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Rising above the Horizon: Visual and Conceptual Modulation of Space and Place

1. Changing Perspectives – from Map to Landscape and back

In a landscape picture, the higher the horizon is lifted, the more the viewer gets to see of the terrain: hills no longer obscure much, if any, of the view and, rather than looking into a space organised by the methods of central perspective, the viewer increasingly finds himself looking at a surface. A photograph of a point of elevation shot vertically from above – best of all from a freely floating flying device – has no horizon in it at all: the entire terrain has become a surface that can be read like a map. In the course of moving

> «from the earth-bound photograph (horizontal view) to the aerial photograph shot vertically, the icons have become even smaller, but the image itself offers an even larger detailed view of the terrain.»[1]

By virtue of their surface-like quality, which remains even when techniques such as hatching are used, such perspectives and their corresponding projections (such as the widely used Mercator projection) render themselves anonymous. They suggest a view from nowhere in particular, one to which all is revealed and from which nothing can be concealed – the eye of God, as it were. The «landscape» exists here as pure external space; it seems to manage perfectly well without a subject that looks at and thus constitutes it. In a certain way this perspectival construction is similar to a mediaeval panel painting of the Earth's surface which, as literature scholar Albrecht Koschorke notes, is quite «lifeless» in this respect, whereas a «landscape backdrop must first be penetrated, incorporated, animated by a human being»[2]. Thus even the designation «landscape» is inappropriate for surface projections. Instead, some other descriptive term such as «terrain formation» (in geomorphological terms) or «piece of nature»[3] (in the terms of natural philosophy). This «cartographic view»[4] –

1 Eberhard Fischer: *Lesen des Luftbildes.* Berlin 1938, p.13.

2 Albrecht Koschorke: *Die Geschichte des Horizonts*. Frankfurt/M. 1990, p. 146. Historian and philosopher of ecology Ludwig Trepl emphasizes that «meaning-making nature» need not necessarily be constructed by means of an individual subject: God or a collective subject (such as «nation» or «spirit of the age») can also be creators of nature as landscape (Ludwig Trepl: Zur Geschichte des Umweltbegriffs. In: Naturwissenschaften 79, 1992, p.387).

3 See, for example, Hans Werner Ingensiep und R. Hoppe-Sailer: *NaturStücke. Zur Kulturgeschichte der Natur*. Ostfildern 1996.

4 Christine Buci-Glucksmann: *Der kartographische Blick der Kunst*. Berlin 1997.

which is also typical of the aerial photograph – has medial predecessors that reach far back into history.[5] Over the course of time they have been manifested visually in panel paintings, site plans and city views.[6] Typical of the cartographic perspective is a surface-like, sketched depiction of the Earth, whereas in landscape art the horizon sinks into the lower third of the picture and the rest is filled with sky: a wide-open space filled with possibilities.

To put it rather pointedly, the concept of landscape brings into play a view of, or rather into nature and its representations, which simply cannot manage without a subject at the center of their perspectival construction. By the turn of the 19th century this is the perspective of the bourgeois subject[7], which increasingly makes landscape the object of literature, art and science, appropriating nature for itself through the landscape perspective. «The transformation of nature into image – as with the growing fashion of plein-air painting – is supposed to occur there and then».[8] In these representations the line of the horizon is a boundary line in front of which a new instrumental access to nature is displayed in the foreground, in a space secured by perspective. In art, the visualization of nature through landscape becomes a means of rehearsing a controlling gaze cast upon nature. This is no longer a nature that is elevated and menacing but rather one that is culturally conditioned and, precisely because of this, is beautiful. This is a perspective that is powerful in literature as well, one example being the writing of Goethe, who sets before his readers a harmonious cultural landscape on his travels through Italy. His account is informed by the facts of natural history concerning animals, plants, and the morphological gestalt of a region, all of which combined holds out the promise that the things of this world will increasingly yield to the penetrating gaze of science and thus be rendered transparent.

Getting to grips with this increasing penetration of an opaque medium in the form of oceans and inland waterbodies provides some impressive insights, perhaps not least because, in this context, the gaze penetrates the depths rather than scouring the distance: it is limited by the opacity of the medium and not by the line of the horizon. Moreover, natural history and natural science repeatedly encounter,

5 In the history of cartography the increasing tendency to represent space on the basis of topographical features is identified with a transformation in which the human view of the world is no longer imagined from the inside, from a history of redemption, but as a view from outside onto the world, a human view of humans themselves. It is no longer the places in the Bible that provide the coordinates by which the world is ordered but rather the abstract system of geometry. For more detail on this, see Ute Schneider: *Die Macht der Karten*. Darmstadt 2004.

6 See also Peter Galassi in *Before Photography*: «[T]he ultimate origins of photography – both technical and aesthetic – lie in the fifteenth-century invention of linear perspective». (*Before Photography: Painting and the Invention of Photography*. New York 1981, p. 12).

7 As geographical theorist Ulrich Eisel puts it in mildly sarcastic tones: «It [the landscape, A.E.S.] is the most concrete thing we have in the world if we want to observe our complacency» (Ulrich Eisel: Triumph des Lebens. Der Sieg christlicher Wissenschaft über den Tod in Arkadien. In: *Urbs et Regio* Sonderband 65, 1997, p. 42.).

8 Koschorke 1990, p. 144.

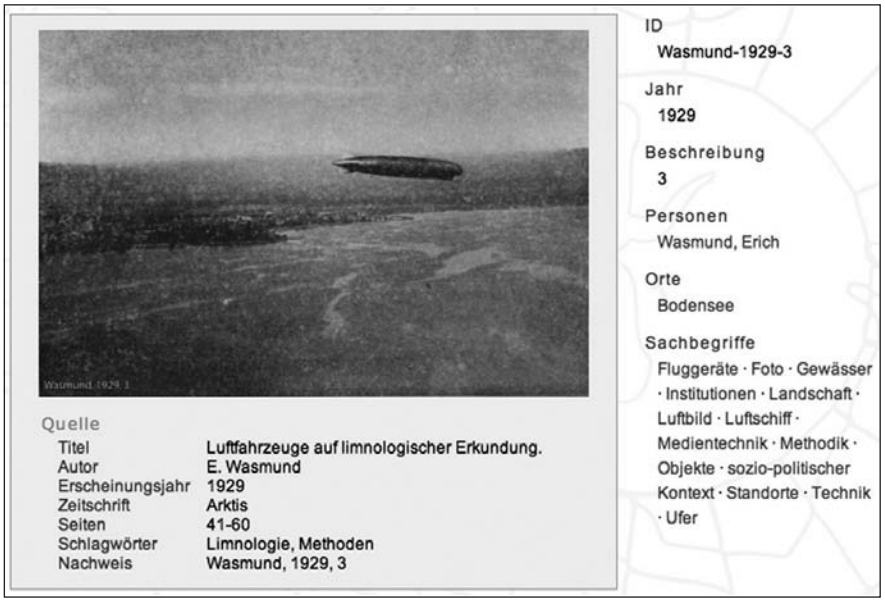

Fig. 1: Screenshot from the image database «Visual Cultures of Ecological Research», depiction in the mode of «detailed view».

confront, but also interpenetrate one another here through the perspective each imposes. Sciences which concern themselves with these objects, including geography, oceanography and limnology (the ecology of lakes and rivers[9]) use methods and concepts from both domains – the laboratory and the field sciences, nomothetic and idiographic methodology.[10]

2. Narrative Strands

The following questions provide the overall structure of this article, which seeks to do no more – but also no less – than offer a brief account of the historical transformation affecting the visualization of «landscape» in ecology. What this contribution additionally seeks to do is demonstrate how the image database containing «visual cultures of ecology»[11], to which all the articles in this publication – to a greater or lesser extent – refer, might be able to realize heuristic potential. This issue is linked

9 Limnology is the science of fresh water, sometimes also called hydrobiology or aquatic ecology. The name and the program of the discipline were coined by Swiss naturalist François-Alphonse Forel (François-Alphonse Forel: *La limnologie, branche de la géographie*. In: *Report of the Sixth International Geographical Congress held in London 1895*, London 1896, S. 593-602). Unlike hydrological or purely biogeochemical problems, limnology is concerned with questions relating to organisms.

