

Davies, S.N.G., Lai, L.W.C. and Chua, M.H. (2018), "Seen from Above: the Theoretical Future of Aerial Photos in Land Use, Land Use Policy, Vol. 78, pp. 19-28.

# **Seen from above: the theoretical future of aerial photos in land use, environmental and planning study**

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## **Abstract:**

Although there is growing interest in the subjectivity of ground photos, similar criticism of aerial photos as a media product widely used in land use, environmental planning and management is seemingly absent. Inspired by pioneering work of Dorrian and Pousin (2013) and informed by the idea of Farman (2010) that users of aerial images can re-contextualise and subvert "master representation", this paper attempts to offer an explanation for this contrast and argues that it is harder to wage a subjectivist battle against aerial photography than against ground photos and discusses the possible better use of government possessed aerial photo data in a digital form. Four reasons for this based on disinterested observation, data neutrality, psychology and focus are offered. Two thought experiments and examples are used to help explanation.

## **Key words:**

Aerial photographs; big data; land use; heritage; maps

*"Maps and images have power; they are neither neutral nor unproblematic with respect to issues of representation. Representation is not reality; to conflate the two is to risk naturalizing the assumptions silently embedded within these images."* (Carolan 2009: p.278)

## **1. Introduction**

Aerial photographs are, for many environmental planners and land use managers, something to be turned to without question as a useful resource. Such photographs, scrupulously taken using carefully designed systems, give and are assumed to give a clear, exact, detailed depiction of terrain. With the use of such tools as orthophotography, infrared filters or today's additional tools like LIDAR (Light Detection and Ranging), AVIRIS (Airborne Visible and Infrared Imaging Spectrometer) and SAR (Synthetic Aperture Radar), seemingly 'invisible' data can be 'seen', extending our understanding of the surface world being depicted. If such images cannot offer Thomas Nagel's 'view from nowhere' (Nagel, 1986), they are, as 'bird's eye views', by definition not a normal human's eye view.

By contrast, ground photos are increasingly analysed as in some sense irretrievably subjective. They are photographs very definitely always taken from somewhere by somebody and, by implication, have been taken with all of an engaged viewer's propensity to see 'this' and not see 'that'; to foreground 'this' and background 'that'. In that light the absence of a similar criticism of aerial photos despite their wide use in environmental planning and management, and hence indirect effect on people's lives, is significant. This paper accordingly takes up the contrast

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and, inspired by pioneering work by Dorrian and Pousin (2013) and informed by the idea of Farman (2010), seeks to question the thought that users of aerial images can – or do – re-contextualise and subvert “master representation”. To that end this paper attempts to offer an explanation for the contrast between the subjectivist perils of a view from somewhere and the empyrean detachment of the bird’s eye view. It will argue that aerial photographs are not easily construed in the kind of subjectivist terms that have been employed against ground photos. It will contend instead that where aerial photographs are concerned the glib and swiftly undermined assumption of early photography that ‘the camera cannot lie’ is precisely why aerial photography is used as it is. By way of illustrating why this is so, we consider the use of aerial photography in land use planning, mapping and management and how aerial photographic data held by governments in digital form may be better used.

In what follows we first set out our stall in terms of the theoretical context that frames the discussion. We move on to outline the aim of this research and to sketch its methodology. The bulk of the paper then follows, using primarily government aerial photographs to establish the clear differences which we have hypothesized to exist.

## **2. Theoretical context: subjectivist attacks on maps and photos**

Like many other social practices, the use of maps has not been immune to subjective critical analysis (Monmonier 2018). The idea behind this is that maps are not free from the biases and preferences of their authors or commissioning authority.

Recently, photos, championed by artists for being heritage items (Arijs 2014), have been subjected to similar criticism. It is a criticism that can be dated back to the ever-controversial Viollet-le-Duc, who preferred maps over photographs (O'Connell 1998). Interestingly, no such

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accusation of bias or authorial preference has been made with respect to the use of aerial photos. Perhaps the reason is the same as that which we can infer animated Viollet-le-Duc. For what he actually hoped to obtain was "a series of photographs taken perpendicularly from the surface of the earth" to represent Mont Blanc because what he wanted – in anticipation of photogrammetry – was to make an accurate map. The bird's eye view, in short, promised accuracy, not bias or distortion.

Some theorists, like Philip (1999), Daston and Galison (2007), Daston (2008) and Muehlenhaus (2013), taking a social perspective, probably under the undue influence of de-constructionism, have critiqued maps and/or photos as inevitably subjective things. Sometimes this stance reflects an *ideological presumption* that tends to rule out any *possibility* that maps and photos, as social products, can correspond to objective reality, supposing such a reality to exist. Such a stance is weakened by the same theorists' admission that maps and photos can be "useful". Accepting that minimal 'usefulness' reduces the claim of radical subjectivity to little more than the hardly controversial – indeed commonplace – claim that a map or photograph in some way reflects the values of its producer. But it also stresses, if sotto voce, how much a map or photograph may also serve as an instrument that helps to give a realistic understanding of the place(s) it shows.

