Measuring Photographs

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ABSTRACT: This article investigates relationships between photography and measuring. It outlines main types of visual measurement within scientific photography (such as spectroscopy or photogrammetry) and proposes to broaden the analysis by understanding measuring as a visual cultural technique, which has a particular reach outside scientific institutions and uses. Here it connects arguments from media theory with questions of photography and argues that the centrality of measurement and metrics can be backtracked from current focus on questions of digital data to earlier techniques and discourses of visuality. It traces the conjunctions between the practices of imaging and measuring in the Renaissance, offering a genealogy that aligns photography with acts and processes of measuring, comparison, standardization and scaling as both their effect and cause. Making or looking at photographs always implies sighting, gauging, measuring and co-measuring, which as cultural techniques can be approached as recursive chains of operations.

Introduction

While finishing the manuscript of this article, we have been, like most people sitting in front of their computer screens, distracted by yet another technological feat-cum-spectacle: the landing of the Perseverance rover on Mars. The live coverage of the entry, descent and landing phase (often referred to as “seven minutes of terror” because the sequence happens faster than radio signals can reach Earth from Mars to confirm what has actually happened) was peculiarly segmented due to the approximately 200 million km distance we were “watching”. A “real-time” computer animation of what was ideally happening during the descent was followed some 11 minutes of the communications delay later with a confirmation of the touchdown from the rover itself. Few more moments later, Perseverance beamed back (also immediately tweeted) its first photographs

to offer a more commonsensical, veridical proof of its landing on the Red Planet. These were intentionally low-quality files to travel fast, and they were grey and grainy because taken through the camera's dust cover.

The power of such “poor images”, to borrow Hito Steyerl's term, cannot be underestimated; plain snapshots of remote and inaccessible places from the microworld to distant universe are widely circulated to raise awareness, appreciation, public support or funding of scientific enterprises. But these images, even if soon supplemented with more examples in colour and high-resolution, simultaneously conceal why they have been made in the first place. Scientists themselves surely enjoy similar photographic updates from their robotic colleagues but at the same time get busy with preparing petabyte hard drives for storing and analysing them. Decades of space missions have meant millions of images sent back for the specialist uses, of which only the very few make it to public circulation as “iconic”. The operational use is interested in the rest.

Making pretty pictures of Mars is essentially only a by-product of a complex of sophisticated scientific instruments, in which cameras couple with sensors, radars, scanners, lasers, ultraviolet and X-ray spectrometers to examine rocks and soils from a distance, identify their chemical and mineral makeup and seek organic compounds that may be signs of past life. Cameras can do and also do much more than just take pictures for humans to look at, photography is a multi-functional family of technologies and one of its principal functions has always been to assist in measuring things. Its measuring function reciprocally interacts with its image-making function; observation, measurement and representation connect and combine not only in the sense that images may serve as surrogates for objects, allowing further manipulations and investigations, that is that photographs can be measured to find out something about various

phenomena and processes, but also, as the intentionally ambiguous title of this paper suggests, photographs can be measuring aids and devices in themselves, gauge the spheres of the visible and invisible both within and outside the sphere of science. This argument resonates with recent discussions in media theory such as Wolfgang Ernst's argument about technical media fundamentally grounded in measurement[1] but it also can be elaborated through the narrative offered in this article, more focused on a particular genealogy of the image. Looking at photographic images and practices in relation to measurement is particularly apt when this is prescribed in relation to current data practices – such as data visualization – but, as the argument in this article shows, modern and early modern treatment of materials and their heterogeneous reality by way of measures, and measuring itself becoming a core cultural technique of standards but also how images, specifically photographic images, are implied in the modern discussion about the measured mass and organisation of society (as image).

Measurement and Scientific Photography

The relationship between photography and measurement has been so far discussed primarily within the context of scientific photography. Such a preference is understandable since science becomes photographic and photography becomes scientific precisely through and as various practices and techniques of measuring and co-measuring. This is also the grounding narrative for a variety of nineteenth century combinations of photographic techniques from daguerreotype onwards: a particular way of combining photography with various scientific measurements such as in astronomy, and thus contributing to what then could be called the ideal of mechanical objectivity.[2] Much of the discussion of image and data could be said to concern a modern division in practices of knowledge, but it does not necessarily always work in such neat and tidy periodisations. In a recent and rare contribution to our problem, Patrick Maynard highlighted the

versatility of the family of technologies we call photography, in which depiction of recognizable scenes can be seen only as one of its many functions. “A society that banned depiction of anything that is in heaven above, the earth beneath, or that is in the water under the earth could be technologically modern and heavily dependent on photography.”[3]