10 This distinction was introduced by Wilhelm Windelband (*Geschichte und Naturwissenschaft.* In ders.: *Präludien II*. Tübingen 1884).

11 http://bildkulturen.online.uni-marburg.de/

here with the notion of rising above the horizon and is elucidated using the historical case study of aerial photography in limnology during the 1920s and 1930s.

So how does landscape enter the sciences which, at the beginning of the 19th century, are subject to increasingly high expectations? How does the landscape help to purify people's perception of nature and to keep their imagination and sensibilities in check? And what is the nature of the heuristic potential of landscape in ecology?

Within this transformation particular attention is given to aerial photography, a technique that spread very rapidly in various fields of research during the first two decades of the 20th century. This is related to issues concerning the technological and socio-political context in which this technique was able to achieve such a great innovative leap. Did the notion of «science as a weapon» already play a role in the First World War with regard to the technoscientific development of aerial photography? What contribution do aerial images make in the transformation from subjective multilayered landscape into objective, transparent and clear-cut scientific images? What innovative potential do aerial images offer in comparison to maps? And what makes the medium of photography stand out in the field of remote sensing?

The analytic focus of this piece is directed in part at lakes and their scientific description in the context of limnological research, in part also at sketching the outlines of an institution – «Illuft», the International Aero-Limnological Center – which went down in history even before it had a chance to begin work. This was an institution whose rise and fall occurred within the space of about half a decade and which was linked primarily with the name of a sole individual, namely limnologist Erich Wasmund. This raises questions that have to do, on the one hand, with Wasmund's institutional and disciplinary environment as well as, on the other, with the extent to which remote sensing was able to make use of theory building in limnology. What types of visualization were current in this science, and which theories were linked with which representations? In this regard, how is the program of the typologization of lakes – one quite prominent during the 1920s – related to functional approaches such as studies of the phosphorus cycle? Why was Illuft unable to follow on successfully from the research program of regional limnology, the classification of lakes? Was the descriptive method too close to natural history procedures, did it promise too little «lawful» quality and therefore not fit into the image this up-and-coming discipline had of itself? Could the «extra» information yielded by raising the horizon in aerial imaging not be appreciated because it seemed to offer too little explanatory potential?

All that can be done here is to tease out the ends of the narrative threads: weaving these individual strands into a pattern would require separate research projects in each case. What is crucial at this initial stage, however, is to highlight the possibilities for elucidating a number of epistemological and media theoretical issues by exploring the visual cultures of ecology. Accordingly, the following sections focus on

various aspects of early aerial photography in limnology and its failure. One thread is picked up by considering the relationship between place and space in the field sciences, another is followed by tracing the brief history of the institution and the individual who ran it. A further narrative thread sketches the status and handling of theory in early limnology, while yet another wraps itself around the aerial image as a medium used in the natural sciences.

3. Landscape goes Scientific

Humboldt's «Naturgeographie», regarded by many geographers as the founding concept of their discipline[12], certainly represents a key contribution towards making good on the promise it implies. At the center of Humboldt's ideas is the bourgeois subject who perceives and describes «his landscape». Aesthetic nature on the one hand and scientific nature on the other become united in a single practical entity which is the subject, resulting in an epistemic perspective that makes the metaphysical and the physical level appear as a unity. This perspective and, along with it, the conceptual preference for individual, specific places becomes a central element in constituting the object of geography initially and of other field sciences later as well. Humboldt's methodological physiognomy constitutes a scientific concept which offers a «new form of empirical natural science alongside the experimental one», at the heart of which lies the notion that «the universal lies in the emphasis on sympathetic guidance for aesthetic observation, which prompts and leads to comparison».[13] This approach links in with a philosophical conceptual position from the 19th century, according to which the experiential sciences are able to operate in the mode of either a nomothetic or an idiographic methodology.[14] The latter focuses on the individuality of a form or a place, which are conceived of as a manifestation of the universal in the particular, the particular being the measure of validity. This methodology comes to acquire relevance for virtually every one of the field sciences, whether geography, geology, ecology, ethnology, sociology or hydrology, united as they are by the strong tie to place. Yet it is not place as an individual unit of measurement that is decisive here, but place as an individual form, or gestalt. This tie to place is also what distinguishes the disciplines just mentioned from the laboratory sciences: these generate a variety of knowledge that is independent of place to the extent that the objects of study are either brought into the laboratory or, more usually, come into being there in the first place and are designed as mov-

12 ... and thoroughly misunderstood by them in the process, as geographical theorists such as Gerhard Hard, Uli Eisel and Hans-Dietrich Schultz have repeatedly emphasized in many publications.

13 Eisel 1997, p. 104.

14 The identification of nomothetic methodology predominantly with the natural sciences was not intended by Windelband. Indeed he regretted the way in which boundaries had been drawn around different realms of objects, describing these divisions as »unfortunate«. His terminological and theoretical innovation had little impact on this »habit«, however, so that the ideologization of the separation between the natural sciences and the human sciences was carried forward.

able objects. These might be, say, lab animals or special plant breeds geared towards a specific experimental design, such as the various types of mice produced at JAX laboratory, or some other techno-phenomenological artefacts such as preserved frog muscles or cell cultures. Historian of science Robert Kohler has summed up the difference between the laboratory and the field sciences very succinctly:

> «(Labs) are places apart from the world – placeless places. [...] Apparent placelessness also encourages us to think that the beliefs and practices of labs are 'objective', because we know from their visual sameness that the same rules of procedure and evidence must apply in all. We take this placelessness as a diagnostic of universality [...] The obvious way for (ecologists) to achieve credibility is to make their practices and workplaces more lablike: adapt laboratory objects and practices to field conditions, or use natural places in ways that can be read as lablike and quasi-experimental. [...] Field practices are not the placeless practices of labs but practices of place. Selecting, reading, modifying, and comparing places are the essential elements of field practice.»[15]

This kind of «objective» and nomothetic method is used in the so-called lawful sciences (Gesetzeswissenschaften), frequently in identification with the natural and laboratory sciences. The main aim here is to generate universal knowledge that is represented at best in general statements and mathematical formulae. Space – like time – is an abstract and geometrically determined category here which, at first sight, appears to manage without any subject at all. At the same time, however, space, according to Kant, is founded on an «a priori intuition»[16] and thus is always both imagination and experience. As such, three-dimensional space is basically a dual figure which, in conceptual terms, cannot manage without a subject to unite the two.

In this context the horizon appears as a measurable line and thus as an empirical entity that provides a fixed point for measuring devices; as such, it can be used in conjunction with geometrical methods as a means of orientation in three-dimensional space. Accordingly, the line of the horizon and the heavenly bodies were an important orientational aid in global maritime navigation – nautical science; indeed,

15 Robert E. Kohler, R. E.: Place and practice in field biology. *Journal of the History and Philosophy of Biology*, 2002, p. 191 f.

16 In the *Critique of Pure Reason* Kant explicates why time and space are, necessarily, not empirical terms but are given a priori: through them the reality of phenomena becomes possible in the first place. «The representation of space cannot, therefore, be empirically obtained from the relations of outer appearance». (Kant in the translation from Norman Kemp Smith 1929, p. 69). Despite this, geometry in his opinion is a science that cannot determine space entirely without intuition, that is, in a purely conceptual manner. It determines space through concepts a priori, but at the same time presupposes characteristics of space as an a priori intuition, such as three-dimensionality: «For geometrical propositions […] are bound up with the consciousness of their necessity; for instance, that space has only three dimensions». (Kant transl. Smith 1929, p. 70; http://www.hkbu.edu.hk/~ppp/cpr/toc.html). Kant calls such statements apodictic. The consequence of this is that we can speak of space «solely from the human standpoint». «If we depart from the subjective condition under which alone we can have outer intuition, namely, liability to be affected by objects,the representation of space stands for nothing whatsoever». (Kant transl. Kemp 1929, p. 71). This is a finding that will play a role in relation to the ideas presented later on in this article, when three-dimensional landscape and its subject-bound perception are «tipped» into a two-dimensional, horizon-free and objective representation.

this is where the horizon first came into use as a specialist term. Together with the theoretical data provided by latitude and longitude coordinates, empirical data collection enabled space to be surveyed and thus, ultimately, place to be determined.

