MUSEUM BARBERINI
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Franz Ossing Potsdam, June 2017

What Kind of Sky is This?

Meteorological Associations to *„Impressionism. The Art of the Landscape"* [1]

Impressionist landscape painting is characterized by the fact that the artists painted in the open, i.e. on site actually exposing themselves to the real weather conditions prevailing on the respective occasion. Their aim was, therefore, not a photographically precise depiction of landscape and weather but rather a reproduction of the impression that nature exerted on them. The intention behind their paintings was to evocate a similar perception in the brain of the viewers as opposed to documenting a concrete reality. With selected examples, this text tries to reconstruct the respective meteorological conditions in which the paintings originated.

The weather in Central Europe is marked by a sequence of areas of high and low pressure and by air masses from different origins that are separated by air mass borders, fronts (Fig. 1). Ideally, these weather systems bring typical types of clouds with them. [2] The appearance of the sky, thus, corellates with the weather situation.

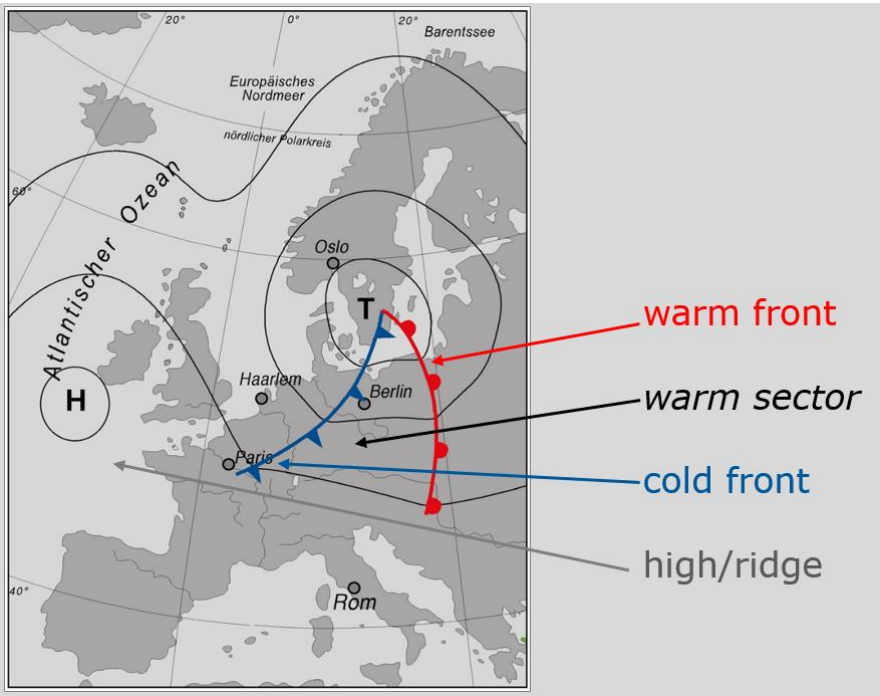

Fig. 1: Typical weather structures in Central Europe (graphics.: GFZ)

The aim is to try to trace the meteorological conditions underlying the impressionist landscape paintings. In doing so, it must be kept in mind, that the paintings were intended

[1] Exhibition (23. 01. 2017 - 28. 05. 2017) on the occasion of the opening of the Museum Barberini Potsdam

[2] The cloud classification follows the guidelines of the World Meteorological Organization WMO (1987)

and conceived as works of art and not as a real reproduction of the situation in which they were painted.

Thunderstorms

Thunderstorms are impressive formations with an immense energy cycle. In our temperate latitudes, the mid latitudes, they typically form within an air mass (e.g. heat thunderstorms) or at the boundary of different air masses. The prerequisite in any case is an unstable, humid, and warm air mass as the required energy is hidden in the evaporated humidity, the water vapor content of the air. When the air rises, be it by warming at the ground or by forced lifting at a cold front or at a mountain range, condensation takes place accompanied by an energy release of the latent heat content of the water vapor. Thunderstorm clouds in Europe develop to typical heights of about ten kilometers. Strong gusts, sometimes with gale forces, heavy rain with hail, lightnings and thunder illustrate the amount of energy in the atmosphere which is exchanged during these processes.

