ART. XVIII.—*Physical Observations on the Andes and the Amazons;* by JAMES ORTON.

THE following observations were made during a scientific expedition across the continent of South America, in the year 1867. The instruments used were two mercurial barometers (one of them short, beginning to mark at 9,000 feet), a Wollaston boiling-point apparatus, and Boussingault's ground thermometer. They were constructed by Mr. James Green of New York, and furnished by the Smithsonian Institution. The barometers perfectly corresponded; and on returning to New York, it was found that the long barometer (its companion was broken in the valley of Quito,) after a tour of ten thousand miles had not varied a hair's breadth. The route

* This Journal, II, xxvii, 52.
† Pogg. Ann., lxxx, 383.
‡ Proc. Acad. Sci. Philad., 1857, 168.
This Journal, II, xlv, 34.

was from Guayaquil to Pará via Quito, Rio Napo and the Amazons. The chief value of these observations is derived from the fact that they were made with instruments of precision at many localities whose altitude was hitherto unknown, or obtained by an aneroid* or boiling apparatus. They also test the utility of the thermo-barometer, experiments having been made with it and the standard barometer simultaneously. It is doubtful if the two were ever carried together to such elevations and across the breadth of the continent. Indeed I do not know that any barometer has been taken down the Rio Napo. It was my desire to throw some light upon that strange anomaly in the Amazon valley first revealed by Lieut. Herndon and theorized upon by Lieut. Maury.† All the calculations of altitude are based upon the barometric observations with the Pacific level as a constant. On the Amazons and its tributary no correction is made for monthly variation as it is unknown; the experiments were made in November and December, and the correction would be therefore additive. The heights of points on the river are reduced to the level of the water; while the barometric pressures are given as they were taken, the elevation of the instruments varying from two to sixty feet. Thus at Guayaquil they were twenty feet above the river, at Napo, Coca and Pará, twenty-five feet, and at Pebas, sixty feet. The pressures corresponding to temperatures of boiling water are from Guyot's tables after Regnault revised by Moritz. These are placed along side of the barometric observations (reduced to 32°) in order to show the agreement between the barometer and boiling apparatus. To obtain the mean annual temperatures of important places, the ground thermometer was sunk from two to three feet, and allowed to remain about six hours.

The first desideratum was the level of the Pacific off Ecuador. After many careful calculations I fixed upon 29·930 as the barometric pressure at the freezing point. Herndon assumes 30·000, and his altitudes are therefore too high. I know not Humboldt's base, but his estimates are uniformly high. Those of Boussingault and Visse I have taken second-hand, and am not sure they are correctly copied. Pentland gives 29·944 as the mean barometer off Peru; Duperrey (1823) gives 29·961 at Paita; and Gilliss at sea off Cape Lorenzo, Oct. 2d, found 29·825. Pentland's corrected for latitude would very closely agree with mine.

The site of Quito is very uneven: my altitude is that of

* "A Traveler who carries an aneroid alone with him must not expect accuracy within two or three hundred feet."—Guyot. It is generally higher than the standard in high temperatures.

† See this Journal, vol. xix, p. 385.

the grand Plaza. It is a singular fact that La Condamine (1745), Humboldt (1802), Boussingault (1831), and Visse (1863) give a decreasing altitude. One is tempted to believe that the Andes are sinking. Boussingault contends that this is true of some individual mountains.* The mean of all the estimates given in the table, excepting that of Caldas which is manifestly incorrect, is 9,521. Villavicencio gives 9,485. I quote him simply to call attention to the fact that the estimates in his *Geografia de la Republica del Ecuador* are not reliable. In a balloon ascent made in January, 1864, from Woolwich, Eng., by Glaisher for the British Association, the reading of the barometer at 3^h 16^m P. M., (corrected and reduced to 32°,) was 20·951 at the estimated height of 9,500 ft. The minimum noticed in Quito was 21·460. The French savans give the length of the seconds pendulum at Quito 3·247753 ft., it being 3·250588 ft. at sea-level on the equator. This is a deduction, not the result of experiment, and gives only 9,166 ft. for the height of Quito. The pendulum experiment at Quito would be very interesting, but great disturbances would doubtless arise from the proximity of so many volcanic mountains.

