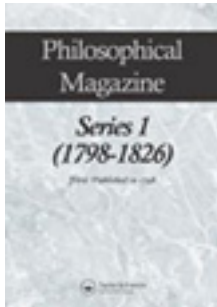


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Philosophical Magazine Series 1

Publication details, including instructions
for authors and subscription information:
[http://www.tandfonline.com/loi/
tphm12](http://www.tandfonline.com/loi/tphm12)

XLVII. On the land winds of Coromandel, and their causes

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Available online: 18 May 2009

To cite this article: William Roxburgh M.D. (1810): XLVII. On the land winds of Coromandel, and their causes , Philosophical Magazine Series 1, 36:150, 243-253

To link to this article: <http://dx.doi.org/10.1080/14786441008563184>

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It will, however, be best to make observations as often as possible both on the one and the other, as it has been ascertained, both by Mr. Cavendish and the late Dr. Hunter, that the temperature of the waters at any given place is a most accurate measure of its mean heat; a determination of which is not only an object of considerable curiosity in itself, but of very great consequence in an agricultural point of view.

The annexed form for registering the observations scarcely requires an explanation. The first column is for numbering the observations, which extremely facilitates the reference to them. The succeeding columns are fully explained by their titles. The last, called *Results*, is added, in order that those persons who choose it may place in one view the observations, and the altitudes deduced from them. Printed sheets in this form, ready for use, may be had of Mr. Jones. The back of each page is left blank, for the convenience of inserting any other notes or observations.

I am, sir,

Your humble servant,

H. C. ENGLEFIELD.

N ^o	Place of Observation.	Wear-ther.	Wind.	Time	Barome-ter.	Th. A.	Th. D.	Results.
1	October 6 Stejne, Bright- helmston . . . }	Sun	NW	2.15	30.268	63	63	1 and 2
2	Stand on Race- ground }	Do.	Do.	3.0	29.876	62	62	400 feet.
3	Stand again	Do.	Do.	3.32	29.861	62	61	
4	Stejne again . . .	Do.	Do.	4.15	30.278	61	61	

XLVII. *On the Land Winds of Coromandel, and their Causes.* By WILLIAM ROXBURGH, M.D.*

THE land winds on the coast of Coromandel are those hot winds which blow at a particular season of the year, and hour of the day, from the western hills, commonly called the Ghauts, towards the Bay of Bengal. In the more inland countries, as above the Ghauts, they are not

* From *Transactions of the Medical Society of London*, vol. i. part I. just published.

confined to any regularity, though they are felt sometimes with a great degree of severity, and for hours together.

I understand also that in the upper parts of Bengal they are sometimes experienced very severely; but whether from the west or the northward, or in what part of the year, I have not been able to ascertain. As far as this only tends to prove the insufficiency of the denomination, it would signify little, although in other respects it would be of more moment.

As they are generally supposed to be peculiar to this country, and are felt during several months in the year, we should imagine their history and causes to have been perfectly investigated and understood; but, I know not why, neither the one nor the other have as yet been satisfactorily explained.

The most plausible reason generally given for the great accumulation of heat in them is the heat of the season in which they prevail, and the long tract of country over which they have to pass. That this, however, is not the true cause, it shall be my endeavour to demonstrate; to which I will add an attempt to point out the most probable one, founded on known chemical principles.

Respecting the theory I have to offer, I regret that it has found but few patrons in this country, which, however, I flatter myself may be ascribed more to the manner in which it has been proposed, than to the foundation on which it is constructed.

In order to facilitate the explanation of my sentiments, as well as to show that the land winds really deserve some attention from the philosopher, I shall briefly recount the phenomena accompanying their beginning and progress, as well as the effects by which they are generally followed.

Could my pen equal my sensations, I should be able to paint their effects in the most lively colours, aided by eight years experience in a country the most noted on the coast* for their intensity.

The land winds are preceded in the latter end of March or in the beginning of April by whirlwinds, which between eleven and twelve o'clock at noon hurry in various directions, mostly from west to east, towards the sea. These are called by the natives Peshashs or Devils, because they sometimes do a little mischief to the lighter buildings.

About the same time, or a little after the appearance of the whirlwinds, we may observe all ranges of hills gar-

* Samulcotah in the Northern Circars.

nished as it were with clouds, which become daily darker and heavier, until they discharge themselves with much thunder and lightning in a heavy shower of rain. After this marked phenomenon the land winds set in immediately with all the violence of which they are capable.

