Translation to english of Version 1 of Norwegian logbooks (1867-1890):

ANVISNING
til
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TR: Translator's remark

INSTRUCTION
for
carrying out meteorological observations at sea

The meteorological observations, which the meteorological institute wants that shall be carried out at sea, do not require other instruments than those which are already in common use on a well equipped ship.

Determination of the place of being is here not necessary to deal with.

For determination of the air pressure, serves the barometer, which can be a mercury-, aneroid-, or metal- barometer. Among those, the mercury barometer is the most perfect.

Mercury barometer. The mercury column within the glass tube, is carried by the pressure of the air. Thus, the height of the column will be a measure for the air pressure. The lower end of the glass tube is placed in a cup with mercury in it; it is the vertical height from the surface of the mercury in the cup to the surface of the mercury within the glass tube, which measures the air pressure.

Several circumstances contribute to, that a barometer almost never gives the correct measure for the air pressure or shows the correct value. These are in all essentials the following:
1. Air in the tube above the mercury. If the tube above the mercury is not devoid of air then the air locked up in the tube will press the mercury down and the barometer will for this reason show too low values. The higher the barometric height, the smaller is the space of the air locked up in the tube, and the stronger the force pressing the mercury down; vice versa for the lower barometer heights. Thus, air in the tube causes an error of variable magnitude. For investigation of the presence of this error, one must place the barometer somewhat slantingly; the mercury then will rise in the tube; if it is devoid of air, it will fill the tube completely to the top of the tube; if air

is present, the air will be observed as a bubble at the top of the tube. It is not

possible to get rid of the undesired air in the tube without boiling it out; to bring the barometer back into good working condition, it is therefore necessary to send it to a skilled instrument maker.

2. In a barometer of the type constructed for use on land, the stand of the mercury will never be at rest on board a ship but will move up and down because of the ships' movements. By this reason, air easily penetrates into the tube, and the reading of the instrument becomes impossible. To prevent this the inner part of the lower end of the tube of a sea barometer in its whole length has been narrowed, thereby preventing pumping of the mercury. However, by this method the mercury looses much of its free ability to move, and sea barometers therefore reacts slower by falling as well as by rising air pressure, and they are not capable to sink as low or rise as high as a barometer which always is capable of following the changings of the air pressure. As to these qualities, there are great differences between the different barometers.

3. If the barometer is not hanging vertically, it shows too high, because it is the vertical distance from the lower surface of the mercury in the cup to the highest top in the tube, which is the measure for the air pressure. To keep the vertical position of the barometer as accurately as possible under the movement of the ship, the barometer has to hang in gimbals.

4. The starting point of the scale shall be placed at the lowest surface of the mercury in the cup. Because the barometer height at sea level may vary between 710 and 780 millimeters (or 28 and 31 english inches), the scale is rather short, and include only those lines, which are situated between these limits. It goes without saying, that correct reading of the barometer height depends upon if the scale has been correctly adjusted. With regard to this, one often finds great errors with the usual barometers. But even if the scale had been adjusted to give correct values in one case, it would, because the scale is fixed to one place, show a wrong value as soon as the air pressure is changing. If the air pressure descends, the height of the mercury in the cup rises, and the scale would have to be raised; however, because it is fixed, it would stand too low, and the reading would be too high. And vice versa if the pressure is rising. By ordinary sea barometers this source of error is disregarded; however, for the most perfect constructed sea barometers, the lines of the scale are adjusted to show correct values for any stand of the barometer.

By sea barometers of usual construction one reads by means of the vernier or with the eye easiest the upper edge of the mercury (not the top) when the upper edge of the vernier is brought into level with the edge of the mercury. The eye must by reading be at same level as the upper edges of the mercury and vernier.

5. In a glass tube, the mercury always stands a little too low,

therefore, the vertical distance from the surface of the mercury in the cup up to its top in the tube is not the precise measure of the air pressure. The wider the glass tube, the smaller is this error. Because it always is the same, it

can be corrected by adjusting the scale downwards just as much as the value of the error.