The observations on Pichincha were taken 80 ft. below the highest pinnacle. That in the crater was made at the foot of the cone of eruption. That on Antisana was taken just above the average snow-limit; and that on Cotopaxi at the base of the cone. Cotopaxi's cone is therefore 6,000 ft. high. At Itulcache begins the series of observations from Quito eastward across the continent. The great Amazonian forest commences about ten miles west of Papallacta. Baeza is situated on a ridge; thence the path to Napo turns from an easterly course directly south through Archidona. Chinipleia was our camp on the Rio Cosanga. The heights on the Amazons as given by other travelers express the altitude above the Atlantic; while I have kept the Pacific as a base. The barometer and boiling point at the Atlantic level are computed; the distance of Pará being taken at 95 miles and the fall of the river two inches to the mile. This makes the Pacific off Ecuador about two feet higher than the Atlantic. Ought we not to expect a difference? Do not the great volcanic mountains on the equator exert an attractive power on the ocean at their feet? At Panamá, the Pacific and Atlantic sink to a common level, for there the Andes drop down to an insignificant altitude. I must add, however, that the obser-

* See Bull. de la Soc. Géol. de France, tom. vi, p. 56, Prof. Schön from observations at Wurtzburg thinks that the atmospheric pressure has increased during the last fifty years. Forbes, 1832.

vations at Guayaquil were taken in July, those at Pará in January with the same instruments. My barometric pressure at Pará may therefore be too high; but the true monthly variation is unknown. At Havana the mean barometer in January is ·200 in *excess* of the yearly mean, and the correction at the equator should be still greater; but Dewey makes the January variation at Pará ·011 *below* the mean. His mean in July is 30·020. We need an extended series of observations at Guayaquil and Pará. If we take Dewey's annual mean at Pará, 29·941 and 35 ft. as the altitude, the barometer at the Atlantic level would stand 29·977. But this makes the Atlantic full 40 ft. below the Pacific. Moreover, if Pará is 35 ft. above the Atlantic, the fall of the river is nearly 4½ inches per mile, which is also absurd. The rate cannot be far from two inches. This would make the fall about fifteen feet and the barometer at the Atlantic 29·932.

Slope and current of the Amazons.

		Distance.	Fall.
Napo village to the Marañon,		600 miles.	21·3 inches per mile.
" " " Pará,		2800 "	6·2 " "
Tabatinga " "		2000 "	2·5 " "

Azevedo and Pinto made the fall from Tabatinga to Pará, 0·9; Castlenau made it a little more. LaCondamine assigns to the Amazon in general a slope of 6·3 in. per mile, which very closely agrees with my calculation. Herndon, who, trusting his boiling apparatus, made Ega over 2,000 ft. high, deduced from this the descent of the Amazons "a little more than a foot per mile, which would about give it a current of 2½ miles per hour!"* He remarks that the current increases considerably after the junction of the Madeira. He calls it 2½ from Pebas to Ega in November, and three below Serpa in February. But the Peruvian navigators consider it from 3 to 3½ at Pebas in December (4 at high water). On the Napo in November I found it 5 below Coca; above Santa Rosa there are rapids. The Brazilian lieutenants make the slope of the Amazons exactly the same between Tabatinga and Manáos as between M. and Pará, or 58 ft. per 1,000 miles. It is interesting to compare the Amazons with other rivers:

Rhone,	fall	24·00 in. per mile;		slope,	1′ 18″
Mississippi,	"	19·87	"	"	1′ 4″
Thames,	"	17·5	"	"	0′ 57″
Nile,	"	6·5	"	"	0′ 21″
Amazons,	"	6·25	"	"	0′ 20″
Ganges,	"	4·	"	"	0′ 13″
Ohio,	"	4·	"	"	0′ 13″

* Herndon's calculations are very singular. Compare the one on page 258 with one on p. 331.

The Mississippi at St. Louis has nearly the same altitude* as the Amazons at the mouth of the Napo : respective distances from the sea, 1,400 and 2,200 miles. Below St. Louis the fall of the Mississippi is 3 in. per mile.

