THE DETERMINATION OF LOGBOOK WIND FORCE AND WEATHER TERMS: THE ENGLISH CASE

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Abstract. The logbooks of the British Royal Navy and of the Hudson's Bay and Honourable East India Companies from the 18th and 19th centuries represent the largest accumulation of such items in the world. They were prepared to a largely standard format using a consistent vocabulary and include observations of wind force, wind direction and general descriptions of the weather of each day. These weather terms are analysed to provide an understanding of the evolution of nautical expressions from those distant times and to provide a means by which they can be expressed in present day terms. This is particularly important for estimates of wind force. These are examined and methods developed by which they can be converted from the original text into Beaufort Scale equivalent terms, providing thereby the opportunity of undertaking scientific analyses of these important historical data.

1. Introduction

Daily weather entries in English logbooks focussed, as did those of other nations, on three elements; wind force, wind direction and general weather descriptions. These were recorded at the start of each nautical day (which was at noon, and 12 h ahead of the civil day (Harries, 1928)), and at other times as conditions changed. If such descriptions can be 'homogenised' and converted into present day terms they would represent a significant and potentially large body of climatological data. During the period embraced by the CLIWOC project (1750 to 1850), wind force was estimated without the aid of instruments, and the information was expressed in brief qualitative descriptions. The general weather was also described, but in a more narrative form. Only wind direction was based on instrumental evidence; that of the magnetic compass. Each of these three elements offered different levels of difficulty in their interpretation and understanding. The general weather descriptions presented the fewest such problems, and whilst some archaic terms were occasionally encountered, the descriptive style of recording was devoid of specialist expressions and the accounts are as readily understandable to the present-day reader as they would have been to writers' contemporaries. Where doubts existed concerning particular terms, valuable recourse could be made to two items: William Falconer's *An Universal Dictionary of the Marine* (published in 1759 and again in 1780 and therefore contemporary with the logbooks) and the full version of

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the *Oxford English Dictionary*. Both provided definitions not only for the weather terms but also for several of the wind force descriptors.

Wind directions were recorded on a 32-point compass using expressions such as north-east-by-east, south-by-west, north-by-east etc. The directions were recorded to an accuracy of 11.25 degree units (a unit known as one compass point). In practice however, and as will be shown in a later chapter, there was a bias towards using those directions that formed part of the 16- (north-north-east etc.), 8- (south-west etc.) and 4-point (north etc.) compasses. There is little or no ambiguity around such measures and the following sections focus on the wind force and weather vocabularies of the English logbooks.

2. The Study of Wind Force Terms

2.1. WIND FORCE TERMS: AN HISTORICAL REVIEW

In common with the approaches taken in the French, Dutch and Spanish examples, efforts were focussed on the interpretation of wind force descriptions; a category for which specialist terms abounded, even in the 18th century, some of which were later to be included in the Beaufort Wind Force Scale. Although Beaufort presented his scale in the logbook of HMS *Woolwich* on 13th January 1806 (Figure 1), it was not until 1838, and close therefore to the end of the study period, that it was formally adopted by the Royal Navy (Garbett, 1926), and only much later did it assume the international significance that it enjoys today. Also of interest was the use of terms that were not adopted by Beaufort. Such descriptions as ‘pleasant gales’, ‘gentle gales’ and ‘small gales’ have long ago passed out of use, and although they had begun to do so in the mid-18th century they were still to be found in many logbooks. There were other terms that had come into or passed out of fashion during the period 1750 to 1850. This gradual change in vocabulary was not unique to the world of the mariner, and represents part of the developments that were taking place in the English language at that time (Bragg, 2002). Mariners made regular contact with peoples whose tongues were other than English, and encountered climatic conditions quite unlike those of the British Isles and foreign terms were readily absorbed into their vocabulary; ‘breeze’, ‘hurricane’, ‘typhoon’ and ‘monsoon’ are familiar, but have an exotic provenance and were assimilated into the English language from the early 17th century onwards. This evolutionary aspect lent a further dimension to the problem, and interest, of textual analysis. It reflects not only the pragmatic needs of the mariner but also, although to a lesser degree, the desire to record and comprehend the natural world that was so much part of the Age of Enlightenment. There is little doubt that understanding of the major circulations of the atmosphere made significant progress as result of the gathering together of these observations allowing Halley (1686), Hadley (1735) and later scientists to speculate on the nature of climatic processes.