In a glass tube, the mercury tends to adhere to the glass, thus standing too low when the air pressure rises, and too high when it descends. By bringing the mercury into vibration, this inconvenience is neutralized, and therefore one ought to tap on the barometer before reading, just as much as to see the mercury vibrate.

6. A column of mercury of a certain weight is longer, the warmer it is. For measuring the air pressure, it is therefore necessary to read the height of the mercury column at a certain temperature, which has been chosen to the freezing point of water (0 deg. C. and R., 32 deg. F.). To determine the barometer height at 0 deg., one has to know the temperature of the mercury. Therefore, to any well fit barometer, a thermometer has been attached. If this is not there, it has to be placed there, otherwise the observations will have no value. By observation of the barometer, the temperature has to be read first, because by reading the scale of the barometer, the termometer easily becomes heated by the close precence of the body, and the mercury of the barometer will not be heated to the same extent. Thus, the thermometer will show a higher temperature than that of the mercury in the barometer tube. Further, the barometer must hang in a place where it is not exposed to sun or rapid temperature changes.

Transport of the barometer has to be carried out with care, as otherwise air easily will enter into the tube. After having released the barometer from the wall or from the gimbals, it must be placed in an inclined position, until the mercury has filled the tube completely (up to the top). Then, it can be taken and carried in a horizontal position. It must not be carried an upright position.

The aneroid barometer is constructed after principles widely different from that of the mercury barometer. A case, devoid from air, which has got elastic bottoms, becomes compressed or expanded by the changes of the air pressure; these movements are transmitted by means of a mechanical device to an arrow, which is pointing on a scale corresponding to the height of the mercury column in a mercury barometer.

An aneroid barometer is therefore not an independent instrument, and has to be calibrated and scaled after a mercury barometer; the fabrication of the aneroids has, however, reached such high degree of perfection, that when they have been produced with skill, are capable to follow and indicate the changes of air pressure with great precision. Good aneroid barometers are better than poor mercury barometers and are least as cheap as the mercury barometers. The aneroid barometer has for the seaman several advantages as compared to mercury barometers. It

reacts quicker, as it easily changes its stand according to changes in air pressure, it occupies very little space, is easy to read, and indicates the air pressure with the same precision in rough sea as in calm sea, as there is no question about pumping. Its drawback is, that, when out of order, it can not be corrected without comparison with a standard normal barometer.

As for the mercury barometer, but for different reasons, the aneroid barometer is considerably dependent on warmth. In good instruments, however, this effect is so uniform, that once examined, the effect will be given for any case. How much the changing caused by warmth amounts to, has to be examined separately for each aneroid; such examination is carried out at the meteorological institute, by exposing the instrument once for a very low temperature, and once for a very high temperature; in both cases, it has to be compared with the standard normal barometer, and it will then show up how big the difference is according to the observed temperature changes, from which it can be calculated how much the barometer stand (or the correction) changes as the heat rises one degree and how big the error is for a particular temperature. Because of this considerable dependence of the aneroid barometer to warmth, often bigger than the corresponding error for mercury barometers, it is necessary to have a thermometer next to the aneroid barometer, indicating its temperature. Aneroids with thermometer attached to the dial must be recommended; such instruments are available by instrument makers in Christiania (TR: Oslo) and in Bergen, furnished with millimeter scales. An examination of these instruments at the meteorological institute has shown, that they are particularly well fit for carrying out the readings.
The graduation is half millimeters.
When the aneroid barometer is at rest, it will be somewhat behind a sensible barometer, that is, its stand is too low by rising barometer, too high by sinking barometer. This can be avoided by tapping with the finger on the case, one will then see, that the pointer moves in the direction to which the barometer moves. After some tapping, it comes to rest. This is an advantage with the aneroid barometer, as it becomes visible if the air pressure at the instant of observation is rising or falling.
The reading of the aneroid barometer is carried out in the same way as for the mercury barometer. Firstly, one reads the thermometer, thereafter one is tapping on the case until the pointer comes to rest, and then is read what the pointer points to. This reading can be done with same accuracy as with mercury barometers.
The so called <u>metal barometers</u> have got a somewhat different construction than the aneroid barometers. All what has been said about the aneroids on external appearance, accuracy and way in reading, also applies for the metal barometer. In common for