Accidental variations of the barometer.—These are generally considered as reduced to nothing at the equator. Humboldt says, the regularity of the ebb and flow of the aerial ocean is undisturbed by storms, hurricanes, rain and earthquakes in the torrid zone of the new continent, on the coast and at the elevation of 13,000 ft. At Dodabetta, India, (alt. 8,640 ft.) Lieut. Strachey found that the most violent and variable wind did not affect the range of the barometer. But in the valley of the Amazons strange irregularities have been noticed in every hypsometric instrument, whether mercurial barometer, aneroid or boiling apparatus. No two travelers have noticed the same irregularity ; but all (save Azevedo and Pinto), have found a lawless disturbing force. Indeed, the anomaly is so constant, that I am inclined to suspect the record of the Brazilian lieutenants, because it discovers no irregularity. Spix and Martius gave Tabatinga the enormous altitude of 670 ft., and elevated Manáos 556 ft. above the sea. This makes the fall of the first thousand miles of the river five times that of the second. Castlenau found Nauta 365 ft., Pebas, 399 ft., and Manáos 293 ft. above the sea; and complaining that his barometer got out of order, rejected a part of his observations. Herndon, with a boiling apparatus, discovered to his surprise that between Nauta and Ega he was ascending according to the instrument, though by the river and his own senses he was descending. At Nauta water boiled at 211°·3, and at Ega at 208°·2, which would put Nauta about 400 ft. above the Atlantic, and Ega, 800 miles farther down stream, at 2,000 ft.! On the Rio Purus, Chandless' barometer stood higher (29·871) than at Manáos, while the observations of Spruce and Wallace, one with an aneroid, the other with a boiling apparatus, made Manáos *lower* than Pará.

My experience was similar. The barometric pressure was very orderly in its increase from the top of Pichincha down to Pará, excepting on the Napo where at one time both the barometer and boiling apparatus unanimously declared that our canoes were gliding up stream though we were descending at the rate of five miles an hour, and excepting also on the Amazons between Tabatinga and Obidos. The boiling point was more irregular than the height of the mercury. Our rate down the Napo was full 40 miles a day ; and the record of the boiling

* Mean bar. at St. Louis, 29·520; at the mouth of the Napo, 29·526.

point for five successive days below the Curaray is as follows: 210°·8; 211°·1; 211°·; 210°·9; 211°·4.

Similar anomalies have been noticed in other parts of the world. Erman's observations in Siberia would place Jakuzk below the level of the sea of Ockozk; yet the Lena flows down from Jakuzk to the sea. Von Buch observed that the mean pressure on the shores of the Baltic was less than in France, and imputed the difference to what he calls a *vallé atmospherique*. The barometric mean at Great St. Bernard deviates by 14 ft. from the true height ascertained by leveling; this Plantamour attributes to an abnormal depression of the temperature of Geneva owing to the neighborhood of the lake. The barometer makes the Caspian Sea 250 ft. higher than the level; and the Antarctic Ocean, 800 ft. above the Atlantic.

The cause of the strange phenomena in the Amazon valley, Herndon (and after him Maury) ascribed to the pressure of the trade-winds as they are dammed up by the Andes. This gigantic wall of mountains, regarded as the rocky shore of an aerial ocean, is equivalent to 14 in. of the barometric column or $\frac{1}{8}$ the weight of the atmosphere. But this theory is not wholly satisfactory. It is true that the inclination of the continent to the east would naturally give a higher barometer than if it were a level table land. "When the atmosphere is swept *en masse* from the sea up the gradual slope of the land surface, we must expect (says Herschel) great discordances between barometric and trigonometric determinations of altitudes." But if the banking up of the trade-winds is the sole cause of the perturbations, ought we not to expect either a gradual though inordinate increase of the barometric pressure in ascending the Amazons, or fixed points of maximum intensity; yet the fluctuations seem to follow no rule. Herndon found the greatest disturbance above Tabatinga; I found it below. Herndon made Ega 2,000 ft. above the sea; I found it 100. Compare also the various altitudes given to Manáos. It is singular that in Herndon's Meteorological Journal, we find a light breeze, *seldom eastward*, between the Huallaga and Ega, while between Ega and Manáos the prevailing wind is east and stronger. The wind theory would lead us to expect just the reverse. It cannot be said that the difference in the observations is due to the fact that they were taken at different seasons of the year. Herndon and myself were at Ega in the same month (December); he boiled water at 208°·2; I had to raise it to 211°·9. I was at Pebas just a month later than Herndon; yet we found the boiling point exactly the same. The trade-winds doubtless have something to do with these variations, as also the position of the moon.* But may not *one* disturbing force be found in the presence of the great Amazonian forest which is a powerful condenser of aqueous vapor? The vapory winds, fresh from the Atlantic, would give a low barometer; after condensation, the mercury would rise.

