ invenimus:

$$4\,\alpha\cos\varphi + \left\{\begin{array}{l}(B_s - B_N)\sin\varphi\cos\varphi + (B_{sw} - B_{No})(\sin 45^\circ \cos\varphi^2 + \cos 45^\circ \sin\varphi\cos\varphi) + \\ (+ B_w - B_o)\cos\varphi^2 + (B_{Nw} - B_{so})(\cos 45^\circ \cos\varphi^2 - \sin 45^\circ \sin\varphi\cos\varphi)\end{array}\right\} = 0.$$

Porro si aequatio $(\mathfrak{A})$ multiplicatur quantitate $\sin\varphi$ accipimus:

$$\left\{\begin{array}{l}(B_s - B_N)\sin\varphi\cos\varphi + (B_{sw} - B_{No})(\cos 45^\circ \sin\varphi\cos\varphi - \sin 45^\circ \sin\varphi^2) + \\ + (B_o - B_w)\sin\varphi^2 + (B_{so} - B_{Nw})\sin 45^\circ \sin\varphi\cos\varphi + \cos 45^\circ \sin\varphi^2)\end{array}\right\} = 0.$$

Tum si haec aequatio ab antecedente subtrahitur, efficitur:

$$4\,\alpha\cos\varphi + (B_{sw} - B_{No})\sin 45^\circ + B_w - B_o + (B_{Nw} - B_{so})\cos 45^\circ = 0,$$

unde prodit:

$$4\,\alpha\cos\varphi = B_o - B_w + (B_{No} + B_{so} - B_{sw} - B_{Nw})\sin 45^\circ \ldots\ldots (B).$$

§. 14.

Jam si pergimus ad disquisitionem aequationis (§. 9) tertiae

$$(IX) + (X) + (XI) + (XII) = 0$$

dilucide apparet esse $(IX) = 0$, $(X) = 0$ et $(XI) = 0$.
quamobrem etiam $(XII) = 0$ esse oportet. Habemus ergo:

$$\left\{\begin{array}{l}- B_N\,\beta\cos\psi + B_{No}\,\beta\sin\psi + B_o\,\beta\cos\psi - B_{so}\,\beta\sin\psi - \\ - B_s\,\beta\cos\psi + B_{sw}\,\beta\sin\psi + B_w\,\beta\cos\psi - B_{Nw}\,\beta\sin\psi.\end{array}\right\} = (XII) = 0.$$

Omisso factore β omnibus terminis communi et ordine meliore composito invenimus:

$$(B_o - B_N + B_w - B_s)\cos\varphi + (B_{No} - B_{so} + B_{sw} - B_{Nw})\sin\psi = (XII) = 0 \ldots\ldots (\mathfrak{C}.)$$

§. 15.

Valores terminorum singulorum aequationis (§. 9.) quartae

$$(XIII) + (XIV) + (XV) + (XVI) = 0$$

perlustrantes jam primo adspectu invenimus esse

$$(XIII) = 0 \text{ et } (XIV) = 0$$

His valoribus in aequatione positis sequitur esse etiam

$$(XV) + (XVI) = 0.$$

Terminus (XV) vero hoc modo scribi potest:

$$\left.\begin{matrix}\beta\,(\sin\psi^2 + \cos\psi^2) + \beta\,(\sin\psi^2 + \cos\psi^2) + \\ + \beta\,(\sin\psi^2 \cos\psi^2) + \beta\,(\sin\psi^2 + \cos\psi^2).\end{matrix}\right\} = (XV).$$

sive additione facta et adhibita formula $\sin\psi^2 + \cos\psi^2 = 1$:

$$4\,\beta\,(\sin\psi^2 + \cos\psi^2) = 4\,\beta = (XV).$$

§. 16.

Transeamus denique ad terminum (XVI). Ordine paulo tantummodo mutato et additione peracta invenimus

$$(B_O - B_N + B_W - B_S)\sin\psi + (B_{SO} - B_{NO} + B_{NW} - B_{SW})\cos\psi = (XVI).$$

Est igitur

$$4\,\beta + \left\{\begin{matrix}(B_O - B_N + B_W - B_S)\sin\psi + \\ + (B_{SO} - B_{NO} + B_{NW} - B_{SW})\cos\psi.\end{matrix}\right\} = (XV) + (XVI) = 0 \;\ldots\ldots\ldots\; (\mathfrak{D}).$$

§. 17.

Hac aequatione quantitate $\sin\psi$ multiplicata prodit:

$$4\,\beta\sin\psi + \left\{\begin{matrix}(B_O - B_N + B_W - B_S)\sin\psi^2 + \\ (B_{SO} - B_{NO} + B_{NW} - B_{SW})\sin\psi\cos\psi\end{matrix}\right\} = 0.$$

Eodem modo aequatione $(\mathfrak{E}.)$ quantitate $\cos\psi$ multiplicata invenimus:

$$\left\{\begin{matrix}(B_O - B_N + B_W - B_S)\cos\psi^2 + \\ + (B_{NO} - B_{SO} + B_{SW} - B_{NW})\sin\psi\cos\psi.\end{matrix}\right\} = 0;$$

et, si aequationes denuo inventas additione conjungimus inde colligitur:

$$\left\{\begin{matrix}4\,\beta\sin\psi + (B_O - B_N + B_W - B_S)(\sin\psi^2 + \cos\psi^2) + \\ + (B_{SO} - B_{NO} + B_{NW} - B_{SW} + B_{NO} - B_S + B_{SW} - B_{NW})\sin\psi\cos\psi\end{matrix}\right\} = 0,$$

id est

$$4\,\beta\sin\psi + B_O - B_N + B_W - B_S = 0,$$

unde sequitur

$$4\,\beta\sin\psi = B_N + B_S - B_O - B_W \;\ldots\ldots\ldots\; (C.)$$

§. 18.

Porro si aequatio $(\mathfrak{D})$ multiplicatur quantitate $\cos\psi$ accipimus:

$$4\,\beta\cos\psi + \left\{\begin{matrix}(B_O - B_N + B_W - B_S)\sin\psi\cos\psi + \\ + (B_{SO} - B_{NO} + B_{NW} - B_{SW})\cos\psi^2.\end{matrix}\right\} = 0.$$

Postremo aequatio $(\mathfrak{E})$ multiplicata quantitate $\sin\psi$ nobis dat

$$(B_O - B_N + B_W - B_S)\sin\psi\cos\psi + (B_{NO} - B_{SO} + B_{SW} - B_{NW})\sin\psi^2 = 0.$$

et hac aequatione a priore subtracta accipimus:

$$4\,\beta\cos\psi + \left\{\begin{matrix}(B_{SO} - B_{NO} + B_{NW} - B_{SW})\cos\psi^2 - \\ - (B_{NO} - B_{SO} + B_{SW} - B_{NW})\sin\psi^2.\end{matrix}\right\} = 0,$$

sive

$$4\,\beta\cos\psi + \left\{\begin{matrix}(B_{SO} - B_{NO} + B_{NW} - B_{SW})\cos\psi^2 + \\ + (B_{SO} - B_{NO} + B_{NW} - B_{SW})\sin\psi^2,\end{matrix}\right.$$

et computatione peracta atque adhibita formula $\sin\psi^2 + \cos\psi^2 = 1$:

$$4\,\beta\cos\psi + B_{SO} - B_{NO} + B_{NW} - B_{SW} = 0$$

unde prodit:

$$4\,\beta\cos\psi = B_{NO} + B_{SW} - B_{SO} - B_{NW} \;\ldots\ldots\ldots\; (D).$$

§. 19.

Altitudines barometri medias singulis XVI ventis flantibus ex observationibus meis Wetzlariensibus annorum MDCCCXXVIII usque ad MDCCCXXXIX tempore meridiei institutis, et ad 0° thermometri Reaumureani reductis derivatas tabula sequens exhibet, in qua columna prima signum, secunda valorem medium status barometri, tertia pondus medii antecedentis i. e. numerum observationum continet, e quibus medium calculo derivatum est.

B_N	331‴,55	227	B_S	329,‴63	795
B_{NNO}	331,07	110	B_{SSW}	329,51	332
B_{NO}	331,35	354	B_{SW}	330,31	721
B_{ONO}	331,77	279	B_{WSW}	329,64	133
B_O	331,40	522	B_W	330,46	363
B_{OSO}	330,10	100	B_{WNW}	330,58	57
B_{SO}	330,04	190	B_{NW}	330,95	108
B_{SSO}	330,57	53	B_{NNW}	331,15	39

Medium b = 330‴,28

Bene notandum est, hoc medium b = 330‴,28 Paris. derivatum esse ex summa omnium altitudinum barometri singulis ventis flantibus, ita ut non conveniat ratio si numeri indicati adduntur et summae pars sexta decima sumatur, sed demum si unusquisque horum numerorum pondere suo apposito multiplicatur et tum summa omnium productorum inde derivatorum numero observationum = 9. 365 + 3. 366 = 4383 dividitur.

§. 20.

Curva ex his observationibus ventis sedecim distributis coordinatis polaribus constructa tales offert irregularitates, ut mox intelligas, numerum observationum nondum esse satis copiosum si sedecim ventos respicere velis. Forsitan observationes etiam per duplex temporis intervallum continuatae hunc ad finem non sufficiant, quum pondera i. e. numeri observationum ventorum singulorum valde inter se discrepent. Pondus venti S e. g. est 795, pondus venti NNW est 39, unde apparet hoc ab illo plus vicies superari; simile quoddam respectu ventorum SSO et WNW contendi potest. His si additur ipsa incertitudo maxima directionis ventorum infirmiorum ab anemoscopio indicatorum, quum saepenumero instrumenta etiam accuratiora hujus generis valde inter se discrepent, venti vero, de quibus hic sermo est NNW, SSO, WNW sint fere infirmissimi, facile intelliges, observationes nostras ad octo solum ventos esse referendas. Hoc assecuti sumus hoc fere modo procedentes.

§. 21.

Numeri ventorum singulorum NNO, ONO, OSO, SSO, SSW, WSW, WNW et NNW nec non summae altitudinum barometricarum ventis illis flantibus observatarum inter duos ventos proxime adjacentes aequali modo distributi sunt. Exemplo rem illustremus. Habemus

	B_{ONO}	B_O	B_{OSO}
	331‴,77	331‴,40	330,10
	279	522	100
sive ventis flantibus	ONO	O	OSO
summas altitud. barometr.	92563‴,83	172899‴,80	33010‴,00
numeros ventorum	279	522	100
	ONO		OSO
dimidiam summam barometr.	46281‴,92		16505‴,00
dimidiam numerum ventorum	139,5		50,
his additis ad ea quae vento	O	sunt observata	

172990‴,80 522,0
46281,92 139,5
16505,00 50,0

accipimus 235777,72 711,5

unde divisione derivatur

B_0

medium 331,'''38

numerus s. pondus 711,5.

Simili modo venti omnes octo

NNW, NNO, ONO, OSO, SSO, SSW, WSW, WNW, NNW,

inter ..... **N, NO, O, SO, S, SW, W, NW, N**

proxime adjacentes distributi sunt, unde series quae sequitur observationum nostrarum oritur:

Signum.	Alt. barometr.	Pondus.
B_N	331''',43	301,5
B_{NO}	331,42	548,5
B_O	331,38	711,5
B_{SO}	330,10	266,5
B_S	329,64	987,5
B_{SW}	330,12	953,5
B_W	330,34	458,0
B_{NW}	330,90	156,0
Medium b = 330''',28.		