both types is that they should possibly hang, not be lying. They must not become exposed to shocks or strong variations of temperature. They should be fixed to the wall, so that they do not move.
An aneroid- or metal-barometer almost never shows correct. If they are to give useable observation results, it is absolutely necessary that it has been compared with a normal barometer under the different air pressures and temperatures to which it is exposed when in use.
The higher above the sea level the barometer is hanging, the lower is the stand. In order to compare different barometer heights, one usually determines the stand which would have

been read near sea level. It therefore is necessary to know the height - at an accuracy of 1 to 2 feet - from the lower part (the cup) to the sea level.
The scales of the barometer usually give the height of the stand in english inches or fractions of inches. It also exist barometers, on which the scale is graduated in french inches and lines, or in millimeters. The millimeter is the unit used for scientific investigations; therefore, it would save much work for the meteorological institute, if the barometers had this graduation. Unforetunately, it is rare for the sea barometers, but will gradually obtain a footing in the future; for rapid and secure reading it is by far the most suitable than english inches with tenths and hundredths. Since one millimeter is about 1/2 line or 1/2 tenths of an inch, one has to do more with rounded numbers and generally only need to observe the tenths. Already 1/4 millimeter is an accuracy , which in most cases is sufficient.
The thermometers of the barometers either are according to Fahrenheit's, Reaumur's or Celsius' scale. Often two scales are attached to same instrument. It is recommended for english inches to use the Fahrenheits degree, for french inches and lines to use the Reaumurs degrees, for millimeters the Celsius' degrees.
The accuracy, with which the barometer should be read, is: nearest hundreth of an english inch, nearest tenth of a french line, and nearest tenth of a millimeter. The thermometer of the barometer is read at the nearest degree Fahrenheit and the nearest half of a degree Reaumur or Celsius.
If barometer observations should have a scientific value corresponding to the effort by obtaining them, one has to know its error. This is most easily obtained by comparing with a Normalbarometer or with another good barometer, for which the error is known, and by means of which one is able to arrive to the correct barometer height. As the activities of the meteorological institute expand, the intention is to establish permanent barometer stations in our ports to give the seaman a convenient opportunity to have his barometer examined. At the time being (TR: 1868), such examinations can be carried out at the following places in Norway.
In Christiania (TR: Oslo) at the meteorological institute, where

barometers are received for examination for any shipmaster, who wish to assist the institute in carrying out observations at sea. At the telegraph stations in Sandøsund, Mandal, Skudesnes, Aalesund (TR: Ålesund), Christiansund (TR: Kristiansund) and Bodø.
In Christianssand (TR: Kristiansand) by science graduate Clausen, lecturer at the Latin school.
In Bergen at Lungegaardshospitalet and later at the new observatory, when it has been finished.
In Tromsø at the college of education, in Vardø at Vardøhus.
In absence of possibilities for direct comparison, the error of the sea barometer may be found in the following way with an accuracy in correspondance with the requirements. Along all the coasts of Europe there are permanent and reliable barometers, which are read every morning at 8 a.m. and the