Overlooking the irregularities between Tabatinga and Obidos, I think my barometrical observations across the continent faithfully delineate the main features from Guayaquil to Pará. We see a striking difference between South America and our own continent in the fact that while Tabatinga, the half-way station, is not over 255 ft. high, Fort Leavenworth at the same distance from the sea, is six hundred feet above it. I will here notice a curious coincidence (it can be nothing more) in the relation between the eastern profile of a continent and its section. Thus, the eastern coast line of the American continents is a rough copy of the line describing the surface from west to east. In the eastern hemisphere, the eastern contour more nearly approximates a section from north to south; and there is some reason for this, for the ocean would eat most deeply into the land between the mountain chains. In the case of South America, the protuberance of Cape St. Roque represents the swell of the Andes; the slope thence to Patagonia is an imitation of the Amazonian valley; while the upward turn of the Tierra del Fuego reminds us of the low Brazilian mountains.

Diurnal variations of the barometer.—These occur with great regularity, notwithstanding violent winds, sudden changes of temperature and humidity. The configuration of the land in India greatly modify the atmospheric tides; but at the foot of the Andes the variations attain their extreme limits at the same hours (10 A. M. and 4 P. M.) as in the high valleys.† The hour of the day may be determined by the barometer at Quito within 15 minutes. The mean daily amplitude,

At Guayaquil is	·091	(Visse, ·147; Darondeau, ·145.)
" Quito,	·084	(Visse, ·090.)
" Pebas,	·104	
" Pará,	·088	

* Sabine found at St. Helena that the mercury was ·004 in. higher when the moon was crossing the meridian above and below the horizon.

† The daily tides were not observed by Richardson at Gt. Bear Lake, lat. 66° 54′; while Prof. Forbes asserts that the barometer at St. Bernard (8,000 ft. high) is lowest at 9 A. M. and highest at 3 P. M; and that Capt. Parry noticed the same reversion in lat. 74°. Dr. Hayes found the maximum at Port Foulke 6½ P. M. and minimum, 3 A. M.

The extreme range decreases with the latitude and also with the increase of altitude:

At Port Foulke,	lat. 78° 18′ N.	it is	1·81 in.	(Sonntag.)
" Pará,	1° 30′ S.	"	·30 "	(Wallace.)
" Guayaquil,	2° 12′ S.	"	·166 "	(Orton.)
" Quito,	0° 13′ S.	"	·130 "	(Orton; LaCondamine, ·133.)
" Antisana Hacienda,	0° 30′ S.	"	·065 "	(Aguirre.)

The diurnal variation decreases with the increase of altitude as well as with the increase of latitude:

Increase of elevation—

Guayaquil,	alt.	10 ft.	var.	·091	
Pará,	"	15	"	·088	
Quito,	"	9500	"	·084	
Antisana,	"	13,300	"	·022	(Aguirre.)
Anomalous, Pebas,	"	345	"	·104	
" Manáos,	"	120	"	·111	(Spruce.)

Increase of latitude—

Guayaquil,	lat.	2° 12′ S.	var.	·091	
	"	23° 55′ N.	"	·060	(computed by Kaemtz.)
	"	39° 4′ N.	"	·044	" " "
Arctic Sea,	"	72° 15′ N.	"	·038	(Sonntag.)
"	"	78° 28′ N.	"	·013	"
"	"	81° 30′ N.	"	·001	"

Increase of altitude with increase of latitude—

Paris,	lat.	48° 50′	alt.	200 ft.	var.	·0315
Geneva,	"	46° 12′	"	350 "	"	·0354
Faulhorn,	"	46° 30′	"	9000 "	"	·0106

Max. fluctuation	at	Port Foulke is in	April;	minimum,	October.
"	"	Philadelphia,	Jan.;	"	May.
"	"	Antisana,	June;	"	December.

Throughout Asia the barometric mean is less in summer than in winter; in Pará, Antisana and Sitka it is the reverse. The monthly variation decreases from the poles to about latitude 40°; thence to the equator it increases. At the equator, (I know not how it is in high latitudes) it decreases with the altitude.