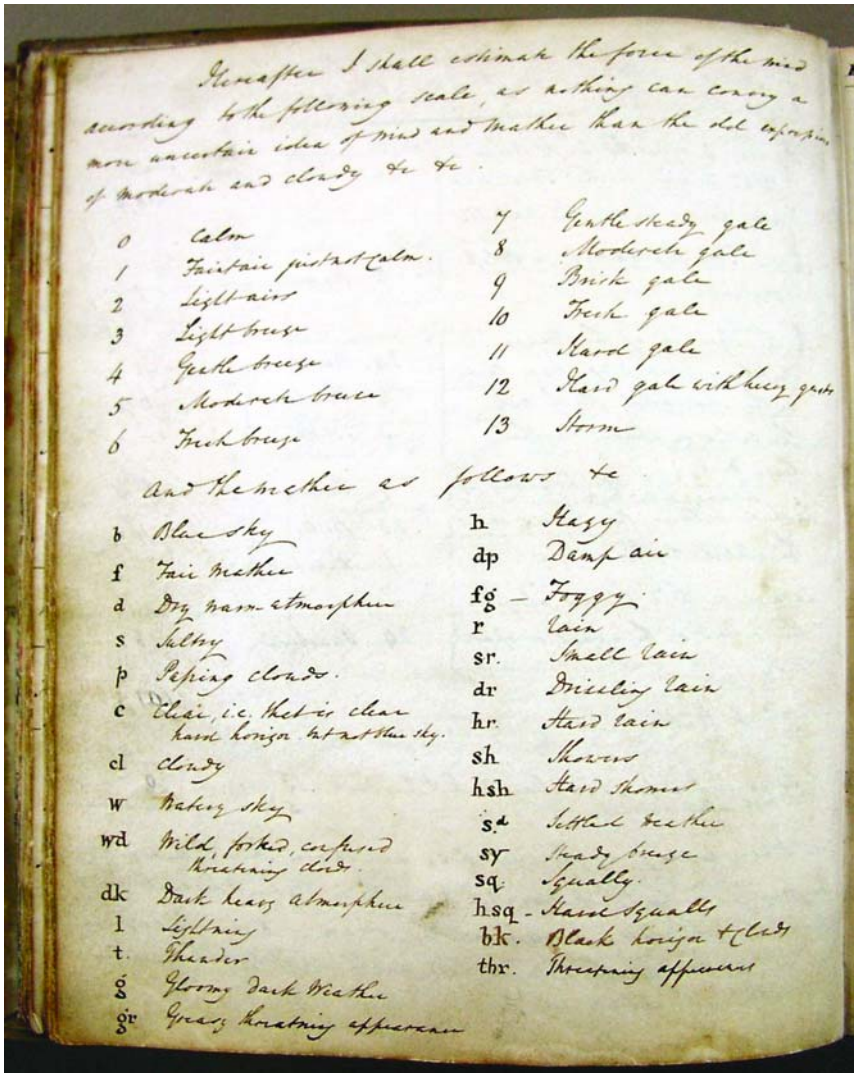

Figure 1. Francis Beaufort's wind and weather scale as originally proposed in the logbook of HMS *Woolwich* facing the page dated 13th January 1806. (Courtesy of the UK Met Office)

Setting to one side the various contemporary dictionaries, little work has hitherto been published in the field of archaic nautical weather term usage. A notable exception, but specific to the logbooks of ships of the Hudson's Bay Company, is that of Catchpole (1992). Wheeler (1995) has studied the contents of some of the few merchant logbooks that have survived, while Lamb (1991), Suárez Dominguez (2002) and Wheeler (2004) have offered interpretations of wind force terms from the early 18th century.

2.2. THE ANALYSIS OF WIND FORCE TERMS

An understanding of the logbook data was gained by conducting an exhaustive sampling exercise of the wind force terms. The sample frame was structured by decades from 1750 onwards. There were three principal sources; the logbooks of the Royal Navy, of the Honourable East India Company (EIC) and of the Hudson's Bay Company (HBC). These are archived respectively in the National Maritime Museum (Greenwich), the British Library and the National Archives (Kew). No significant numbers of private merchant ship logbooks from this period have survived. The geographic range of the sample frame was kept as wide as possible. The former two sources allowed for the inclusion of logbooks of voyages across the North and South Atlantic and Indian Oceans, but for the latter the logbooks were limited to those vessels that had made the annual passage from London to the Company's ports in Hudson's Bay at York, Churchill and Moose Factory. The Pacific Ocean is poorly represented by logbooks for this period, although a number of EIC vessels negotiated the South Chine Sea *en route* to the factories in Canton. This limitation notwithstanding, the geographic range allows for the natural spectrum of climate and weather to be encompassed from high- and mid-latitudes, through the more settled conditions of the sub-tropical anticyclones, to the trade winds belts and the occasional severity of the tropics. Over 22,000 wind force entries were sampled, comprising 14,800 from Royal Navy logbooks, 5400 from those of the EIC and 1900 from the HBC. This distribution is in approximate proportion to the availability of logbooks.

2.3. WIND FORCE TERMS: STRUCTURE AND USAGE

English wind force terms were brief and often specialised. They had consisted from as early as the 16th century of a system of a noun term such as 'gale' or, more latterly, 'breeze', with an adjectival qualifier, of which 'fresh', strong' and 'moderate' are common examples. Secondary, sometimes adverbial, qualifiers such as 'very', 'slight' and 'extreme' were also used, but with relative infrequency. Good examples of this double qualification are 'very fresh gale' or 'extremely hard gale'. A second category of descriptors included single word noun expressions such as 'storm', 'hurricane' and 'calm'. A final, much more diverse, category included such descriptors as 'blowing hard', 'blowing fresh' or 'decreasing gale'. This gerund-with-noun form sometimes had an additional adverbial qualifier, as in expressions such as 'blowing extremely hard'. These constructions had been popular before 1700 (Suárez Dominguez, 2002), but were becoming archaic by the start of the CLIWOC period. They had passed out of use in the Royal Navy (no records were found), and remained in occasional usage by the probably longer-serving officers of the East India and Hudson Bay Companies. To summarise, wind force descriptions were commonly one of the following forms:

1. a) single adjective + noun, e.g. strong gale
   b) double qualification + noun, e.g. very fresh gale
2. unqualified noun, e.g. storm
3. verb (usually the gerund) + adjective, e.g. blowing fresh.

The descriptive structures were thus brief and note-like in form meeting, one assumes, the needs of officers for uncomplicated and unambiguous descriptions of one of the most important aspects of the weather that they experienced. Only very rarely did officers engage in lengthy, narrative descriptions of the wind. Paradoxically one of the few to have done so was Francis Beaufort who, in a seemingly leisurely Indian Ocean cruise, found time to describe at length the weather of his voyage. Here is one example dated 15th June 1806 (and a mere 6 months after committing to paper for the first time the scale that was to carry his name), when sailing in the Indian Ocean at 2°S 50°E:

> A most charming trade – indeed I never experienced such heavenly weather as for this past fortnight – The thermometer never changing more than one degree from midday to midnight – the air clear and fresh – kind enough to soften the action of the Sun, favourable to our voyage, and not enough to disturb the tranquil surface of the deep.

