Lastly, we have the case of a forest artificially produced by irrigation (during the two driest months of the year) in a region so dry that cultivation is rendered possible only by irrigation. Seventeen years' registers at a station within the forest shew an excess of 6 per cent. over the probable rainfall of that station, as computed from the registers of two stations, one of which is 4 miles, the other 13 miles distant from the forest, and both on the borders of the cultivation.

The evidence is, then, in kind, not rigorously conclusive, and it must be admitted that in no case has it been guarded by those special precautions which are demanded by strict scientific enquiry. But I have no reason to believe that it is not as trustworthy as observations made under the general supervision of intelligent and educated men usually are; and such as it is, it tends to support and confirm the conclusions drawn *a priori* from general physical considerations. It justifies, I think, at least, the view I have already expressed elsewhere, namely, that I can no longer regard the long suspected influence of forests on rainfall as a question of equally balanced probabilities.

II.—*On the Changes observed in the Density of the Surface Sea-water, coincident with, and due to Aerial Disturbances, and consequent Alteration of Baric Pressure over adjacent Sea Areas: and on the Usefulness of a more exact Measurement of the Specific Gravity of Sea-water: more especially with Reference to the Waters near, and about, the Hooghly River Pilot Station.*—*By* Samuel R. Elson.

[Received March ;—Read February 2nd, 1887.]

(With Pl. IX.)

In a work which I published some years since, entitled 'The Hooghly Sandheads Sailing Directory,' on the strength of observations made with a small glass instrument, the stem of which was graduated to two thousandths only, I asserted, that the sea water at the Hooghly River Pilot Station contained more salt at low water than it did at high water. But this seeming paradox requires some slight modification, for, I have since then found, with a soda-water bottle hydrometer, which readily weighs the sixteenth of a thousandth of salt in the water, that, in every case, on the least tendency of the sea thereabouts to set to the westward, in response, as I suppose, to aerial disturbances which lessen the baric pressure over the sea area to the southward, the water shows at once a decrease in salinity, consequently, the relative degree of saltness

between these westward flowing waters outside, and those situated under the lee of Saugor and Edmonstone Islands, and their continuations, as outlying, partially dry, sands, to the northwards, will be altered, as I shall presently endeavour to show.

As an instance out of many I have known of the suddenness of a change of this sort:—At 1·30 P. M. of the 10th of August last, I found the sea at the Pilot Station registered a specific gravity of 1·024: but only four days afterwards, at the same hour with regard to the tide, and almost in the same position, it was only $1{\cdot}013\frac{8}{16}$ or was $\cdot010\frac{8}{16}$ less salt. But gradually, during these four days, a westward set of the sea hereabouts had got up, which steadily increased until it was running at the rate of two miles an hour or more, and, as is always the case, its presence was unmistakably announced by a rather sudden change in the colour and appearance of the sea (in fact, it was this marked change that induced me to test the water again), the water changing from a wholesome sea-green to a yellowish (but not muddy or turbid) hue, or of the colour of stagnant ditch, or tank water.

But, generally speaking, after the westward set has run for some time, this sickly looking water changes its appearance for the more natural green. And, so far as my limited and solitary observations go to show, the amount of salt increases as the westward set slackens. Therefore, these intermittent incursions of greater or less supplies of fresher water from, I suppose, the great easterly mouths of the Ganges, must be taken into consideration, when making comparisons as to the relative amounts of salt contained in the sea-water off, and in, the different parts of the outlet channels of the Hooghly and its estuary.

As I have said before, in a paper read before your Society some time back, entitled 'The Tides and Currents of the Hooghly &c., &c.,' none, or but very little, of the water from the river Hooghly can possibly reach the Pilot Station, situated as it is about 36 miles S. S. E. from Saugor Roads, seeing that, by the direction vessels ride when at anchor, in all the lower part of the river, from Mud Point to Saugor, the ebb tide sets S. W. and S. S. W. away towards Balasore Roads, or Bay, which is an extensive circular and shallow basin some 40 miles broad. Therefore, Saugor Island and its outlying, partially dry reef, called Saugor Sand, running down as it does over 22 miles S. S. E. from the tail end of Saugor Island, whilst the over-active sun's rays are copiously extracting vapour therefrom, must, and undoubtedly does, afford efficient shelter to the muddier and semi-opaque, and therefore, warmer water on its immediate westward side, from an early incursion of the above-mentioned drift of fresher waters, from the eastward, as, doubtless, the following serial observations, carefully taken for the purpose, show.