The annual range at Port Foulke (0·4 in.) is about 20 times the diurnal; that of Antisana (0·05) is about twice the diurnal. The annual variation is more decidedly marked in India than in tropical America. This is owing, says Dove, to the comparatively constant wind throughout the year in the New World; while in India, equatorial currents prevail when the sun's altitude is greatest and polar currents when it is least.

Comparison of mercurial barometer with boiling apparatus.—After numerous observations taken with these instruments side by side from the sea-level to the top of Pichincha, I conclude that the boiling apparatus, though very convenient, can not be depended upon and is the least reliable in high altitudes. In the Amazonian valley it is certainly useless. The accuracy of Regnault's Tables of corresponding pressures was tested on the Andes by Visse in 1848, and he found the agreement very satisfactory. But my experiments on the same ground do not confirm this. At Guayaquil he found a difference of ·0092 in.; I found ·008. At Quito his difference was ·015 ; mine ·045. On Pichincha, his difference was ·0045 ; mine, taken at the same hour of the day, was ·008. At Papallacta, the boiling point indicated a pressure ·205 too small, and at Archidona a pressure ·364 too great. On Mont Blanc, Saussure found the barometer 17·136, and the pressure indicated by boiling water, 17·883. At Rochester, they differ by ·130.

Mean annual temperature.

Guayaquil, 83° (Boussingault with ground thermometer sunk one foot found 78°·8; Hall with six months obs. with air thermometer found 78°·03. Appleton's Am. Cyclop. gives 88°.)

Quito, 58°·8 (LaCondamine, 58°; Humboldt, 57°·92; Boussingault, with ground ther. sunk one foot, 59°·36; Caldas, 59°·; Hall and Salaza, 59°·6; Aguirre, 58°·1.)

Archidona,	77°·	
Santa Rosa,	79°·5	
Pebas,	80°·	(Castelnau, 79°·7)
Tabatinga,	82°·	(" 79°·34)
Pará,	80°·2	(Dewey, 80°·5)

The isothermal line in the United States corresponding to the mean temperature of the valley of Quito runs through the state of Tennessee. The temperature of Nashville is 58°·5. The mean temperature at Fort Massachusetts on the Rocky Mountain plateau (alt. 8400 ft.) is 41°·1. The temperature of Quito is just 1° less than that of Rome ; but the spring months at the two cities have the same mean temperature. The mean temperatures of Antisana Hacienda and Quebec are the same, but the seasons are nearly reversed.

	Spring.	Summer.	Autumn.	Winter.	Year.
Quebec,	38°·00	67°·67	43°·67	13°·33	40°·67
Antisana,	42°·16	38°·26	40°·70	41°·80	40°·70

The coldest hour at Quito is 6 A. M.; the warmest between 2 and 3 P. M. The latter corresponds with that on the east coasts of the United States and Asia ; on the west coast of America and Europe it is 1 or 1½ P. M. The greatest heat at Pará occurs at 2 P. M.; the hottest month is November and the coolest is March. The decrement of temperature in ascending from Geneva to St. Bernard is 1° for every 487 ft.; between Quito and Antisana it is 1° for every 340 ft.

Barometrical measurements across South America.