The visualization of these place data in maps made the latter increasingly reliable and capable of yielding more information. This in turn facilitated the emergence of an increasingly precise and tightly-meshed network of places archived within a geometrical system of coordinates consisting of latitudes and longitudes as well as height and depth contours. This knowledge and system of surveying also plays an important role in early geography, ecology, and hydrology, sciences that began to emerge as disciplines and institutions from the mid-19th century onwards. Images of various kinds are therefore an integral element within the body of knowledge of these disciplines. Measurement data are represented in diagrams, instructions are given for handling samples and planning travel routes, morphometric schemata and cross-sections of terrain are offered, and morphological drawings and landscape pictures produced – initially in the form of etchings, watercolors and oil paintings[17] and then, from the late 19th century onwards, photographs.

The innovative power and radicalism accompanying the invention and rapid spread of the medium photograpy, compared to previous customary ways of looking, is described by art critic Paul Fechter as an «intrusion of photography» into the world of pictures. Nowadays in the 1930s, he asserts, we want and need to see much more than «before», when «pictures [used to] accompany text»; now, by contrast, we only have «text accompanying pictures». Fechter pointedly attributes the ambiguity of this state of affairs to the difference between the subjective/artistic and objective/photographic origin and reception of images.

> «The way film and photography offer that which they record is one-eyed, through a photographic lens; combinations and excerpts are produced whose effects often border on the artistic, albeit from completely different vantage points. The work of art comes alive through being filled with the life of the artist, the work of photography through being filled with the life of the surface».[18]

In his reference to photography poised at the gateway to art, Fechter sums up polemically what photography itself asserts in equally polemical terms as a method in science and technology (and what makes it so interesting as such), namely the putative neutralization of the photographic lens and, with it, the cultivation of the cartographic and objectified scientific gaze. The kind of expectations people had

17 See, for instance, Chunglin Kwa: Painting and photographing landscapes: pictorial conventions and gestalts. In: *Configurations* 16, pp. 57–75.

18 Peter Fechter: *Der Einbruch der Photographie. Deutsche Rundschau 62,* 1936, p. 121. The attitude of Paul Fechter towards national socialist ideology was recently examined by Andreas Zeising in Ruth Heftig, Olaf Peters, Barbara Schellewald (eds.) *Kunstgeschichte im «Dritten Reich». Bd. 1. Theorien, Methoden, Praktiken*. Eds.. Berlin 2008.

of aerial images, accordingly, were (and probably still are) widespread. This is how geographer Paul Perlewitz gives expression to these expectations:

> «The aerial image depicts – objectively – the current state of the object to be studied; it shows the multiform character of an area of land, often only then enabling local causal interrelationships to become apparent».

What is interesting, however, is how Perlewitz continues, referring to the aerial image in terms of both scientific methods discussed above, the nomothetic and ideographic:

> «On the other hand it brings out the details and characteristic features in a very vivid way, thus greatly supporting current research efforts to study individual phenomena by providing a natural depiction.»[19]

The aerial image thus announces its arrival in rather ambiguous conceptual terms.

4. The Domestication of the Aerial Image – From Weapon to Method?

Photography is rapidly taken up in the disciplines of the field sciences, its usefulness being seen above all in extending the existing inventory of methodological tools. The use of the new medium makes it possible to work more quickly, creating more opportunities to compare objects in space and time. It makes things visible that had previously been invisible to the human eye,[20] documenting and objectifying things that had previously seemed to be at the mercy of the hand doing the drawing.[21] Photography holds out the promise of providing backup for scientific authority: it represents control and objectivity along with greater efficiency and precision. It was brought into play as a new economy of seeing, and it runs through all areas of the field and laboratory sciences, including so-called applied and basic research.

All these elements are amplified when it comes to aerial photography. After the First World War, photogrammetry is conceived of as a cross-cutting technology, one that has great innovative potential, one that opens up new spaces for opportunity. This, indeed, is to be understood quite literally, as photogrammetry is seen and used, in both the scientific and cultural context, as a technology for appropriating space. This is further reinforced by its «vehicle», flight: first with hot-air balloons and then, particularly in Germany, with the Zeppelin airships and, eventually, with airplanes. Optimism regarding the speed and spread of aircraft gives rise to a host of technological visions that stretch the imagination: «There will probably soon be just as many aeroplanes as there are drivers of powered vehicles who populate

19 Paul Perlewitz: *Die Luftfahrt im Dienste der Geographie*. In: *Geographische Zeitschrift 32*, 1926, p.9.

20 Some impressive examples of this include studies of movement by Jules Etienne Marey and Edward J. Muybridge, the inventors of chronophotography, as well as X-ray photography and photographic and film production using optical (light) microscopy.

21 Drawings of microscopically preserved objects, for example, come increasingly to be replaced by photographs.

our country roads today».[22] Bauhaus teacher Moholy-Nagy attempts to grasp the unbelievable thus:

> «Space in every dimension, space without boundaries. Boundaries become fluid, space is recorded in flight: enormous number of relationships. The aeroplane has a special task in this context: new views arise from the aeroplane, from low down to high up, but the most crucial for us is the view from the aircraft, the fuller experience of space, because it alters every previous notion of architecture.»[23]

With the advent of the aeroplane a whole new view of the city and land opened up – «a geopolitical eye»[24]. The incredible and, at first, barely imaginable shortening of distances drew attention to new political possibilities – and vulnerabilities. «By the 1920s, the planet itself had become a manageable standard of measure, a vast space familiar enough for airlines to impose their modernist geometry.»[25]

«Space» here is used not predominantly in the sense of geometry but is rather conceived of above all as «Lebensraum» (living space). Moreover, the distance between «space and nation» (Raum und Volk) and «nation without space» (Raum ohne Volk) is a short one, demonstrating above all how extraordinarily fragile this space is in the 1920s and 1930s, and how ideologically charged. The focus, however, is actually on surface, terrain, nation-state soil.[26] Architect Karl H. Brunner takes up these themes in his attempt to lend the bird's-eye view a little metaphysical gravitas by introducing, in *Instructions of Bird's Eye View* (Weisungen der Vogelschau), the expression «optical spirit of totality». In this way he seeks to generate support for the great unifying whole, to summon up collective enthusiasm for a German Nation, which had already been borne up to unprecedented heights by the airships of Ferdinand Graf von Zeppelin, in particular the Graf Zeppelin[27]:

22 From H. Koppe: Luftnavigierung und die Arbeiten des Navigierungs-Ausschusses der WGL. In: *Jahrbuch der wissenschaftlichen Gesellschaft für Luftfahrt*, 1929.

23 Laszlo Moholy-Nagy: *Von Material zu Architektur.* München 1929, p. 222.

24 This highly apposite expression was coined by historian of science Peter Fritzsche in his highly informative book *A nation of fliers. German aviation and the popular imagination*. He explains: «Nature had become a guest in what was now coming to resemble the global house of humankind.» (1992, 172).

25 Peter Fritzsche: *A nation of fliers. German aviation and the popular imagination*. Cambridge 1992, p. 173.

26 A large corpus of literature exists on this set of themes and, in particular, on the role of geography and ecology in scientifically reifying nation and space. To mention just two of these here: Margrit Bensch: *Die «Blut und Boden»-Ideologie. Ein dritter Weg der Moderne.* Berlin 1995; Joachim Radkau und Frank Uekötter (eds.): *Naturschutz und Nationalsozialismus.* Frankfurt/M. 2003.

27 Fritzsche emphasizes the heroic aspect here, the isolation from the outside, which generated the unifying national feeling. «Numerous commentators echoed this theme of national unity. According to one Konstanz newspaper, the world flight of the Graf Zeppelin in August 1929 had unified the German people. […] Modern technology restored the heroic and in doing so recomposed the nation.» Fritzsche 1992, p. 152.

> «The overall picture shows every inhabitant the area around his home […] This picture-framed awareness of *Heimat* has so far been available only to those who inhabit towns in the hill and mountain areas.»[28]

The aerial image shows *Heimat* from a modern perspective, by presenting the total view from above. It is produced with the aid of sophisticated German technology, while simultaneously constituting a perfect representation of the ideology of «nation and space» («Volk und Raum»-Ideologie). Thus from the 1920s onwards, cultural events, villages, towns, bridges, landscapes, sanatoriums and historical monuments begin to be shown from an aerial perspective. The postcard – also known as «photocard» – helps to cultivate and propagate this new perspective. It rapidly becomes a popular cultural practice: «Nearly all large and many medium-sized towns have felt the need to produce such cards in order to channel their yearning for expansion in the right direction.»[29] The medium is the message, widespread quote from media theorist Marshall McLuhan seems to fit accurately for this cultural practice of creating space (Raumerschliessung).