		Temperature.		Specific gravity.
		Air.	Water.	
June 18th, 1886	Saugor Roads (bound out)	84·5°	85·5°	$1·023\frac{14}{16}$
„ 20th „	Eastern Channel Light. W. by N., 4 miles	85·4°	86°	1·018
„ 21st „	Eastern Channel Light. North, 9 miles	85·5°	86·5°	1·021
„ 22nd „	Intermediate Light (bound in)	...	86·5°	$1·020\frac{6}{16}$
„ „ „	Lower Gasper Light ...	...	86·5°	1·021
„ „ „	Upper Gasper Light ...	...	86·5°	$1·023\frac{2}{16}$
„ „ „	Saugor Roads ...	...	86·5°	$1·023\frac{4}{16}$

Note :—The Saugor Roads observation of the 18th was taken on the last quarter flood, and that of the 22nd on the last quarter ebb.

By this we have an accumulation of salt in Saugor Roads of $·005\frac{4}{16}$ over and above what was found in the water at the Eastern Channel Light Station, thirty-six miles farther seawards, only a day or two previous. There was a set to the westward of the yellowish green water at the Sandheads, or Eastern Channel Light Station, on the 20th and 21st June, which would probably account for some of the above great differences in the relative specific gravity, though not for all. We also see by the above observations that at a distance of eight or nine miles dead to seaward of the above station, and well out in the 20 fathom line of soundings, there was an increase in the density of the sea water of ·003, this indicating that the induced lateral stream of fresher water from the eastward was not of necessity a very broad one : the reason of which I will attempt to explain further on, when I come to speak of the influence which the Swatch of no Ground doubtless has upon this westward set of the outside waters of the littoral. But even out there, we see the density did not exceed that of the sheltered muddy waters at the Lower Gasper Light Station, thirty-three miles farther north, and that it fell far short of that of Saugor Roads.

With reference to this very interesting question of the increased specific gravity of these inshore waters of the littoral during the dry months of the year, it is worthy of note that our late senior pilot, Mr. C. Smyth, used to say his long experience led him to believe that the reason vessels so seldom 'felt the ground,' or 'bumped,' in the Gasper Channel,—when their known draft of water, depth given by the charts, height of sea-surface above 'lowest low water,' or zero, as given by the tide table, and allowance for swell running, showed they had apparently not much water to spare under their keels,—was, that some sort of meeting of the tidal currents piled up the water, as it were, about

this spot, on the ebb tide. He was evidently not far wrong in his surmises as to there being a *something* which assisted vessels to cross the Gasper bar in safety.

Ever anxious to learn something more of the causes of these *freaks*, as some would call them, of the currents at the Sandheads, and of the varying specific gravity of its waters, on the 13th of November last I gladly availed myself of an unexpected opportunity for further investigation by taking serial observations of the sea-surface temperature and density on some one line, or compass bearing, right off from the turbid water of the Pilot, or Eastern Channel Light Station, out into the deep blue sea of the Bay of Bengal. Nor, for my purpose, could it have occurred at a better time, with regard to the relative state of the weather, when going and returning, as will be seen. I went off S. E. towards Rangoon as acting special pilot in the B. I. S. N. Company's 6 *S. S. Sirsa* and, commencing at the Lower Saugor Sand buoy, which is about 5 miles farther inshore and towards the land than the Eastern Channel Light Vessel, I took observations with the bottle hydrometer, and thermometer, every two hours, with the following results:—

	Temperature.		Specific gravity.
	Air.	Sea.	
November 13th, 1886 Noon, 2 miles S. W. from Lower Saugor Sand buoy ...	86°	83°	1·009$\frac{13}{16}$
At 2 P. M. 20 miles S. E. of E. C. Light Station	...	83·5°	1·009$\frac{6}{16}$
At 3·30 P. M. Passed through a frothy line of demarcation running E. and W. between light and dark green coloured water.			
At 4 P. M. 45 miles on same line ...	81°	83°	1·021$\frac{7}{16}$
At 5·30 P. M. 60 miles on same line ...	...	82°	1·022$\frac{11}{15}$
November 14th 6 30 A. M. 200 miles on same line or in 19° 80′ N. 91° 2′ E. ...	81°	83°	1·022$\frac{6}{16}$
At Noon 265 miles miles on same line ...	81°	81·5°	1.022$\frac{6}{16}$
At 5·30 P. M. 320 miles on same line ...	81°	82·5°	1·023$\frac{10}{16}$