In any case, measurement is often seen as a hallmark of the post-Enlightenment modern rational scientific enterprise and a privileged source of knowledge (as well as methodological conundrums), especially in the natural and empirical social sciences. The emergence of modern systems of measurement historically coincides with the emergence of photographic technologies; besides their common social, cultural and economic background both technologies also share epistemic ideals of precision, consistency, convertibility, objectivity and universal accessibility. Early commentaries on photography (from Arago to Talbot, Poe to Holmes) stress the advantage of photography to provide minute, accurate and commonly-scaled data; photographs have been used to measure anything from the brightness of celestial objects to subatomic particles, from motion to social phenomena. Here, questions of photographic images, measurement and especially the work of standards[4] go hand in hand as the infrastructure of what then becomes coined as scientific photography that actually includes an assemblage of different techniques.

In *Photography and Science*, Kelley Wilder aptly summarizes various approaches to measuring photographs, in a short subchapter entitled “The Impulse to Measure”. Photographs depict specific objects at a specific time and in a specific place and measuring photographs can tell us something about those particular objects or their states and conditions. Photographs can be produced intentionally to be measured or one can measure photographs that were originally produced for other purposes. “The very notion that photographs could possibly be measured

forms the foundation of various types of scientific photography, such as Raman spectroscopy and photogrammetry, two methods that bend photographic observation to mathematization."[5]

According to Wilder, spectroscopy is a field that basically dispenses with the pictorial: measuring diffraction through photography does not produce images that would depict anything recognizable but rather collects light over time to produce spectral images as quantifiable data. As a special case in point, photogrammetry contains visual information alongside the mathematical. In any distant surveying, we need control or orientation points that make it possible to read certain parameters of the scene through its photographs. We can extract measurements from the photographs, while a lot of their pictorial detail can be seen as irrelevant or accidental. "Unlike the Raman spectrograms, photogrammetric photographs provide a picture we can recognise as a photograph."[6] Yet, the photogrammetric practice becomes primarily about data that has multiple uses based on institutional needs from military operations and planning to cultural heritage, architecture to territorial surveys.[7]

However, the way Wilder phrases the difference between spectroscopy and photogrammetry deserves attention. Spectrographic images are seen as "unconventional records", "images that don't appear to depict anything recognizable" and often are not considered photography at all, while photogrammetry offers "much more pictorial images". A human observer looking for depictions that are more or less coextensive with their unaided vision creeps in as the agent of distinction. However, technically speaking, the distinction lies in the instrumentation, in the different ways electromagnetic radiation was tamed before hitting the photographic emulsion and in the miscellaneous expert ways of seeing required by such instrumentation. It is rather significant that Wilder's book reproduces a large number of fascinating photographs but no cameras. Or we can argue that "cameras" as the scientific

imaging instruments rarely resemble ordinary photographic apparatus and employ a wide variety of methods, from cameraless to post-lenticular, typically interconnected assemblages of control mechanisms, modulators and detectors. This distinction is central in understanding one core aspect of the link between photography and measurement as mediated in questions of instruments.

However, the nature of the instruments of measure is not merely restricted to scientific practices, as has become clearer over the past years of alternative techniques of visuality of data. Photographic measuring, seen as an unconventional practice conducted in scientific laboratories, has become much more apparent recently due to digital imaging and visualizations of data. In Sean Cubitt's words:

> Today scientific measurement has become the dominant mode of realism. The older realism (today often referred to as photorealism, as if the analog camera and the human eye were indistinguishable) is a humanism: it depends on the idea that the true measure of reality is the human sensorium and that representations of things too big or small or fast or slow for human vision are therefore not "realistic." This opens the doors to important new visual technologies such as data visualization, especially important for displaying material – such as climate change – which is only mediately visible to human beings. Digital imaging partakes of that level of scientific realism, scoring, collecting, comparing, and assembling, but no longer articulating through the single universal portal of the human gaze. In its place, an automated system of measurement and statistical comparison has emerged.[8]

In contrasting photorealism with the realism of scientific measurement, Cubitt pinpoints the issues we want to investigate in the following pages. However, our approach is not one of contrasting the older photorealism (pictures) with the current realism of measurement (data) but rather of showing certain complicity of imaging and measuring, which also has its history. This history is also broader than a focus on scientific measurement and thus also starts to build our argument about the broader implications of measurement as a cultural technique.

