https://doi.org/10.17895/ices.pub.9286

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Continuous Current Measuring from Lightvessels.

Review of Progress, with Results for a third Winter — 1937/38.

By

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In Volume C of this series which appeared in 1936, I published a short paper entitled "Continuous Current Measuring in the Southern Bight", and the issue of last year (Volume CV) contained a second paper under the title "Continuous Current Observations for Fishery Research Application". Both those papers were written in the hope that programmes of non-stop current measuring would be undertaken from more lightships in the southern North Sea. It is believed that continuous observations providing information upon water-flow under all conditions of weather and in no matter how silty water, are essential in fishery research. A very simple and robust apparatus designed to do what was needed, and which had been in use long enough to justify claims that it really could do so, was described. Sample results were presented.

It is now known that the instrument in question can (as was expected) run for very long periods with only the most negligible upkeep costs, and it seems desirable to state where it is at present in use.

The Vertical Log has recently been installed on five more lightships for continuous use throughout the year, and has been used during an entire winter from yet another one. In view of this considerable increase in the number of observing points, it is thought that workers in various branches of marine research may be interested to learn what data are available at the present time.

The instrument is, thanks to the kind permission of Trinity House, kept in continuous commission aboard the following English lightships: Cromer Knoll, Varne, and Royal Sovereign. That aboard the Varne lightvessel was installed early in March 1938 in substitution for the Drift Indicator which had been in use there for nearly twelve years. The change-over became necessary owing to the pending replacement of the wooden lightship by a large steel vessel. During the last three winters, Vertical Logs have been in continuous use from the Galloper and Sandettié lightvessels. In the case of the last-named, the Lowestoft Laboratory again acknowledges kind co-operation on the part of the Office Scientifique et Technique des Pêches Maritimes. During this last winter (1937/38) one of the instruments has been kept in continuous commission aboard the Horns Rev lightvessel. In this case the work was under the control of Dr. TÅNING.

All the instruments supplied by the Lowestoft Laboratory to carry out observations on its behalf differ very little from what was shown in the two illustrations contained in the paper of a year ago. The few changes which have since been made in no way constitute any departure from simplicity — rather the reverse in fact. They will be mentioned below, and it is to be added that the apparatus has now taken on its final form, no further modification whatsoever being contemplated.

A matter which calls for attention here is the very welcome extension of the work which has taken place in a rather unexpected quarter.

The Vertical Log has now been adopted by the Rijkswaterstaat for use from Dutch lightvessels[1]), and although their observations were not undertaken for fishery research purposes the results are no less useful in the latter connexion than if they had been. For their purposes the Dutch engineers have made

[1]) See J. VAN VEEN, "Die Anwendung von Carruthers' 'Vertical Log' Strommesser an Bord der niederländischen Feuerschiffe" — in Ann. d. Hydrogr. usw., LXVI Jahrg. (1938), Heft 1, p. 52.

See also a letter from Dr. VAN VEEN to the Editor of the Journ. du Conseil on the subject of Current Measurements from Dutch Lightships. This appeared on page 335 of the December 1937 issue of that publication (Vol. XII, No. 3).

Values set down are measures of wind from a direction south of west where positive; negative values imply and are a measure of wind from north of east on the eastern side of the North Sea.

A paper by GRAHAM published in the Ministry's Fishery Investigations in 1934, gives figures for relative brood-strength for the year-classes 1922 to 1930, and an indication for 1931 has since been supplied to the writer. They are as follows:—

1922	*1923*	*1924*	*1925*	*1926*
2	7	6	6	1
1927	*1928*	*1929*	*1930*	*1931*
3	8	2	7	7++

Comparison is possible for nine steps and it is seen that in all cases but one the cod figures rise with increase of implied wind from north of east, and fall with increase of wind from south of west. The disagreement occurs with the pressure step 1924 to 1925, where a fall in pressure goes with no change in cod, but it is hardly likely that the cod figures 6 and 6 can be taken to denote precise equality. Since this pressure series was not obtained in the course of a search specially devoted to the cod, it is quite possible that further investigation would result in the discovery of a much better parallelism.