In his painting „*Le Port de Camaret par ciel d'orage*" (Fig. 2) Eugéne Boudin depicts a retreating thunderstorm on a cold front. The view opens into a northerly direction across the port of Camaret. The sails of the ships indicate a weak westerly wind, and accordingly the thunderstorm moves to the right, i.e. east. Low wind speeds and a mirror-like water surface indicate the calmness after the storm. On the right side of the picture heavy rain is seen as a dark wall but in the upper centre a blue sky is already visible and the sun illuminates the upper rear part of the white thunderstorm cloud. At the horizon above/behind the tower further strong convective clouds (cumulus congestus) are to be found. The typical clouds that accompany a thunderstorm at medium altitude (altocumulus cumulonimbogenitus, Ac cbgen) as well as lower stratocumulus (Sc cbgen) are also perfectly represented by the artist.

Fig. 2: Eugène Boudin: *Le Port de Camaret par ciel d'orage,* 1873, oil on canvas, 79 x 110 cm, Palais des Beaux Arts de Lille, © bpk / RMN - Grand Palais / Jacques Quecq d'Henripret

The photo in Fig. 3 shows an analogous thundery situation. During the passage of a cold front thunderstorms developed which moved towards the northeast. The photo captures the rear part of such a thunderstorm with a clearing sky at the left border of the image. The actual thundercloud is shining white with the main body, however, on the right where the sky is almost black with heavy rain. In the centre of the picture a stratiform, horizontal, dark grey cloud layer is seen, a typical midlevel accessory cloud of thunderstorms (Ac cbgen). Underneath a second cloud layer has formed which can be frequently found at the rear of downbursting cold air produced by such storms (Sc cbgen). All these cloud elements of a typical Central European thunderstorm are echoed in Boudin's painting.

Fig. 3: Retracting thunderstorm at a cold front (Cb cap inc, Ac cbgen, Sc cbgen, Potsdam, 26.05.2009, ~ENE, 17:57, photo: F. Ossing)

Ridges of high pressure

Typically, a zone of higher air pressure develops in the wake of a cold front which may develop into a discrete high or, on the other hand, may form only an interstage ridge of high pressure until the next low pressure system follows. Layer clouds, stratocumulus clouds are, according to WMO, the most frequent type of cloud at all and, in addition to scattered Cumuli, a frequent representative in high pressure ridges.The port of Zaandam in Holland is subject of Monet's painting „*Bateaux a Zaandam*" with a sky which is downright archetypical for a ridge of high pressure (Fig.4). A blue sky characteristic of a fresh maritime-polar air mass bears flat, white, layered heap clouds. A moderate wind of about Bf 3 scale causes the pennons on the boats' masts to flutter and is just strong enough to dry the stretched brown sails but at the same time hardly moves the water surface in the harbour. In short, it is a pleasant summer's day.

Fig. 5 shows such a sky at Greetsiel some 150 kilometres east of Zaandam on the North Sea. The returning fishing boats find their home port with calm water and at low wind speeds, flat stratocumulus clouds cover about one third of the sky.

Fig. 4: Claude Monet: *Bateaux a Zaandam,* 1871, oil on canvas, 44,4 x 72,5 cm, private collection

Fig. 5: Flat stratocumuli in a ridge of high pressure (Sc cugen, Greetsiel, 23.08.1967, afternoon, ~NE, photo: F. Ossing)

Atmospheric optics

What our eyes perceive is either direct radiation of a source of light such as our sun or the stars or it is reflected light at certain wave lengths that are processed to colours by our eye

and the brain. The light of sun on its passage through the atmosphere is scattered, reflected, and absorbed by the air molecules and other atmospheric particles. These three fundamental processes determine which light of what wave lengths, i.e. colours, reach our eye.

The impressionists were masters of light, they played with the appearance of colours in the atmosphere. At the same time it is artistic implicitness that the reproduction of the impression took precedence over the true-to-life reproduction.