On this outward trip the ordinary fine weather of the winter monsoon prevailed, following a rather heavy cyclonic disturbance down the bay: but on the return journey on the 20th, 21st, and 22nd of the same month there was a hard cyclone prevailing to the south, and then southwest of the Hooghly Pilot Station; and a strong set of the sea up along the eastern side and, I suppose, the centre of the Bay of Bengal, carrying the vessel I was on board of, the B. I. S. N. Company's

S. S. "*Nowshera*," onwards to the N. W., some three or four miles an hour faster over the ground than her dead reckoning showed her to be going through the water, on her N. W. course towards the Pilot Station and Hooghly River Sandheads, even all the way from the Alguada Reef, and I found the following :—

	Temperature. Air.	Temperature. Sea.	Specific gravity.
November 22nd, 1886 7 A. M. Sea indigo. 55 miles S. E. of Eastern Channel Light Station	81°	83°	1·023$\frac{10}{16}$
Note :—This temperature accords with, and the specific gravity exceeds what we had found at a distance of 200 miles, when bound the other way, only eight days before.			
At 8·30 A. M. 14 miles S. E. of E. C. Light Vessel. Sea dark green		80·5°	1·022$\frac{3}{16}$
At 10·10 A. M. 2 miles N. N. E. of E. C. Light Vessel. 1st quarter ebb ...	79·5°	79·5°	1·016$\frac{2}{16}$
Note :—This gives a difference of — 3°·5 in temperature and of + 006$\frac{3}{16}$ in the specific gravity from what prevailed at, and near about the same spot, on the 13th inst. or only eight days before.			
At 11·30 A. M. at Intermediate Light Station. Half ebb		79·5°	1·013$\frac{7}{16}$
At 3 P. M. 2 miles above Saugor Light House S. W.	81°	81°	1·007

We will now take the observations which were made at a position near the Eastern Channel Light Station, and compare them, to show what changes of density and temperature of the sea are there due to these fitful changes and disturbances of weather in the bay, during this month of November last.

	Temperature. Air.	Temperature. Sea.	Specific gravity.
On the 31st October 1886, 2 miles N. E. of E. C. Light, and just previous to a cyclonic whirl in the Bay, with its usual precursory westward set of the sea at the Sandheads	84·5°	86·5°	1·015$\frac{5}{16}$

	Temperature. Air.	Sea.	Specific gravity.
(After this I was absent from Sandheads until the 13th.)			
On 13th November 1886, in nearly same position, just after the cessation of the strong westward set caused by a cyclonic whirl down the Bay, and all was again quieted	86°	83°	$1{\cdot}009\frac{15}{16}$
On 22nd November, in same position, during a severe and widespread cyclonic disturbance farther down the Bay which had been some days in existence: and when a strong north westward set of the sea was pouring in towards this position from, and across, and most likely out of, the depths of the peculiar sub-marine ravine, or gut of deep, and (as Commander Carpenter has told us) cold water, called 'The Swatch of No Ground*	79·5°	79·5°	$1{\cdot}016\frac{3}{16}$

From the above, and what has been shown before, it seems the fresher water setting from the eastward, off and on, ever since the 31st of October (on the evening of which day the changed colour and appearance of the sea alongside led me to test it, and I found a slight diminution in its density, even then), or for half a month, was completely crowded out, as it were, by the last mentioned north-westward moving current of the 20th, 21st, and 22nd of November: which the *S. S. Nowshera's* log book furnishes ample proofs of; and, as a consequence, the salinity of the water at the station increased too, and probably, for a while, exceeded its normal: but, on this point, the few observations I have had opportunity to make and record will not permit me to write with that degree of assurance that I should like to do.

Maury says of the hydrometer:—'In the physical machinery of the universe there is no compensation to be found that is more exquisite or beautiful than that which, by means of this little instrument has been discovered in the sea between its salts, the air, and the sun: but Maury could hardly have meant the instrument commonly found on shipboard,

* For a description of which see paper by Commander Carpenter, R. N. (read before your Society some time back).

which can only be guessed at, if read to less than the nearest ·002, but, if so, what an amount of really valuable information may be got out of an instrument, which, although a rough and rude one, is so much more exact: the one is as different from the other as was the old cross staff of Christopher Columbus' time from the double reflecting sextant of to-day. Our forefathers were content to find their vessel's position to the nearest two or three miles, but modern navigators are not satisfied unless they get it to the fraction of a mile.