These were, it must be stressed, rare departures from the conventions of the day and wind force records made on the basis of the above three grammatical categories were to all intents and purposes universal among English logbooks. It is fortunate that this important weather element was described in such a concise fashion and is therefore subject to textual analysis.

2.4. PRELIMINARY ANALYSIS OF THE USAGE OF WIND FORCE TERMS

Among the 22000 entries in the sample, a total of 99 different descriptors were identified. It was decided to overlook the secondary adjectival qualifiers of type 1b and regard those terms as being of type 1a. The former were found to add only shades of description to the primary adjectives and were limited to a few terms such as ‘very’, ‘extremely’ or ‘excessively’. The Appendix table at the conclusion of this paper identifies all 99 wind force descriptors defined on this basis.

Such a large number of terms suggests the lack of any common vocabulary. But this was not the case. Figure 2 shows the cumulative percentage of usage when terms are ordered by their frequency of occurrence in the sample. Today’s Beaufort Scale has 13 points and the 13 most widely used terms in the sample account for as many as 90% of all sampled logbook entries. These terms are listed in Table I, which indicates the nine that were to be adopted in the Beaufort system and its various versions of the later 19th and 20th centuries (Wallbrink and Koek, 2001). Conversely, 45 of the terms were used on fewer than six occasions and can be

TABLE I
Frequency of use of the 13 most popular English wind force terms over all sources

Term	Rank by usage	Absolute frequency	Cumulative frequency by percentage
Moderate	1	4109	18.79
Fresh gales	2	3232	33.57
Fresh breezes	3	3182	48.12
Light airs & calm	4	1880	56.72
Light breezes	5	1561	63.86
Moderate breezes	6	1549	70.94
Little wind	7	1492	77.77
Strong gales	8	865	81.72
Calm	9	641	84.65
Variable	10	367	86.33
Strong breezes	11	327	87.83
Pleasant breezes	12	319	89.29
Moderate gales	13	238	90.37

Note. Items in bold were later to be included in the Beaufort Scale.

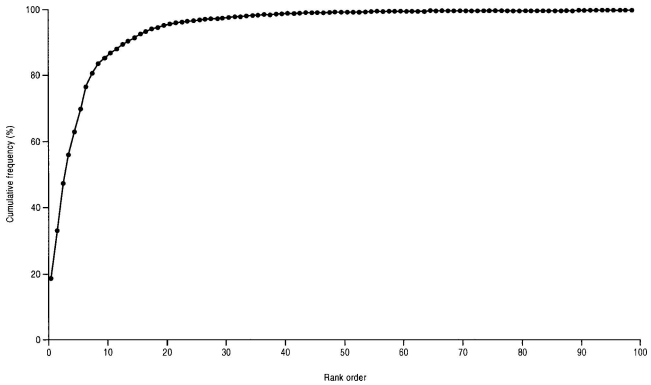

Figure 2. Cumulative percentage of wind force term usage based on Royal Navy, EIC and HBC records.

attributed to the idiosyncrasies of the officers in question. On this basis it can be suggested that there was a widely used and well-understood convention for wind force terms many years before Beaufort's contribution, and one upon which he drew heavily. Given that few officers attended the only formal naval college at the time (Portsmouth, founded in 1729) such consistency of vocabulary usage is remarkable. But officers did not lack education. Most were trained 'on deck', were skilled and experienced in their duties (Lavery, 1989) and coached in a strong oral tradition that saw terms passed down the generations, evolving only slowly as they did so.

Nevertheless differences were encountered between the vocabularies of officers in the three English services – the Royal Navy, EIC and HBC. Royal Navy officers used a relatively narrow range of terms (53 only were found) in a 'linear' system that categorised forces using an ordinal magnitude scale. This was the structure that was adopted by Francis Beaufort in which winds were described by reference to their force alone. The officers of the HBC also used this system but the sample was geographically and climatologically narrow (the far northern latitudes only) and their vocabulary counted only 37 terms. The EIC officers' terms uniquely include acknowledgement of the nature and origin of the wind, and extended their vocabulary to 73 items. Thus, in addition to breezes and gales, they also took care to indicate trade winds or monsoons, but again qualifying those classes by adjectives such a 'fresh', 'moderate' or 'strong'. Table II lists the terms used most commonly by the officers of the three services. The use of trade wind descriptors forms the major distinction between the vocabularies of the Royal Navy and the EIC officers and they provide three of the 13 most used terms in the latter, but are absent from the corresponding Royal Navy list. Even when sailing within the trade winds latitudes Royal Navy officers continued to describe the winds as breezes, and not as trades. Only 0.2% (27) of all sampled entries in the Royal Navy logbooks were of trade winds; a figure that rises to 15.7% (836) in those of the EIC. Monsoons were noted on 18 occasions in the latter, but not at all in the former. It is important to add that

TABLE II
The 13 most frequently used wind force terms by Royal Navy, EIC and HBC officers

Rank by usage	Royal Navy	East India Co.	Hudson's Bay Co.
1	Moderate	**Fresh breezes**	**Fresh gales**
2	**Fresh breezes**	**Light airs incl. Clam**	**Fresh breezes**
3	**Fresh gales**	**Fresh gales**	**Strong gales**
4	**Light airs incl. Calm**[a]	**Light breeze**	Stiff gales
5	Little wind	**Moderate breezes**	Moderate
6	**Moderate breezes**	Pleasant breezes	**Moderate breezes**
7	**Light breezes**	Variable	**Light airs incl. Calm**
8	**Calm**	Little wind	**Light breezes**
9	**Strong gales**	Fresh trades	**Stiff breezes**
10	**Strong breezes**	Moderate trades	Little wind
11	**Moderate gales**	Pleasant trades	Light winds
12	**Hard gales**	Moderate	Pleasant breezes
13	Variable	**Strong breezes**	Easy breezes
Cumulative percentage for that source	98.6	77.8	95.6
Total number of terms	53	74	37

Terms adopted by Beaufort are in bold.
[a]Indicates 'light airs inclinable to calm'.

these terms were not employed without reliable discrimination, and trade winds were only noted in those latitudes where they might be expected to prevail and, in a similar way, monsoons were recorded only in the seas off the Indian and south-east Asian land masses. Furthermore, the meaning of the term 'trade winds' was well understood. It had come into use in the mid-17th century, and had been the subject of scientific investigation before the close of the century (Halley, 1686), and later by Hadley (1735).