In conclusion, the reader to whom the subject matter of this paper is of interest, is enjoined to bear in mind the remarks made concerning the absence of proportionality between the sets of data expressing the fluctuations compared.

APPENDIX

Note One.

Letting each of the places Brussels, Kew, Helder and Yarmouth be denoted by its initial letter, and letting the suffixes d and j denote the mean atmospheric pressures for December and January respectively, the quantity plotted in Fig. 1 was:—

$$(B_d + B_j + H_d + H_j) \text{ minus } (Y_d + Y_j + K_d + K_j) \; .\,.\,.\,. + 100$$

all pressures having been expressed in tenth-millibars and the number 100 added to avoid the inconvenience of negative values.

Note Two.

Letting B stand for Blaavands Huk, U for Utsire, and S for Spurn, and letting the suffixes m, a, and ma stand for March, April, and May respectively, the quantity plotted in the pressure graph of Fig. 2 was:—

$$(B_m + B_a + B_{ma} + U_m + U_a + U_{ma}) \text{ minus } (S_m + S_a + S_{ma})$$

each of the nine values being the mean atmospheric pressure (expressed in tenth-millibars) at the place and for the month indicated.

This "gradient" has no real meaning in terms of implied wind such as it would have had if twice the quantity subtracted had been taken away (then it would have represented the sum of two gradients = twice the average) but the quantity indicated was plotted in order to magnify the ups and downs somewhat.

Note Three.

From the Daily Weather Report (British Section) of the Meteorological Office, the observations of wind strength and direction at Spurn, Tynemouth and Inchkeith (four observations daily) were collected into the sixteen main divisions of the compass after converting from Beaufort numbers into miles per hour. The months February + March + April + May were taken into account. At this stage values had been obtained which, if multiplied by 6, would represent the "miles of wind" from the various directions during the entire period of four months. For each year, from 1410 to 1450 observations were dealt with. Amongst other steps next taken, a summation was made of all cardinal components for each year, and the quantity plotted represents the result of resolving all the entries having east in them along the east line and adding the components so obtained. The resulting values ranged from 6,473 for 1923 and 6,094 for 1928, down to 2,602 for 1927.

certain alterations and do not use a separate unit for viewing direction. It is necessary to speak of these Dutch observations in some detail and to describe the apparatus as the Rijkswaterstaat use it. The places where they use it should be stated and the nature of the very comprehensive graphs of results which they prepare should be made known. With the ample facilities at his disposal, the Chief Engineer of the Rijkswaterstaat (Dr. J. van Veen) has carried out calibrations of the Vertical Log which greatly increase its utility; this will be referred to below.

The instrument has been in continuous use aboard the Maas lightship since July 1937, and the writer was informed in early February that similar observations would be instituted from the Noord-Hinder and Haaks lightvessels in that month (February 1938), and from the Terschellingerbank some weeks later. Thanks to the kindness of Dr. van Veen it is possible to reproduce here a portion of one of the graphs upon which the Dutch data on water-flow past lightships are entered. The graph in question stretches over half a year and presents an unbroken record of wind, of vertical tide, of total run of Flood and Ebb, and of overall set. That such graphs are or will be available for four lightships, can hardly fail to be a matter of interest to workers in several fields of marine research. Dr. van Veen has also furnished the writer with simple statements as to residual flow averaged for whole months.

Dutch Practice.

From Netherlands lightvessels a somewhat modified form of the apparatus is used. The spindle below which the cup system hangs has been housed in gimbals, and direction is taken by noting the position of a bubble which moves away from centre in accordance with the lead-away of the cups themselves. The method of direction viewing adopted is more or less that familiar to users of Jacobsen's Libelle meter. Instead of the rope suspension figured in my last year's paper a chain suspension is employed. For certain reasons noted below a chain suspension is now used also by the Lowestoft Laboratory, but (so correspondence shows) it is of greater strength than that used by the Rijkswaterstaat.