§. 22.

His observationibus si applicatur formula (§. 4.)

$$B_V = b + \alpha \sin (v.\ 45^0 + \varphi) + \beta \sin (v.\ 90^0 + \psi),$$

cujus coefficientes et anguli α, β, φ et ψ ex aequationibus (§. 12, 13, 17, 18)

$$4\, \alpha \sin \varphi = B_N - B_S + (B_{NO} + B_{NW} - B_{SO} - B_{SW}) \cos 45^0 \ldots\ldots (A)$$

$$4\, \alpha \cos \varphi = B_O - B_W + (B_{NO} + B_{SO} - B_{SW} - B_{NW}) \sin 45^0 \ldots\ldots (B)$$

$$4\, \beta \sin \psi = B_N + B_S - B_O - B_W \ldots\ldots (C)$$

$$4\, \beta \cos \psi = B_{NO} + B_{SW} - B_{SO} - B_{NW} \ldots\ldots (D)$$

determinari possunt, calculum habemus qui subjectus est.

§. 23.

Est ex observationibus Wetzlariensibus si applicatur aequatio supra indicata

$$4\, \alpha \sin \varphi = B_N - B_S + (B_{NO} + B_{NW} - B_{SO} - B_{SW}) \cos 45^0 \ldots\ldots (A)$$

$b = 330''',28$ $\quad B_N = 331''',43 \quad B_{NO} = 331''',42 \quad B_{SO} = 330''',10$

$\quad - B_S = 329,64 \quad + B_{NW} = 330,90 \quad + B_{SW} = 330,12$

$B_N - B_S = 1,79 \quad B_{NO} + B_{NW} = 662,32 \quad B_{SO} + B_{SW} = 660,22$

$\quad - (B_{SO} + B_{SW}) = 660,22$

$B_{NO} + B_{NW} - B_{SO} - B_{SW} = 2,10$

$\log (B_{NO} + B_{NW} - B_{SO} - B_{SW}) = \log 2,10 = 0,32222$

$+ \log \cos 45^0 \ldots\ldots = 9,84949$

$\log (B_{NO} + B_{NW} - B_{SO} - B_{SW}) \cos 45^0 \ . = 0,17171 = \log 1,485.$

$$(B_{NO} + B_{NW} - B_{SO} - B_{SW}) \cos 45^0 = 1{,}485$$
$$+ B_N - B_S \; . \; . \; . \; . \; . \; . \; . \; . \; . = 1{,}790$$
$$\text{Est ergo ex (A)} \; . \; . \; . \; . \; . \; . \; 4\,\alpha \sin \varphi = 3{,}275$$

§. 24.

Est porro si applicatur observationibus nostris aequatio

$$4\,\alpha \cos \varphi = B_o - B_w + (B_{NO} + B_{SO} - B_{SW} - B_{NW}) \sin 45^0 \; . \; . \; . \; . \; . \; . \; . \; . \; (B)$$

$B_o = 331''',38$ $\quad B_{NO} = 331''',42$ $\quad B_{SW} = 330''',12$

$- B_w = 330{,}34$ $\quad + B_{SO} = 330{,}10$ $\quad + B_{NW} = 330{,}90$

$B_o - B_w = 1{,}04$ $\quad B_{NO} + B_{SO} = 661{,}52$ $\quad B_{SW} + B_{NW} = 661{,}02$

$- (B_{SW} + B_{NW}) = 661{,}02$

$B_{NO} + B_{SO} - B_{SW} - B_{NW} = 0{,}50$

$\log (B_{NO} + B_{SO} - B_{SW} - B_{NW}) = \log 0{,}50 = 0{,}69897 - 1$

$+ \log \sin 45^0 \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . = 9{,}84949$

$\log (B_{NO} + B_{SO} - B_{SW} - B_{NW}) \sin 45^0 = 0{,}54846 - 1 = \log 0{,}3536$

Ergo $(B_{NO} + B_{SO} - B_{SW} - B_{NW}) \sin 45^0 = 0{,}3536$

$+ B_o - B_w \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . = 1{,}0400$

Ergo ex (B) . . . . $4\,\alpha \cos \varphi = 1{,}3936$

§. 25.

Est (ex §. 23) $\log 4\,\alpha \sin \varphi = \log 3{,}275 = 0{,}51521$

(§. 24) $- \log 4\,\alpha \cos \varphi = \log 1{,}3936 = 0{,}14414$

$\log \operatorname{tang} \varphi = 10{,}37107 = \log \operatorname{tang} 66^0\,57'$

Ergo $\varphi = 66^0\,57'$.

§. 26.

Si porro applicatur aequatio (§. 17)

$$4\,\beta \sin \psi = B_N + B_S - B_o - B_w \; . \; . \; . \; . \; . \; . \; . \; . \; (C)$$

habemus $B_N = 331''',43$ $\quad B_o = 331''',38$

$B_S = 329{,}64$ $\quad B_w = 330{,}34$

$B_N + B_S = 661{,}07$ $\quad B_o + B_w = 661{,}72$

$- (B_o + B_w) = 661{,}72$

$4\,\beta \sin \psi = - 0{,}65.$

§. 27.

Deinde si applicatur aequatio (§. 18.)

$$4\,\beta \cos \psi = B_{NO} + B_{SW} - B_{SO} - B_{NW} \; . \; . \; . \; . \; . \; . \; . \; . \; (D)$$

habemus $B_{NO} = 331''',42$ $\quad B_{SO} = 330''',10$

$+ B_{SW} = 330{,}12$ $\quad + B_{NW} = 330{,}90$

$B_{NO} + B_{SW} = 661{,}54$ $\quad B_{SO} + B_{NW} = 661{,}00$

$- (B_{SO} + B_{NW}) = 661{,}00$

$4\,\beta \cos \psi = 0{,}54$

§. 28.

Ex (§. 26) $\log 4\,\beta \sin \psi = \log (- 0{,}65) = 0{,}81291 - 1$ neg

et ex (§. 27) $- \log 4\,\beta \cos \psi = \log 0{,}54 = 0{,}73239 - 1$

sequitur $\log \operatorname{tang} \psi = 10{,}08052$ neg $= \log \operatorname{tang} (360^0 - 50^0\,17') = \log \operatorname{tang} 309^0\,43'$.

Est ergo $\psi = 309^0\,43'$.

§. 29.

Habemus §. 23, §. 25. $\log 4\,\alpha \sin \varphi = \log 3{,}275 \qquad = 10{,}51521$ (posito $\log r = 10$)

$+ c \log. 4 \;.\;.\;.\;.\;.\;.\;.\;.\;.\;. = 9{,}39794 - 10$

$+ c \log \sin \varphi = c \log \sin 66^0\, 57' = 0{,}03613 - 10$

$\log \alpha = 0{,}94928 - 1 = \log 0{,}8898.$

Valor α etiam ex aequatione (§. 24.) $4\,\alpha \cos \varphi = 1{,}3936$ erui potest, ex qua numerus idem invenitur. Est ergo $\alpha = 0''',8898$.

§. 30.

Ad inveniendum valorem β habemus (§. 27, 28.)

$\log 4\,\beta \cos \psi = \log 0{,}54 \qquad = 9{,}73239$ (posito $\log r = 10$)

$+ c \log 4 \;.\;.\;.\;.\;.\;.\;.\;. = 9{,}39794 - 10$

$+ c \log \cos \psi = c \log \cos 309^0\, 43' = 0{,}19450 - 10$

$\log \beta = 0{,}32483 = \log 0{,}2113.$

Idem valor etiam ex aequatione $4\,\beta \sin \psi$ (§. 26) derivari potest.

Duplici ergo ratione invenimus:

$\beta = 0''{,}2113.$

§. 31.

E valore $b = 330''',28$ ex observationibus derivato (§. 19.) et ex valoribus pro α, β, φ et ψ supra (§. 25—30) deductis constituitur formula observationibus nostris adaptata:

$$B_v = 330''',28 + 0''',8898 \sin (v.\ 45^0 + 66^0\, 57') + 0''',2113 \sin (v.\ 90^0 + 309^0\, 43').$$

§. 32.

Si vero secundum hanc formulam, medio vero barometrico $b = 330''',28$ Paris. adhibito, observationes nostrae computantur, valores omnes B_N, B_{NO} . . . . . B_{NW} computatos nimis parvos invenimus, quod evidenter elucet, si valores calculo derivatos et valores observatos, uti supra indicati sunt (§. 21.), in tabula descriptos componimus, ut facile inter se comparari possint, quam ob causam differentiae valorum computatorum et observatorum (c — o) appositae sunt.

Venti.	Altitudines barometri calculo derivatae.	Altitudines barometri observatae.	Differentia valorum comput. et observ. c — o.
N	330''',94	331''',43	— 0''',49
NO	331,25	331,42	— 0,17
O	330,79	331,38	— 0,59
SO	329,81	330,10	— 0,29
S	329,30	329,64	— 0,34
SW	329,59	330,12	— 0,53
W	330,09	330,34	— 0,25
NW	330,47	330,90	— 0,43
Medium b = 330''',28 Paris.			

§. 33.

Causa harum differentiarum magnarum et omnium negativarum facile apparet, si valores computatos paulo accuratius indagamus. Invenimus enim summam omnium valorum computatorum = 2642''',24 et medium eorum, ponderibus omnium sumtis aequalibus $= \frac{2642''',24}{8} = 330''',28$, ergo medium idem, quod supra (§. 21.) ex omnibus observationibus, adhibitis ponderibus unicuique valori secundum observationum numerum attribuendis inter se vero disparibus deduximus. Hoc medium verum, quod in omnibus disquisitionibus considerandum est, in quibus de atmosphaerae pressione media agitur, e. g. in derivanda altitudine loci supra mare etc., in hac tamen nostra disquisitione, ubi de altitudine agitur barometri vento unicuique propria calculo deducenda *non est* adhibendum. Etenim in hoc calculo valores ex observationibus deducti omnes uno eodemque modo ad constituendam formulam conferunt, quamobrem omnibus his valoribus etiam pondus aequale tribuendum est. Apparet igitur medium barometricum b in formula nostra adhibendum ita esse derivandum, ut singulis valoribus inventis B_N, B_{NO} etc. . . . . . . B_{NW} omnibus unum idemque pondus sit adscribendum. Habemus ergo medium quaesitum:

$$b = \frac{B_N + B_{NO} + B_o + B_{so} + B_s + B_{sw} + B_w + B_{NW}}{8}$$

sive positis numeris supra (§. 21.) inventis:

$$b = \frac{331''',43 + 331''',42 + 331,38 + 330''',10 + 329''',64 + 330''',12 + 330''',34 + 330''',90}{8}$$

$$b = \frac{2645''',33}{8} = 330''',67.$$

Hoc medium $b = 330''',67$ a notis hic adhibendum majus est quam medium supra (§. 21) inventum 330,'''28, quia venti N, NO, quibus altitudo barometri maxima adjuncta est apud nos multo sunt rariores (numerus eorum est 850) quam illi, quibus convenit altitudo mercurii minima S et SW, quorum numerus 1941 numerum illorum supra indicatum plus duplo superat.