readings are reduced to sea level and corrected for all errors and sent to London or Paris by telegraph. At the former place they are published in Mercantile and Shipping Gazette, at the latter place in Bulletin internationale de l'observatoire de Paris. As the meteorological institute subscribes to those papers, it has for every day got lists on the barometer stand at the coasts of Europe. To find the correction of the barometer, it is only requiered, that the shipmaster makes a complete observation of his barometer - that is, also notes the stand of the thermometer of the barometer besides the barometer stand itself - at 8 hrs. morning when in port or near coast, as often as possible. The meteorological institute is thereby capable of finding the error of the barometer. To obtain the degree of reliability wanted, it is the best that the observations are as numerous as possible, and are carried out both by high and low barometer stand. For barometers, which formerly have been compared with permanent barometers ashore, they would give a test, wethrt the barometer has suffered some changes or not; this particularly applies to aneroid- and metal-barometers. In Norwegian ports, and near Norwegian coasts it would also be advantagous to observe at 2 and 8 hrs.p.m., because corresponding observations are made at these hours at the meteorological stations.
The thermometer serves for determination of the temperature of air and water. Their scales may be Celius's,
Reaumurs or Fahrenheits, which usually has been marked at the scale. The scale, which at present is used in most countries, is Celsius's or the hundredth degree scale; it has got 0 degrees at the freezing point of water and 100 degrees at its boiling point. This scale is the one which as a rule is used for scientific studies and therefore these thermometers are recommended in preference to others. Reaumur's scale has got 0 degrees at the freezingpoint of water and 80 degrees at its boiling point. Fahrenheit's has got 32 degrees at the freezing point and 212 at the boiling point. Degrees below 0 shall be noted with a minus before the temperature reading, degrees above 0 may be noted with a + before the temperature reading, but this

may also be left out.
The thermometers, which are in use at sea, ought to be properly mounted, to prevent them from breaking too easily.
A wooden or metal mounting with a metal capsule or metal cover before the bulb would be convenient. Air or water must be given acsess to run freely around the bulb.
It is difficult to find a thermometer, which indicates completely correct. The thermometers which are in use for observation therefore have to be examined with the Normal thermometer. This is carried out in Christiania (TR: Oslo) at the meteorological institute for those who are willing to carry out observations. Anybody is, however, to a certain degree capable to examine his thermometer himself.
One places the thermometer in finely crushed ice (or snow), in such a manner that the bulb and the tube below the freezing point is closely in touch with and surrounded by the ice.
The test should be carried out in a heated room, so that the ice melts. The melting water must flow away; therefore it is convenient with a sieve or a funnel for this use. When the

thermometer has been placed (up to 1/2 hour) in the ice and it is observed that it neither rises nor sinks, the indicated temperature is noted. This point is the true freezing point: A thermometer Celsius or Reaumur should in this case show 0.0 degree and a Fahrenheit +32.0. One enters in the remark column: "The thermometer indicated in melting ice (snow) .... + or - n. n. degrees and the tenths." The error, which the thermometer (TR.: in the original text it is said "barometer", which must be a mistake) has got at the freezing point, will be approximately the same at higher or lower temperatures, unless it is a poor one. In stead of fine crushed ice, one can also use a mixture of snow and water or fine crushed ice and water, to ensure that the mixture becomes fairly thick and pulpy. This way is the best for thermometers with a mounting which otherwise would prevent that the bulb to be completely surrounded by fine crushed ice. One must pack the mixture well around the bulb.
Because the freezing point of a thermometer may change in the course of time, particularily when it is new this examination should be carried out once in a year.
The thermometer, which is used for determination of the temperature of the air, must hang in a place where the air is not stagnant nor in too strong draught, as from the wind or the sails; it must not be exposed to warm air from heated rooms or objects, it must be in shadow and has to be kept completely dry, and free from rain, snow or sea spray.
The temperature of the sea surface temperature is to be determined in the following way: One takes a bucket of water up from the water as far from the ship's side, preferably after the bucket has been left some time in the sea to assume the temperature of the water. The bucket with the sea water is placed on deck in shadow, a thermometer is placed in it and is read after about 5 minutes time. While reading, the bulb and the