Below the cups, the Dutch do not hang a heavy chain terminating in a propeller (of opposite sense to the cups) as is the practice of the Lowestoft Laboratory. They have supplied weight in the form of a 40 kg. plummet which is joined on to the bottom of the cups by means of an elaborate swivel. The plummet is pear-shaped and is of course attached with its hemispherical end upwards. The use of this heavy weight is advised to obtain good results in strong currents, and arrangements have recently been made to experiment with such a plummet aboard an English lightvessel. If it could be used considerable economy would be achieved, but experience alone will show whether it can be adopted in place of the easily manhandled chain aboard lightvessels which are not provided with a specially designed and convenient davit such as the Dutch lightships have.

Dutch practice is to note the revolutions each half-hour during day and night on one counter only. The "number of revolutions per minute" being known, an accurate velocity is read off from a calibration curve. To the velocity so obtained a precise direction is assigned by noting the position of the bubble. The calibration curve in question was prepared by comparing the showing of the Vertical Log against the indications of Ott precision instruments of electrically recording type. Dr. van Veen has made this curve available to all users of the instrument — a copy of it appearing in each of his two short papers earlier referred to. Such a calibration curve could be prepared only from observations made on shipboard. This is so because the Vertical Log could not be towed through still water in an experimental testing tank. The present writer had never been able to do more than compare the showings of a Vertical Log with the results from frequent runs of a deep-riding float. The latter had been done on several occasions for all stream speeds up to almost $3^1/_2$ knots, and in the course of the original tests, experiments were made with various weights beneath the cups. With the rig finally adopted (heavy chain and opposing propeller beneath the cups) it was found that up to the speed mentioned, revolutions put on could be converted into sea miles by dividing by 300. Examination of Dr. van Veen's calibration curve shows it to be very nearly a straight line, and reveals that if it be taken as such, a general conversion factor exactly equal to that arrived at by the present writer ($\div$ 300) is obtainable from it.

In the case of the Dutch observations, the underwater part of the Vertical Log is submerged to such a depth that the mid-point of the cups is 10 metres below surface.

The portion of a graph relating to continuous observations made aboard the Maas lightship is here reproduced with Dr. van Veen's kind permission.

English Practice.

The following remarks apply to the observations carried out aboard the Cromer Knoll, Galloper, Sandettié, Varne, Royal Sovereign, and Horns Rev lightvessels — the observations aboard the French and Danish ships having been made in keeping with requests from Lowestoft.

The apparatus used was and is nearly the same as figured in the two illustrations which appeared in my last year's paper. The writer much prefers to continue using the separate cheap and "home-made" unit for the viewing of direction. Much cost is thereby saved and there are other attractions which need not be gone into in detail here. It continues to be our practice to use eight small revolution counters, each one of which takes account of water movements towards one particular compass octant. The way in which the observations are carried out has been described