§. 34.

Hoc sumto medio, eaque eruto conditione, ut omnibus ventis atque altitudinibus mercurii iis flantibus observatis idem adscribatur pondus, formula nostra est:

$$B_v = 330''',67 + 0''',8898 \sin (v. 45^0 + 66^0\ 57') + 0''',2113 \sin (v. 90^0 + 309^0\ 43').$$

Ex hac formula derivati sunt valores B_N, B_{NO} etc. . . . . B_{NW}, quos tabula sequens exhibet. Columna hujus tabulae prima ventos continet, secunda valorem primae partis formulae $0''',8898 \sin (v. 45^0 + 66^0\ 57')$, tertia valorem secundae partis formulae $0''',2113 \sin (v. 90^0 + 309^0\ 43')$ utramque posito v secundum ventorum ordinem $= 0, 1, 2 \ldots$ usque $= 7$; columna quarta utriusque partis summam continet, quinta altitudinem barometri computatam, sexta eandem observatam, septima denique differentiam inter altitudines computatas et observatas.

Barometri motus medius venti directione pendens ex observationibus XII annorum MDCCCXXVIII usque ad MDCCCXXXIX meridie medio Wetzlariae institutis derivatus.

Venti.	Formulae pars prima.	Formulae pars secunda.	Utriusque summa.	Altitudo mercurii computata.	Altitudo mercurii observata.	Differentia comp.-observ.
N	+ 0'''82	— 0''',16	+ 0''',66	331''',33	331''',43	— 0''',10
NO	+ 0,83	+ 0,14	+ 0,96	331,63	331,42	+ 0,21
O	+ 0,35	+ 0,16	+ 0,51	331,18	331,38	— 0,20
SO	— 0,33	— 0,14	— 0,47	330,20	330,10	+ 0,10
S	— 0,82	— 0,16	— 0,98	329,69	329,64	+ 0,05
SW	— 0,83	+ 0,14	— 0,69	329,98	230,12	— 0,14
W	— 0,35	+ 0,16	— 0,19	330,48	330,34	+ 0,14
NW	+ 0,33	— 0,14	+ 0,19	330,86	330,90	— 0,04

Adhibito medio $b = 330''',67$.

§. 35.

Secundum clarissimi Gaussii theoriam combinationis observationum etc. Gottingae 1823 art. 37. est error m medius maxime probabilis, si E, E′, E″, E‴ etc. errores i. e. differentias observationum singularum et valorum earum maxime probabilium calculi ope erutorum significant, n vero numerum harum differentiarum indicat:

$$m = \frac{\sqrt{EE + E'E' + E''E'' +}}{n} = \sqrt{\left(\frac{M}{n}\right)}$$

si, ut paucis utar, $EE + E'E' + E''E''$ + etc. ponitur $= M$.

Haec si ad nostras observationes applicamus, ut errorem earum medium maxime probabilem inveniamus, habemus, si differentias columnae ultimae secundum ordinem signis E, E′, E″ etc. usque ad E^{VII} notamus

$$\begin{aligned} EE &= 0{,}0100 \\ E'E' &= 0{,}0441 \\ E''E'' &= 0{,}0400 \\ E'''E''' &= 0{,}0100 \\ E^{IV}E^{IV} &= 0{,}0025 \\ E^{V}E^{V} &= 0{,}0196 \\ E^{VI}E^{VI} &= 0{,}0196 \\ E^{VII}E^{VII} &= 0{,}0016 \end{aligned}$$

$$EE + E'E' + E''E'' + \ldots E^{VII}E^{VII} = M = 0{,}1474 \text{ et } n = 8$$

unde error medius maxime probabilis

$$m = \sqrt{\left(\frac{0{,}1474}{8}\right)} = 0''',1357.$$

§. 36.

Differentias maximas venti N O et O offerunt, id quod primo adspectu ex situ urbis Wetzlariae derivari posse arbitrabar. Sita est enim urbs a N N O usque ad O versus montem eam longe superantem, quo fit ut venti N N O, N O, O N O et O non solum maxime debilitentur, sed etiam ab anemoscopiis in urbe erectis non satis accurate indicari possint; status igitur barometrici ad ventos N O et O pertinentes facile confunduntur, dum illi, quod ad hunc, huic quod ad illum pertinet adscribitur, quamobrem status barometricus venti N O diminuitur, status vero venti O ita augetur, ut aequales fere appareant. Non negandum est hanc opinionem speciem aliquam verisimilitudinis prae se ferre, mox vero causam alteram multo efficaciorem differentiae illius reperi, qua accuratius indagata atque ad lucem promota probe intellexi, situm urbis orientem et septentrionem versus montibus obtectae pauca tantummodo aut nihil fere hanc ad rem conferre.

§. 37.

Ratione enim iterum ad calculos vocata atque denuo redintegrata, spatium observationum duodecim annorum in duas partes aequales sex annos complectentes divisi. Inveni pro sexennio annorum spatio MDCCCXXVIII usque ad MDCCCXXXIII tabulam ita conformatam:

Tabula sexennii MDCCCXXVIII usq. MDCCCXXXIII.		
Signum	Altitud. barometr.	Pondus
B_N	331''',31	123,5
B_{NO}	331,57	242,0
B_O	331,44	408,0
B_{SO}	329,73	130,0
B_S	329,64	494,0
B_{SW}	329,64	395,5
B_W	330,46	324,5
B_{NW}	330,89	74,5

ex qua apparet, per hoc temporis spatium, ad ventum N O statum barometricum multo altiorem pertinere, quam ventis vicinis N et O, id quod calculus secundum methodum summae minimae quadratorum institutus etiam postulat; sequitur igitur hoc sexennio commutationi ventorum N, N O, O ex situ urbis oriente locum non esse datum. Si vero haec causa ad alterum spatium sex annorum MDCCCXXVIII — XXXIII nihil refert, etiam in altero illo annorum complexu MDCCCXXXIV ad XXXIX efficacior esse non potest. Origo igitur irregularitatis indicatae non in situ urbis, sed in alio quodam momento quod dicitur efficaciori quaerenda et invenienda erit. Calculus continuatus dat pro sexennio MDCCCXXXIV usque ad MDCCCXXXIX tabulam infra positam:

Tabula sexennii MDCCCXXXIV usq. MDCCCXXXIX.		
Signum.	Altitud. barometr.	Pondus.
B_N	331''',47	178,0
B_{NO}	331,24	306,5
B_O	331,46	303,5
B_{SO}	330,46	136,5
B_S	329,64	493,5
B_{SW}	330,46	558,0
B_W	330,05	134,0
B_{NW}	330,87	82,0

ex qua apparet, ad ventum NO hoc temporis spatio pertinere statum barometricum multo humiliorem, quam ad ventos proxime vicinos N et O, quod nulla ventorum et observationum commutatione explicari potest, qua quidem status barometrici ventorum illorum aequales evadere possunt, nullo modo vero status altior ad N O in medio situm pertinens eum in modum diminui potest, ut etiam multo minor fiat, quam ii, cum quibus commutari fortasse potuerit. Differentia ergo sine dubio ex irregularitatibus, sive potius ex legibus meteorologicis derivanda est, quam rem etiam disquisitio diligenter continuata ratione evidentissima demonstrat.

§. 38.

Etenim si spatium observationum nostrarum duodecim annorum in partes quatuor aequales dividimus, ita ut una quaequae pars tres annos complectatur, haecce nobis offertur computandi ratio:

I. Triennium MDCCCXXVIII—MDCCCXXX.		
Signum.	Altitudo barom.	Pondus.
B_N	331''',39	45,0
B_{NO}	331,58	132,0
B_O	331,12	196,0
B_{SO}	329,38	63,0
B_S	329,55	242,5
B_{SW}	329,76	163,5
B_W	330,37	205,5
B_{NW}	330,90	46,5.

Hoc triennio primo observationum nostrarum status barometricus venti N O, uti esse debet, multo altior apparet, quam status barometricus ventorum N et O. Omnia sunt regularia atque calculo congrua excepto vento S O, quod tamen huc non refert, ubi venti N, N O et O tantummodo respiciuntur.

II. Triennium MDCCCXXXI—MDCCCXXXIII.		
Signum.	Altitudo barom.	Pondus.
B_N	331''',27	78,5
B_{NO}	331,57	110,0
B_O	331,50	212,0
B_{SO}	330,08	65,0
B_S	329,73	251,5
B_{SW}	329,57	232,0
B_W	330,60	119,0
B_{NW}	330,87	28,0

Etiam hic omnia sunt regularia.

III. Triennium MDCCCXXXIV—MDCCCXXXVI.		
Signum.	Altitudo barom.	Pondus.
B_N	332''',49	79,5
B_{NO}	331,87	149,5
B_O	331,97	162,0
B_{SO}	330,56	67,0
B_S	329,92	283,5
B_{SW}	330,67	271,0
B_W	329,76	48,5
B_{NW}	331,30	36,0

Jam primo adspectu elucet, causam differentiarum considerabilium in calculo observationum totius temporis spatii supra indicatarum, in hoc triennio potissimum esse quaerendam. Nam status barometricus venti N O multo humilior est, quam vicini N, aliquanto etiam minor quam status barometricus venti O. Paulo inferius indagabimus quo *singulo anno* hujus irregularitatis causa gravissime valeat, nunc primum demonstrandum est, etiam triennium quartum ab irregularitate indicata fere prorsus esse liberum, quod tabula sequens exhibet:

IV. Triennium MDCCCXXXVII—MDCCCXXXIX.		
Signum.	Altitudo barom.	Pondus.
B_N	330''',65	98,5
B_{NO}	330,76	157,0
B_O	330,89	141,5
B_{SO}	330,36	69,5
B_S	329,26	210,0
B_{SW}	329,26	287,0
B_W	330,22	85,5
B_{NW}	330,53	46,0

in qua statum barometricum venti N O majorem invenimus, quam statum venti N, uti esse debet. Ventus O hoc triennio quidem statum barometricum habet altiorem paulo plus aequo, differentiam maximam vero venti N O et ventorum proxime illi adjacentium N et O triennio antecedente MDCCCXXXIV — MDCCCXXXVI invenimus.

§. 39.