Measuring as a Cultural Technique

Our main aim is not to engage in philosophical discussion of measurement and its role in science, technology or modern society. However, a few preliminary observations are needed to clarify what we mean by measure and measurement because to understand the conjunction between measuring and photography, it is necessary to move beyond the realm of scientific imaging and outside of a purely mathematical doctrine of measurement. We propose, in short, to understand measuring as a cultural technique that however also has a particular reach outside scientific institutions and uses. A technique more mundane and ordinary, pre-scientific in the sense that it hasn't yet become a coherent and standardized scientific method but is no less important, rather the opposite: it brings along an elementary form of getting hold of the world, of its practical appropriation, organisation and parametrization. Cultural techniques, in brief, are such fundamental (even anthropological) techniques that precede the concepts they give rise to; “People wrote long before they conceptualized writing or alphabets; millennia passed before pictures and statues gave rise to the concept of the image; and to this day, people may sing or make music without knowing anything about tones or musical notation systems” as Thomas Macho puts it.[9] In our case, cultural techniques of measuring speak to the grounding operations through which standards, relations, and their quantification can take place. They are operative

parts of modern institutions and as such, are also mediating between aesthetic and epistemic practices: measure, division, counting and numbering, and many others are examples of such cultural techniques that can take place also through images. As Cornelia Vismann points out, the operation of a line can itself trigger a cascading chain of implications where the cultural technique is then retrospectively also of legal, material, and mediating value:

> To start with an elementary and archaic cultural technique, a plough drawing a line in the ground: the agricultural tool determines the political act; and the operation itself produces the subject, who will then claim mastery over both the tool and the action associated with it. Thus, the Imperium Romanum is the result of drawing a line – a gesture which, not accidentally, was held sacred in Roman law. Someone advances to the position of legal owner in a similar fashion, by drawing a line, marking one's territory – ownership does not exist prior to that act.[10]

In a similar manner, cultural techniques of measuring can be said to operate at the back of a number of institutional practices and which itself deserves attention: not only as a theme of quantification – of turning the world into a number – but a variety of material, institutional, and visual, even tactile contexts that define the stakes of measurement itself. The metrological impulse of measurement is often seen as the work of standards but it also operates at the back of different material instrumentation where images are one part in a longer chain of recursive cultural techniques. Hence, for example in administrative terms, the links between measurement, listing, counting, and governance are one such example.[11]

Before addressing measuring photographs or measurements turned into photographs, it is necessary to consider photography as a means of measurement in itself. While this link is clearly a core element in the work that recognizes the role of technical images from photography to cinema in scientific work, it also relates to a non-scientific sense of what measurement does in terms of images. This move will also enable us to bring visual culture and its practices closer to the critical debates over the current intensification of measurement and metrics, when different kinds of assessment, quantification, establishing equivalencies are embedded, multi-scalar and active components of our everyday lives, central to how our lives are ordered, governed and defined. Measuring expands beyond the worlds of science and technology and becomes an everyday routine, nourished by data-gathering devices and data-processing platforms.[12]

Even if we claim that measurement is by now a cultural technique that is scaffolding for a variety of other societal mechanisms of quantification, valuation, classification, sorting, etc., we can find some help through Rudolf Carnap's distinction between three different kinds of scientific concepts: classificatory, comparative and quantitative.[13] Classificatory (or qualitative) concepts place objects within a certain class, such as objects that are blue, cold or cubical. They can be weak or strong (animal, vertebrate, mammal, dog, poodle…) and so constitute wider or narrower classes. A comparative concept, such as “warmer” or “cooler” relates one object to another object, in terms of more or less with respect to the same attribute. Before measuring temperature with calibrated thermometers, one could compare and rank objects by using, for example, their skin as a gauge. Finally, quantitative concepts attribute specific amounts to objects while using numerical expressions, for instance, being 1 meter long, having a mass of 2 kilograms, or lasting 5 minutes. Quantitative concepts allow for making more precise classes and comparisons; they build on the former, “less scientific” concepts and open up the possibility not

only of quantification but also of computation and modelling. Although many aspects of Carnap's view were seen as problematic by later measurement theory, he introduced a helpful and intuitive distinction, which reflects both historical development and a certain classification of sciences. His three kinds of concepts also imply kinds of *practices* employed outside of the field of science. Placing things into classes, comparing and quantifying them are routine, everyday cultural techniques that often entail various affective, perceptual, material or technical gauges, scales and rules.