lower part of the thermometer must stay in the water. Since the thermometer for this use, when it becomes dry, will retain salt on its surface and the salt absorbs moisture from the air, and thereby bringing the thermometer to a lower stand than that of the air, then it is, for always to be spared from drying the thermometer, the best to have two thermometers, of which one should always be used for determination of the air temperature, the other for the water temperature.
The thermometers have to be read with an accuacy of the nearest tenth of a degree. Before temperature readings below 0 degr., it shall always be noted a - .
The hydrometer serves for determination of the specific weight (density) of the sea water. It is generally made of glass and consist of a floating body of great rigidity, with upper part consisting of a stem, which has got the same cross section throughout its length. The lighter the sea water, the deeper the hydrometer will float, the more heavy, the lighter the hydrometer is floating; on its stem one can on a scale read the specific weight of the water. The graduation runs from 1.000 to 1.040. The density of pure fresh water has been taken as unit. Since the density of the water in addition to the salinity also depends on its heat content the temperature has to be observed at the same time as the reading of the

hydrometer. One notes only hundredths and thousandths; for the sake of simplicity the graduating of the scale has been marked with figures from 0 to 40. Thus, a reading of 35 means that the water by the actual temperature has got a density of 1.035 compared to the density of pure water. The hydrometer is an instrument, the observation of which is of great interest, but which, as with the barometer and the thermometer, is not indispensable. Hydrometers ought to be examined, because they are rarely completely correct; this is carried out at the meteorological institute for those, who wish.
The direction of the wind is to be given after the compass. A 2 point accuracy is sufficient, i. e. only the 16 points N, NNE, NE, and so on is to be used.
By close-hauled sailing the wind on board is felt to arrive more from ahead than it blows at sea. As to sailing ships, the deviation is as a rule not above 2 points, which means it can be left out of consideration. On steamships in motion, it can be very great, even up to 16 points, when the ship runs faster than the wind. On steamships in motion, the wind must not be estimated from the smoke, but from what is observed at the sea.
The wind force is wanted to be given according to the following scale, where the scale figures are just half those of the Beaufort Scale for the wind force:
0 = stille
1 = Svag eller løj
2 = Laber. Frisk Bris. Bovenbramsejl til Bramsejl

3 = Frisk Kuling. Bramsejl til enkeltrevet Merssejl Klos

4 = Sterk. Enkeltrevet Merssejl til klosrevet Merssejl bide-
5 = Storm. Klosrevet Merssejl til Stormstagsejl. vind
6 = Orkan. Intet Sejl kan føres.

(TR: The following sailing terminology and names of the sails have been identified in our dictionary:
Bovenbramsejl = Royal
Bramsejl = Topgallant sail
Enkeltrevet Merssejl = Single reefed topsail
Klosrevet = close reefed
Intet sejl kan føres = No sail can be carried
Bidevind = close hauled or by the wind)

The weather shall be noted as klart (TR: clear sky), letskyet (TR: light clouds), halvklart (TR: half covered sky), overskyet eller tykt (TR: overcast or thick), Regn (TR: rain), Sne (TR: snow), Slud (TR: mixed snow/rain), Hagel (TR: hail), Taage (TR: fog), Tordenvejr (TR: thunderstorm), disigt (TR: mist). The observer is asked to use these expressions.
The remark column has been meant for noting phenomenaes, which are not regularly observed during watch, but only once a day or at any time it appears. As objects for this column may be mentioned:
Magnetic deviation, when observed. The fact, that the magnetic deviation is not known, or not considered at all, makes such observations less useful. If the magnetic deviation found, has been corrected for the deviation of the compass,