Causam irregularitatis in singulos annos triennii MDCCCXXXIV — XXXVI persequentes observationes ad octo ventos relatas in uno conspectu collocamus hac ratione:

Annus MDCCCXXXIV.		
Signum.	Altitudo barometri.	Pondus.
B_N	332''',80	31,5
B_{NO}	332,61	55,0
B_O	332,87	57,5
B_{SO}	331,24	23,5
B_S	330,74	86,5
B_{SW}	330,52	87,0
B_W	329,68	13,5
B_{NW}	332,88	10,5

Annus MDCCCXXXV.		
Signum	Altitudo barometri.	Pondus.
B_N	332''',79	14,5
B_{NO}	332,05	51,0
B_O	332,01	70,0
B_{SO}	330,76	19,0
B_S	330,23	102,5
B_{SW}	330,27	81,0
B_W	330,18	16,5
B_{NW}	330,66	10,5

Annus MDCCCXXXVI.		
Signum.	Altitudo barometri.	Pondus.
B_N	332''',07	33,5
B_{NO}	330,75	43,5
B_O	330,38	34,5
B_{SO}	329,74	24,5
B_S	328,82	94,5
B_{SW}	330,26	103,0
B_W	329,59	18,0
B_{NW}	330,87	14,5

Unoquoque anno singulo triennii hujus meteorologici satis memorabilis statum barometri venti N O humiliorem invenimus quam statum venti N. Anno MDCCCXXXIV differentia 0‴,19 non est magna, crescit vero anno MDCCCXXXV ubi est 0‴,74, et anno sequente MDCCCXXXVI. augetur ad 1‴,32. Spatium ergo horum annorum duorum, praecipue autem annus posterior MDCCCXXXVI caussam efficacissimam irregularitatis continet, qua efficitur ut status barometricus venti N O ex omnibus observationibus XII annorum MDCCCXXXVIII — XXXIX deductus, humilior evadat, quam esse debet secundum calculum nostrum supra institutum.

§. 40.

Triennium meteorologicum MDCCCXXXIV—XXXVI memorabile dico. Incipit anno sicco, calore magno, itaque vini crescentia excellente et status medius barometri est permagnus; terminatur vero anno MDCCCXXXVI humidissimo sterilitate non mediocri, et statu barometrico humili, quo, quod maxime huc pertinet, venti N O praecipue sunt insignes.

§. 41

Jam anno MDCCCXXXV hoc vento flante observavi

1) die 29 Aprilis meridie 324‴,99,

vis venti (si quatuor ventorum gradus statuuntur) erat 3, sol halone magno circumdatus, tempore vespertino 5^h 15′ tempestas orta est fulgure et tonitru pluviaque juncta et directio venti N O mutata est in S vigore = 1.

2) die 1 Maji 326‴,43 vento N O = 1.

Mox, hora 1. pomeridiana tempestas orta est fulgure tonitru et grandine permagnis globulis conjuncta, postea venti directio mutata est in S. Haec quidem hoc die a me Wetzlariae sunt observata, in aliis regionibus haud procul distantibus actiones atmosphaerae rariores et vehementiores oculis sunt oblatae, quibus barometrum nostrum Wetzlariense affectum est. Typhonem intelligo Confluentiae ortum, de quo in ephemeridibus publicis leguntur memoriae prodita:

„Coblenz, 2. Mai 1835. Wir waren Zeugen eines seltenen Naturschauspiels. Gestern (also den ersten Mai) Nachmittags vor 3 Uhr bildete sich bei einem Nordwestwinde (Wetzlariae hujus diei meridie directio venti erat N O.) gerade an der Stelle, wo die Mosel sich mit dem Rheine verbindet, eine Windhose, welche gleich über dem Wasser die Viertel-Breite des Rheins einnahm und als eine sehr hohe Wassersäule spitz verlaufend zum Firmamente hinaufstrebte. Nachdem dieselbe im stärksten Wirbel ungefähr zehn Minuten auf dem Wasser gekreiset hatte, prallte sie am Ehrenbreitensteiner Ufer gegen das Land, verwandelte sich da in einen Staubwirbel, entwurzelte einige Bäume und trieb eine Partie Wäsche hoch in der Luft über ein Haus fort. Auch Thüren und Fenster wurden ausgerissen und fortgeschleudert. An dem vor der Moselbrücke, an der Mündung der Mosel in den Rhein gelegenen Hause des Gerbermeisters Johann Peter Münch scheint die Windhose entstanden zu sein. Sie hob das Dach auf und führte es hoch in die Lüfte; es fiel 44 Schritt vom Hause nieder. Die davon abgesonderten Schiefer kamen eine Viertel Stunde davon zur Erde. Auf dem Speicher wurden die Wände auseinander gedrückt und theilweise fortgeschleudert, geschlossene Fenster aufgerissen und mit fortgenommen. Von allen den angespannten Häuten, von denen jede mit dem Rahmen 43 Pfund wiegt, die theils in die Mosel, theils in den Rhein geworfen, sind nur einige wieder gefunden worden; sonstiges Hausgeräth, das sich auf dem Speicher und im Garten befand, ist verschwunden, so dass der dadurch dem schon früher durch Unglück heimgesuchten Familienvater entstandene Schaden auf 150 Thaler geschätzt wird. Bemerkenswerth ist, dass die Windhose an der Werkstätte das Fenster aufriss und einen fest eingesetzten Pfosten herauszog, ohne dass die daneben beschäftigten Arbeiter nur einmal einen Luftzug wahrnahmen. Ein vom Felde nach Neuendorf mit einem Tragkorb auf dem Kopfe zurückkehrendes Bauernmädchen wurde von derselben plötzlich aufgehoben, doch zum Glück von einem neben ihm gehenden Landmann aufgehalten und bei Seite geworfen. Der Tragkorb jedoch wurde eine Viertel Stunde weit mit fortgerissen und fiel in den Rhein. — Ein starkes Gewitter mit Hagelschlag und grossem Regenguss folgte unmittelbar." Frankf. Ober-Postamts-Zeit. 1835 Beil. Nro. 123. cf. etiam Poggendorff Annalen der Physik 1835 St. X. S. 231.

§. 42.

Etiam magis depressum est barometrum anno MDCCCXXXVI. Vento flante N O observavi:

die	3 Februarii	322‴,93	
„	8 Martii	323,09	
„	9 Aprilis	324,90	
„	10 Aprilis	324,78	pluribusque diebus hujus mensis
„	1 Maji	324,52	pluribusque Maji diebus
„	24 Decembr.	325,68	
„	26 Decembr.	323,60	et diebus seqq. 27 et 28 ej. mens.

Februarius insignis erat tempestate et phaenomenis electricis tempore hiemali non saepe occurrentibus; tempestas fulgure et tonitru juncta Wittenbergae, Nordhemii, Vesaliae, in Hungaria, aliisque locis observata est. Ex Silesia ita publice scriptum legitur:

„Am 11. Februar, dem bekannten Gewittertage, fand Abends um 7 Uhr auf der Landstrasse zwischen Tarnowitz und Beuthen, auf dem sogenannten Trockenberge, östlich vom Fuchsschachte, ein seltenes Naturereigniss Statt. Die Bergleute bemerkten beim Anfahren eine dermassen electrische Erscheinung als brannten alle die Strasse entlang gepflanzten Bäume und sahen an denselben, oben an den Spitzen, soviele Lichter als die Bäume Zweige hatten. Ihre gewöhnlichen Bergmannskrücken, die sie beim Gehen gebrauchten und die unten mit Eisen beschlagen sind, erzeugten, wenn auch tief in den Schnee gesteckt, beim jedesmaligen Herausziehen und in die Höheheben an der Spitze eine hell leuchtende Flamme, welche gerade in die Höhe loderte, wenn gleich de Wind etwas stark war und es dabei etwas hagelte. Die seltene Erscheinung wurde auch in mehreren entfernten Orten wahrgenommen, z. B. auf dem Grenzwege unterhalb Cundschacht. Auch östlich vom ehemaligen Stadtrevieren-Zechhause sah man eine ähnliche Erscheinung, diese jedoch bald nach 6 Uhr, jene aber etwas später. O. P. A. Z. 1836. Beilage Nro. 64.

Statum barometri humilem diei 8vi Martii die proximo procella secuta est.

Sic etiam statum barometricum humilem primi Maji die proximo procella secuta est. Nuntiatur enim: London, 3. Mai 1836. Eine so hohe Fluth, als man seit vierzig Jahren nicht erlebt hat, setzte gestern am 2ten Mai bei sehr stürmischem Wetter mehrere Strassen und Plätze der Hauptstadt unter Wasser. Es ist dabei mancher Schaden geschehen und auch ein Schiffsmann verunglückt. Die Themse brauste wie die vom Orkan gepeitschte See, und man hatte die grösste Mühe, Barken und Kähne in Sicherheit zu bringen. O. P. A. Z. 1836. Nro. 129.

Eodem die tempestas gravis Berolini erat (O. P. A. Z. Beilage Nro. 129). Depressio barometri versus finem Decembris apud nos observata vento NO vehementissimo et ingenti nivis copia conjuncta erat, singulis locis altitudo nivis 6 et 7 pedes aequabat.

§. 43.

Ex iis, quae (§§. 40, 41, 42.) sunt proposita jam patet, annis MDCCCXXXV et MDCCCXXXVI copiam magnam causarum obtinuisse, quibus barometrum vento flante NO valde deprimeretur, neque causae locali, quam dicunt aut commutationi ventorum observatorum tribuendam esse differentiam, quam inter statum barometri ad ventum N O pertinentem observatum et computatione erutum supra (§. 34, 36.) invenimus.

§. 44.

Itaque consilium cepi investigandi an omissis iis annis, quibus potissimum irregularitas illa adduceretur majorem congruentiam calculi et observationum adipisci possim. Omissis itaque primo annis MDCCCXXXV et XXXVI status barometri inveni sequentes:

Observationes decem annorum MDCCCXXVIII—MDCCCXXXIX exclusis annis MDCCCXXXV et NDCCCXXXVI.		
Signum.	Altitudo barometr.	Pondus.
B_N	331‴,24	253,5
B_{NO}	331,38	454,0
B_O	331,37	607,0
B_{SO}	330,11	222,0
B_S	329,66	790,5
B_{SW}	330,09	769,5
B_W	330,38	423,5
B_{NW}	330,98	130,0
Medium sumptis ponderibus aequalibus = 330‴,65.		

§. 45.

Ex his valoribus computatione simili §. 22 seqq. instituta formula prodiit

$$B_v = 330''',65 + 0''',8407 \sin(v.\ 45^\circ + 67^\circ\ 30') + 0,2328 \sin(v.\ 90^\circ + 294^\circ\ 5'),$$

supra (§. 34.) datae simillima. Secundum hanc formulam valores computati sunt, quos exhibet tabula sequens:

Tabula computata ex observationibus annorum decem MDCCCXXVIII usq. ad MDCCCXXXIX, exclusis annis MDCCCXXXV et MDCCCXXXVI.						
Venti	Formulae		Utriusque summa.	Altitudo mercurii		Differentia comp-observ.
	Pars Ima.	Pars secunda.		computata.	observata	
N	+ 0‴,78	— 0‴,21	+ 0″57	331‴,22	331‴,24	— 0‴,02
NO	+ 0,78	+ 0,09	+ 0,87	331,52	331,38	+ 0,14
O	+ 0,32	+ 0,21	+ 0,53	331,18	331,37	— 0,19
SO	— 0,32	— 0,09	— 0,41	330,24	330,11	+ 0,13
S	— 0,78	— 0,21	— 0,99	329,66	329,66	0,00
SW	— 0,78	+ 0,09	— 0,69	329,96	330,09	— 0,13
W	— 0,32	+ 0,21	— 0,11	330,54	330,38	+ 0,16
NW	+ 0,32	— 0,09	+ 0,23	330,88	330,98	— 0,10

Est ergo differentia status barometrici computati et observati minor, quam in tabula supra (§. 34.) proposita, idem valet de errore medio maxime probabili. Invenimus enim:

$$
\begin{aligned}
E\,E &= 0{,}0004\\
E'\,E' &= 0{,}0196\\
E''\,E'' &= 0{,}0361\\
E'''\,E''' &= 0{,}0169\\
E^{IV}\,E^{IV} &= 0{,}0000\\
E^{V}\,E^{V} &= 0{,}0169\\
E^{VI}\,E^{VI} &= 0{,}0256\\
E^{VII}\,E^{VII} &= 0{,}0100\\
\text{Unde } M &= 0{,}1255 \quad \text{ergo } m = 0''',1253.
\end{aligned}
$$

Itaque m jam minor est quam valor supra (§. 34.) in ventus $m = 0''',1377$.