Their commencement is generally in the latter end of April, or beginning of May, and their reign lasts to the earlier days of June, during which period they generally exert their violence from ten or eleven o'clock in the morning until about three or four o'clock in the afternoon.

In this season the atmosphere is commonly hazy and thick, except that in the evenings and nights the sky is serene and clear, provided the land winds do not continue the whole day.

The rising sun which portends a land wind day appears of a fiery red, and as if involved in mist, which mist is changed afterwards into clouds that lie heavy on the Ghauts.

The land wind of each day is almost always preceded by a long calm, and immediately by a cloud of dust.

Their diurnal violence is terminated along the coast about two or three o'clock, by the setting in of the sea-breeze, which wafts delight and health as far as its influence extends, which is not more than ten or twelve miles inland. An abatement of their intensity from thence to the Ghauts is all that can be hoped for.

The sea-breeze regularly begins in the afternoon at one or two o'clock, blowing pretty steadily until sunset, when it dies away gradually, and at sunrise it is again perceptible, though weakly.

When I say its influence is only felt ten miles inland, I do not wish to be understood that it does not extend further: I mean only its powerful refreshing properties, which it loses in proportion to the distance from the sea, and in an inverse ratio to its strength, which is not great. In general it arrives at thirty miles distance from the sea in the evening, and is then only agreeable by the ventilation it effectuates.

In the country above the Ghauts, as in Mysore, the east wind prevails also in the afternoon, but from a period much earlier, or cotemporaneous with the sea-breeze on the coast, which renders it clear that this inland breeze either does not extend further than to the Ghauts, or really originates there; a point which deserves to be ascertained, as another phenomenon depends upon this circumstance.

Should the sea-breeze fail, as sometimes happens, the land wind decreases gradually until it dies away in the beginning of the night, which, on account of its calmness, is dismal to a degree : next morning, a little motion of the air is again perceptible, but at the usual time the wind sets in as strong and hot as the day before. Every thing we put our hands upon is then distressing to the touch, which must be the case when the temperature of the body is inferior to that of the atmosphere. This we experienced for almost a fortnight in the year 1799 in the Northern Circars, when the thermometer at eight o'clock in the night stood at 105° , and at noon at 112° . Shades, globes, tumblers, then very often crack and break to pieces, and the wooden furniture warps and shrinks so much, that even the nails fall out of doors and tables, &c. In their greatest intensity, however, I have never seen the thermometer rise higher than 115° , viz. in the coolest part of the house, though some say they have observed it at 130° .

The Ghauts, and the hills at no great distance from them, are then seen lighted all night by spontaneous fires, and often in a very picturesque manner.

These illuminations appear, in general, about the middle of the mountains, and seldom or never extend to the top or bottom of them. They take place especially on those hills on which the bamboos grow very thick ; which has probably led the natives to explain this phenomenon so rationally, by ascribing it to the friction of these bushes against each other.

Lieutenant Kater, of his majesty's 12th regiment, thinks that the corky bark of the *adenanthera pavonina* is often spontaneously inflamed, as he has frequently found, on his surveys, its bark converted into charcoal, and several of these trees burnt down to the roots, although they were not in the vicinity of any other trees.

In Europe I know these spontaneous ignitions have been much discredited ; and I doubt not but should these few sheets ever be published, many objections will be raised against what I have related ; but I have endeavoured to state facts only, which a luxuriant imagination might have painted in more striking colours, but I am sure not with stricter adherence to truth.

The land winds are noted for the dryness which they generally produce on the face of the country, as well as on that of the animal creation. This sensation is particularly felt in the eyelids, which become in some measure quite
stiff

stiff and painful. This is owing to the immediate volatilization of all humids that irrigate our organs, and which, in this particular one, probably gives rise to inflammations of the eyes, so frequent at this time of the year*.

The continuance of this wind causes pain in the bones, and a general lassitude, in all that live; and, in some, paralytic or hemiplectic affections. Its sudden approach has, besides, the dreadful effect of destroying men and animals instantaneously.

It is not very uncommon to see large kites or crows, as they fly, drop down dead; and smaller birds I have known to die, or take refuge in houses, in such numbers, that a very numerous family has used nothing else for their daily meals than these victims of the inclemency of the season and their inhospitality. In populous places it is also not very uncommon to hear, that four or five people † have died in the streets in the course of a day, in consequence of being taken unprepared. This happens especially at the first setting in of those winds.