In order to be capable of being an efficient and, above all, an economically profitable cross-cutting technology, photogrammetry is reliant on the broadest possible disciplinary basis in the sciences. Overtures are made quite explicitly to disciplines that rely on «fieldwork», disciplines oriented towards the scientific work that goes on outside the laboratory and is carried into areas of societal practice, such as cartography, agricultural and forestry, as well as mining, water management and transport, among many others. The following quotation is taken from a talk given in 1927 at the «2nd General Assembly of the International Society for Photogrammetry»:

> «What made the photogrammetry measuring method stand out from most of the others was, firstly, the rapidity of the field photograph (Feldaufnahme), which more or less shows the state of the object to be measured as it is now, then the short duration of the object to be measured, then the brevity of the homework to be done afterwards to deliver the desired outcome before interest in the changing object has started to fade, and finally the vivid nature of the measuring result, which is due to the image-like effect of the photographic method. Set against this, the sometimes lower level of accuracy and the high costs of the field and home work are not always taken into account. Let us now turn to some areas of the economy in which photogrammetry is acquiring significance, beginning with water management.»[30]

28 «[Das] Gesamtbild zeigt jedem Ortsbewohner die Gegend seiner Wohnstätte […] Dieses im Bild gefaßte Heimatbewußtsein konnte bisher nur die Stadt in bergigem Lande darbieten.» Karl H. Brunner (1928) *Weisungen der Vogelschau*, quoted in Carlberg, Klaus: *Zeppelin. Die Geschichte eines unwahrscheinlichen Erfolges*. München 1979, p. 129

29 «(f)ast alle großen und viele mittleren Städte haben das Bedürfnis nach solchen Karten empfunden, um ihren Ausdehnungsdrang in richtige Bahnen zu leiten.» Loc. cit., p. 130.

30 Sebastian Finsterwalder: *Bedeutung der Photogrammetrie für Technik und Wirtschaft. In: Vorträge gehalten bei der 2. Hauptversammlung der internationalen Gesellschaft für Photogrammetrie.* Berlin 1927, p. 11.

The etymology of the name by which the method becomes known in German-speaking countries is intended to mark it off from photography, clearly illustrating once more the programmatic nature of photogrammetry: it is principally to be about measurement and control, about the exact mapping of the terrain. «The significance of photogrammetry lies in the fact that the photographic image provides a perfect determination of a specific state, including every detail, at the moment the photograph was taken, one that can be tested at any time.»[31] It is precisely this – recording the moment – that Paul Virilio identifies as the major strength of photography: it lies in the «momentariness of its [photography's] perception»[32], or again, as Pierre Noras puts it, in the «moment plucked out» from a continuous series of events and becoming fixed as a photographic image. If we consider, in addition, the etymological ambiguity of the Greek suffix *-graphy,* then the politics of naming being pursued by photogrammetry comes much more to the fore. The suffix can be read as being either passive or active, it is an «abstract noun of action or function».[33] «In one brilliant stroke of language, the naming of photography replicates the fascinating dilemma of its own impossible historical and epistemological identity.»[34] Photogrammetry is to be preserved and purified from this ambiguity, which is inherent to the medium of photography from the very beginning. It is an ambiguity which is still acknowledged in the 19th century but which, at the beginning of the 20th century, with the monopolization of photography as an *objective eye* in the scientific context, is increasingly overlooked.

4.1 Taking Feldaufnahmen with the Armed Eye

The «field» mentioned in the quotation by Finsterwalder in 1927 hints at other, additional meanings, though: the «field photograph» is quite plainly associated with military connotations at this time. And so it was, too, even before the start of the First World War, although in this case, the focus had been principally on the use of airships as a vehicle to carry the optical eye. «One might say that certain branches of military science are hard to conceive of without photography.»[35] The exhibition of photogrammetry and aerial photography almost brazenly provides information about their military origins, as the majority of the pictures on show come from the Reich archives and document the strategic as well as didactic importance of aerial photography in warfare. The military past need not pose any structural impediment to civil uses – this is the mantra running through just about all the talks given at this meeting of the

31 Erich Ewald: *Ausstellung über Photogrammetrie und Luftbildwesen. In: Vorträge gehalten bei der 2. Hauptversammlung der internationalen Gesellschaft für Photogrammetrie*. Berlin 1927, p. 15.

32 Paul Virilio: Die Kamera als Waffe und das Ende der Fotografie. Ein Gespräch mit Heinz-Norbert Jocks. In: *Kunstforum «Der Gebrauch der Fotografie II»,* Wien 2004, P. 64.

33 Oxford English Dictionary

34 Geoffrey Batchen: *Burning with desire. The conception of photography*. Cambridge 1997, p. 107.

35 M. Frank: Vorbereitung zum Kriege und Photographie. Photographische Korrespondenz. In: *Zeitschrift für Photographie und photomechanische Verfahren* 51, 1914, p. 474.

photogrammetry society. Take the following example, with its rather unfortunate metaphor of the phoenix rising from the ashes, which is all the more instructive for it:

> «It [photogrammetry, A.E.S.] is still surrounded to a large extent by the eggshells of its wartime development. But once it has shaken these off and become fully-fledged, it will be able to follow freely the line of flight of enterprise for the benefit of humanity. It will pay back with interest the capital invested in it by science in the past and in the present.»[36]

The formulation leaves open the extent to which «science» here is conceived of quite unthinkingly as a part of the military apparatus.

The dual-use aspect of technology appears in textbooks, too, more or less explicitly, more or less intended. *Instructions for reading the aerial photograph* by Eberhard Fischer, for example, was published in the series «Serving in the *Luftwaffe*», containing a first part, *photographs of terrain* and a second part, *photographs of troops*. While this compact little book was intended in the first instance for use in the military context, a whole series of other works existed that pursued a similarly didactic program but were intended more for civilian use. Reading and interpreting aerial imagery becomes more and more a civil society affair after the First World War – not only in Europe but also in the United States, as the book by Herbert E. Ives *Airplane Photography*, published in 1920, shows. The author is himself a member of the military – «officer in charge of experimental department, photography branch, air service» – and does not neglect to make mention of the military origins of photogrammetry. His approach is not so much to frame it as a cross-cutting technology but rather to see it as a science in its own right, namely «aerial photography».

Aerial photography was not alone in having experienced a powerful innovative stimulus during the First World War. Other technologies that were to become part of the canon of the engineering and natural sciences experienced a similar developmental stimulus. These included, for example, the materials sciences and mechanical engineering, which were entrusted with the task of developing an array of different vehicles for use on land, in the air and in the water. Certain sub-disciplines within chemistry, medicine and biology were also affected, as was the development of nitrogen production and bacteriology, which took place in a technoscientific environment. In his pithily entitled book *Forschung als Waffe* (Research as a weapon) Helmut Maier has produced an impressive study, rich in primary material, about armaments research at institutes that were part of the Kaiser-Wilhelm-Gesellschaft during the first half of the 20th century. In it, he demonstrates that a certain political and institutional consistency existed in the web of relationships between the military, engineering disciplines – Maier's study focuses here on materials research – and of science in general. Such points of contact were already considered perfectly normal prior to 1914; in the years leading up to 1918 they shifted even further towards armaments research, so that in the Second World War the following statement was able to appear quite unremarkable:

36 Finsterwalder (1927), p. 14

> «Research serves life quite in and of itself; for that very reason it is a weapon, because it is sustained by its own set of laws and remains aware of its theoretical foundations, which give it direction, power, an eye for the fundamental as well as creative imagination.»[37]

The moment army commanders decided to consider industrial facilities and the civilian population as military targets, so Maier argues, a military and strategic «boundary removal» occurred, taking technoscientific research into society in a real-world or social experiment. The limited geography of the battlefield was left behind; instead, the entire «field» was declared a laboratory for the nation state's armaments research program. Also in the 1920s a process of increasingly close intermeshing occurs between «science and foundation policy and the lab bench», an «industrialization» of the scientific system, which is controlled by a corresponding resource management. More and more scientific institutions are supported by an ever growing number of foundations and orders from industry, mostly with material donations and grants but also by the provision of scientific personnel.