§. 46.

Quum vero, ut jam supra (§. 39.) indicavimus, annus quoque MDCCCXXXIV, quamvis medio barometrico altiore gaudens, irregularitatibus barometricis si ventum spectamus non prorsus vacaret, etiam hunc annum excludendi consilium cepi, sperans fore ut majorem fortasse calculi et observationum congruentiam adipiscerer. Nec spes me fefellit inventi enim sunt status qui sequuntur:

Status barometrici annorum MDCCCXXVIII usque ad XXXIX, excluso triennio MDCCCXXXIV usque ad MDCCCXXXVI.

Signum.	Altitudo barometr.	Pondus.
B_N	331''',02	222,0
B_{NO}	331,21	399,0
B_O	331,21	549,5
B_{SO}	329,95	199,5
B_S	329,53	704,0
B_{SW}	329,90	682,5
B_W	330,40	410,0
B_{NW}	330,75	120,0
Medium positis ponderibus aequalibus = 330''',50.		

Medium barometricum humile est ob exclusionem anni MDCCCXXXIV, quo majus erat solito.

§. 47.

Ex his observationibus secundum methodum summae minimae quadratorum computata est formula:

$$B_v = 330''',50 + 0''',8010 \sin (v.\ 45° + 68°34') + 0''',2841 \sin (v.\ 90° + 291°\ 9'),$$

cujus ope tabula sequens derivata est:

Tabula novem annorum MDCCCXXVIII usque ad MDCCCXXXIX, excluso triennio tertio MDCCCXXXIV usque ad MDCCCXXXVI.						
Venti.	Formulae		Utriusque	Altitudo mercurii		Differentis
	Pars Ima.	Pars IIda.	summa.	computata	observata.	comp-observ.
N	+ 0''',75	— 0''',27	+ 0''',48	330''',98	331''',02	— 0''',04
NO	+ 0,73	+ 0,10	+ 0,83	331,33	331,21	+ 0,12
O	+ 0,29	+ 0,27	+ 0,56	331,06	331,21	— 0,15
SO	— 0,32	— 0,10	— 0,42	330,08	329,95	+ 0,13
S	— 0,75	— 0,27	— 1,02	329,48	329,53	— 0,05
SW	— 0,73	+ 0,10	— 0,63	329,87	329,90	— 0,03
W	— 0,29	+ 0,27	— 0,02	330,48	330,40	+ 0,08
NW	+ 0,32	— 0,10	+ 0,22	330,72	330,75	— 0,03

Hac in tabula differentiae etiam minores sunt quam in antecedente X annorum (§. 45.), et valor erroris maxime probabilis multo diminuitur. Habemus:

$$E\,E = 0{,}0016$$
$$E'\,E' = 0{,}0144$$
$$E''\,E'' = 0{,}0225$$
$$E'''\,E''' = 0{,}0169$$
$$E^{IV}\,E^{IV} = 0{,}0025$$
$$E^{V}\,E^{V} = 0{,}0009$$
$$E^{VI}\,E^{VI} = 0{,}0064$$
$$E^{VII}\,E^{VII} = 0{,}0009$$
$$M = 0{,}0661$$
$$\text{unde}\quad m = 0''',09090.$$

§. 48.

Res nobis hic offertur sane mirabilis.

Valor erroris maxime probabilis XII annorum (§. 35.) erat 0''',14
„ „ „ „ X „ (§. 45.) „ 0,13
„ „ „ „ IX „ (§. 47.) „ 0,09

error medius ergo IX annorum h. e. 3287 observationum ad partem fere tertiam minor est errore medio XII annorum i. e. 4383 observationum, id quod ex irregularitatibus atmosphaericis pendet triennii tertii MDCCCXXXIV usque ad MDCCCXXXVI.

§. 49.

Si formulas ad computationem duodecim, vel decem et novem annorum a nobis inventas inter se comparamus differentias hasce animadvertimus. Constans α secundum ordinem formularum indicatum diminuitur, angulus φ crescit, constans β augetur, angulus ψ diminuitur. Mutationes tamen non sunt magni momenti, ita ut unam eandemque formulam paulo tantummodo variatam facile recognoscas. Quam ob rem ad formulam primam, totum temporis spatium duodecim annorum complectentem revertimus, ut ex illa status barometrici pro sedecim ventis deducamus et methodo graphica rem oculis proponamus. Pro sedecim ventis ex formula illa duodecim annorum

$$B^v = 330''',67 + 0''',8898 \sin (v.\ 45^\circ + 66^\circ\ 57') + 0''',2113 \sin (v.\ 90^\circ + 309^\circ\ 43'),$$

posito secundum ordinem v = 0, ½, 1, 3/2, 2, 5/2 . . . . . etc. invenimus tabulam hic appositam:

Barometri motus medius a venti directione pendens ex observationibus XII annorum MDCCCXXVIII usque ad MDCCCXXXIX ipso meridie Wetzlariae institutis pro ventis XVI derivatus.

Venti.	Formulae datae Pars Ima.	Pars IIda.	Utriusque Summa.	Altitudo mercurii computata.	observata.	Differentia comp. observ.
N	+ 0''',82	— 0''',16	+ 0''',66	331''',33	331''',43	— 0''',10
NNO	+ 0,89	— 0,02	+ 0,87	331,54		
NO	+ 0,83	+ 0,14	+ 0,96	331,63	331,42	+ 0,21
ONO	+ 0,64	+ 0,21	+ 0,85	331,52		
O	+ 0,35	+ 0,16	+ 0,51	331,18	331,38	— 0,20
OSO	+ 0,01	+ 0,02	+ 0,03	330,70		
SO	— 0,33	— 0,14	— 0,47	330,20	330,10	+ 0,10
SSO	— 0,62	— 0,21.	— 0,83	329,84		
S	— 0,82	— 0,16	— 0,98	329,69	329,64	+ 0,05
SSW	— 0,89	— 0,02	— 0,91	329,76		
SW	— 0,83	+ 0,14	— 0,69	329,98	330,12	— 0,14
WSW	— 0,64	+ 0,21	— 0,43	330,24		
W	— 0,35	+ 0,16	— 0,19	330,48	330,34	+ 0 14
WNW	— 0,01	+ 0,02	+ 0,01	330,68		
NW	+ 0,33	— 0,14	+ 0,19	330,86	330,90	— 0,04
NNW	+ 0,62	— 0,21	+ 0,41	331,08		

§. 50.

Secundum valores in hac tabula computatos delineatae sunt figurae 1 et 2, quas tabula annexa continet mensura decies aucta. Fig. 1. Circulus bbb . . . . . b est linea medium barometricum 330''',67 paris. indicans, lineae rectae, quibus apposita sunt signa B_N, B_{NNO} . . . . . B_{NNW} status barometricos ad singulos sedecim ventos pertinentes significant. Figura 2. idem coordinatis rectangulis indicat; recta bb et linea medii barometrici. His figuris primo adspectu facile percipitur, quod calculo observationibus nostris eruimus.

§. 51.

Restat, ut calculi ope inveniamus cui ventorum maximum et minimum status barometrici sit adscribendum. Hunc in finem differentietur aequatio generalis

$$B_v = b + \alpha \sin (v.\ 45^\circ + \varphi) + \beta \sin (v.\ 90^\circ + \psi),$$

ratione habita v et ponatur = 0 coefficiens ejus differentialis primus. Habemus

$$d.\,B_v = \alpha \cos (v.\,45^0 + \varphi)\,45^0\,dv + \beta \cos (v.\,90^0 + \psi)\,90^0\,dv, \text{ unde}$$

$$\frac{d.\,B_v}{dv} = \alpha \cos (v.\,45^0 + \varphi)\,45^0 + \beta \cos (v.\,90^0 + \psi)\,90^0 = 0, \text{ sive}$$

$$\frac{d.\,B_v}{dv} = \alpha \cos (v.\,45^0 + \varphi)\,dv + 2\,\beta \cos (v.\,90^0 + \psi) = 0.$$

et positis valoribus numericis, ex observationibus nostris (§. 25, 28, 29, 30) inventis:

$$\frac{d.\,B_v}{dv} = 0''',8898 \cos (v.\,45^0 + 66^0\,57') + 0{,}4226 \cos (v.\,90^0 + 309^0\,43') = 0.$$

§. 52.

Aequatio generalis $\frac{d.\,B}{dv} = \alpha \cos (v.\,45^0 + \varphi) + 2\,\beta \cos (v.\,90^0 + \psi) = 0$ vires algebrae transcendens ut rite solvatur in aliam formam mutanda est. Quam ob rem ponimus v. 45^0 = x, ergo v. 90 = 2 x, tum adhibita formula $\cos (a + b) = \cos a \cos b - \sin a \sin b$ invenimus

$$\alpha\,(\cos x \cos \varphi - \sin x \sin \varphi) + 2\,\beta\,(\cos 2\,x \cos \psi - \sin 2\,x \sin \psi = 0.$$

Est autem $\cos 2\,x = 2 \cos x^2 - 1$ et $\sin 2\,x = 2 \sin x \cos x$; his valoribus positis habemus:

$$\alpha\,(\cos x \cos \varphi - \sin x \sin \varphi) + 2\,\beta\,(2 \cos x^2 \cos \psi - \cos \psi - 2 \sin x \cos x \sin \psi) = 0.$$

Nunc si ponimus pro sin x valorem $\sqrt{(1 - \cos x^2)}$ accipimus:

$$\alpha\,(\cos x \cos \varphi - \sin \varphi \sqrt{(1 - \cos x^2)} + 2\,\beta\,(2 \cos \psi \cos x^2 - \cos \psi - 2 \sin \psi \cos x \sqrt{(1 - \cos x^2)} = 0.$$