One important dividing line intrudes into Carnap's hierarchical sequence: classificatory and comparative concepts are typically observational while quantitative ones require a substitute for our perception, some sort of device or instrument that detects, registers and often records the particular quantity. Measured data need to be, however, somehow accessible to human observers and a different kind of perception emerges, one of reading the gauge's marks against a metricized space:

> In order to find out the time, weight or speed of something, to be able to say how heavy it is, what time it is, or how quickly we drive, is it not sufficient only to watch the pointer on the scale of the respective measuring device? This way of measurement by *reading* the data off the scales of measurement tools or instruments seems so easy only because we do not consider all the necessary empirical and theoretical presuppositions which facilitated the construction and employment of these measuring devices.[14]

The dials and scales of measuring devices belong among the oldest (as well as the most ubiquitous) visual media that substitute for or rather bypass direct sensory perception. It is not

modern scientific imaging methods or even the telescope or the microscope that have ushered us into the realm of the invisible, but rather sundials, clepsydras and balances that had prompted the technique of visual reckoning and cultivated what Ofer Gal and Raz Chen-Morris call "empiricism without the senses".[15] The theoretical and methodological discussions of measurement are mostly concerned with what and how is measured but rarely address the equally important question of how are measurements presented and perceived: "what *shows up* when we measure, and [...] how we *show* (display) our measurements to ourselves".[16]

As an advocate of logical positivism, Carnap was mainly concerned with the specific language of science. But measurement is a practical and empirical procedure that entails much more than assigning numerical values to concepts. Visual and tactile manipulation, communication and thinking are central to its development and use, both within the expert communities of engineers and scientists and in the wider sphere of everyday life. Measurement is embedded in objects – not only in measuring devices but in all those that were measured while being made, including the word count of this article, the deadline it was due, or the potential impact it might generate. Measurements are thus assumed in a variety of projections and assumptions that then build up in other expectations that define a whole logistical apparatus of what goes where and when and by whom. Measurements are also embedded in images and in the devices for making, viewing, storing and disseminating those images, which typically begin their life as technical plans, parametrized images used in the process of designing and manufacturing objects.

On balancing images

Quentyn Metsys's *Moneylender and his Wife* (aka Banker or Moneychanger) from 1514 is a masterpiece of the Flemish renaissance that beautifully illustrates the transition from medieval to

modern world. It was made in Antwerp during its transition from a small fishing and crafts town into a major trading centre, a cosmopolitan port which became the principal city for commerce between northern and southern Europe. On the counters of merchants and dealers of this economic capital of Europe, exotic goods and materials met and were exchanged: spices from India, English textiles, sugar from the Canaries, French wines, Dutch cheese and fish were shipped to and from various destinations in Europe, Asia, America and Africa. One consequence of this busy commerce was an equally vigorous exchange of currencies, which came in large numbers and varieties.

Metsys's genre painting shows the banker carefully estimating the value of coins that have arrived with merchants from different corners of the world by measuring them one against another according to their weight. The neutral character of both figures suggests it is an allegorical painting rather than a commissioned piece by a particular banker. It diverges radically from traditional portrayals of bankers and moneylenders who typically represented parsimony or greed; what we see instead is a concentrated play of gestures tied up with the measuring instrument. The balance is similarly devoid of its commonplace metaphorical significance; it is not a symbol of last judgment but a practical tool used to establish relationships between different material and geopolitical entities. It represents a nexus of the burgeoning global capitalist trade. The wife, reading a prayer book, overlooks her husband's business suggesting that trade shall always be supervised by moral values.