> «‹Doing the rounds› of the foundations and other organisations – including ‹competing› ones –was just part of the daily job of an institute director in the Weimar Republic».[38]

All these interconnections seem to apply likewise to the institutionalization of photogrammtery.[39] But why, then, was Illuft, the International Aero-Limnological Centre, not able to become established? This appears all the more astonishing given that water management, or the object inland watercourses in general, was considered an especially favourable context in which to apply the method, at least from the perspective of one doyen of photogrammetry, Sebastian Finsterwalder[40]. Here he is again: «Let us now turn to some areas of economics in which photogrammetry is gaining in significance, beginning with water management»[41], which he goes on to speak about for almost half his lecture, providing considerable detail about problems and issues to do specifically with water. He speaks of mapping rivers and lakes in inaccessible terrain, of measuring waterforces, and of identifying suitable flood protection measures and more easily implementing them; he also speaks of the de-

37 From a wartime report from 1942 of the same title, from the KWI, quoted in Helmut Maier: *Forschung als Waffe. Rüstungsforschung in der Kaiser-Wilhelm-Gesellschaft und das Kaiser-Wilhelm-Institut für Metallforschung 1900-1945/48*. Göttingen 2007, p. 17.

38 Maier 2007, p. 242.

39 So far there has been no detailed study of this that might elucidate the disciplinary, institutional and technical historical aspects.

40 Sebastian Finsterwalder (1862–1951) held a Chair in mathematics and later in geometry at the Technical University of Munich. His interests included geodesic surveys in the highlands and used aerial images for this, which he himself took (from a hot-air balloon). Finsterwalder tried to institutionalize aerial photography, and he was also a member of the consultancy panel for Graf Zeppelin. (Biographical information at http://www-hm.ma.tum.de/geschichte/node20.html)

41 Finsterwalder 1927, p. 11.

sign of hydraulic engineering measures in general, of how agricultural land might be managed and, finally, of navigation on canals, rivers and lakes.[42]

The section to follow will not be able to clarify entirely the reasons why Illuft failed, not least due to the difficulties encountered in searching for sources. But one or two leads can be followed nonetheless. First, though, let us return to the question posed at the start of this section, namely whether there actually was a domestication of the aerial photograph, an integration into civil society of the dominant bird's-eye view – that is, whether the path from weapon to method was followed. Seeing the camera itself – like research – as a weapon[43] is a widespread analogy. Indeed the figure of the armed eye is an age-old metaphor that also fits well with aerial photography's special capacity to record landscapes scientifically. Using the camera as an instrument, the method of remote sensing creates a distance between those photographing and the world. It generates images that are open to interpretation and yet are considered to be objective. It also makes it possible to occupy land visually and provides the means by which the terrain thus fixed can then be colonized. It seems as if the dual-use aspect of photogrammetry which, regardless of the change from analogue to digital, extends right through to current-day remote sensing is inextricably linked with the medium.[44]

5. Airy Knots: The Rise and Fall of ILLUFT

Illuft, the International Aero-Limnological Society, was established in 1930 at the fifth meeting of the International Association of Theoretical and Applied Limnology (Societas Internationalis Limnologiae, SIL). The host country, after a three-year break, was Hungary, and the main part of the conference took place in the Institute of Chemistry at Budapest University. The initiator of Illuft, Erich Wasmund, had organized an exhibition with picture and map material, which was set up in the neighboring Institute of Mineralogy along with an exhibition of optical and other instruments. As part of the program of entertainment on offer between slide lectures and a steamboat ride, the exhibition is visited by all the conference participants – theoretically about 150 individuals, as this is the number of conference participants registered.[45] Wasmund's lecture two days later takes place, by contrast, in front of «a smaller circle of interested participants», parallel to a talk on «Semi-

42 Finsterwalder was not alone in his assessment. Geographer Paul Perlewitz emphasizes that the aerial photograph facilitates «finding fishing grounds, mussel banks etc. for sea fishing». «In America it has been possible to discover whales and seal colonies from an aircraft. In times of war this method is used to find submarines and mines in the water, which has influenced warfare and global economy thereafter.» (Perlewitz 1926, p. 16f.).

43 Virilio (2004) paraphrases Mussolini when he says that the camera is the most powerful weapon for controlling the people.

44 At any rate as long as warfare is based predominantly on visual and less on acoustic or other signals.

45 The Society had about 650 members in 36 countries at this time.

micro laboratory rapid procedures with demonstrations».[46] *Illuft – Rationale for an Aero-Limnological Center* is the title of the programmatic lecture which, not unexpectedly, concludes with a reference to the urgency of setting up Illuft. The project is supported by a memorandum that had already been circulated in the community and whose commentaries are then published along with it in a special offprint. Interestingly, at the same conference and independently of the Illuft activities, an international exchange of transparencies showing objects of limnological and marine biological interest is agreed. Panoramic all-round views are considered to be of particularly interest, as they are suitable to «determine data from lake typology, silting processes, topographic conditions and conditions important for regional production biology.»[47] At the final conference session on 28th August the participants decide that Illuft should be established, that it should be affiliated to the SIL and operate under the directorship of Erich Wasmund. It is emphasized in doing so that Illuft should function as a kind of organizational interface for limnological research, and that it should be supported by all countries. At the same time, though, «active aerial research remains the prerogative of each individual country».[48] It is also emphasized that Illuft cannot expect to receive any kind of financial support and that it must try «to finance itself with the aid of institutions and state authorities with an interest in aviation», since the SIL was in «rather a state of crisis».[49]

The aim of establishing the Illuft as a company is pursued by Erich Wasmund (1902–1945) from the end of the 1920s onwards. He himself undertakes long journeys by airplane[50], attempts to demonstrate, on the basis of various research questions[51], how aerial pictures could be used in limnology (Fig. 2 & 3). Clearly, then, Wasmund is not content merely to expound theory, he also offers a sort of guide to the practice of aerial photography, referring to his own experiences in exploring the «oceans of the air».

46 Friedrich Lenz: Tagungsbericht. *Verhandlungen der internationalen Vereinigung theoretischer und angewandter Limnologie 5.* Stuttgart 1931, p. 28, 27.

47 Friedrich Lenz: Tagungsbericht. *Verhandlungen der internationalen Vereinigung theoretischer und angewandter Limnologie 5.* Stuttgart 1931, p. 22. This is an idea offered by Buschkiel after a slide lecture given by Thienemann on tropical inland water. Whether or not this collection was created and what became of it, I do not know. This could be interesting with regard to researching visual cultures of ecology.

48 Erich Wasmund: Arbeitsbericht der internationalen limnologjschen Luftfahrtsstelle 1930–1932. In: *Verhandlung der internationalen Vereinigung theoretischer und angewandter Limnologie* 6, 1933, p. 38.

49 *Verhandlungen der internationalen Vereinigung theoretischer und angewandter Limnologie* 5, 1931, p. 28, 12. The Secretary of the SIL, Friedrich Lenz, points out that, after all, International Marine Research also receives state funding and that those countries ought to be just as interested in limnological research. It is decided to write a «letter of application» and to send it via the 36 SIL representatives to their respective governments.

50 Erich Wasmund: Luftfahrzeuge auf limnologischer Erkundung. In: *Arktis,* 1929, p. 41–60 and ibid. Flugbeobachtungen über Mittel- und Osteuropäischen Gewässern. In: *Geographische Zeitschrift* 36, 1930b, p. 528–546, 593–611.

51 Erich Wasmund: Pollenregen. Seeblüte auf dem Bodensee im Luftbild. In: *Paläontologische Zeitschrift* 12, 1930a, p. 73–99.