The EIC system of wind force descriptors might therefore be more properly described as a 'matrix' of terms, one axis of which was force *per se* from light to strong, and the other a generic classification of breeze, trade, monsoon or, simply, 'wind'. The vocabulary of the EIC officers is summarised in Table III, which shows how the most commonly used terms can be categorised by these two criteria. The table includes all the 'types' of wind that were recorded (breezes, gales, monsoons and trades) but does not include the less commonly used adjectival qualifiers such as 'feint', 'little' and 'stiff'. Single word terms such as 'storm' and 'hurricane' have also been excluded.

Such close attention to meteorological detail on the part of EIC officers cannot be readily explained. In part it reflects their more common acquaintance with, to them, exotic circulations and weather systems, yet the system may have had a degree of formal acknowledgement and was described in the privately published documents of James Capper (1801). Capper had been in the service of the EIC, travelling extensively on their behalf. His publication notes not only that winds can be described by force but also that they could be classified by species [sic]. He wrote:

TABLE III

The most commonly used wind descriptor categories employed by officers of the East India Company

Adjectival qualifier	Wind type				
	Breeze	Wind	Trade	Monsoon	Gale
Light	8.43	0.056	2.08	0.056	0.150
Gentle	0.506	–	0.206	–	0.244
Moderate	7.63	0.862	3.30	0.056	0.956
Pleasant	5.56	0.670	3.26	0.112	2.19
Steady	1.65	0.037	1.35	–	0.824
Brisk	0.02	0.094	0.750	–	0.693
Fresh	9.50	0.581	3.86	0.075	8.43
Strong	2.72	0.131	0.374	0.037	2.38
Moderate 2.9		Light airs 9.9		Hard gales 1.0	

Note. The numbers are percentages of the total count of EIC entries (5336). N-dashes (–) in rows indicate no records. Percentages for non-matrix terms are also given (last row).

> Those who would now wish to be perfectly understood, when treating of winds, must previously make a new catalogue of them. . . In this manner it is my intention to proceed, and to begin by making a new division of those, with which I am acquainted, into four different classes, or rather genera, of which, the first excepted, there are many different species. The perennial; periodical; the topical; and the general.

The trade winds were, in this system, perennial, but the monsoons periodical. All extra-tropical winds were regarded as general in character. That this system failed to attract wider attention is possibly due to Capper's contemporary, and first hydrographer to the EIC, Alexander Dalrymple. Dalrymple was an important figure, and mentor for Francis Beaufort (Cook, 1985, 1989). He was almost certainly the proposer of the wind scale that bears the Beaufort's name (Fry, 1967; Konvitz, 1983; Wheeler and Wilkinson, 2004). He lamented (Dalrymple, 1779) the "want of precision" in wind force description and proposed a 13-point scale that paid attention only to the force of the wind, and not to its origin. This 'linear' system was eventually to become universal in English logbooks.

2.5. THE HISTORICAL DEVELOPMENT OF WIND FORCE TERMS

Although there is no evidence to suggest that the general understanding of the various wind force terms changed over time, it should be noted that the inclusion of new words and abandonment of others had a transforming influence on nautical vocabulary. The most significant of these changes had taken place in the half century before 1750 and, as Tables II and III indicate, a vocabulary close to the Beaufort system was already in use at that time. There were, nevertheless, some important changes after the mid-18th century. These are most evident in the Royal Navy records in which the use of the term breezes (of all forms; 'fresh', 'strong' etc.) increased, whilst that of unqualified term 'moderate' decreased, as did the use of 'gales', especially fresh gales and most of those for lower orders such a 'easy', 'light' etc. The term 'moderate' had only come into popular nautical usage in the first half of the 18th century. Surveys of late 17th century terms (Suárez Dominguez, 2002 and Wheeler, 2004) have shown it to be all but absent from logbooks of that period. A century later Beaufort railed against its use, stating in the preamble to his first description of his wind force ". . .nothing can carry a more uncertain idea of wind and weather than the old expression of moderate and cloudy &c. . .". Its popularity was nevertheless unchallenged (Table I) and, indeed, Beaufort used it frequently until 1806.

Of similar interest is the term 'breeze'. It first came into general usage in the early 18th century. By the 1750s it is found (taking all its adjectival forms into account) in 20% of all sampled entries of Royal Navy logbooks. This figure grows steadily through the decades to stabilise at 55% by the beginning of the 19th century.

'Moderate', meanwhile, was in a steady decline from 35 to about 15% over the same period. These changes marked linguistic and not climatic changes and were not echoed in the EIC logbooks. The word 'breeze' had entered English only in the late 16th century, possibly through no other figure than Sir Walter Raleigh who adopted the Spanish term 'brisa' and provides (Raleigh, 1597) one of the first printed uses of this term in English when he describes the difficulties of navigating the coast of Guyana ". . .against the brize [sic] and east winds". By the end of the 17th century its English definition was narrowly defined and embraced only the diurnal circulations known today as land and sea breezes. Sir Henry Mainwaring's *Nomenclator Navalis* (*The Seaman's Dictionary*) published in 1644 and reprinted by Manwaring and Perrin (1922) is unambiguous in its definition:

> A breeze is a wind which blows out of the sea and doth daily in all seasonable fair weather keep his [sic] course, beginning likely about nine in the morning and lasting till it be within little of night. We do not commonly call all winds that blow off the sea upon any coast breezes, unless it be there where this course is certain. . .