Doubtless, the energy which brings the waters up from the ever-frigid bed of the deep sea :—the energy of attraction and repulsion ;—of contraction and expansion, or, of deadweight and buoyancy :—this energy of motion, under different states and circumstances, of the chemically suspended salt atoms, contained in each ocean drop, will yet be made to divulge its partially hidden and secret treasures to the practical scientist for the navigator's benefit: as has been the case with the latent energy of that other heat vehicle and prime motor of the hurricane blast, as well as of the gentle zephyr—the invisible water-vapour globule in the air strata aloft. All that is required is the aid of willing workers and their faithful records: for all the facts as set forth above, meagre as have been the opportunities for observing them, go far to prove that the hydrometer, when constructed to show minute aggregation, or segration of salt atoms in the water, must prove to be no mean aid to the sailor, more especially to the coasting navigator, since it is near coasts that the currents generally are more capricious, or disguised by others which have never been properly explained. It will aid him either as a monitor of his vessel's proximity to land; of her being caught in the toils of some abnormal current, which may be hurrying his vessel on to her destruction (as was nearly the case during the cyclone in the Bay of the 19th, 20th, 21st and 22nd of November last, with the ship "*Airlie :*" which vessel was found to have been driven by the storm-impelled current 140 miles to the N. W., out of her dead reckoning, right through the dangerous South Preparis Channel, and actually had an oyster shell washed up on to her deck); or its indications may be made even to warn the watchful shipmaster of the on-coming, though yet distant, cyclone; let alone its probable use to scientists, in more ways than one.

My instrument, a rather large soda-water bottle, when ballasted, or weighted, so as just to float with its wire pedestal (or support and cup or pan for weights) in water at a temperature of 95° (which is the warmest of any sea water), happens to have a fluid displacement, or, which is the same thing, weighs in air exactly 10,000 grains—a convenient figure for calculating the several counterbalancing weights by. The weights are made by dividing and subdividing 320 grains weight

of copper wire: the whole 320 grains being, of course, equivalent to 1·032, or thirty-two thousandths—a figure far above any degree of saltness of sea water, but chosen on account of its convenience of divisability:—thus, the 320 grains of wire doubled, straightened out and cut, gives ·016, or sixteen one-thousandths: of which make sixteen coils, or loops to denote it, of one piece. The other piece doubled as before and cut gives ·008, and so on, until the one-sixteenth of a thousandth is arrived at,—a fraction which will be found to readily sink the bottle, or 'turn the scale' of this frictionless balance.

Below is added a diagram (Pl. IX) for corrections for temperature of fresh water; and a suitable table of corrections for temperature of sea water will be found in '*Maury's Physical Geography of the Sea*,' and in many other books of a like character, for those who like to seek out for themselves the "*exquisite and beautiful compensations*" which as a part of its machinery the sea salts provide in the physical economy of the Ocean.

III.—*Notes on Indian* Rhynchota: Heteroptera, No. 1.

By E. T. Atkinson, B. A., President.

[Received and Read December 1, 1886.]

Order Rhynchota, Burmeister.

Hemiptera, Linn.: *Rhyngota* Fabr.: *Proboscidea*, Scop.: *Dermaptera*, Retz.

Insects with an incomplete metamorphosis, not exhibiting the marked changes from larva to pupa and imago observable in the *Lepidoptera*: furnished with a mouth or rostrum which is fitted for piercing and sucking. The rostrum is usually 3—4-jointed and contains four seta that arise from the anterior portion of the lower surface of the head and represent the maxillæ and mandibles of other orders of insects. Antennæ with 3—5 joints, rarely more; the wings are usually four in number, but are sometimes abbreviated or altogether wanting.

Suborder Hemiptera, Latreille.

The first pair of wings (*hemelytra*) are horizontal, with the veins arranged differently from those of the second pair (*wings*), and usually comprise a basal coriaceous portion (*corium* and *clavus*), and a membranous portion (*membrane*) at the apex. This membrane is sometimes entirely absent. The wings are entirely membranous and are sometimes absent.