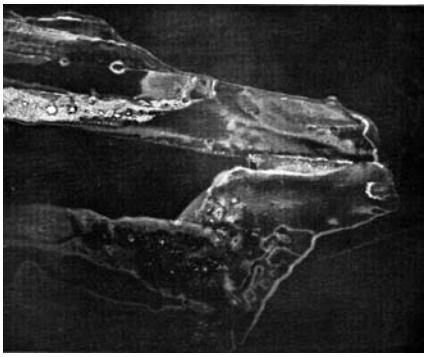

Fig. 2: «Senkrechte Aufnahmen mit der Reihenbildkammer der deutschen Versuchsanstalt für Luftfahrt, Berlin-Adlershof, entstammend einer Aufnahmeserie Februar 1929 über dem vereisten Bodensee. Die weißen Flecken sind sich schon zusammenfügende feste plattige Eismassen, die grauen oder nur schillernden Streifen und Schlieren lose treibende Eisnadelmassen, die bei den Belichtungs- und Durchleuchtungsverhältnissen vom Luftschiff aus sich beobachten lassen, während die Reflexion und die geringe Übersicht auf der Wasserfläche selbst sie dem Beobachter an Bord eines Seeschiffes im allgemeinen ganz verbirgt. Bemerkenswert die schlierigen und gerundeten, gelegentlich auch an rhythmische Fällungsbilder erinnernden Strukturen, die in völlig gleicher Form bei Algenwasserblüten vom Verf. vom Flugzeug September 1929 über dänischen Seen beobachtet wurden und die den Formen der Seeblüte ähneln.»

Fig. 3: «Technisch und örtlich wie Abb.1. Bei etwas niedrigerer Flughöhe und stärker gesenkter Aufnahmerichtung wird der Einblick und die Durchsicht in die Struktur der Pollensuspension deutlicher. Besonders klar erscheint der Ansatz zu rhythmischer Fällung, in Art der LIESEGANG'schen Ringe, im Vordergrund.» («Abb.1: Schrägaufnahme mit Fliegerhandkamera, aus Dornier-Delphin-Flugboot des Bodensee-Aerolloyd durch Pilot W. Truckenbrodt, Anfang Juni 1929 vor dem Konstanzer Trichter im Obersee zwischen Horn (Landspitze des badischen Bodanrücken) und Münsterlingen (Kanton Thurgau), auf Ersuchen des Verf's aufgenommen. Flughöhe ca. 300m, man sieht auf der leicht gewellten Seefläche breite Zonen mit Pollenregen erfüllt, in der Mitte ein typischer gerundeter Streifen dicht schwefelgelb angereichterter Pollen.»)

> «The significance of aviation as a means of limnological research in its own right lies in being able to look at the inland waters from above, to look into them, onto them and through them – all of which is possible only when moving at altitude»[52]

he writes in 1930, thus presenting his scientific community with the prospect of a new method and theory. Wasmund stresses that aviation can and should become a method not only for limnology but that the aerial image has its «own intrinsic value». He goes on to explain what he means by outlining the possibilities that aerial photography opens up to limnology. Wasmund names the following as potential applications: a view of freshwater and riverbanks from above; an insight into the morphological conditions of, say, a catchment area or of beach formations; insight into a river's history provided by a view of soil moisture – visible in its totality only from above; a view of sociological plant formations, identifying turbulences caused by

52 Erich Wasmund: Illuft. Begründung einer Aero-Limnologischen Zentrale. In: *Archiv für Hydrobiologie* 21, 1930c, p. 503.

Fig. 4: «Grimselpaß-Seen. Blick vom Aaeretalursprung nach S über Grimselpaß (2165 m) mit Hospiz, Passstrasse, Grimselsee (1875 m) und Totensee (2166 m) ins Obere Rhonetal mit Dorf Obergestelen (Oberwallis). Flughöhe 4000 m. Glaziale Rundhöckerlandschaft, die Paßseen durch Eisschliff entstanden. Luftbild zeigt regionale Bestimmtheit des hochalpinen Urgebirgssees. Nährstoffarme Unterlage (Gneisgranit, Hornblendeprotogine, Schneedecke spät ausapernd wie auf dem Bild, kümmerliche Vegetationsdecke) Ursache der Oligo-Dystrophie der meisten Paßseen im Hochgebirge, Humusbildung über Waldgrenze, bei fehlendem Kalk sowohl unter wie über Wasser typischer Boden, bezeichnend auch Name «Totensee», ähnlich häufig in gleicher Lage auch «Schwarzer See». Luftbild Einsicht auf Landschaftsbild, Zusammenhang mit Seenentstehung, Übersicht und Aufsicht auf Bodenbildung. Klima und Seetyp als Folge. Hingegen Vertikalgliederung zugunsten des glazigenen Eindrucks zu gering hervorgehoben, vgl. Abbildung bei Collet (Taf. I), mit Blick vom Nägelisgrätli herunter, dort Bodenbildung aus geringerer Höhe mit seinen Vor- und Nachteilen. Abgedruckt auch bei Pesta, dort weitere Lit.

Fig. 5: «Lena in Nordsibirien. Von der Lena, drittgrößtem Strom Asiens, brachte «Graf Zeppelin» aus der Gegend bei Jakutsk ebenfalls ein prachtvolles Luftbildmaterial heim. Aufnahmen zeigen breite Flußniederungen bei herbstlicher geringer Wasserführung, erfüllt mit riesigen Stromarmen, schmalen Kanälen und abgeschnürten Flußbögen. Grüne Wiesen mit Buschwerk über dem in 2m Tiefe ewig gefrorenen Boden heben sich von gelben Sandbänken ab, die Rippelung, Zungenbildung und andere Stromwirkungen zeigen. Über dieser so russischen Weite erhöht hohe Alto-Stratus-Decke imposanten Eindruck sibirischer Monotonie. Man vergleiche solche Strombilder z. B. mit Bodenbildern der Wolga in jüngeren limnologischen Arbeiten, die dem Nicht-Landeskenner nie das wahre Bild von Größe und Formenwelt geben. Nur das Luftbild vermag, wie vieles, auch das (Hervorhebung A.E.S.). Auch der Mensch, dem das Fliegen noch nicht neues Lebenselement geworden ist, könnte angesichts solcher Bilder, die uns das Wort Vogelschau ungern gebrauchen lassen, das Wort Mittelholzers verstehen, das ihn beim Flug über Spitzbergen überkam: ‹Es ist, als ob die Erde ein neues Antlitz, der Mensch ein neues vollkommeneres Auge gewonnen hätte.›»

navigation; the visualization of interference by currents; research into temperature and pressure conditions caused by the movement of water; the mechanics of glacial structures. And finally, seeing through the water ultimately makes it possible to map underwater mountains or to quantify and examine the behaviour of animal groups – and in any case, as Wasmund says, photos are more intuitive than maps (Fig. 4 & 5).

5.1 Ideal Starting Position?

When Wasmund goes to Lake Constance in 1926, the conditions for setting up an Illuft appear especially conducive. Not only are the objects of study, Lake Constance and other Alpine lakes in the immediate vicinity, there are also scientific resources close to hand – the *Biologische Seeninstitut* in Langenargen and the *Anstalt für Bodensee-Forschung* in Konstanz-Staad[53], and above all companies such as *Dornier-Werke* and the *Zeppelinwerke* in Friedrichshafen, with its corresponding «fleet», the *Drachenstation* (Kite Station) Friedrichshafen with its airships, and the Konstanz air travel company. From the very start, Wasmund conceives of the whole Illuft company as a project involving close cooperation between private enterprise, politics and science. This is reflected in the list of supporters and contributors – by no means only regional – to the exhibition at SIL conference in Budapest. They include *Deutsche Luft Hansa* Berlin, *Luftschiffbau Zeppelin*, *Bodensee-Aero-Lloyd*, *Luftverkehrs AG Österreich*, the German Experimental Institute for Aviation (Berlin), the *Wetterflugstelle* (met flight station) of the *Deutsche Seewarte* (Hamburg-Fuhlsbüttel), the Swiss *Luftverkehr AG Astra-Aero* (Zurich), representatives of the *Luftbildstelle* of the Prussian Ministry for Trade and Commerce (Berlin), among others. He is also supported by established scientists in limnology, meteorology and geography, such as Einar Naumann from Lund (Sweden), Franz Ruttner from Lunz (Austria), Wilhelm Halbfass from the Geographical Institute Jena (Germany), Reinhard Demoll from the Bavarian Biological Experimental Institute for Fisheries in Munich and the Director of the MPI Plön, Chairman of the SIL, August Thienemann. Wasmund has a knack, it seems, for «doing the rounds» of the institutions and foundations and creating networks among research and industry. He hopes that his networking activities will also give him access to the stock of aerial images already in existence which, he estimates, amount to about 50,000 pictures.