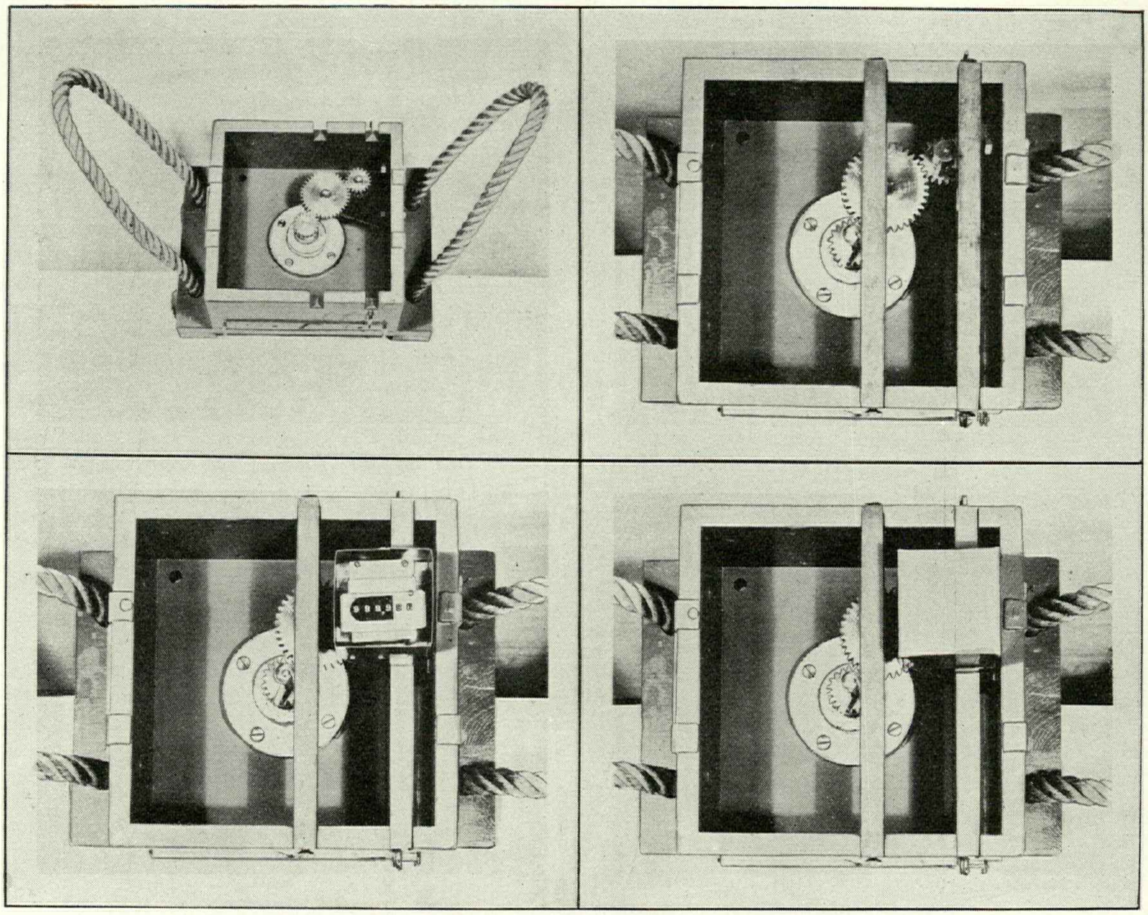

Fig. 2. Showing the Registering Parts of the Vertical Log Current Meter.

in earlier papers, and the use of the hand-set wooden "compass" has been found to be very convenient and suitable. The observer has not the least difficulty in deciding which of the eight small counters (each one bears an identification number) has to be in registration at any time. The wooden "compass" is very easily kept set by reference to objects whose bearing is known, and if desired it is just as easy to read off without hesitation a precise direction of stream as it is to decide within which octant the stream direction falls. On some lightvessels it is necessary to refer to the ship's compass only during foggy weather, marks of known bearing being available most of the time.

If a better "grip" on the water is desired than that afforded by the light hanging chain employed with the direction unit, rope "tassels" can easily be secured in the links. The very nature of the simple device employed to view direction means that wild plungings of the vessel have the minimum effect in masking the direction of the stream. The pointer on the inboard wheel remains very steady because there is so much scope for the damping out of the movements due to the plunging of the ship in heavy weather. It should also be remarked that the direction of stream can be very easily read off no matter how the ship is held "off tide" by wind. The pointer can swing right round to point straight inboard if the stream sets under the ship.

As regards the main part of the instrument (that figured last year as the "measuring unit") we may now note the few changes — chiefly by reference to Fig. 2.