Posito cos x = y et uncinis solutis habemus:

$$\alpha \cos \varphi\,y - \alpha \sin \varphi \sqrt{(1 - y^2)} + 4\,\beta \cos \psi\,y^2 - 2\,\beta \cos \psi - 4\,\beta \sin \psi\,y \sqrt{(1 - y^2)} = 0,$$

sive aequatione transposita:

$$(4\,\beta \sin \psi\,y + \alpha \sin \varphi) \sqrt{(1 - y^2)} = \alpha \cos \varphi\,y + 4\,\beta \cos \psi\,y^2 - 2\,\beta \cos \psi,$$

et reductione facta

$$(4\,\beta \sin \psi\,y + \alpha \sin \varphi)^2\,(1 - y^2) = (\alpha \cos \varphi\,y + 4\,\beta \cos \psi\,y^2 - 2\,\beta \cos \psi)^2, \text{ sive}$$

$$(16\,\beta^2 \sin \psi^2\,y^2 + 8\,\alpha\,\beta \sin \varphi \sin \psi\,y + \alpha^2 \sin \varphi^2)\,(1 - y^2) = \left\{\begin{array}{l} \alpha^2 \cos \varphi^2\,y^2 + 8\,\alpha\,\beta \cos \varphi \cos \psi\,y^3 - \\ - 4\,\alpha\,\beta \cos \varphi \cos \psi\,y + 16\,\beta^2 \cos \psi^2\,y^4 - \\ - 16\,\beta^2 \cos \psi^2\,y^2 + 4\,\beta^2 \cos \psi^2 \end{array}\right\}$$

sive

$$\left\{\begin{array}{l} 16\,\beta^2 \sin \psi^2\,y^2 + 8\,\alpha\,\beta \sin \varphi \sin \psi\,y + \alpha^2 \sin \varphi^2 - \\ - 16\,\beta^2 \sin \psi^2\,y^4 - 8\,\alpha\,\beta \sin \varphi \sin \psi\,y^3 - \alpha^2 \sin \varphi^2\,y^2 \end{array}\right\} = \left\{\begin{array}{l} \alpha^2 \cos \varphi^2\,y^2 + 8\,\alpha\,\beta \cos \varphi \cos \psi\,y^3 - \\ - 4\,\alpha\,\beta \cos \varphi \cos \psi\,y + 16\,\beta^2 \cos \psi^2\,y^4 - \\ - 16\,\beta^2 \cos \psi^2\,y^2 + 4\,\beta^2 \cos \psi^2 \end{array}\right\}$$

sive

$$\left\{\begin{array}{l} - 16\,\beta^2 \sin \psi^2\,y^4 - 8\,\alpha\,\beta \sin \varphi \sin \psi\,y^3 + \\ + (16\,\beta^2 \sin \psi^2 - \alpha^2 \sin \varphi^2)\,y^2 + \\ + 8\,\alpha\,\beta \sin \varphi \sin \psi\,y + \alpha^2 \sin \varphi^2 \end{array}\right\} = \left\{\begin{array}{l} 16\,\beta^2 \cos \psi^2\,y^4 + 8\,\alpha\,\beta \cos \varphi \cos \psi\,y^3 + \\ + (\alpha^2 \cos \varphi^2 - 16\,\beta^2 \cos \psi^2)\,y^2 \\ - 4\,\alpha\,\beta \cos \varphi \cos \psi\,y + 4\,\beta^2 \cos \psi^2 \end{array}\right\}$$

Aequatione iterum transposita fit:

$$\left\{\begin{array}{l} 16\,\beta^2\,y^4 + 8\,\alpha\,\beta \cos (\varphi - \psi)\,y^3 + (\alpha^2 - 16\,\beta^2) \cdot y^2 - \\ - (2 \sin \varphi \sin \psi + \cos \varphi \cos \psi)\,4\,\alpha\,\beta \cdot y + \\ + 4\,\alpha\,\beta^2 \cos \psi^2 - \alpha^2 \sin \varphi^2 \end{array}\right\} = 0$$

et, si aequationem dividimus per coefficientem 16 β^2 termini primi, accipimus:

$$\left\{\begin{array}{l} y^4 + \frac{\alpha}{2\,\beta} \cos (\varphi - \psi)\,y^3 + \left(\frac{\alpha^2}{16\beta^2} - 1\right) y^2 - \\ - \frac{\alpha}{4\,\beta}\,(2 \sin \varphi \sin \psi + \cos \varphi \cos \psi)\,y + 1/4 \cos \psi^2 - \frac{\alpha^2 \sin \varphi^2}{16\,\beta^2} \end{array}\right\} = 0$$

§. 53.

Est $\cos(\varphi - \psi) = \cos(360^0 + \varphi - \psi)$, quam ob rem ad nostras ventorum barometrique observationes adhibita aequatio haec formam accipit sequentem:

$$y^4 - 0{,}96365\, y^3 + 0{,}1086\, y^2 + 1{,}2271\, y - 0{,}83660 = 0,$$

quae Euleri methodo solvi potest. Hunc ad finem primum amoveatur terminus secundus, quam ob rem ponimus:

$$y = y' + \frac{0{,}96365}{4} = y' + 0{,}24091; \text{ inde sequitur:}$$

$$\left.\begin{array}{rl} y^4 = & y'^4 + 0{,}96365\, y'^3 + 0{,}34823\, y'^2 + 0{,}05593\, y' + 0{,}0033685 \\ -\,0{,}96365\, y^3 = & \ldots - 0{,}96365\, y'^3 - 0{,}69647\, y'^2 - 0{,}16779\, y' - 0{,}013474\,. \\ +\,0{,}1086\, y^2 = & \ldots\ldots + 0{,}1086\, y'^2 + 0{,}052326\, y' + 0{,}006303\,. \\ +\,1{,}2271\, y = & \ldots\ldots\ldots + 1{,}2271\ldots y' + 0{,}29562\ldots \\ -\,0{,}83660\, y = & \ldots\ldots\ldots\ldots\ldots + 0{,}83660\ldots \end{array}\right\} = 0.$$

$$y'^4 \qquad - 0{,}23964\, y'^2 + 1{,}167566\, y' - 0{,}5447825 = 0.$$

sive

$$y'^4 = 0{,}23964\, y'^2 - 1{,}167566\, y' + 0{,}5447825.$$

§. 54.

Sint radices hujus aequationis $y' = \pm\sqrt{a} \pm \sqrt{b} \pm \sqrt{c}$ et coefficientes

$$0{,}23964 = P,\ -1{,}167566 = Q,\ 0{,}5447825 = R$$

e quibus formetur aequatio auxiliaris cubica

$$z^3 - \tfrac{1}{2} P z^2 + \frac{4R + P^2}{16} z - \frac{Q^2}{64} = 0,$$

cujus radices erunt

$$z = \left\{\begin{array}{c} a \\ b \\ c \end{array}\right\}.$$

Computatione facta aequatio auxiliaris nostra prodit:

$$z^3 - 0{,}11982\, z^2 + 0{,}1397849\, z - 0{,}021301 = 0.$$

§. 55.

Quae ut solvatur Cardani regula aut quovis alio modo termino secundo liberanda est. Quam ob rem ponimus:

$$z = z' + \frac{0{,}11982}{3} = z' + 0{,}03994, \text{ unde sequitur:}$$

$$\left.\begin{array}{rl} z^3 = & z'^3 + 0{,}11982\, z'^2 + 0{,}0047857\, z' + 0{,}000063713 \\ -\,0{,}11982\, z^2 = & \ldots - 0{,}11982\, z'^2 - 0{,}0095713\, z' - 0{,}00019114\,. \\ +\,0{,}1397849\, z = & \ldots\ldots + 0{,}1397849\, z' + 0{,}0055829\ldots \\ -\,0{,}021301 = & \ldots\ldots\ldots\ldots - 0{,}021301\ldots \end{array}\right\} = 0$$

$$z'^3 \qquad + 0{,}1349993\, z' - 0{,}015845527 = 0,$$

sive $\quad z^3 = -\,0{,}1349993\, z' + 0{,}015845527.$

§. 56.

Notum est secundum Cardani regulam pro $z'^3 = pz' + q$ esse:

$$z' = \sqrt[3]{\left[\frac{q + \sqrt{\left(q^2 - \frac{4p^3}{27}\right)}}{2}\right]} + \sqrt[3]{\left[\frac{q - \sqrt{\left(q^2 - \frac{4p^3}{27}\right)}}{2}\right]}$$

sive brevius $z' = \sqrt[3]{A} + \sqrt[3]{B}$.

Haec formula si applicatur ad aequationem inventam

$$z'^3 = -0{,}1349993\ z' + 0{,}015845527$$

habemus $p = -0{,}1349993$, $q = 0{,}015845527$.

$$\log q = 0{,}19992 - 2$$

$$\log q^2 = 0{,}39984 - 4 = \log 0\ 00025109$$

$$\log p = 0{,}13033 - 1 \text{ neg.}$$

$$\log p^3 = 0{,}39099 - 3 \text{ neg.}$$

$$+ \quad \log 4 = 0{,}60206$$

$$+ \ c \log 27 = 8{,}56864 - 10$$

$$q^2 = 0{,}00025109$$

$$-\frac{4\,p^3}{27} = +\ 0{,}00036449$$

$$q^2 - \frac{4\,p^3}{27}\ 0{,}00061558$$

$$\log \frac{4\,p^3}{27} = 0{,}56169 - 4 \text{ neg} = \log - 0{,}00036449$$

$$\log \left(q^2 - \frac{4\,p^3}{27}\right) = 0{,}78929 - 4$$

$$\log \sqrt{\left(q^2 - \frac{4\,p^3}{27}\right)} = 0{,}39465 - 2 = \log 0{,}024811.$$

$$q = 0{,}015845527$$

$$+\sqrt{\left(q^2 - \frac{4\,p^3}{27}\right)} = 0{,}024811$$

$$q + \sqrt{\left(q^2 - \frac{4\,p^3}{27}\right)} = 0{,}040656527$$

$$A = 0{,}020328264$$

$$\log \quad A = 1{,}30810 - 3$$

$$\log \sqrt[3]{A} = 0{,}43603 - 1 = \log 0{,}27292.$$

$$q = \quad 0{,}015845527$$

$$-\sqrt{\left(q^2 - \frac{4\,p^3}{27}\right)} = - \quad 0{,}024811$$

$$q - \sqrt{\left(q^2 - \frac{4\,p^3}{27}\right)} = -\ 0{,}008965473$$

$$B = -\ 0{,}004482737$$

$$\log \quad B = 0{,}65154 - 3 \text{ neg}$$

$$\log \sqrt[3]{B} = 0{,}21718 - 1 \text{ neg} = \log - 0{,}16488.$$

$$\sqrt[3]{A} = 0{,}27292$$

$$+ \sqrt[3]{B} = 0{,}16488$$

$$z' = 0{,}10804$$

§. 57.

Cardani formula quo adhiberi solet modo, eo hic quoque a nobis adhibito, unam tantummodo radicem aequationis cubicae nobis offert $z' = 0{,}10804$. Ad nostram vero rationem rite ineundam etiam duae radices reliquae sunt eruendae, id quod eadem illa formula adhibita hoc modo effici potest.

Notum est, radicem cubicam tres habere valores, primus est qui radicis extractione solita invenitur $\sqrt[3]{A}$, quem litera significamus a. Valores duo ceteri solutione aequationis quadraticae inveniuntur et posito indicato primo

1) $\sqrt[3]{A} = a$, ceteri sunt

2) $\sqrt[3]{A} = \frac{a}{2}\,(-1 + \sqrt{-3})$

3) $\sqrt[3]{A} = \frac{a}{2}\,(-1 - \sqrt{-3})$.