In his painting *„Le Havre. L'Avant-Port au Soleil couchant*" E. Boudin illustrates a vespertine scene that perfectly displays the mood of a sunset at the port but at the same moment allows himself the necessary artistic freedom (Fig. 6)

Fig. 6: Eugène Boudin: *Le Havre. L'Avant-Port au Soleil couchant*, 1882, oil on canvas, 54,5 x 74,5 cm, private collection

We look directly into the setting sun which is reflected weakly on the water surface. The layer clouds are illuminated from below, thus exhibiting a bright undersurface. As the sky around the sun is not tinted red but is kept in a clear yellow this speaks for a fresh air mass with few suspended particles.

However, a view into the setting sun, in particular in such a clear air mass, allows little room for play for the eye. Colours can hardly be detected in the direct backlight, objects appear dark grey or black (Fig. 7).

It was Claude Lorrain who already in the 17th century developed the method of brightening up the colours in the foreground of his painting with a view into the sun. Boudin applies the same method: the ship's flag provides an conspicuous spot of colour, the sailors' clothings show – although in a dull shade – colours that could not actually be seen in this

direct backlight. Thus, the painting reflects the mood of a sunset in a way that a casual passer-by would hold in his memory.

Fig. 7: Objects appear black in the backlight of the setting sun.
(Cs fib un, Gescher, 02.02.2008, 17:51, WSW, Photo: F.Ossing)

Also in his paintings *„Le Havre. Coucher de soleil sur la mer*" (Fig. 8) and *„Fécamp. Le bassin*" (Fig. 9) Boudin uses the same method.

Furthermore in Fig. 8 we notice that the reflection of the setting sun in the water is completely supressed.

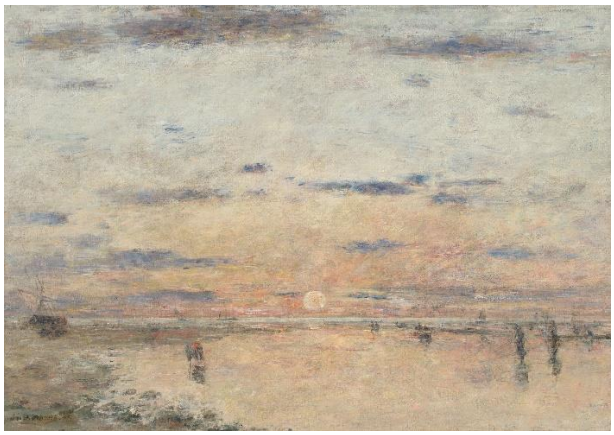

Fig. 8 (left): Eugène Boudin: *Le Havre. Coucher de soleil sur la mer,* 1885, oil on canvas, 65 x 92,5 cm, private collection

Fig. 9 (right): Eugène Boudin: *Fécamp. Le bassin*, 1883, oil on wood, 26,5 x 35 cm, private collection

Fog

There is hardly another atmospheric phenomenon that generates so many different moods as fog. Basically being nothing but a cloud lying on the ground fog can give a landscape a completely different dynamic, from a glistening light to a very subtle reflection of colours. Monet shows us a water surface near Bennecourt with ice floes and a veil of fog (Fig. 10). The fog softens the colours, Monet evokes this mood using almost pastel shades.

Fig. 10: Claude Monet: *Glacons à Bennecourt*, 1893, oil on canvas, 60 x 100 cm, private collection

The difference in the temperature between water and air together with, usually, low wind speeds leads to the creation of fog. The photography in Fig. 11 shows cool air drifting above a warmer water surface. A thin, transparent veil of fog is formed while warmer air ascends over the water. The water vapor that was evaporated from the surface is dragged up with this air and immediately condenses again in the cooler air in the form of uncountably many tiny droplets: fog is formed.

Figb. 11: Fog above a water surface (St neb, 26.07.1991, Metis sur Mer/Matane, Gaspé, Canada, 12:50, photo: F.Ossing)

About air masses and fronts

As indicated above, the weather in temperate latitudes is characterized by constant changing of air masses. Air mass borders (fronts) and air pressure distribution (high and low air pressure areas) determine the weather patterns (see Fig. 1). Weather is "the soul of all scenery".[3] The impressionist painters knew this very well for they exposed themselves directly to the weather events and recreated it in their own individual way.