The companies and also the state authorities are not disinclined to support Illuft, as is clear from the commentaries on the Illuft circular. The company Deutsche Luft Hansa, for example, and the Experimental Institute for Aviation consider cooperation between limnological research and aviation to be desirable. This includes

53 William Maerker worked at this institute until 1927, spending his «spare time taking photographic images of the Lake Constance region from an airplane: splendid pictures bear witness to the high degree of skill he achieved in this art form», as Max Auerbach notes in his obituary in the *Verhandlungen der internationalen Vereinigung theoretischer und angewandter Limnologie* 5, 1931.

airship captain Oberleutnant Hans von Schiller[54] from Luftschiffbau Zeppelin and aircraft captain W. Truckenbrodt from the Bodensee-Aero-Lloyd and Luftverkehrs-Gesellschaft Konstanz, who were happy to assure him that materials, aircraft and hand-held aerial camera «are available as often as possible». The voices of the scientific community are not quite in such accord. Nonetheless there are supporters here, too. They include the Austrian Franz Ruttner, who expects aerial images to be able to provide extraordinary services to limnological research, and the Italian M. Bossolasco, who supports Wasmund not only with a detailed commentary but also with an article of his own entitled *Questioni fotogrammetriche di aerolimnologica*, which was published in the year of the conference, 1930, in the renowned *Internationale Revue für die gesamte Hydrobiologie und Hydrographie*. Even the well-known meteorologist Hugo Hergesell «agree[s] in principle», although he strongly recommends that institutional ties be sought to an established institute, while Swedish limnologist Naumann also considers a «clear, image-based representation of the inland waters» to be desirable and indeed feasible, but scientifically tenable only if they are «real overviews» and if there is no danger of them being mistaken for «a random collection of touristic images that offer no real overview».[55] Thienemann, too, displays a certain skepticism towards the medium of photography, which he sees as a method located mainly in geographical research, whose task it is ultimately to produce a «picture of the Earth's surface».

> «Certainly, this so-called geographical thinking also dominates large parts of limnology: for it is, after all, nothing other than the synthesis of all phenomena which occur in and at a certain *Lebensraum*, and the *Lebensräume* with which limnology is dealing, the inland water, are parts of the Earth's surface, like all other living habitats. [...] But no geographer would see biological limnology, i.e. the idiobiology and biocoenology of freshwater, as being part of his science! Rather, these are parts of general ecology, parts whose uniqueness is conditioned through the particularity of the area of life being studied. [...] Limnology at its highest level treats the inner waters as a unified whole, not only in spatial terms: rather, it conceives of it as a unified whole of *Lebensraum* and *Lebenserfüllung* (living fullness): it sees biotope and biocoenosis in mutual interaction. [...] Limnology as we understand it, though, is saturated at its very highest level with biological perspectives, with biological thinking, and is not content with geographical thinking.»[56]

54 Schiller was also navigation officer on the first round-the-world flight of the LZ 127 from August 1 to September 4 1929, in which roughly 50,000 km were covered in 6 stages.

55 Naumann had identified such unscientific pictures in the publications and considered them to be no less damaging to the reputation of the new upcoming science of limnology *Verhandlungen der internationalen Vereinigung theoretischer und angewandter Limnologie 5,* 1931, p. 27 – and almost verbatim 7 years previously in Einar Naumann: Einige allgemeine Gesichtspunkte betreffs des Studiums der regionalen Limnologie. *Verhandlungen der internationalen Vereinigung theoretischer und angewandter Limnologie 5,*1923, p. 100–110.

56 Thienemann 1931, p. 5. The title of his lecture at the conference, «The Use of the Leica camera in limnological excursions and research trips» (p. 564 f.) appears to contradict the skeptism implied here towards images.

Two points can be drawn from this rather polemic statement:

One is the disciplinary demarcation from geography which had been preceded by a disciplinary wrangle.[57] This may have also meant that the research program of Carl Troll, for example, who was mapping ecotopes based on aerial images, was simply ignored. The second point is the reference to the different kind of philosophical framing of limnology as a science, which seeks to be biological and ecological, in other words, is interested in proposing general theories and laws. At the same time, however, it also turns its attention to the particular, to the gestalt – to the individual lake, for example, or to a plant or animal community in a particular place. And it is precisely this, according to Thienemann – the use of both perspectives – that makes limnology stand out, and indeed makes it even better than geography, because limnology «is not content with geographical thinking».

5.2 Unhealthy conditions

With his *Working report from the International Aero-Limnological Center 1930-1932* in 1933, Wasmund himself announces the end of Illuft.[58] He reports soberly that the goals achieved and the amount of work involved stood in «no healthy relation» to one another. The responses to a circular letter sent out by Wasmund asking for co-workers are rather sparse, the limnological community is not especially interested in aerial pictures, half the inquiries directed at Illuft come from geographers and natural scientists. The financial situation of the aero-limnological center is pretty gloomy, too, principally due to the economic crisis, as Wasmund opines. Since November 1930 he has been at the limnological station in Plön and is able to take advantage here of the resources of Thienemann's institute, but these consist above all, quite literally, in having a share in the postage kitty and in the possibility of setting up and storing a small collection of literature and pictures. This includes especially a collection of aerial images encompassing 525 shots, as well as a few large aerial maps; Wasmund is especially proud of «a splendid aerial plan of the Chiemsee at a scale of 1:5000». Wasmund also refers to the political situation as a factor affecting the sluggish progress of the institution: the emergency decrees made a company such as Illuft virtually a «hopeless» undertaking. The prospect of the «dictated peace» that limited «aerial interests» to German territory and research and development of aviation technology perhaps being less strictly enforced with the establishment of the Reich Ministry of Aviation in 1933 is only a weak hope.[59] Concluding, the reporter

57 The geographers did not want to include the limnologists in their subject canon. For more detail on this, see Astrid E. Schwarz: *Wasserwüste, Mikrokosmos, Ökosystem. Eine Geschichte der «Eroberung» des Wasserraumes.* Freiburg i. B. 2003.

58 *Verhandlungen der internationalen Vereinigung theoretischer und angewandter Limnologie* 6, 1933, p. 34–45.

59 The fact that the Allies' ban on the production of military-related technology was not especially effective is now well-known and could be discussed under the rubric of dual use. Peter Fritzsche points out that as early as «1928, just two years after the lifting of restrictions on German commercial aviation, Luft Hansa flew more miles and carried more passengers than all other European

(Wasmund) explains that he «(must) consider the expansion of the external organization as hopeless, if this expansion meets with no positive response.»

Illuft is not expanded further. A position is created for Wasmund at the Kiel center for marine geology. And thus the trained geologist turns to other techno-scientific projects – underwater drilling and diving, submarine mapping, coastal protection and land reclamation. Whether Wasmund's analog aerial image database survived the war or even acquired significance as a source for post-war limnology cannot be discerned as yet from the archive material available.[60] But was it really principally the unfavorable political and economic conditions, as Wasmund suggests, that meant Illuft could not become a success? After all, in other scientific spheres such as geographical or meteorological research, the method certainly was a success. The arguments suggesting that its failure might have had more to do with matters internal to science can be outlined only briefly here.

6. Iconoclastic Controversies in Limnology

The following quotation taken from a piece about *Remote sensing at Lake Constance* offers evidence for the supposition that satellite-based remote sensing was to develop a strongly heuristic character in limnology from the 1960s onwards:

> «Why aerial photograph? Why remote sensing? The aerial photograph […] has the largest density of information per unit of surface and thus offers an optimum amount of information. […] Images and measuring data from remote sensing [are] a local and national kind of information independent of administrative points of reference, which is needed especially in cases of difficult questions of environmental research and monitoring.»[61]

In the 1960s, if not before, limnology uses remote sensing technology and develops a positive heuristics that enables it, via the technical evaluation of information and especially visual language, to link up with global environmental discourse.