The natives use no other means of securing themselves against this wind but shutting up their houses, and bathing in the morning and evening; Europeans cool it through wetted yats ‡ made of straw or grass, sometimes of the roots of the watie §, which, wetted, exhale a pleasant but faint smell. It will be incredible to those that have never witnessed it, but the evaporation is really so great, that several people must be kept constantly throwing water upon the tats (eight feet by four) in order to have the desired effect of cooling a small room.

It would be scarcely necessary to observe, if it were not in contradiction to public opinion, that the cold produced is not a peculiar property of the wind, but depends upon the general principle, that all liquids passing into an æriiform state absorb heat, and cause immediately around them

* The eye flies, so often supposed to occasion it, produce a transient and sharp pain in the eye, but never, I believe, a lasting inflammation.

It is generally thought infectious, and may be so by the interference of the eye flies carrying the contagious matter from an affected eye to a sound one.

† Four people dropped down dead at Yanam, in the year 1797, an hour after my arrival there from Masulipatam: and at Samulcotah four or five died the same day on the short road between that place and Peddapore: the number of inhabitants of either of these places does not exceed, I believe, five thousand.

‡ The frame of them is made of bamboos in the form of the opening in the house to be tatted, let it be door or window, which is then covered with straw in the manner every one thinks best suited to retain the water longest.

§ *Andropogon muricatum.*

a diminution of it, and consequently a relative coldness. On the same principle depends also the cooling of wine and water, in the land wind seasons, the latter in light earthen vessels which allow an oozing of the water through their pores, and the former in bottles wrapped in a piece of cloth or in straw, which must be constantly kept moistened.

The great violence of these winds is at last terminated by frequent showers of rain, in June, in the low countries, and by the greater quantity of the regular rains falling in the inland countries, which seem to suspend the partial formation of clouds along the Ghauts, and to leave them clearer, and visible at a greater distance than they had been at any other period of the year before.

After the enumeration of so many disagreeable circumstances, I am naturally led to an investigation of the causes that produce them. Before this can be done, however, I must prove, according to promise, that the theory of our philosophers is founded in error.

They ascribe, as already observed, the extraordinary heat which distinguishes these winds from most others, to the absorption of caloric in their passage over an extensive tract of country, at a time when the sun acts most powerfully in our latitudes.

According to this theory, the heat should increase in proportion to the space over which this wind is to travel; it should be hotter on the coast than it is at any part of the country inland, or, which is the same, it should decrease by degrees from the eastern to the western sea of the peninsula. Experience, however, teaches us the reverse; for it is hottest near the Ghauts, and among the valleys between those ranges of hills, than at any place on the coast; and the heat of those winds decreases also as they approach the Bay of Bengal, and in a direct ratio from the Ghauts to the sea: accordingly, it is at Ambore* hotter than at Vellore†, and at this place again than at Arcot‡, Conjeveram§, and Madras, where the land winds are seldom felt with any degree of severity.

* A place situated in the most western valley of the Ghauts, immediately at the foot of the steepest ascent into the Mysore country.

† Lies in a spacious valley nearly at the entrance of the Ghaut mountains, and has the advantage of an open communication with the flat country to the north-east.

‡ A large city, the capital of the nabobs of the Carnatic, east of the ranges of hills called the Ghauts.

§ . . . miles east of the latter place in the road to Madras, a large populous place. I have chosen this tract or line as the most known, although not the hottest; for Ellore, Rajahmundry, and Samulcotah in the Northern Circars, are by far more exposed to these winds.

Time is another measure applicable to the acquisition of heat, as it increases to the greatest pitch which a body is capable of receiving in proportion to its continuance: the land winds should therefore be cooler when they set in at ten or eleven o'clock, and hottest at their termination in the afternoon; they should be so at least at noon, when the sun is nearly vertical, and has the greatest influence on the substances from which heat is to be attracted. The contrary, however, comes nearest to the truth; for it is known that these winds set in with their greatest violence and heat at once, which rather abate than increase, as might be expected.

We should, on this principle, further suppose the heat would increase gradually with the return of the sun to our latitudes, from its southern declination, and stand always in proportion to its position. We find, however, that experience also contradicts this point of the theory under discussion; for after the sun has passed our zenith*, the land winds set in at once with all their intensity, in the manner before described, and they cease as abruptly before its return again †.