In the background of the painting, we can see shelves with various objects including some paperwork. It is most likely that while weighing the coins, the moneylender would also write his measurements down. More than that, he would record, in a neatly organised manner, his assets and liabilities to provide visible evidence of his network of transactions. He would

quite probably use double-entry bookkeeping, which emerged in Italy during the fourteenth century and was disseminated especially thanks to a chapter on accounting in Fra Luca Pacioli's *Summa de Arithmetica, Geometrica, Proportioni et Proportionalita*, published in 1494. According to Pacioli, a merchant should have three books: a journal, a memorial, and a ledger, a balance sheet with debits and credits separated. What Pacioli proposed (or rather described and systematized) was a technique of visualizing a set of input and output relations, balancing measurable quantities on a paper in a very similar manner the moneylender would do with the three-dimensional instrument in front of him. Perhaps we can see their difference as one between hardware and software, material and conceptual techniques for making relationships visible and generating a common ground, on which different entities can be brought together through acts of co-measuring. Although Pacioli is remembered today particularly for his contribution to the history of accounting, we should also pay attention to the larger context of his book and work: he gained his education in mathematics and geometry in the family of Piero della Francesca, in 1470 moved to Rome, where he lived as a guest in Leon Battista Alberti's house and later closely collaborated with Leonardo da Vinci, who supposedly illustrated Pacioli's treatise on the golden ratio, *De divina proportione*.

A similar shift from metaphorical to practical understanding of the balance can be found in a short but remarkable dialogue by Nicholas of Cusa. *Idiota de staticis experimentis* (The Layman on Experiments Done with Weight-Scales, 1450) concerns the practical application of weighing in various areas of knowledge and science; through a discussion of a learned Orator and a pragmatic Layman, Cusanus proposes an empirical research program based on weighing individual things in order to compare their different weights and to gain new kind of accurate and precise knowledge. “It seems to me that by reference to differences of weight we can more truly

attain unto the hidden aspects of things and can know many things by means of more plausible surmises,"[17] says the Layman and continues with a number of examples to show that, for example, different weights of two seemingly identical objects (say, volumes of water) reveal a hidden, invisible difference in their nature. Weighing can be also used to assess the health or sickness of various individuals:

> If you were to allow water to flow through the narrow aperture of a water-clock into a basin during the time that you counted the pulse-beat of a healthy adolescent one hundred times, and if you did a similar thing with respect to a sick adolescent, don't you think that there would be a difference of weight between those [two collections of] water? [...] Therefore, by reference to the weight of the [collections of] water we could ascertain a difference of pulses in the case of someone young, someone elderly, someone healthy, and someone sick. And, likewise, we could arrive at a truer knowledge of the illness; for, of necessity, there would be one weight with respect to one illness and another weight with respect to another illness. Hence, from a consideration of such different experimental results pertaining to the pulses, together with a consideration of the weight of urine, a more accurate judgment could be made than [could be made] merely from feeling the pulse and [assessing] the color of the urine.[18]

This is only a short demonstration of a 20-page list of awkward, cumbersome comparisons and twisted conversions; the Layman similarly proposes to measure minerals, metals, plants, or the amount of water running out from a clepsydra that can be again used to measure other things from heartbeat to musical harmonies. It is not enough to measure things by means of a weight-

scale, the measurements should be "recorded both serially and multiply"[19] in different provinces and brought together and collected in a book. Needless to say, the method seems extremely intricate to us because we are used to simply read numbers off scales and easily forget that measuring, for example, temperature involves some sort of figuration of the expansion of mercury or of the changes in electrical resistance. However, the significance of Cusanus's new program of knowledge-making cannot be overstated, for he puts forward a method that is truly universal and that will gradually develop: first among practical professions (making and trading things), then sweep over the sciences in the nineteenth century (in what is sometimes called the "second scientific revolution", in which the study of natural phenomena was given mathematical expression through precise measurement, starting with statistical mechanics and physics), and permeate the whole realm of culture today. In his last, unfinished works, Vilém Flusser identified "Cusanian revolution" as the key moment when human thinking was recoded from alphabetical to numerical mode.[20]

Cusanus's dialogue can be fruitfully read next to the famous treatise *On Painting* (1435) by Alberti, his contemporary.[21] Alberti's understanding of linear perspective embodies a very similar program of ubiquitous comparisons and co-measures – we can never know the thing in itself but only by comparing it with other things. To make an image of the world is to take a measure of that world; the image is build upon relations and proportionality:

> For this reason the surfaces in a painting certainly appear very clear and very bright when the same proportion occurs there between black and white as [occurs] in the objects themselves, of an illuminated thing compared with a shaded one. All these things, then, are found out by comparison. In comparing therefore the objects, there is certainly such a