In the 19920s and 1930s there is a series of competing research programs in limnology which range across the entire spectrum from experimental to descriptive research of nature, from nomothetic to idiographic methodology. The *Regionale Seentypologie* (regional study of lake typology) is a synthetic program which is con-

companies combined. […] Junkers and Dornier planes dominated aeronautical markets […]. Even before Hitler's military buildup, Germany possessed in Luft Hansa not only a considerable reserve of trained aviators in case of war but also a fleet of airplanes that experts believed could be converted to military use in a matter of days.» (1992: 178).

60 The initiative would have had to come from elsewhere, such as from institute director August Thienemann, because Marine Commander Erich Wasmund dies on 28.4.1945 as a result of a bullet lodged in his pelvis August Thienemann: *Erich Wasmund (2.8.1902-28.4.1945). Ein deutsches Forscherleben.* Plön 1948. The author is grateful for further information on this archive or other limnological collection projects (see the slide project 1930), which are of particular interest for the project Visual Cultures of Ecological Research (http://bildkulturen.online.uni-marburg.de).

61 Peter Rokosch: Fernerkundung am Bodensee. In: *Garten und Landschaft 2,* 1975, p. 70.

cerned, on the one hand, with classifying and mapping the diversity of individual bodies of water found on land. On the other hand, the lakes are to be examined in terms of their «relations of production» – meaning here not economic production such as fish stocks, but the biological productivity of lakes in general. The question is more one of functional interrelationships, such as the way in which nutrients are distributed and stored in the sediment and free bodies of water, and how the physical-chemical conditions effect biocoenoses (communities of plants and animals). The regional typology of lakes served two purposes: first, to develop scientific theories about the *Seetypen* (lake types), but also, second, to get an idea about the potential of the nation's water resources.

However, there is no agreement about how organisms ought to be entered into a characterization of water body types. August Thienemann proposes that lakes should be classified on the basis of the relations of production of their bottom fauna. Einar Naumann believes that «special faunal characteristics have been too prominent».[62] Another controversial issue is which factors are to be taken into account in characterizing production, and how they are to be weighted. Thus various strands of discussion and debate are sparked off which gradually harden along terminological lines and increasingly develop a negative heuristic until, by the closing years of the 1950s, regional lake typology peters out as a research program. In part, the rigid terminology is not equal to questions concerning functions and processes. In part the program is completed, the recording and typologizing of the lakes accomplished, with some of its specialist terms (such as oligotrophic and eutrophic, referring to low-nutrient or high-nutrient bodies of water) becoming part of the basic terminological inventory of limnology today.

Regional limnology seems almost predestined to be addressed using the aerial photography method. In 1923 – that is, at least 8 years before Wasmund presents his Illuft to the wider scientific community – its founder, Einar Naumann, also holds this view still: he considers «the clear pictorial representation of inland water» to be a very important task because «photographic material selected for the purpose offers, first, a good overview of the dependency of bodies of water on surrounding nature» and thus provides «an excellent illustration to accompany the information on the regional map. Second, though, the most varied culturally-based relations can also be read off from it.»[63] Naumann is so convinced of the idea of «representative images» for regional limnology that he himself takes the initiative and establishes a private archive which, thanks to the assistance of many colleagues, seems to him to be «reasonably useful»; «on the whole, though, it is highly primitive».[64]

At first sight Naumann's problem seems to be above all a technical one: he does not trust contemporary photography to be capable of providing «real overviews»: the advantages of air transport would have to be used better to do this – and that, he

62 Naumann 1931, p. 72.
63 Naumann 1923, p. 105.
64 Ibid., p. 106.

says, is both complicated and costly. His forceful criticism of and rejection of «touristic images put together at random» in limnological publications, however, reveals another area of unease. Naumann recognizes that his community needs to develop a different visual culture in order to be able to use photographs scientifically, yet he sees above all a «touristic» view widespread, a «country and its people» view, which he considers to be unscientific.[65] But what the «right view» looks like that provides these representative images from which the picture data can then be «read off» for limnological questions – in other words, how a «limnological image» must be produced and read – Naumann fails to specify. Accordingly, no photographs appear in his numerous publications about lake types, only conceptual schemata.

The fact that Wasmund's aerial images were by no means «touristic pictures» is documented in the programmatic Illuft publication of 1930: twelve figures are included in it with which Wasmund seeks to demonstrate his new program. He is well aware of the fact that it requires special technical skill to read and interpret aerial images. He attempts to demonstrate where the epistemic gain of an interpretation of aerial images might lie for limnology by reference to the twelve selected examples (see picture captions 4 and 5). His terminology of seeing into, over and onto proves here to be, if anything, somewhat lacking in conviction: he repeatedly reverts to the geological mode of description – it is not so much the image that is being described as the expectation of the «regional determination of the high-alpine primeval mountain lake». His expectation of the aerial image manifests perhaps most clearly in his description of the *Lena in northern Siberia*, namely, that it provides «the *true* picture of greatness and world of forms» (emphasis added). Wasmund provides a thoroughgoing ontologization of the medium of «aerial image» here:

> «It is, after all, a well-known and natural thing, that most limnological text illustrations – if there are any at all – look so similar that one might confuse the one with the other. If that is already true of certain partial views that are important for some specific problem, then even more so for the lake as a whole, as an individual, which almost never fits into the film plane. It is a different matter with the aerial image, which captures the lake as organism in its entirety, intermeshed with the landscape which, like a mother, enables it to form and mature.»[66]

This suggests yet another interpretive possibility as to why Wasmund had such little success with his Illuft. He may have been capable of making the right contacts with industry and state authorities, and even the scientific community was prepared to accept images as epistemic objects. But what Wasmund was not able to do was to demonstrate an appropriate method of interpretation that would have convinced,

65 The extent to which there is a hint here also of establishing a distinction from geography as a science, possibly also specifically from German geography, and/or colonialist programs of expansion, the stylization of the other as exotic, must remain an open question here.

66 Wasmund 1930c, p. 506. The language here also reveals Wasmund's proximity to the current ideology at the time. But this is not the place to investigate his ideological involvement in the Dritte Reich – however, it would be an important issue to grasp the full picture of the failing of Illuft.

for example, tourism skeptic Naumann of the epistemic gain to be had from aerial images. Instead, he drifts off into an almost mystical organicism which, in a certain way, represents a reversal of perspective with regard to the motif of landscape in early plein-air painting. For Wasmund, it is not nature that is «transformed» into the image[67], but conversely nature which appears to disappear completely in the picture: the aerial image captures the lake. This stands in stark contrast to the description of the image which he offers, however, as here the aerial image is credited with as good as no cognitive function whatsoever: the «regional determination of the regional primeval mountain lake» is already given before the aerial image has even been looked at and interpreted. Wasmund's ontologizing holistic rhetoric is quite at odds, at any rate, with the contemporary use of aerial images by geographer and landscape ecologist Carl Troll, who definitely was not after the «unifying view from above» but rather sought «a fragmented landscape»[68]. Whether or not Troll really was able to divest himself of holistic rhetoric and, if so, what then distinguished his natural philosophy from that of his colleagues, must remain an open question here, as must the question of whether a notion of fragmentation played a role in regional limnology, which was ultimately concerned with developing at once a functional and typologically efficient system or organization for different bodies of water in the landscape. One interesting point of debate would also be whether spatial fragmentation is «produced» by a raised horizon.[69] This, it seems to me, can be proven neither by theoretical nor by historical arguments. On the contrary, it seems to have been very difficult – if not impossible – to resist the impression of a «total space» in the face of the first photographic images taken from a «bird's eye view». The «fuller experience of space» so pleasantly formulated by the artist Laszlo Moholy-Nagy is described as being virtually unavoidable, bringing into play an «enormous number of relationships».

Perhaps, to conclude, this leaves more questions open than were posed at the start of this piece. It is my hope, nonetheless, that the narrative strands mentioned at the beginning are now ready to be picked up and woven further or re-spun, enriched with further visual material – or that they may even bring to light new visual material.

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67 To remind the reader, here again is the statement made by Koschorke, quoted in the introductory section «Changing perspectives? From maps to landscape and back»: «The transformation of nature into image is supposed to occur – as with the growing fashion of plein-air painting – there and then.» (1990, p. 144).

68 Chunglin Kwa: Painting and photographing landscapes: Pictorial conventions and gestalts. In: *Configurations* 16, 2008, p. 65.

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