A material change in the temperature of this climate is certainly effected by the approach of the sun from the south; but the heat which is thus caused, and which increases by imperceptible degrees, is never so great, and is only felt by those who expose themselves to it unprotected; for the air remains proportionally cool, and our houses afford, in this season, a pleasant retreat. We find it far otherwise in a land wind; for this penetrates our inmost recesses, and renders life miserable every where.

I have before observed, that winds equally hot with those of periodical duration are felt in all parts of the country, and at different seasons; a circumstance alone sufficient, if proved, to overthrow the groundwork of the old theory.

For a confirmation of this, I will appeal to the general observation, that immediately before a long rain the weather is sultry, and that a single shower is always preceded by a warm disagreeable wind.

We are very particularly reminded of the approaching great monsoon in October by the oppressive heat we have in the calm evenings of that month, which, I am persuaded, would equal that of the land winds in May, if the atmo-

* The sun is in the zenith at Madras about the 26th of April.

† The sun is again in our zenith on its southern declination about the 19th of August.

sphere was not cooled in the latter part of the night by breezes that have wafted over extensive inundated plains.

I can refer, secondly, to my Meteorological Journal, according to which, the 4th of June 1800, at Madavaram, a place not far from Bengalore, the thermometer rose for a short time to 104° just before a slight shower of rain, and at a time when heavy clouds darkened the western hemisphere.

Further, in the months of March and April, 1804, we had often at Bengalore, in the afternoons, strong gusts of wind from the eastward, which, in common, were styled land winds, and were really as hot and disagreeable as moderate land winds are in the Carnatic. I could have multiplied instances of this kind, but am of opinion that in a fact so much known it would be perfectly needless.

The last refuge of the defenders of this theory is the valleys of the Ghauts, in which they pretend the heat is generated by the concentrated and reflected rays of the sun.

I will not deny but the heat occasioned by these causes may contribute much to raise the heat of the land winds; but the sudden appearance of the latter, their usual strength, and abrupt disappearance, all militate against that explanation as a principal cause.

The heat of these winds should in this case, to say a few words more on the preceding subject, decrease regularly from the point where it is greatest towards the opposite, on both sides, as is the case on the coast of Coromandel. On the contrary, we find that, immediately on our having ascended the Ghauts, or on the top of hills * elevated above the clouds, we have escaped their heat all at once. It is hereby remarkable, that the direction of the wind remains to appearance nearly the same every where. In Mysore, for example, the wind is, in the land wind season, west during the greater part of the day; in the afternoon it is from the east, and commonly warmer than the former.

This, together with what had been said before, will, I hope, be thought sufficient to establish my opinion re-

* Major Lambton, at the top of Carnatighur, one of the highest hills in the Carnatic, about three thousand two hundred feet above the level of the sea, found, in the middle of the land wind season, the thermometer at 79° and 80° in the mornings, and, at noon, 82° and 84° , when it was below at 103° and more.

This observation may be the more depended upon, as the Major remained for a considerable time on the top of this hill, in the pursuance of his most accurate survey, in the course of which he pays great attention to this as well as to all other points that could influence his learned labours.

lative to what *can not* be the cause of the heat in the land winds.

It remains now to point out a theory, supported on a firmer basis, which I shall endeavour to do in the following pages. It is founded on a chemical principle, and will explain, I think, the heat of these winds in a satisfactory manner.

The principle itself needs no demonstration, as it is admitted as a general law; viz. that "all bodies, when they become more dense, suffer heat to escape; or, what is the same, they give out heat." For example, when gases or aëiform substances become vapours, they discharge as much heat as was necessary to keep them in their former gaseous state: further, vapours in condensing into fluids are known to do the same, as also fluids, acquiring solidity.

I am sorry that the quantity of heat set free in the condensation of vapours required for a pound of water has escaped my memory; but I recollect it was very considerable. We know, however, that a great deal of it is required for the evaporation of the same measure, and it is but reasonable to admit that the same quantity with which it has combined should be discharged on its returning to its former state of fluidity.