Alfed Sisley painted a clear winter morning under a sky that can be attributed to a weak high or a high pressure ridge (Fig. 12) The direction of view can be narrowed down to approximately west following the cast of shadows of the trees. Weakly developed cumulus clouds and flat clouds at the horizon indicate that the upward development of the clouds is not strong. This means that the vertical layering of the atmosphere is only slightly unstable. High pressure is correlated to subsiding air which stabilizes the atmosphere. Accordingly, the vertical cloud growth is only small.

Fig. 12: Alfred Sisley: *Matinée d'hiver,* 1874, oil on canvas, 54,5 x 73,5 cm, private collection

The cloud type depicted by Sisley can be determined precisely, the WMO cloud catalogue [4] calls this flat heap clouds *cumulus humilis* (Fig. 13)

[3] Gedzelman, n.d.

[4] WMO, 1987

Fig. 13: Flat heap clouds (Cu hum, 07.07.2002, Flavon/TN, Italy, 14:50, N, photo: F.Ossing)

The end of such a high-pressure period is frequently revealed by an increasing high cloud cover. At first, single high-flying feather clouds appear which progressively become denser (Fig. 14), an almost unmistakable sign of an approaching warm front which often brings bad weather with continuous rain.

Fig. 14: Increasing feather clouds ahead of a warm front (Ci fib rad, 08.01.1995, Ketzin/Havel, 14:25, NW, photo: F.Ossing)

Sisley experienced such a sky with invading cirrus clouds near Moret-sur-Loing (Fig. 15). The sky is still blue but high cirrus streaks are a distinct signal of approaching bad weather which is also noticeable with the increasing cloudiness on the horizon. Warm fronts are areas of bad weather with typical drizzle or steady rain that can last for hours – not the weather a painter needs.