The rope-handled box in which the registering part of the instrument is housed, has been altered in a way which makes for extra strength, and which permits easy renewal of the rope handles by anyone who has not the time to make the most seamanlike kind of knot. The box is now carried upon a strong "swing seat" made of thick hardwood, and all that is necessary when renewing the ropes is to make simple overhand knots beneath. The holes in the sides of the box through which the rope handles were previously passed are now conveniently used for the attachment of a preventer rope, and the new position of the rope handles gives more clearance for easy attention to a new fitment. By means of the simple set of cogs shown in the photograph, it has been possible to provide a small wheel turning in time with the big vertical spindle. Thanks to this arrangement we are now able to have a really satisfactory Master Counter. A second pair of cuts has been made in the box to take one of the standard wooden slats, and upon this a small counter has been mounted away from the middle to engage with a vertical pin carried by the outer of the two small wheels. Since the latter rotates in time with the main spindle we thus get duplicate registration. The idea is that the "off-middle" small counter can be used to register all the revolutions made. Then, if one of the eight small counters (which are changed by hand as the stream direction changes from one octant to another) fails to function properly, the reading it should have given can be obtained in an obvious way. It is very convenient to have a small counter mounted specially to act as a Master (see the top right-hand part of the illustration) because the spares which the observers have can be drawn upon for renewal in case of need. Also, the use of such a small counter could be reverted to in the unlikely event of trouble arising with the very satisfactory Master Counter which is shown in the bottom left-hand part of Fig. 2. This, which is now standard in the instrument as used aboard English lightships, has been in use for several months with great success. A large six-figure counter with direct reading was obtained from the makers of a well-known gas-meter. The working parts of it are much bigger and therefore much less liable to give trouble than are those of the small counters. It was mounted on a square of oak down through a hole in the centre of which its spindle passes, and brass sides were then fitted so that the counter was enclosed in a box. Melted vaseline was then poured into the box to about half-depth. After this had solidified, colourless medicinal paraffin was poured in so that the counter was covered with oil of the kind shown by experiment to be the best for the purpose.

This Master Counter works all the time in an oil bath, and when in use it is covered over by a cardboard half-box previously soaked in molten paraffin wax and well greased inside and out. In recent months it has been found possible to make good the readings of any small counter which had worked badly, and to lose no records where it had become necessary to replace one of the small counters. Using an instrument fitted with the reliable big Master Counter here figured, it is possible to work in our routine fashion (alternation of eight or less counters to get the total water movements within the various compass octants concerned) and yet at the same time have another observer working as do the Dutch. The two ways of observing can be in progress at the same time without interference the one with the other. The large Master Counter in its oil bath can be removed at will for accurate reading.

Apart from this change there remains only the substitution of chain ($^3/_8$ inch) for rope suspension to be noted.

As stated above, it is intended later to try using a heavy plummet as the only weight beneath the cups. Should this prove practicable, all that would really need to be bought from the makers by anyone desiring to possess the instrument, would be the set of cups and the heavy ball-bearing spindle from which the submerged portion of the instrument hangs. If the counters were bought independently, nearly everything else could be made in the laboratory. The cogs could be obtained from almost any engineer, and the plummet (the dimensions of which would be supplied on request) could be ordered from any foundry. An instrument as bought from the makers in England, would comprise what was shown as "the measuring unit" in the writer's paper of last year. With it would go ten small counters. The making of the direction-viewing unit and the fitting of a Master Counter if desired, would need to be arranged for by the purchaser.

It should be mentioned that there was a good reason for substituting a chain suspension for the rope one.

It was done to ensure that if any vessel came alongside the lightship without time being given to haul the instrument inboard, the boom and box could be got inside the rail and the chain left hanging over it. Any chafing would not matter with the chain whereas the rope in such circumstances might have been rubbed through.

Results Obtained.

An inexcusable error was made when stating the results from the Galloper lightvessel in the paper of a year ago (Rapp. et Proc.-Verb., Vol. CV., 1937, App. 6 to Part III — p. 24). The information for January 1937 and Winter 1936/37 was wrongly given; the residual currents for these two periods were respectively:—

3·9 miles a day towards S. 28° W.
and
2·6 miles a day towards S. 34° W.