this should be clearly noted in the Remark column.
The state of the sea, and the direction from where the waves are coming.
The temperature of the sea water and its specific weight. The colour of the sea.
Current whirls, direction and speed of the current.
Ice, it's limits and drift. Ice bergs, their number, size and motion.
The clouds, especially the upper clouds, their direction of motion, noted down in the same manner as for wind direction, i.e. from where the clouds arrive.
Waterspouts. Rings around sun or moon.
During thunder storms, the time - to the nearest minute or couple of minutes - when the first and the last clap of thunder was heard (not the sight of first and last lightning), the direction according to the compass where the thunderstorm first appeared and where it ended, wether it falls hail, intensity of rain, wether the lightnings and the claps of thunder are strong or weak, wether the lightning strikes etc. These observations would be of particular value.
The northern light shows at times up like a regular bow, at times beaming, or blazing, in the last case the rays sometimes seem to meet in a point in the sky a little to the south of zenith. This is called the crown of the northern light. It shall be noted down wether the northern light shows up like a bow,

calm or beaming, wether the bow is high or low, if possible, the highest elevation of the edge in degrees above the horizon, compass direction towards the highest point of the bow, and towards the points of intersection with the horizon, wether the northern light appears with crown, wether it has got colours, wether any sound is heard, wether it extends over greater or smaller parts of the sky.
By all the phenomenaes mentioned the time of occurrence ought to be noted, and the duration of the observed phenomenaes.

On the title page is entered name and home port of the ship, and name of the shipmaster, and in addition the make and number of the instruments used for the observations, name of the manufacturer, in short, specifications which distiguish them from other instruments of the same kind, wether the barometer is a mercury-, aneroid- or metalbarometer, kind of scale, wether eng. or french inches or millimeters, their height above sea level, wether the thermometer is Celsius (C) Reaumur (R) or Fahrenheit (F), wether it has been used for the air or water temperature. The amount of the corrections is added by the meteorological institute or by he, who examines the instruments. The back side of the title page must be used, if it is too little space on the first side.
1. column. Date. Here is entered year, month and date. Beginning of the day is counted from midnight. By circum- navigation it must be clearly stated which date is counted two times when one is sailing towards east or which date is left out when sailing towards west.

2. column. Hour. The time for every changing of the watch is printed in the logbook. If it was not possible to carry out the observations by the time stated in the logbook, observations taken by 8 hrs. a.m. or 8 hrs. p.m. are desired in any case. These hours are printed with bigger types.
3. column. Place of being. At sea latitude and longitude shall be given every noon. If an observation has been obtained, the observed latitude and the corrected noon longitude is entered. If observation is lacking, the position according to dead reckoning shall be entered in the column with addition of the letter b. In case the longitude is not counted from the Greewich meridian, this must be clearly stated on first page. Near land, bearings on known points on land can be given in stead of latitude and longitude. When situated in port, name of the port shall be given.
4. column. Barometer. The barometer's thermometer is read first, and the temperature of the barometer is entered in the column "Therm". By first observation, the letters C, R, or F for Celsius, Reaumur or Fahrenheit must be added in accordance with the scale of the thermometer. The observed height of the barometer must be entered in the column Height, without

correction. If the barometer is observed in port or near coast in order to obtain a basis for determining corrections, these observations must be entered on their right place for date and hour in the logbook.
5. column. Temperature. The reading of the thermometer shall be entered into the column without corrections. All readings below 0 degr. shall be given the sign -. By the first observation, it must be stated wether the degrees are Celsius, Reaumur or Fahrenheit, by adding C, R or F. The air temperature is entered in the first of the two columns, the water temperature in the last one.
6. column. Direction and force of the wind. The direction according to the compass, the force preferable according to the scale given above.
7. column. Weather. According to the designations given above.
8. column. Remarks. How to complete this column, see above. In case last column is too small for a day, use the last sheets of the logbook.
Generally, the rule is, that all readings of the instruments shall be entered into their respective columns without corrections, after the rules for observations have been followed.

After the finish of the voyage, or when the logbook has been completed, it must be marked "post-free matter" and mailed to the Meteorological Institute Christiania, or to nearest enlistment office, which will send it further. New logbooks could be obtained at any enlistment office by any shipmaster, who will contribute to the progress of meteorology by carrying out observations at sea.

Det meteorologiske Institut, Marts 1868