By the mid-18th century this narrow definition had been relaxed and the term was applied more generally across the lower range of the wind scale irrespective of its physical cause. The second half of the 18th century witnessed its final, if gradual, acceptance as a general nautical term. Of equally exotic origin are the terms 'hurricane' (from the Carib term 'furacan'), 'monsoon' (probably from the Arabic 'mausin') and 'typhoon' (from Chinese term 'tai fung' for 'great wind'). Mention must also be made to the term 'gale'. Although it had been part of the English vocabulary from possibly as early as the times of Danish and Norwegian settlement in the 9th and 10th centuries, its meaning in the context of its nautical application was determined largely by a range of adjectival qualifiers. In Beaufort terms it occupies the higher range of the wind force scale, where it is qualified as 'moderate', 'fresh' or 'strong'. But in the mid- to late-18th century it is found with qualifiers such as 'light', 'gentle' and 'small'. These were archaic at the time, harking back to the decades before breeze was adopted for wider use and almost all winds between light airs and storm were a gale of one form or another. The generality and inference of benignity to be drawn from the term cannot be better exemplified than by the words Shakespeare gives Prospero in *The Tempest* when he wishes his departing visitors ". . .calm seas and auspicious gales. . .".

3. The Interpretation of Wind Force Terms

3.1. PRELIMINARY COMPARISONS

Having confirmed the existence of a conventional, if unofficial, system of recording wind force, it is important to express those descriptors in present day terms of the

Beaufort wind force scale. It is not to be expected that those terms that were used infrequently might be confidently re-expressed, but those that enjoyed wider currency and did not depend on the literary whim of the recording officer might reasonably be expected to have a modern-day equivalent.

In any attempt to convert late 18th and early 19th century terms into Beaufort Scale equivalents it must be recalled that Francis Beaufort was himself an experienced Royal Navy officer and former midshipman for the EIC (Courtney, 2002). Furthermore, his logbooks from his years of service have survived and are held in the UK Met Office archives. An analysis of the wind terms favoured by Beaufort are summarised in Table IV. Given that Beaufort had been brought up in the traditions of the Royal Navy it is unlikely that his own use of terms would differ in their meaning from those generally understood at the time. The continuity between Beaufort's own use of terms and his later formal wind scales provides the first point of departure in expressing logbook terms in Beaufort scale equivalents. It will be recalled that the list of the 13 most widely-used terms in Table II includes nine that were adopted by Beaufort. His contribution was to clarify and to give lasting and formal recognition to those commonly understood definitions. In these cases, therefore, the translation is direct. This suggestion is supported also by the findings of Wheeler (1995) who was able to make more immediate comparisons between late

TABLE IV
Summary of Beaufort's first two wind force scales and his own logbook vocabulary

Terms used in Beaufort's first scale of 1806	Terms used in Beaufort's second scale of 1807	Terms used by Beaufort in his logbooks (1790–1793)
Calm		Calm
Faint air just not calm		–
Light airs	Light air	Light airs
Light breeze	Light breeze	Light breeze
Gentle breeze	Gentle breeze	–
Moderate breeze	Moderate breeze	Moderate breeze
Fresh breeze	Fresh breeze	Fresh breeze
Gentle steady gale	Stiff breeze	Strong breeze
Moderate gale	Moderate gale	–
Brisk gale		–
Fresh gale	Fresh gale	Fresh gale
Hard gale	Strong gale	Hard gale & strong gale
Hard gale with heavy gusts	Whole gale	–
Storm	Storm	–
	Hurricane	

Note. N-dashes (–) in rows indicate no records.

18th century wind force terms and the conditions that they represented by reference to the carefully prepared and illustrated logbooks of the mariner and marine painter Nicholas Pocock (Cordingly, 1986). The latter, however, were few in number and employed only the most widely used terms. They could offer no assistance over the full range of terms of gales, trades and breezes.

Fortunately a rich fund of contemporary texts can be also called upon. Falconer's *An Universal Dictionary of the Marine* and Mainwaring's *Nomenclator Navalis* have already been cited, and to them can be added John Smith's *A Sea Grammer* (from 1627 but republished in Goell (1970)), Nathaniel Butler's *Boteler's Dialogues* (from the 1640s and republished in Perrin (1929)) and Romme's (1804) *Dictionnaire de la marine Anglaise* and the later dictionaries of Smyth (1865), Paasch (1890), Pirrie (1895). All these publications assisted in defining some of the wind force terms that Beaufort was to abandon to history, and to place them on his scale.

3.2. STATISTICAL COMPARISONS

Because of its importance for navigation, English logbook keepers were assiduous in recording the distance sailed by their vessels in the course of each nautical day (noon to noon). Harland (1984) drawing on Prager (1905) has demonstrated that a non-linear relationship exists between wind force and a vessel's speed, for which distance per day is a close surrogate. The two increase in tandem to force 8 (fresh gale), after which increasing wind forces are matched by decreasing sailing speeds. This latter characteristic is a consequence of greater stresses on sails, rigging and masts that result from increasing wind forces and the consequent need to take in sail and, as a result, suffer a loss of speed. Differences in the precise nature of this relationship are introduced by such factors as the sailing qualities of the ship, the course in relation to the direction of the prevailing wind and general management of the vessel, but the overall nature of the relationship does not differ.