His applicatis ad Cardani formulam atque posito $\sqrt[3]{A} = a$, $\sqrt[3]{B} = b$, valores sequentes radicis aequationis cubicae invenimus:

1) $z' = a + b$

2) $z' = a + \frac{1}{2}\,b\,(-1 + \sqrt{-3})$

3) $z' = a + \frac{1}{2}\,b\,(-1 - \sqrt{-3})$

4) $z' = \frac{1}{2}\,a\,(-1 + \sqrt{-3}) + b$

5) $z' = \frac{1}{2}\,a\,(-1 + \sqrt{-3}) + \frac{1}{2}\,b\,(-1\ \sqrt{-3})$

6) $z' = \frac{1}{2}\,a\,(-1 + \sqrt{-3}) + \frac{1}{2}\,b\,(-1\ \sqrt{-3})$

7) $z' = \frac{1}{2} a (-1 - \sqrt{-3}) + b$
8) $z' = \frac{1}{2} a (-1 - \sqrt{-3}) + \frac{1}{2} b (-1 + \sqrt{-3})$
9) $z' = \frac{1}{2} a (-1 - \sqrt{-3}) + \frac{1}{2} b (-1 - \sqrt{-3})$.

Ex his valoribus novem quantitatis quaesitae z', ob aequationem conditionalem

$$\sqrt[3]{(A \cdot B)} = \frac{1}{3} p,$$

quae in derivatione formulae Cardani nobis offertur, ii tantummodo tres sunt eligendi, in quibus valores singuli $\sqrt[3]{A}$ et $\sqrt[3]{B}$ ejusmodi sunt naturae, ut productum $\sqrt[3]{(AB)} = \frac{1}{3} p$ nullam quantitatem imaginariam contineat, sive valorem det, uti dicunt, possibilem. Huic conditioni congrui sunt ex novem valoribus supra datis z' solum ii tres, qui signis 1), 6) et 8) sunt descripti. Habemus ergo tres veras radices aequationis cubicae has:

1) $z' = a + b$
2) $z' = \frac{1}{2} a (-1 + \sqrt{-3}) + \frac{1}{2} b (-1 - \sqrt{-3})$
3) $z' = \frac{1}{2} a (-1 - \sqrt{-3}) + \frac{1}{2} b (-1 + \sqrt{-3})$.

§. 58.

Quae si applicantur ad aequationem nostram cubicam auxiliarem, in qua, ut supra (§. 56.) invenimus est

$$\sqrt[3]{A} = a = 0{,}27292; \ \sqrt[3]{B} = b = -0{,}16488$$

habemus:

1) radicem primam $z' = a + b = 0{,}10804$,

2) radicem secundam $z' = \frac{1}{2} a (-1 + \sqrt{-3}) + \frac{1}{2} b (-1 - \sqrt{-3}) = 0{,}13646 (-1 + 1{,}7320 \sqrt{-1}) - 0{,}08244 (-1 - 1{,}7320 \sqrt{-1}) = -0{,}13646 + 0{,}23635 \sqrt{-1} + 0{,}08244 + 0{,}14279 \sqrt{-1})$ sive $z' = -0{,}05402 + 0{,}37914 \sqrt{-1}$.

3) radicem tertiam $z' = \frac{1}{2} a (-1 - \sqrt{-3}) + \frac{1}{2} b (-1 + \sqrt{-3}) = 0{,}13646 (-1 - 1{,}7320 \sqrt{-1}) - 0{,}08244 (-1 + 1{,}7320 \sqrt{-1}) = -0{,}13646 - 0{,}23635 \sqrt{-1} + 0{,}08244 - 0{,}14279 \sqrt{-1}$ sive $z' = -0{,}05402 - 0{,}37914 \sqrt{-1}$.

Ceterum si aequatio cubica $z'^3 + 0{,}1349993 z' - 0{,}015845527 = 0$ dividitur per aequationem inventam radicalem $z' - 0{,}10804 = 0$ invenimus aequationem quadraticam $z'^2 + 0{,}10804 z' + 0{,}146671 = 0$, qua soluta accipimus $z' = -0{,}05402 \pm 0{,}37914 \sqrt{-1}$ uti supra inventum est.

Erat autem (§. 55.) $z = z' + 0{,}03994$, sunt igitur, positis valoribus pro z' nunc inventis radices z aequationis auxiliaris $z^3 - 0{,}11982 z^2 + 0{,}1397849 z - 0{,}021301 = 0$ hae:

$$z = \begin{cases} a = +0{,}14798 \\ b = -0{,}01408 + 0{,}37914 \sqrt{-1} \\ c = -0{,}01408 - 0{,}37914 \sqrt{-1}. \end{cases}$$

§. 59.

Ut inveniamus radices aequationis

$$y'^4 = 0{,}23964 y'^2 - 1{,}167566 y' + 0{,}5447825 \text{ (§. 53.)}$$

$$y' = \pm \sqrt{a} \pm \sqrt{b} \pm \sqrt{c}, \text{ valores } \pm \sqrt{a}, \pm \sqrt{b}, \pm \sqrt{c}$$

ita inter se sunt combinandi ut $\frac{1}{8} Q = \sqrt{a} \sqrt{b} \sqrt{c}$ valorem accipiat negativum.

Est vero

$$\sqrt{[A \pm \sqrt{-B}]} = \sqrt{\left[\frac{A + \sqrt{(A^2 + B)}}{2}\right]} \pm \sqrt{\left[\frac{A - \sqrt{(A^2 + B)}}{2}\right]}$$

Igitur $\sqrt{a} = \sqrt{0{,}14798} = 0{,}38468$
$\sqrt{b} = \sqrt{(-0{,}01408 + 0{,}37914 \sqrt{-1})} = 0{,}42739 + 0{,}44356 \sqrt{-1}$
$\sqrt{c} = \sqrt{(-0{,}01408 - 0{,}37914 \sqrt{-1})} = 0{,}42739 - 0{,}44356 \sqrt{-1}$.

Habemus ergo

$$y' = \begin{cases} \sqrt{a} + \sqrt{b} - \sqrt{c} = 0{,}38468 + 0{,}88712\sqrt{-1} \\ \sqrt{a} - \sqrt{b} + \sqrt{c} = 0{,}38468 - 0{,}88712\sqrt{-1} \\ -\sqrt{a} + \sqrt{b} + \sqrt{c} = 0{,}47010 \\ -\sqrt{a} - \sqrt{b} - \sqrt{c} = -1{,}23946. \end{cases}$$

Erat autem $y = y' + 0{,}24091$ (§. 53.), unde sequitur sumtis valoribus duobus posterioribus:

$$y = \begin{cases} +\ 0{,}71101 = \cos x = \cos v \,.\, 45^\circ = \cos 44^\circ\ 41' \\ -\ 0{,}99855 = \cos x = \cos v \,.\, 45^\circ = \cos 183^\circ\ 5'. \end{cases}$$

§. 60.

Adhibitis his valoribus ope formulae (§. 34.).

$$B_v = 330''',67 + 0''',8898 \sin (v \,.\, 45^\circ + 66^\circ\ 57') + 0''',2113 \sin (v \,.\, 90^\circ + 309^\circ\ 43')$$

invenimus

1) barometri maximum venti azimutho $44^\circ\ 41'$ i. e. vento flante **NO** $= 331''',63$
2) barometri minimum venti azimutho $183^\circ\ 5'$ i. e. flante vento **S** $+ 3^\circ\ 5'$ versus **W**, ergo vento fere **S** $= 329''',69$.

§. 61.

Restat ut inquiramus, quo vento flante barometrum statum medium obtineat, quem ad finem solvenda est aequatio (§. 34.) sumto $B_v = 330''',67$ i. e posito $0{,}8898 \sin (v. 45^\circ + 66^\circ\ 57') + 0''',2113 \sin (v. 90^\circ + 309^\circ\ 43') = 0$, sive generaliter

$$\alpha \sin (v \,.\, 45^\circ + \varphi) + \beta \sin (v \,.\, 90^\circ + \psi) = 0.$$

Haec aequatio, quae artis algebraicae ope computari nequit, simili modo uti supra (§. 52.) factum est in formam algebraicam redigi potest.

Posito enim $v. 45^\circ = x$, ergo $v. 90^\circ = 2x$ et adhibita formula notissima $\sin (x + y) = \sin x \cos y + \cos x \sin y$

$$\alpha (\sin x \cos \varphi + \cos x \sin \varphi) + \beta (\sin 2x \cos \psi + \cos 2x \sin \psi) = 0.$$

Est autem $\cos 2x = 2 \cos x^2 - 1$ et $\sin 2x = 2 \sin x \cos x$ unde prodit

$$\alpha (\sin x \cos \varphi + \cos x \sin \varphi) + \beta (2 \sin x \cos x \cos \psi + 2 \cos x^2 \sin \psi - \sin \psi) = 0.$$

Haec aequatio duas quantitates incognitas $\sin x$ et $\cos x$ complectens facillime ad unam tantummodo reducitur ope formulae $\sin x = \sqrt{(1 - \cos x^2)}$ qua sequitur

$$\alpha [\cos \varphi \sqrt{(1 - \cos x^2)} + \cos x \sin \varphi] + \beta [2 \cos x \cos \psi \sqrt{(1 - \cos x^2)} + 2 \cos x^2 \sin \psi - \sin \psi] = 0.$$

Posito $\cos x = y$ et uncinis solutis habemus:

$$\alpha \cos \varphi \sqrt{(1 - y^2)} + \alpha \sin \varphi \,.\, y + 2 \beta \cos \psi \,.\, y \,.\sqrt{(1 - y^2)} + 2 \beta \sin \psi\, y^2 - \beta \sin \psi = 0$$

ex quo sequitur radicalium transpositione:

$$(\alpha \cos \varphi + 2 \beta \cos \psi \,.\, y) \sqrt{(1 - y^2)} = \beta \sin \psi - \alpha \sin \varphi \,.\, y - 2 \beta \sin \psi \,.\, y^2,$$

inde reductione quadraturae ope:

$$(\alpha \cos \varphi + 2 \beta \cos \psi \,.\, y)^2 \,.\, (1 - y^2) = (\beta \sin \psi - \alpha \sin \varphi \,.\, y - 2 \beta \sin \psi \,.\, y^2)^2,$$

sive computatione facta:

$$- 4 \beta^2 \cos \psi^2\, y^4 - 4\, \alpha \beta \cos \varphi \cos \psi\, y^3 + (4 \beta^2 \cos \psi^2 - \alpha^2 \cos \varphi^2)\, y^2 + 4\, \alpha \beta \cos \varphi \cos \psi \,.\, y + \alpha^2 \cos \varphi^2 =$$
$$+ 4 \beta^2 \sin \psi^2\, y^4 + 4\, \alpha \beta \sin \varphi \sin \psi\, y^3 - (4 \beta^2 \sin \psi^2 y^2 - \alpha^2 \sin \varphi^2)\, y^2 - 2\, \alpha \beta \sin \varphi \sin \psi \,.\, y + \beta^2 \sin \psi^2,$$

et terminis transpositis:

$$\left\{ \begin{array}{l} 4 \beta^2 y^4 + 4\, \alpha \beta \cos (\varphi - \psi) \,.\, y^3 - (4 \beta^2 - \alpha^2) \,.\, y^2 - \\ - (2 \cos \varphi \cos \psi + \sin \varphi \sin \psi)\, 2\, \alpha \beta\, y + \beta^2 \sin \psi^2 - \alpha^2 \cos \varphi^2 \end{array} \right\} = 0,$$

tum divisione facta per coefficientem $4 \beta^2$ termini primi:

$$\left\{ \begin{array}{l} y^4 + \frac{\alpha}{\beta} \cos (\varphi - \psi)\, y^3 - \left(1 - \frac{\alpha^2}{4 \beta^2}\right) y^2 - \\ - \frac{\alpha}{2 \beta} (2 \cos \varphi \cos \psi + \sin \varphi \sin \psi) \,.\, y + \frac{1}{4} \sin \psi^2 - \frac{\alpha^2}{4 \beta^2} \cos \varphi^2 \end{array} \right\} = 0.$$

Postremo, adhibitis valoribus numericis ex observationibus nostris deductis accipimus:

$$y^4 - 1,9273\, y^3 + 3,4344\, y^2 + 0,43683\, y - 0,53188 = 0.$$

§. 62.