A sober attitude is that map and photo users, who very much want an objective understanding of reality however difficult that might in theory be, would not waste time playing with merely subjective things, especially when it is truly "a matter of life and death" rather than imaginary killing and saving. This will be the nub of our argument for why critical strictures aimed at ground level photography have not been extended to aerial photography. For it is not without strong relevance that aerial photography was born, as a critically useful tool, over the

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trenches of First World War battlefields as a natural 'child' of a long tradition of what we might style 'overview reconnaissance' that dates back millennia via the first military observation balloons in the 18<sup>th</sup> century (Gillespie 2004: 372-373) to the commonplace of 'seizing the high ground' to command an overview of a battlefield (Corson and Palka (2004: 403). When the object is to kill or be killed, however repugnant such a misuse of human genius may be, of one thing we can be sure; everyone involved has a very lively interest in avoiding merely seeing what they want to see.

Put very simply, looking down above the heat and dust of battle allows a commander to see the relationship between his own and enemy forces and make his dispositions accordingly. The clearer the view the better. So a progression from real time but imperfect direct observation from an advantageous hilltop through time delayed 'bird's eye' verbal and sketch reports from a balloon and time delayed scaled photographs to today's real time satellite and battlefield drone 'eyes' makes clear sense. We want that view from the empyrean, detached as it is from the shortcomings of a merely earthbound perspective.

It follows that maps and photos produced and/or used by the military or police in their operations, whatever may be the 'bias' in choosing this area to photograph or map rather than that, can hardly be intentionally "made beliefs" that are in some sense displaced or disconnected from the real world they are intended to represent. Indeed critics who would argue for such an ineradicable shortcoming find it extremely difficult clearly to expound the displacement or disconnect their critique suggests.

### **3. Research aims and methodology**

It is from this stance that this paper attempts to (a) canvass the possible reasons for the phenomenon that aerial photographs are not subject to as much, or any, of the criticism levelled at ground photographs by

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theorists on heritage studies; and (b) discuss the future use of government held aerial photo data for land use, environmental and planning study.

This work is not a technical exposition of some novel methods in air reconnaissance, remote sensing or use of drones. It is rather an analytical attempt to evaluate the objectivity of aerial photography. The method to tackle the first aim is by a careful textual and contextual analysis of the writings on the subject matter. Here Gombrich's (Gombrich (1980)) distinction between man-made and machine-made images offers our key to a better understanding to the claim that "all photography is propaganda". For the second aim, our method is by way of probing the use of aerial photos in Crown prosecutions in relation to planning enforcement in Hong Kong.

Our method for meeting our second aim may seem somewhat parochial in focus. It is not, not simply because Hong Kong is a large, modern city closely integrated with and a significant part of the global trading and financial system, but more because no great imagination is needed to see how the particular use of aerial photographs in Hong Kong that we shall explore and explain can be generalized. For what is of significance here is the very nature of evidence in a court of law bound, as that is, by the laws or rules of evidence and their strict criteria as to admissibility with respect to proof of facts (Capowski, 2012). That aerial photographs are accepted in a system of courts in an international city at the pinnacle of which stands a Court of Final Appeal with its judges drawn, at the time of writing, from Hong Kong, the United Kingdom, Australia and Canada, suggests their value per se as evidence. But also as evidence not merely in any court of law,<sup>1</sup> but in any situation where there is a need for

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<sup>1</sup> Here we would refer to <http://www.aerialarchives.com/legal.htm> (accessed on 25.5.2018) and its citation of the use of aerial photographs in legal cases in the USA

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unimpeachable evidence. It is this acceptance of aerial photographs in such a demanding context that, we believe, stands as a stout and general buttress to their claims to objectivity.

Prior to these endeavours and to provide the setting, there is a need to explain the relationship between government aerial photos and maps.

#### **4. Government aerial photos and maps**

Aerial photos taken by the state/government form a carpet of images of a territory targeted for reconnaissance, whatever might be the need to which the visual information so gathered is intended to be put. **Figure 1** shows conceptually how earth features are recorded on an aerial photo by plane or satellite photo taking.

With the passage of time, these photos become relics representing a 'frozen' moment in the appearance of a given territory and, thus are *prima facie* heritage pieces, as well as indispensable primary sources for exploring, rediscovering, and ascertaining present propositions raised over ground features and even underground matters in the territory.