The recorded distance sailed each day was the mapped separation between successive midday locations as explained in Norie (1889). Although not absolutely precise because of the methods used in its determination relying on the log-line and minute glass, this measure provides an acceptable approximation to the ship's overall daily speed. Examination therefore of distances sailed under given conditions offers the possibility of ordering terms for which no formal definition exists in contemporary documents. A sample was drawn based on those days for which only one wind force prevailed (or was recorded). Such days were relatively infrequent, and few or no such entries could be found for some of the less frequently occurring terms. Because of the differences between their vocabularies outlined above, the Royal Navy and the EIC data were treated separately. The sample sizes were respectively 2661 and 2142. The mean distance sailed under each force descriptor was calculated firstly for those Royal Navy terms adopted by Beaufort and

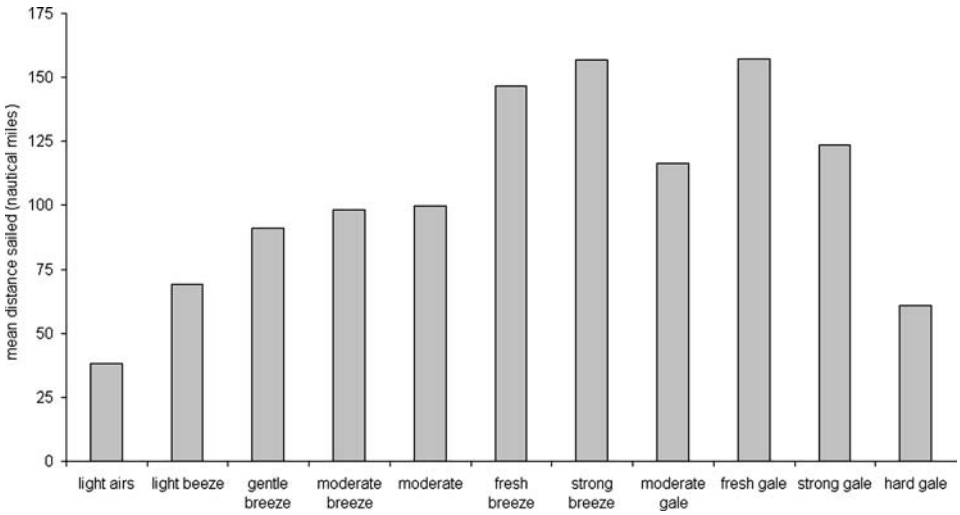

Figure 3. Mean distances sailed (in nautical miles) by vessels experiencing winds of different Beaufort forces. A category for 'moderate' is also included.

for which a clear definition therefore exists and, secondly, for the full range of terms encountered in the EIC logbooks. Figure 3 orders the terms by their Beaufort scaling, and into which the popular but hitherto undefined term 'moderate' can be placed (in terms of mean distance sailed when it prevailed) to give it an unambiguous definition. This places it close to, but slightly less than, Beaufort force 4 (moderate breezes). The resulting pattern closely resembles the non-linear nature of the relationship between wind force and ship speed and, with one exception, agrees with the ordering of the Beaufort Scale. The exception is term 'moderate gales'. Although widely-used in the 1750s (when 80% of its occurrences were noted), the term had passed from popularity by the 1800s, when no records of its use can be found in either Royal Navy of EIC logbooks. The mean distance measure places it in the Beaufort force 4 category. But this definition is based almost exclusively on data from the 1750s and 1760s, and may possess a degree of bias not present in the mean distances for the other terms drawn more widely across the time period. Dalrymple and Beaufort allocate it respectively to forces 7 and 8 (later revised to force 7) in their scales and brought the term back into use, although Beaufort seems not to have used it in his own logbooks before 1793. On this basis, moderate gale is taken to represent force 7 but only for the post-1780 period, and some ambiguity persists regarding its definition before that date.

3.3. THE WEATHER VOCABULARY OF THE EAST INDIA COMPANY OFFICERS

The results for the wider EIC sample are summarised in Table V as a matrix set out to conform to Table III. Recalling the earlier observation that the term gale

TABLE V

Mean distances (in nautical miles) sailed per day by vessels under the most commonly recorded wind forces

Adjectival qualifier	Wind type				
	Breeze	Wind	Trade	Monsoon	Gale
Light	69.2	58.3	104.7	*85.0*	88.6
Gentle	91.1	–	96.6	–	81.4
Moderate	98.3	98.3	128.1	*184.0*	111.8
Pleasant	112.2	118.2	132.1	*141.9*	121.4
Steady	136.7	–	139.9	–	143.2
Brisk	–	*186.5*	145.5	–	140.6
Fresh	146.6	140.4	139.1	*162.5*	157.4
Strong	156.8	124.6	165.3	*173.0*	123.6
Moderate 99.6		Light airs 38.3		Hard gales 60.9	

Note. N-dashes (–) in rows indicate no records of distances. Italicised entries indicate means based on small numbers of observations. The data refer to EIC logbooks only.

had a wider range of definitions than is currently the case, it is not surprising to note that the mean distances and, by implication, strengths of the many forms of gale overlap with those for trade winds and for breezes. 'Light', 'gentle' and, even more curiously termed, 'pleasant gales' are set at a much lower order in the scale than are Beaufort's 'fresh gales'. The optimum force on this EIC system occurs with fresh gales - as is the case today (Harland, 1984) - and shorter sailed distances are associated with 'strong gales' and 'hard gales'. Sub-sampling over the constituent decades reveals only random differences in the mean distances for each category with no temporal trends or changes other than that noted for moderate gales. It can, therefore, be concluded that whilst terms had been adopted into the vocabulary, and others had passed out of use, they maintained the same meaning throughout their periods of use. Interestingly, the sample drawn from Royal Navy logbooks revealed the same order but suggested also that the EIC vessels were consistently faster over all forces by an average of 16%. This may be a result of the EIC's need for their ships to hasten their cargoes between the Asian ports and England, while Royal Navy ships had duties that did not necessarily require constant maximum speeds. There was general agreement at the time (Sutton, 2000) that the EIC vessels were the best then available and likely to out-perform those of the Royal Navy. Furthermore, the EIC ships were of a standard size, designed for fast sailing, whereas the Royal Navy vessels embraced a wider range of sizes and, consequently, performance.