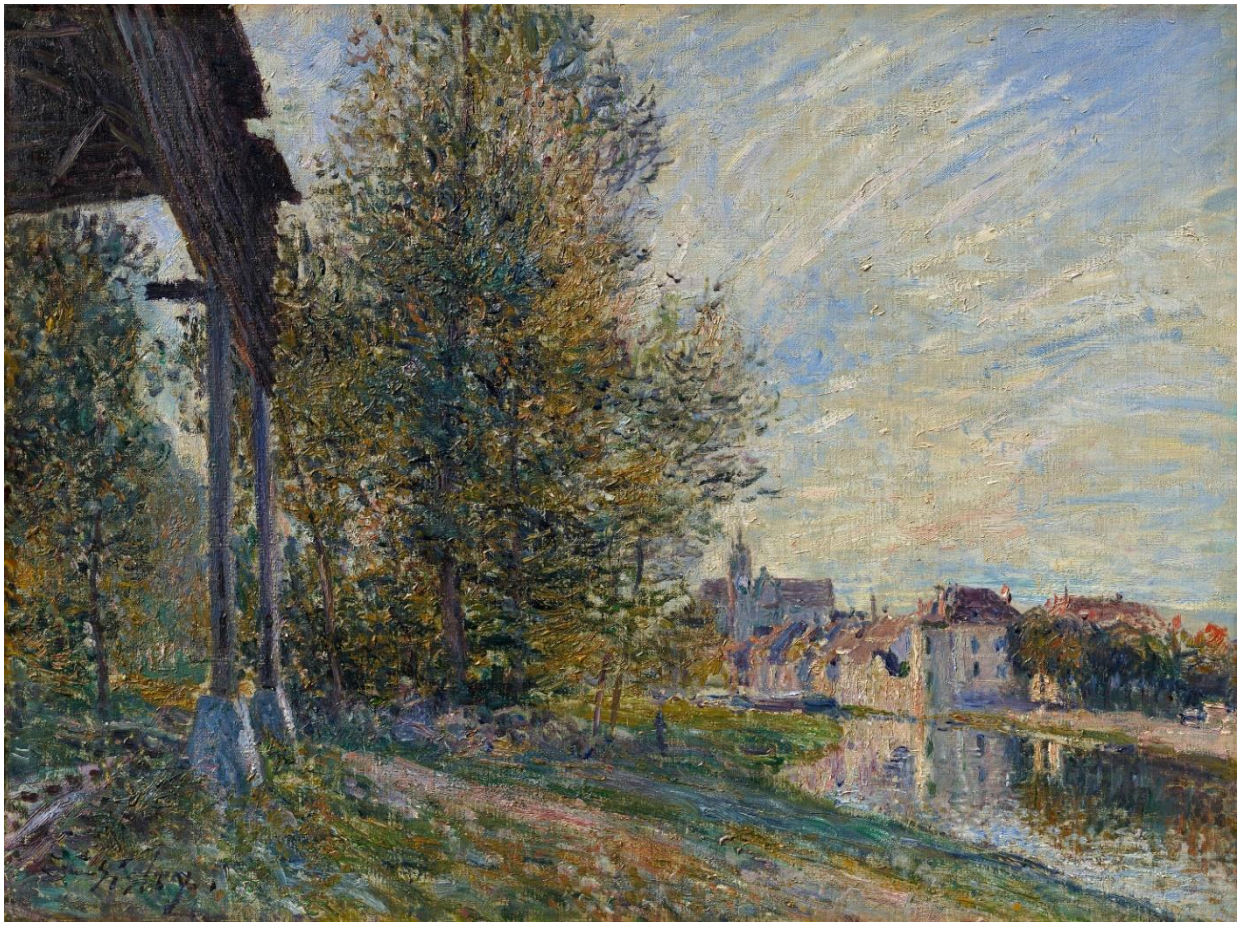

Fig. 15: Alfred Sisley: *Près de Moret-sur-Loing*, 1883, oil on canvas, 51 x 65,5 cm, private collection

Once this warm front has passed through one finds himself in the area of a low pressure system that offers comfortable temperatures in the warm season but usually does not last long: the warm sector. Midlevel sheep clouds, *altocumuli*, are typical for the sky of warm sectors but a meteorological thumb rule also says that altocumuli signal a change in the weather.

Camille Pissarro depicts such an altocumulus sky in his painting *„Les Coteaux du Chou, Pontoise*" (Fig. 16). In the evening these midlevel clouds are illuminated from below by the low sun and are tinted in red-violet.The upper parts of the atmosphere still remain in full sunlight and thus appear clear blue while in the lower levels the sunlight is already reduced. This physically means that the sun rays on their long way from the horizon to the eye of the viewer have out-scattered the short wave light components while the longer wave lengths give the clouds a reddish-violet colour. Fig. 17 presents such altocumulus clouds with an illuminated underside in an early evening sky.

It also may be remarked here that Pissarro has lightended up the landscape a bit: according to the low position of the sun the flowery meadow should be somewhat darker or even in the shade. This, again, is simply the impression and not a true-to–life depiction.

Fig. 16: Camille Pissarro*: Les Coteaux du Chou, Pontoise*,1882, oil/canvas, 60,3 x 73,6 cm, private collection

Fig. 17: Vespertine sheep clouds (Ac str tr pe, 16.01.1996, Belle Mare, Mauritius, 1900, W, photo: F.Ossing)

The Earth's Shadow

In a fresh polar air mass in a clear sky, the sky in zenith shows a distinctive a dark blue which becomes clearer towards the horizon. At the horizon the sky appears almost white (Fig. 18).

Fig. 18: White horizon, blue zenith: effects of the scattering of light in the atmosphere
(Cunevo/TN, Italy, 08.04.2015, 15:50, N, photo: F.Ossing)

This is a result of the scattering of sunlight in the atmosphere. The English physicist Lord Rayleigh was able to prove in 1871 that the light is scattered more or less equally in all directions in particles where the diameter is smaller than the wavelength of the light. Furthermore, short wave light (blue) is scattered far more efficiently than light at larger wavelengths (red). This is why the sky appears blue to us. Suspended particles such as dust are far more larger than air molecules and therefore scatter the light in a different manner. In 1908, the physicist Gustav Mie found that large particles scatter the light more effectively across the whole range of wavelengths than smaller particles. The light is, thus, scattered over a broad band of wave length (colours) and is, therefore, white. [5]

Light that reaches our eye from the horizon makes its way through a broader mass of air than light from the zenith and is, thus, scattered on more dust particles than the zenith light: The sky at the horizon hence appears white.

The viewer of the Monet painting „*Maree basse aux Petites-Dalles*" however sees a darkened horizon displaying even a violet tinge (Fig. 19). Apparently, Monet has painted the rising shadow of Earth in the evening.