The results from various lightships for winter 1937/38 are of particular interest and are given below. They are seen to show the existence of conditions very different from those of the two preceding winters, and it may be possible to make some use of the (now published) data relating to the last three winters when, some years hence, the outcome of the local fish spawnings is known. In all cases it is the mean residual current in miles per lunar day towards a true direction which is given, and the observations refer to the depth of $1^1/_2$ fathoms approximately.

Galloper Current.

December 1937	0·1	S. 27°W.
January 1938	1·3	N. 26°E.
February 1938	2·0	S. 43°W.
Winter 1937/38	0·2	S. 77°W.

For each month, the vector average of the winds observed aboard the lightvessel has been computed; the winds were observed eight times daily and the following data are in miles per hour from a true direction.

Galloper Wind.

December 1937	1·4	N. 49°W.	(246; 15·8)
January 1938	11·8	S. 68°W.	(247; 19·2)
February 1938	3·3	N. 1°E.	(223; 21·0)

Of the two figures in brackets, the one on the left gives the number of observations of wind, and the other denotes the mean strength of wind in m.p.h.

Sandettié Current.

December 1937	0·3	S. 32°E.
January 1938	0·5	N. 66°E.
February 1938	1·5	S. 23°W.
Winter 1937/38	0·5	S. 4°E.

Of interest here are the results from the Varne. The water-flow past that lightvessel was calculated from observations made with the Drift Indicator at the depth of 6 fathoms.

Varne Current.

December 1937	4·2	N. 14°E.
January 1938	6·2	N. 23°E.
February 1938	2·1	N. 2°W.

Varne Wind.

December 1937	0·4	N. 2°E.	(248; 13·4)
January 1938	11·1	S. 63°W.	(244; 17·4)
February 1938	3·0	N. 13°W.	(224; 15·0)

It is of interest to note that at the Royal Sovereign lightship off Eastbourne, the excess of flood run (towards east) over ebb run (towards south-west) was as follows — the excesses being in miles per day:—

Royal Sovereign.

During December 1937	1·6
— January 1938	3·1
— February 1938	0·8

These data differ from each other in a manner which accords with the monthly variations just noted in the case of the Varne lightvessel.

For the Maas lightvessel I am able to set down data kindly supplied by Dr. VAN VEEN, whose values I have converted into miles per day.

Maas Current.

December 1937	2·9	N. 42°E.
January 1938	2·9	N. 40°E.
February 1938	1·0	N. 5°E.

Data for the Horns Rev lightship have been kindly sent to me by Dr. TÅNING and are as follows:—

Horns Rev Current.

December 1937	3·8	NNW.
January 1938	4·3	NNW.
February 1938	1·9	NNW.

There is a reason for presenting also the data from the Cromer Knoll lightvessel, and these were:—

Cromer Knoll Current.

December 1937	0·2	S. 74°W.
January 1938	1·2	S. 66°E.
February 1938	0·0	S. 52°W.

The reader will note that the increased flow from the Channel in January 1938 (as shown by the Varne data with which those of the Royal Sovereign are in keeping) was reflected more at the Galloper and even as far as the Cromer Knoll, than at the Sandettié. He will also see that during winter 1937/38 as a whole there was little flow past the Sandettié and Galloper lightvessels, and that during February, the Sandettié average water-flow was towards the SW. quadrant.

These conditions of current ruling in winter 1937/38, so different from those of one and two years before, may conceivably have had some determinative influence upon the fortunes of fish born at the time in the Southern Bight. That we shall one day know, and there is no reason to suppose that from now on we shall ever lack such data on winter currents as those just set down.

It is not proposed to publish another paper on this subject next year; workers who find the data of interest and of use, will be able to obtain them on application.