> power as to make us conscious of what is more, less, and equal. Consequently, we say what is great is greater than this small [object], very great what is greater than this great object, lucid what is clearer than a dark [object], and very lucid what is more lucid than this clear object.[22]

The understanding of things occurs only through comparison and measurement, says Alberti while setting up the agenda for visual arts of next centuries. "Mensuration is a fundamental power of vision, and measurement must find a precise expression in depiction. Exactly measurable quantity is one of Alberti's central concerns because it is by means of measurement that we are able to give certainty to the judgments of vision."[23]

Probably the most famous link between measuring and image making is provided by Albrecht Dürer less than a century later. His *Treatise on measurement* (1525), best known for instructions on precision drawing, was intended, as the artist declared in its introduction, not only for painters, but also for goldsmiths, sculptors, stonemasons, carpenters, and all those for whom using measurement is useful. In his book on painting and experience in fifteenth-century Italy, Michael Baxandall has drawn attention to the widespread skill of surveying quantities, the "public's general disposition to gauge" that permeates the practical, mercantile and painterly geometry alike. The problems of proportion pervaded theological, philosophical, scientific but also practical matters and gauging became a daily practice of understanding relations between things and between things and the perceiver:

> To the commercial man almost anything was reducible to geometric figures underlying any surface irregularities – the pile of grain reduced to a cone, the barrel to a cylinder or a

> compound of truncated cones, the cloak to a circle of stuff allowed to lapse into a cone of stuff, the brick tower to a compound cubic body composed of a calculable number of smaller cubic bodies, and so on. This habit of analysis is very close to the painter's analysis of appearances.[24]

We have to be careful not to mistake this kind of practical gauging with later precision measurement, this is a different and a more rudimentary form of quantification: to quantify does not necessarily mean to numericize or digitize. Although we can claim that the "[p]ainter-mathematicians of the quattrocento painted with a picture unit, a quantum, in mind",[25] their images were, so to speak, poor and came in low resolution, in the sense that the quantification has not permeated the material texture of the image. The techniques of visualization-cum-quantification, amplified by printing, were gradually impressed into a still larger family of objects, shared by still larger groups of people – they are simultaneously material and social. The desire to quantify reality did not emerge from applied mathematics, from the search for or imposition of mathematical laws but rather the opposite; it developed bottom-up from various administrative, trade and fabricating practices and the need to connect them and make them work together. "Precision requires standardization [and] agreement about standards of comparison. This point is important because it shows that precision is never the product simply of an individual using a carefully constructed instrument. It is always the accomplishment of an extended network of people."[26]

Seeing as sighting

Photography incorporated standards of realistic picture production; the photographic camera emerged as a device designed to meet specific pictorial requirements defined in the Renaissance

and further naturalised the concept of two-dimensional visual field.[27] The quantitative comparison between the picture and its object, repeatedly invoked by writers on perspective, became embodied in the photographic apparatus, externalised in and automatized by the camera. It is important to note, following a remarkable paper by Jehane R. Kuhn, that perspective did not emerge as a response to some inherent need of painting, as a technical solution to a problem painters might face in an effort to produce realistic impressions, but rather was an impingement on painting from without that advantageously converged with pictorial concerns. According to Kuhn, perspective was derived from a cluster of formulas and routines for indirect measurement and "arose within surveying practice, as a topographic technique."[28] A correct perspective construction was presented as a kind of transcription of objects or scenes, a method of determining proportions and relations from a distance. It was not understood as coextensive with human vision but rather "speaks of vision artificially constrained, stabilised and geometrised by the use of measuring instruments; it belongs to the vocabulary of surveying".[29]

In photography, such constraints and stabilising procedures are performed by the gear and materials used (at least since their industrial production). The camera becomes thoroughly standardized to meet specific pictorial conventions and one of its effects, constituting a dramatic change in the form of representation, is the levelling of visual attention both within and in between photographic images. In Walter Benjamin's words:

> To pry an object from its shell, to destroy its aura, is a mark of a perception whose "sense of the universal equality of things" has increased to such a degree that it extracts it even from a unique object by means of reproduction. Thus is manifested in the field of

> perception what in the theoretical sphere is noticeable in the increasing importance of statistics.[30]

Benjamin's take on the homogenising and equalising effects of photography is typically interpreted through its links to the exchange relations of modern capitalism, to money as the "universal equivalent" in circulation. Alan Sekula's reading of Oliver Wendell Holmes's essay on stereoscopy was instrumental in establishing this relationship and in understanding photographs as "capable of denoting the quantitative exchangeability of all sights".[31] Notwithstanding their peculiar historical complicity, both money and photography are remediations of a more rudimentary cultural technique, one of measuring or, more precisely, co-measuring. Measuring implies comparison, which in turn implies the observation of entities that are being compared. The operational economy of the process of co-measuring gravitates towards quantification and numerical expression although it can very well linger on the level of more or less, bigger or smaller, brighter or darker, closer or further.