Locality.	Alt.	Barom.	Boiling Point.	Regnault's Equiv.	Difference.	Other estimates.
			°			
Pacific Ocean,	0	29·930	212·01			*Bar.* of Visse, 29·904; Boussingault, 29·867.
Guayaquil,	10	29·899	211·95	29·891	–·008	*B. P.* of Visse, 211°·8.
Guaranda,	8840	21·976				*Alt.* of Visse, 8,872; Hall, 8,928.
Arenal,	14,250	18·123				*Alt.* of Visse, 13,917; Hall, 14,268.
Mocha,	10,900	20·393				
Ambato,	8490	22·241				*Alt.* of Visse, 8,541; Boussingault, 8,787. *Bar.* of Jameson, 22,218.
Tacunga,	9181	21·693				*Alt.* of Visse, 9,180; Boussingault, 9,384. *Bar.* of Jameson, 21·700.
Tiupullo,	11,662	19·858				*Alt.* of Visse, 11,702.
Machachi,	9900	21·212				*Alt.* of Visse, 9,823.
Quito,	9520	21·530	195·8	21·485	–·045	*Alt.* of LaCondamine, 9,596; Humboldt, 9,570; Caldas, 8,947; Boussingault, 9567; Visse, 9307; Aguilar, 9496; Bureau des longs. 9540; Tramblay's *Ann.* 9538; Jameson, 9513. *Bar.* of LaCondamine, 21,404; Humboldt, 21,403; Aguilar, 21·465; Jameson, 21·566. *B.P.* of Tramblay, 184°·18; Visse, 195°·6.
Panecillo,	10,101	21·043				*Alt.* of Humboldt, 10,244; Aguilar, 10,135. *Bar.* of Jameson, 21·207. *B. P.* of Visse, 194°·7.
Pichincha, top.	15,827	17·038	184·5	17·030	–·008	*Alt.* of LaCondamine, 15,606; Humboldt, 15,922; Visse, 16,200; Hall, 15,380; Boussingault, 15,676; Jameson, 15,704. *Bar.* of Visse, 16·942.
Pichincha, crater.	13,800		189·2	18·672		*Alt.* of Visse and Moreno, 13,600.
Antisana H.	13,300	18·583				*Alt.* of Humboldt, 13,465; Boussingault, 13,356. *Bar.* of Jameson, 18·630; Aguirre, 18·573.
On Antisana,	16,000	16·782				
Pinatura,	10,410	20·791				*Alt.* of Boussingault, 10,348.
Padregal,	11,860	19·817				
On Cotopaxi,	12,860	19·004				
Riobamba,	9200	21·705				*Alt.* of Boussingault, 9413; Visse, 9157.
Cajabamba,	10,918	20·512				*Alt.* of LaCondamine, 11,000.
Itulcache,	8885	22·006				
Tablon,	10,516	20·800				
Papallacta,	10,511	20·803	193·8	20·598	–·205	

Locality.	Alt.	Barom.	Boiling Point.	Reg-nault's Equiv.	Differ-ence.	Other estimates.
Guila,	8622	22·206				
Pachamama,	7920	22·751				
Baeza,	6625	23·793				
Chinipleia,	6200	24·145				
Cochachimbamba,	4252	25·832				
Curi-urcu,	3247	26·746				
Arehidona,	2115	27·816	209°00	28·180	+·364	
Napo,	1450	28·419	209·4	28·407	−·012	
Santa Rosa,	1100	28·814	210·4	28·982	+·168	
Coca,	858	29·022	210·65	29·127	+·105	
M'h of R. Aguarico	586	29·321	211·00	29·331	+·010	
do. R. Curaray,	500	29·408	210·8	29·215	−·193	
do. R. Napo,	385	29·526	211·4	29·566	+·040	*Alt.* at Nauta by Castelnau, 365.
Pebas,	345	29·510	211·1	29·390	−·120	*Alt.* of Herndon, 537. *B. P.* of Herndon, 211°·1.
Loreto,			211 4	29·566		
San Antonio,	256	29·655				
Tabatinga,	255	29·656	211·5	29·625	−·041	*Alt.* of Spix and Martius 670; Azevedo and Pinto, 150; Agassiz, 200.
Tunantins,	138?	29·770				*Alt.* of Azevedo and Pinto, 124.
Ega,	100?	29·813	211·9	29 862	+·049	*Alt.* of Herndon, 2052; Azevedo and Pinto, 120; *B. P.* of Herndon, 208°·2.
Manáos,	199?	29·705				*Alt.* of Herndon, 1475; Castelnau, 293; Spix and Martius, 556; Azevedo and Pinto, 92. *B. P.* of Herndon, 209°·3; Gibbon, 210°·87; Wallace, 212°·5.
Serpa,	158?	29·752				*Alt.* of Azevedo and Pinto, 84.
Obidos,	114	29·802				*Alt.* of Azevedo and Pinto, 58; Agassiz, 45.
Santarem,	107	29·808	211·5	29·625	−·183	*Alt.* of Herndon, 846; Azevedo and Pinto, 50. *B. P.* of Herndon, 210°·5.
Mt. Alegre,	83	29·834				
Gurupá,	38	29·890				*Alt.* of Azevedo and Pinto, 42.
Pará,	15	29·889	211·95	29·891	+·002	*Alt.* of Herndon, 320; Azevedo and Pinto, 35; Dewey, 35. *Bar.* of Herndon, 29·708; Dewey, 29·941; Orton (reduced to level of river) 29·914. *B. P.* of Herndon, 211°·5.
Atlantic Ocean,	−2	29·932	212·16			*Bar.* of Dewey, 29·977.

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