The persons on the slope of the cliff and at the beach cast long shadows while the rock itself has a red hue. It is, thus, late afternoon/early evening, the view goes towards the Northeast.

With a clear visibility and an unobstructed view, such as at the sea, one can see the shadow of the Earth on the eastern horizon at the moment when the sun is setting in the west (Fig. 20). The reddish-violet upper rim of the shadow, the so-called venus belt, rises above the horizon, followed by a dark blue band which by and by covers the whole sky; the shadow of Earth. Night is falling.

[5] Bens et al., 2008

This, once again, shows the objective of the artist: reproduction of an impression. Of course the shadow of the Earth can only appear when the sun has already set. For reasons of light refraction in the atmosphere the Venus belt can already be seen while the sun is directly on the horizon and shining considerably weaker. Consequently the rock should not be illuminated in a strong red and the shadow of the persons should be more subtle. Monet integrates the whole time span around sunset in his painting. The mood of a quiet summer evening at the sea in a polar-maritime airmass at sunset and the moment thereafter, before the blue twilight hour, is so perfectly reproduced.

Fig. 19: Claude Monet: *Maree basse aux Petites-Dalles*, 1884, oil on canvas, 60 x 73 cm, private collection

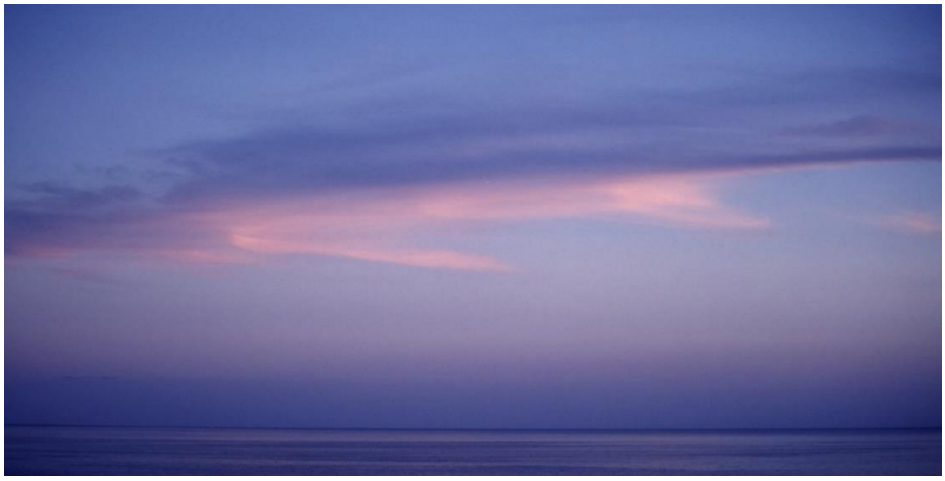

Fig. 20: The rising shadow of the Earth at the eastern horizon, shortly after sunset (Ci spi, earth's shadow, 18.01.2003, Sharm el Sheik, 17:15, SSE, photo: F.Ossing)

Summing up, it may be concluded that it seems possible to relate concrete weather situations of western central Europe to the landscape depictions of the impressionist artists.

Literature:

Bens, O., Brauer, A., Gedzelman, S.D., Ossing, F. (2008), *„Dunes and scattered light. Jacob van Ruisdael's painting "Dünenlandschaft mit Eselstreiber" ["Dune landscape with donkey driver"]*, (MdbK Leipzig), http://bib.gfz-potsdam.de/pub/wegezurkunst/ruisdael_mdbk/dunesandscatterlight.pdf

Gedzelman, Stanley D. (n.d.), *„The Soul of all Scenery: The History of Sky in Art"*, digitally available at: http://www.sci.ccny.cuny.edu/~stan/skyart.html

Westheider, O., Philipp, M. (ed.) (2017), *„Impressionismus. Die Kunst der Landschaft"*, exhibition catalogue, Museum Barberini Potsdam, Prestel-Verlag München-London-New York, 248 S.

WMO (World Meteorological Organization, 1987),"*International Cloud Atlas*", Vol. II, WMO, Genf, 212, pp.; actualized: https://www.wmocloudatlas.org/home.html and https://library.wmo.int/pmb_ged/wmo_407_en-v1.pdf

Credits:

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