There were sufficient observations in the logbooks to provide mean distances for the 35 most commonly used wind force terms, which encompass 97% of all entries. Of the remaining terms a number, such a 'hurricane' and 'storm', can also

be confidently placed on the Beaufort Scale (forces 11 and 12 respectively). Some particularly archaic terms could also be classified on the basis of studies of late 17th century terms already completed (Suárez Dominguez, 2002; Wheeler, 2004). This raises the percentage of terms that can be ordered on the Beaufort Scale to just over 98. Of the remaining terms, all have been used fewer than four times. 'Squally' is, however, a special case. The term was in frequent use but was known to be without definition as a force, and Dalrymple (1779) perfectly expresses the contemporary view when he wrote:

> There is one species of winds not reducible to any of the foregoing terms: and that is what English Navigators call squalls. . . [they] are so various in duration and violence, it seems impossible to reduce them to any standard. . .

For this reason, the term was not included within the range of wind force descriptors and can more properly be regarded as a general weather expression. Indeed, Beaufort was to do just this in his weather notation proposal of 1806.

It is thus possible to arrange in order of force the commonly used descriptors that account for the vast majority of entries in the sample of over 22,000 (Figure 4). Those terms that Beaufort adopted provided key points around which the remainder could be grouped, and each of which had to be allocated to a Beaufort Force category. The boundaries between the categories could only be placed subjectively. It was clear that to categorise the list by forcing the same number of terms into each of the Beaufort forces was unrealistic. Thus, Beaufort's light airs (force 1) has only one equivalent, but Beaufort's fresh breeze (force 5) has 12 archaic terms

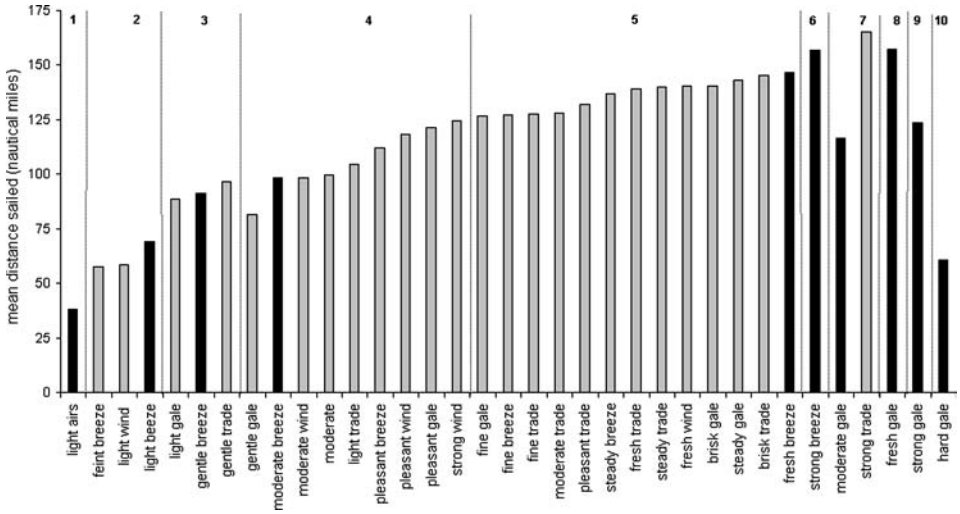

Figure 4. Wind force terms arranged by mean distances sailed (in nautical miles), but adjusted in a small number of cases to take account of particular circumstances.

with similar 'distances sailed'. Because some of the mean distances were based on small samples, rigid adherence to orderings based on distances sailed was also inappropriate. An example of the need for a more subjective approach is offered by 'gentle gale'. Dalrymple puts it at force 6 on his 12 point scale. Beaufort uses 'gentle steady gale' in his 1806 proposal in which it occupies force 7, but drops it 1 year later preferring 'stiff breeze'. There is, however, no record of Beaufort having used it in his own logbooks, and it was a term employed rarely by Royal Navy officers (2 entries only, with a further 13 in EIC logbooks) and it did not reappear in any of the later versions of Beaufort's scale and it is tentatively located in the force 4 category of 'moderate breezes'.

The most striking feature of this ordering is the concentration in the middle ranges in forces 4 and 5. Within this range are gathered terms that are similar in force but distinguished by their origin and character. Thus various forms of breezes, trades, lesser gales and 'winds' are all represented. Given the Gaussian character of the distribution of wind forces, it is not surprising that many terms are found in those categories of greatest wind speed frequency as observers groped for a means of distinguishing between winds of different origin but possessing only marginally different strengths. The great achievement of Dalrymple and Beaufort was to simplify the confusion of these middle order terms. On the other hand, the situation in the extremes of the distribution is less ambiguous, with a small number of well-established and widely-used expressions to describe the less commonly occurring conditions. Forthcoming research will, hopefully, identify any fine adjustments that may be necessary for this scheme.

4. Weather Terms

Much attention has been given to Beaufort's wind force scale. Less attention has been devoted to his weather scale, in which different forms of weather are coded and reported by key letters (a system that was withdrawn from formal use by the UK Met Office in 2004). In his original 1806 proposal 29 forms of weather were coded from 'blue sky', through 'lightning', 'hard rain' and 'squalls', to 'threatening appearance'. His 1807 version reduced the number of coded elements to 26. Once again, its origins can be traced to Alexander Dalrymple's proposals of two decades earlier. Both are, however, mere formalisations of the existing nautical vocabulary. Most are unambiguous and clearly understandable to present-day readers. They describe weather under a number of headings that include, the state of the sky, general weather, precipitation and particular events. Table VI lists those terms that were commonly found in the current sample of logbooks. This is not to suggest that the list is exhaustive, and there may well be rarely used terms awaiting discovery. But there are no grounds to suppose that the meaning of these terms differs from those generally understood today, a conclusion confirmed by their respective entries in the OED and by reference to contemporary documents (cited above). Some minor