In order to apply this principle to explain the presence of heat in our land winds, I must first observe, that the atmosphere in January, February, and March, is perfectly clear and serene; and then I will call to mind what has been said of the phænomena of those winds, that they are preceded by clouds on and among the Ghauts, and that a heavy shower of rain from that quarter announces their arrival; that during their continuance clouds are observed to lie on the Ghauts; and that the atmosphere, even in the low country, is hazy and thick. I must add also, that the countries west of the Ghauts are at this season frequently visited by heavy showers of rain, accompanied with much thunder and lightning, and sometimes with hail. Here in the Mysore country I have found the heaviest showers of this kind to come from the north-west*, which is exactly in the direction of the countries remarkable for the great heat of the land winds in this season. At times, we have also showers from the east and south-east, and my attention shall not be wanting to ascertain whether it is not at the time when the land winds blow hottest in the Carnatic,

* The hottest land winds in this season (1804) at Madras were, I understand, from the north-west; which corresponds with the direction from which the rains came in Mysore at that period.

By this we see, that the clouds formed on the Ghauts, charged with water and electricity (by causes I am not now to investigate), are drawn to the westward, whilst the heat which, during the formation of these clouds, must necessarily be discharged, is carried to the east or to the lower parts of the coast, and causes the properties for which the land winds are so remarkable.

I have acknowledged already, that the heat occasioned by the power of the sun in this season, contributes to the aggregate of it in the wind; but I must observe also, that it acts only as a secondary cause, and passively, by preventing its absorption and diminution in the career over a variety of substances, particularly moisture, with which it would combine, if they had not been previously removed or incapacitated.

In colder climates, this absorption takes place in a greater degree, as substances are abundant with which the heat produced by the formation of rain can combine and become imperceptible*. It is, however, there also often remarked, that the heat of the sun in a cloudy day is more powerful than at any other time. In common this is ascribed to the reflection of the rays of the sun from the clouds; but I opine it is often the consequence of the formation of water in the clouds, which obscure the sky at that moment.

It has been observed, that the heat of the land winds is not felt on the top of high hills, or on plains of a very inconsiderable perpendicular height above those in which it rages most violently; as for example, in Mysore near the Ghauts, which is only about five hundred feet higher than the valleys immediately below. This might be considered a weighty objection against my theory; as heat, considered in the light of an elastic fluid, expands equally on all sides; and from whatever cause it proceeds, it should be supposed to extend even further where it meets with less resistance, as from the air in higher regions, which is known to be lighter and more penetrable than near the earth.

But the reverse takes place; for almost immediately above the clouds no other heat is perceptible than what might be owing to the nature of the climate.

This circumstance may be accounted for by the diminished density of the air in the lower parts of the country,

* Earl Dundonald's Treatise, p. 20. "The frequent changes in the degree of heat and cold in the atmosphere are to be ascribed more to the alternate disengagement and fixation of heat by chemical combination, than to the effects of the solar rays."

produced

produced by the heat of the season, which would naturally cause the wind to rush thither, with all its contents, and with greater impetuosity. The coolness of the atmosphere on elevated situations may be ascribed also to the evaporation of the uppermost strata of the clouds, which accompany the land winds.

Many arguments I have dispensed with, which might have been produced to elucidate and to establish my theory, as they were chiefly such as could be collected from simple inference, and from affirmative application of doctrines advanced before.

I will only add, that both the sirocco and samiel may be owing to similar causes as those which appear to be productive of the pernicious, or rather disagreeable, effects of our land winds.

XLVIII. *Hints respecting a New Theory on the Orbits of Comets.* By Mr. W. CRANE, of Edinburgh.

To Mr. Tilloch.

SIR, THE following theory, for any thing I know, is original: should it be deemed worthy of a place in the Philosophical Magazine, its insertion will much oblige

Your humble servant,

W. CRANE,

Sept. 27, 1810.

Student of Medicine, Edinburgh.

“Hast thou ne'er seen the comet's flaming flight?
The illustrious stranger passing, doubles wide
Heaven's mighty capc, and then revisits Earth.”—*Young.*

THE difficulties with which this intricate branch of astronomy is surrounded, the short part of an orbit of a comet that is visible to us, and the rarity of their appearance, have given rise to innumerable theories, many of which have no sooner been advanced than they were immediately abandoned as erroneous.

The school of Peripatetics assigned comets no place in our planetary system, they only considered them as sub-lunary things made up of the exhalations in the terrestrial regions; which was the opinion of many, until Tycho Brahe and Kepler proved by observation that they were beyond the moon, and consequently not composed of terrestrial vapours: this was further confirmed by the observations made by Cassini, of that seen in the year 1665, and of another that appeared in April 1680. Cartesius thought them to be permanent bodies, like the planets, and to be constantly carried