Radices hujus aequationis methodo supra (§. 53—56.) indicata aut quavis alia solutae sunt:

$$y = \cos x = \cos v \,.\, 45° = \begin{cases} -\ 0,40232 = \cos 113°\ 43'\ 24'' \\ +\ 0,36112 = \cos 291\ 10'\ 10'' \\ +\ 0,98425 \pm 1,6408\, \sqrt{-1}. \end{cases}$$

quarum priores tantummodo hic adhibendae sunt. Ex iis sequitur, barometrum statum medium obtinere vento flante ex

$$\text{azimuthis} \begin{cases} 113°\ 43'\ 24''\ \text{i. e. fere OSO} \\ 291°\ 10'\ 10''\ \text{i. e. fere WNW,} \end{cases}$$

ita ut azimutha duorum ventorum eorum, ad quos medium barometricum pertinet inter se diametraliter fere sint opposita.

§. 63.

Quae hucusque ex observationibus nostris calculi ope eruimus ea hic paucis verbis colligere et figuris duabus annexis dilucide ante oculos ponere liceat.

Vento flante WNW barometrum statum medium obtinet, ventis flantibus NW, NNW, N, NNO, altitudo barometrica continuo crescit donec oriente vento NO maximum statum attingit, statum medium 0''',96 Paris. superantem. Tum flantibus ventis ONO et O altitudo barometri celeriter decrescit, oriente vento OSO medium statum occupat, decrescit porro ventis flantibus SO, SSO donec flante S ad minimam altitudinem accedit, quae a medio 0''',98 Paris. superatur; ventis porro flantibus SSW, SW, WSW, W status barometri iterum crescit, donec vento flante WNW statum habet medium. Figura annexa 1. motum hunc barometri ex vento pendentem coordinatis polaribus expressum ante oculos ponit, mensura decies aucta. Circulus b b b b est linea medii barometrici, curva B_{WNW}, B_{NW} . . . . B_W motum barometri indicat puncta B_{WNW} et B_{OSO} sunt loca medii barometrici, B_{NO} maximum, B_S minimum statum ejus significat. Idem Fig. 2. coordinatis rectangularibus delineatum est. Recta b b b b linea est medii barometrici, B_S locum minimi, B_{NO} locum maximi a nobis calculo inventi indicat. Motus totalis medius barometri ex venti directione oriens est 1''',94 sive fere 2''' Paris.

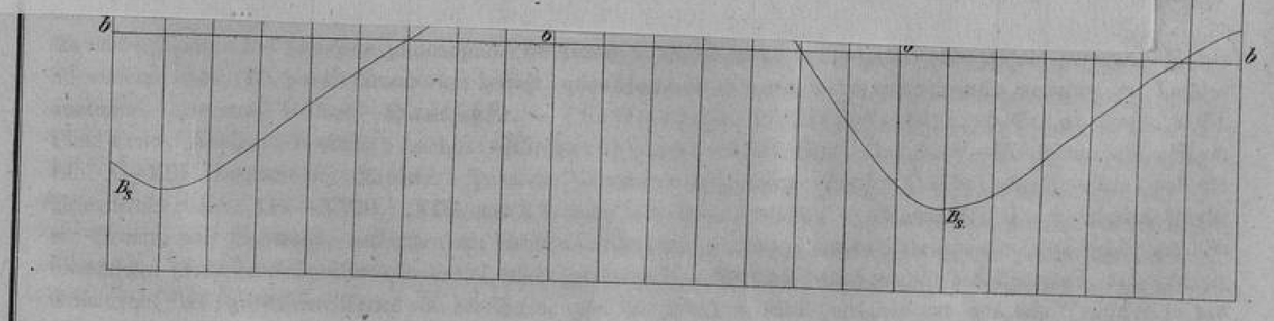
§. 64.

Ceterum hic notandum esse censeo, omnes observationes iisdem instrumentis factas esse, quorum descriptio accuratior in commentatione de variationibus barometri unoquoque die revertentibus, Gissae **MDCCCXXIX.** §. 3. proposita legitur. Ad haec instrumenta ita descripta accessit barometrum siphoniforme Apelianum a me methodo excellente Romershusiana diligenter excoctum, diametro interiore quatuor fere linearum Parisinarum, quod cum barometro siphoniformi a me composito et observationibus semper adhibito frequenter comparatur.

Corrigenda.

§. 5 Linea 2 post N ponendum est signum:)

§	Linea	loco	legendum est
„	7	$(135^\circ + \psi)$	$(135^\circ + \varphi)$
6	„	determinantae	determinatae.
„	6	D	d.
7	15	=	+
„	31	$- \sin \psi \, d\beta$	$- b \sin \psi \, d\beta$.
„	32	$(45^\circ + \psi)$	$(45^\circ + \varphi)$.
„	33	$- \cos (45^\circ + \varphi) \, d\alpha$	$- b \cos (45^\circ + \varphi) \, d\alpha$.
8	26	$- \alpha\beta \sin (45^\circ + \psi) \sin \varphi$	$- \alpha\beta \sin (45^\circ + \varphi) \sin \psi$.
10	5	$(45^\circ + \psi)$	$(45^\circ + \varphi)$.
15	9	$(\sin \psi^2 \cos \psi^2)$	$(\sin \psi^2 + \cos \psi^2)$.
17	9	$- B_s$	$- B_{so}$
21	8	172899,80	172990,80.
33	16	notis	nobis.
45	27	in ventus	inventus.
47	7	Differentis	Differentia.
53	10	$- 0{,}83660 \, y = + 0{,}83660$	$- 0{,}83660 = - 0{,}83660$.
56	13	$- \frac{4p^3}{27} 0{,}00061558$	$- \frac{4p^3}{27} = 0{,}00061558$.
„	19	$\sqrt{B}$	$\sqrt[3]{B}$.
„	21	$\sqrt[3]{B} = 0{,}16488$	$\sqrt[3]{B} = - 0{,}16488$.
61	5	algebraeicae	algebraicae.
„	23	$4 \beta^2 \sin \psi^2 y^2$	$4 \beta^2 \sin \psi^2$.



Lith. b. G. D. Brühl Jr. in Giessen

Liemfert de barometri motu.

Fig. 1.

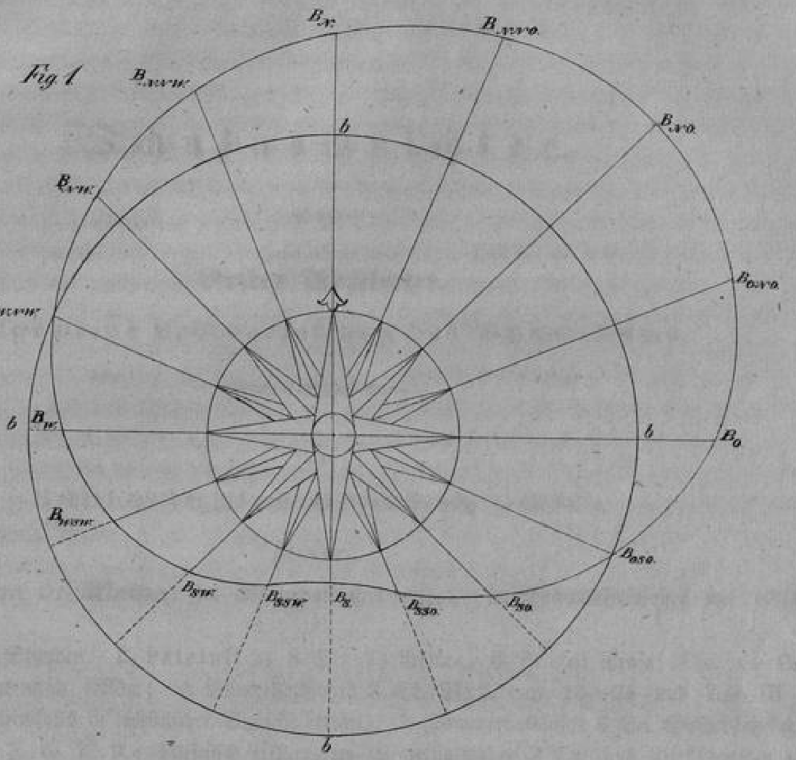
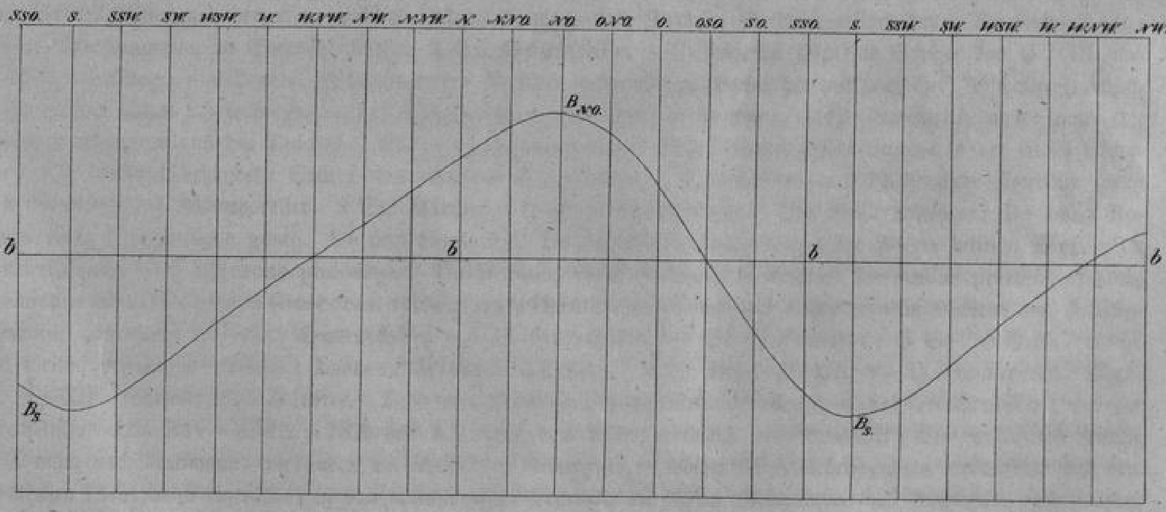


Fig. 2.



Lith. b. G. D. Brühl Jr. in Giessen. Lambert de barometri motu.