TABLE VI
List of commonly used weather terms in Royal Navy, EIC and HBC logbooks

Logbook term	Secondary and qualifying expressions (used either singly or in combination) and *notes*
Fair, clear, cloudy, hazy, pleasant	*These terms were used without qualification*
Weather	unsettled, variable, agreeable, dirty, thick
Fog (and **foggy**)	wet, **thick**. *This term could be used without qualification*
Rain (and rainy)	at times, thick, continual, light, hard, **heavy**, drizzling, misling†, much, **small**
	This term could be used without qualification
Showers (and **showery**)	heavy, flying, or rain, of sleet, of snow, of **hard rain.** *This term could be used without qualification*
Hail	*This term was mostly used without qualification*
Snow	showers of, continual. *This term could be used without qualification*
Sleet	showers of. *This term could be used without qualification*
Tornado	*This term was used without qualification*
Water spout	*This term was used without qualification*
Thunder	peals of, severe, claps of, at times
	This term could be used without qualification
Lightning	*The direction in which the lightning was seen was commonly given.*

Items that were used (sometimes slightly adapted) by Beaufort in his 1807 scheme are in bold.

differences exist with respect to present day, clearly defined, applications of a small number of these terms. Fog, for example, enjoys the definition of being visibility of 1000 m or less, but the term was doubtless used with less precision although similar general understanding in past centuries.

Sea surface conditions were infrequently recorded in English logbooks and in a very general fashion that usually described swell rather than 'sea' *sensu scricto*. The direction from which the swell was coming was usually noted. HBC logbooks, because of their high latitude sailing, include diligently-prepared records of sea ice, and Catchpole (1992) has provided a detailed categorisation and interpretation of these terms. The term 'iceberg' had yet to come into use in English, the mariners instead referring to 'islands of ice'. Again, no formal system of description is apparent and the logbook records rely wholly on the literary skills of the officers in question. An example of this narrative style is given in the logbook of the *Prince Rupert* prepared by Joseph Spurrell. The entries for August 3rd 1760, when the ship was in the entrance to the Hudson Strait, reads: ". . .2 pm sailing in open ice, 10 [pm] falling and forcing through close ice, sailed between two ledges of ice and gave us a very hard squeeze, 10 am ice looser." HBC logbooks abound with such accounts.

5. Conclusion

Although English logbooks provide a large number of wind force descriptors, it is clear that an unofficial but widely-used system was operating long before Francis Beaufort offered a formal scale. More importantly, it has been possible to express most of the archaic wind force terms in Beaufort Scale equivalents – an important precursor to any scientific treatment of the data. Accounts of the state of sea and the general weather used less specialist and more everyday means of describing those conditions.

The CLIWOC team (CLIWOC, 2003) have produced a multi-lingual dictionary in which all archaic wind forces terms in French, Dutch, Spanish and English are given with their Beaufort Force equivalent numbers. A downloadable pdf version is available at www.ucm.es/info/cliwoc.

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Appendix: Wind Force Terms and Frequency of Use

Term	% use	Term	% use
Baffling	0.009	Light monsoon	0.014
Baffling airs	0.005	Light trades	0.506
Baffling winds	0.005	Light wind	0.253
Blowing fresh	0.104	Little breeze	0.005
Blowing hard	0.054	Little wind	6.742
Blowing strong	0.041	Moderate	18.567
Blowing violent	0.005	Moderate airs	0.005
Blowing winds	0.005	Moderate breezes	6.999
Breeze	0.023	Moderate gales	1.075
Brisk breeze	0.005	Moderate monsoon	0.014
Brisk gales	0.176	Moderate trades	0.840
Brisk trades	0.181	Moderate winds	0.212
Brisk wind	0.005	More wind	0.009

(*Continued on next page*)

(*Continued*)

Term	% use	Term	% use
Calm	2.896	Much wind	0.036
Constant gale	0.005	Pleasant breezes	1.441
Decreasing breeze	0.009	Pleasant gales	0.542
Decreasing gales	0.018	Pleasant monsoon	0.027
Easy breeze	0.090	Pleasant trades	0.800
Fair breeze	0.009	Pleasant wind	0.208
Fair wind	0.005	Pretty breeze	0.009
Favourable gale	0.005	Settled gales	0.005
Feint airs	0.027	Settled trades	0.005
Feint breeze	0.045	Severe gale	0.005
Feint trades	0.005	Small airs	0.009
Fine breezes	0.253	Small breeze	0.059
Fine gales	0.095	Small gales	0.005
Flying gale	0.005	Steady breeze	0.461
Fine trades	0.063	Steady gales	0.208
Fresh	0.117	Steady trades	0.325
Fresh breezes	14.378	Steady wind	0.009
Fresh gales	14.604	Stiff breeze	0.127
Fresh monsoon	0.018	Stiff gales	1.057
Fresh trades	0.985	Storm	0.018
Fresh winds	0.167	Strong breezes	1.478
Freshening gale	0.005	Strong gales	3.909
Gale	0.027	Strong monsoon	0.009
Gentle breeze	0.249	Strong trades	0.099
Gentle gales	0.090	Strong wind	0.036
Gentle trades	0.050	Unsettled trades	0.023
Great gale	0.005	Unsettled wind	0.140
Hard gales	1.021	Unsteady breeze	0.009
Heavy gales	0.032	Unsteady trades	0.018
Hurricane	0.032	Unsteady wind	0.009
Increasing breezes	0.054	Variable	1.658
Increasing gales	0.068	Variable airs	0.018
Increasing trades	0.009	Variable breezes	0.077
Less wind	0.014	Variable trade	0.014
Light airs & c	8.495	Variable wind	0.176
Light breezes	7.053	Violent gale	0.014
Light gales	0.104		

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