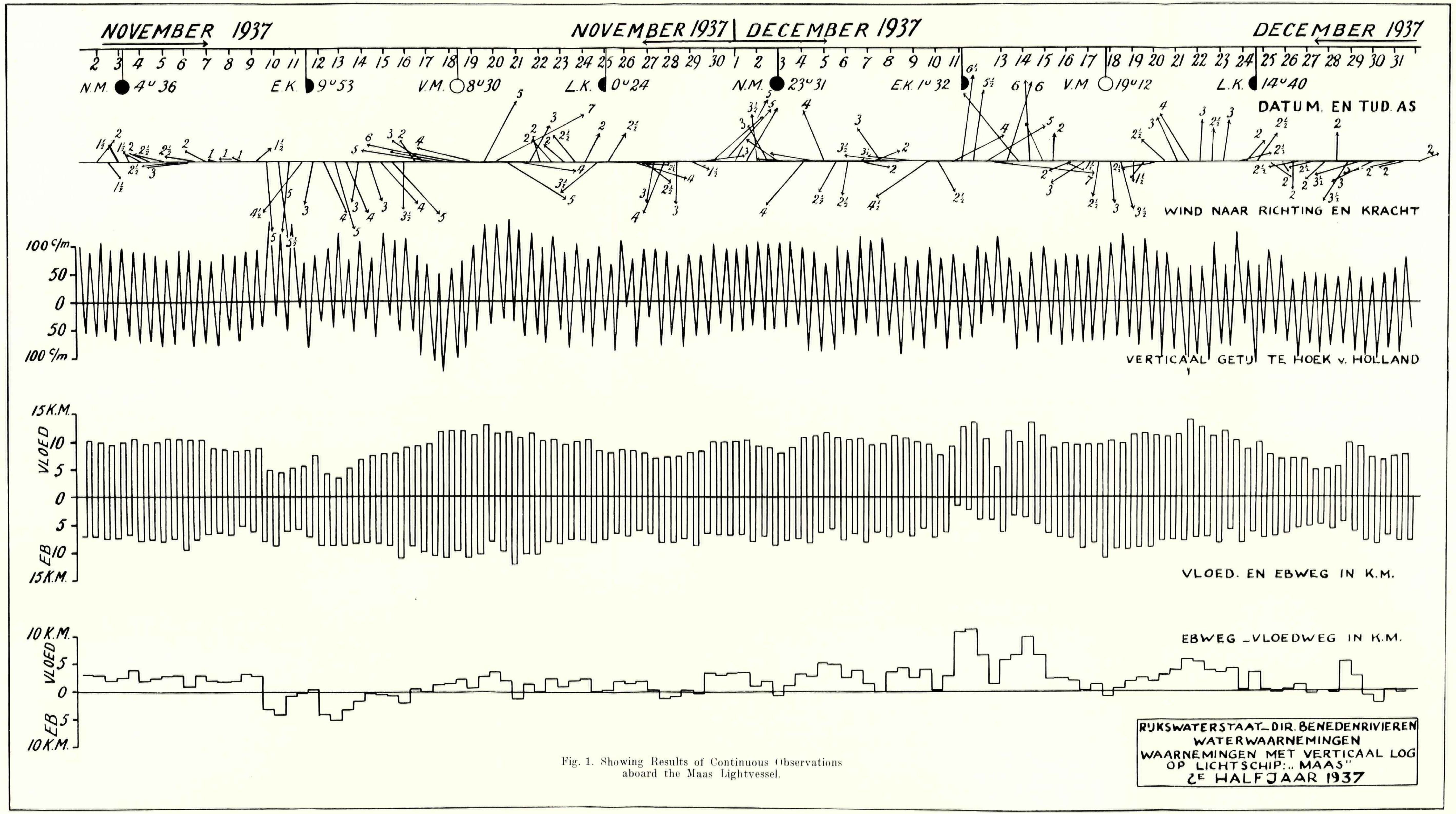

Fig. 1. Showing Results of Continuous Observations aboard the Maas Lightvessel.