Here, the triangle of concerns around measure, comparison, and subsequently scale become tightly interlinked both in the history of photographic practices as demonstrated in this text and in broader terms, as part of institutional uses of measure and measurement. The scholarly interest in questions of standards and standardisation has been renewed which has led into the broader interest in logistics of images which furthermore reinforces the point about cultural techniques of measurement in and out of photography. Measure and measuring is to be treated as part of recursive chain of operations that diachronically and synchronically maps out a regime of knowledge practices embedded in aesthetic practices. While the interest in measurement has become a core tenet in relation to contemporary issues of digital aesthetics,

data culture, and metrics, it is thus also part of this complex web of institutional operations. Furthermore, even if the main focus of this article has been on photography, the history of measurement in cultural techniques of images relates to those issues in renaissance and early modern painting as well which helps to illuminate the stakes. In an earlier context Tomáš Dvořák has argued that techniques of measure and quantification are to be considered as generative methods that are more operative in constructing worlds than merely passive representations of proportions that precede the act of measurement.[32] This is less a relativist stance than it is eccentric (in the epistemic sense): in other words, it refers back to the possibility of establishing measures across seemingly incommensurable scales which can be connected in the act of measure: the astronomically distant, the gigantically large, or the subatomic small are logistically connectable based on established standards where also the role of the visual persists as a connective glue across such scales of impossible, or indeed eccentric comparisons. What's more, and central to our argument in this article as well, is that this is not restricted to scientific measures. Also other institutional contexts of visuality and images have to work through various heterogeneous categories of in/visibility, un/seeability, un/observability, in/accessibility, un/noticeability as the constant work of adjustment, scaling, and negotiation takes place as an active production of reality. Instead of merely tracking reality, measurement and its accompanying cultural techniques are productive of the real.

[1] See e.g. Ernst, *Chronopoetics*.
[2] See Daston and Galison, *Objectivity*.
[3] Maynard, "Photo Mensura," 47.
[4] See e.g. Canales, *A Tenth of a Second*.
[5] Wilder, *Photography and Science*, 34.
[6] Ibid., 41.
[7] See Albertz, "140 years of 'Photogrammetry'," Laussedat, *Recherches sur les instruments.*.
[8] Cubitt, *The Practice of Light*, 108.
[9] Macho, quoted in Siegert, *Cultural Techniques*, 11
[10] Vismann, "Cultural Techniques and Sovereignty," 84.
[11] See Young, *List Cultures.*
[12] See e.g. Beer, *Metric Power*, Lupton, *Quantified Self*, Mau, *Metric Society*.
[13] Carnap, *Philosophical Foundations of Physics*, 51–121.
[14] Berka, *Measurement*, 2.
[15] Gal and Chen-Morris, "Empiricism without the Senses."
[16] Maynard, "Photo Mensura," 41.
[17] Cusanus, "The Layman on Experiments," 606.
[18] Ibid., 608.
[19] Ibid., 624.
[20] See Flusser, *From Subject to Project*.
[21] On the Cusanus - Alberti relationship see also Harries, "On the Power and Poverty of Perspective" and Carman, *Leon Battista Alberti and Nicholas Cusanus.*
[22] Alberti, *On Painting*, 38.
[23] Snyder, "Picturing Vision," 241.
[24] Baxandall, *Painting and Experience*, 87–8.
[25] Crosby, *Measure of Reality*, 196.
[26] Wise, *Values of Precision*, 8–9.
[27] See e.g. Snyder, "Picturing Vision."
[28] Kuhn, "Measured Appearances," 117.
[29] Ibid., 116.
[30] Benjamin, "The Work of Art," 223.
[31] Sekula, "The Traffic in Photographs," 23. For a thorough treatment of the subject see Henning, *Photography*, 105–26.
[32] Dvořák, "Beyond Human Measure."

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