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and the International Court of Justice. Equally, the National Collection of Aerial Photography (NCAP) in the United Kingdom specifically notes the value of aerial photographs as evidence in boundary disputes (<https://ncap.org.uk/case-studies/boundary-disputes> accessed on 25.5.2018) and in the evaluation and assessment of land use change (<https://ncap.org.uk/case-studies/land-use-change> accessed on 25.5.2018).

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**Figure 1: Conceptual representation of aerial photography and landform**



Prior to the rise of remote sensing devices that can be used as aerial surveying tools for the private collection of ground data in digital form



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that today constitute what has become part of "big data", aerial photos were initially largely the monopoly of military and governmental agencies, which used these photos for mapping (Dawe 1969) and surveillance purposes, whether routine or task specific. For at least the last fifty years this monopoly has been broken. Today there are many private firms operating in co-opetition with government and state agencies and, with the rise of satellite and drone imagery, their numbers are set to grow ever more rapidly. Many of these private concerns have put their data into the public domain or sell them in digital or other forms for a charge. A good example is the Earth Resources Observation and Science (EROS) Center of USA, though to most people the most immediate example will be Google Earth.

## **5. Aerial photos versus other photos: a methodical inquiry**

"All photography is propaganda." So Martin Parr described any published image that appears as an *individual* piece intended to tell some specific message. Possibly. However, aerial photographs as a set of data can hardly be said to fit Parr's understanding at all well. Parr's "Propaganda", on close analysis, simply means communication of a specific message. But that message, as a photograph simpliciter, need not necessarily misrepresent or distort but instead *highlight* or *expand* reality.

### ***5.1 Possibilities of subjectivity***

Where the objective/subjective issue is involved, the image itself is what it is, whatever subjectivity there may be would come only in:

- a. processing - supposing that someone is deliberately using processing to impose a way of seeing (q.v. cropping, air-brushing, photoshopping)
- b. interpretation - what we think we can see/are seeing or wish to persuade others to see or believe they are seeing

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Of course there is a possible 'subjective' element in the choice over what to photograph and from what height with what resolution. But other than, for example, decisions like not to include sensitive military/security sites, the sense of 'subjectivity' here seems to be very attenuated and probably unrelated to the aerial photograph as a record of what is photographed. The variables would be more likely to be concerned with economy, speed (i.e., urgency of purpose for which the image was commissioned (q.v. wartime reconnaissance photos)), available technical resources (quality of camera, stability of platform, quality of film, quality of image processing system, etc.), and so on, rather than, for example, wilful ideological bias.

Primarily developed for military and associated mapping purposes, aerial (or generically "remote sensing") photographs have been widely applied to scientific research from geology and soil analysis (for instance Veenenbos (1955); Goosen (1967); Matsuda, Ota, Okada, Shimizu and Togo (1977); Fox and Cziferszky (2008); Gheyle et al (2016) and Hearn and Duncumb (2018) to mention but a few) to land management, monitoring land and marine habitats and species (see for instance Wear, Pope Lauterbach (1964); Zonneveld (1974); Tiwari, Tewari and Singh (1983); Williamson and Matheson (1992); Næsset (1996); Franklin and Dickson (1999); Taylor, Brewer and Bird (2000); Sickel, Ihse, Norderhaug, and Sickel (2004); Wynne (2004); Aswani and Lauer (2006); Magnusson, Fransson and Olsson (2007); Morgan, Gergel and Coops(2010); Schlund et al (2014); and Bryson et al (2016)).

Indeed we may repeat that the photograph is what it is – an image of a given tract of the Earth's surface of a certain resolution at a certain scale – and, depending on whether it has been taken with a plain lens or with some filtering, may be used by any scientist, geographer, historian or

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even visual artist for whatever purposes he or she has in mind.<sup>2</sup> It follows that such photos may be used to study landscape, land use, transportation; urban development; and heritage and land economics (for instance Culver and Fentem (1953); Gautam (1976); Lo (1979); Hariri (1984); Taylor, Brewer and Bird (2000); Kazmierski, Kram, Mills and Phemister (2004); Pelpola and Hickin (2004); Paül and Matthew Tonts (2005); Bielsa, Pons, and Bunce (2006); Lai, Davies, Tan and Yung (2009); Svenningsen et al (2015) etc.)

Bocking's (2009) treatise on Canadian aerial surveys during the Cold War consolidated the core sociological interpretation of aerial photos. This draws attention to the view, common also as a general critique of the practice of mapping, that the technology enables scientists to assert greater authority over ground researchers and surveyors, replacing knowledge of local particulars with "a synoptic, universal view". However, this critique seems to presume that the aerial photographic view is always a substitute rather than a complement. We shall revisit this point in a thought experiment later.

## ***5.2 Critical stance towards aerial photography***

The collection of essays by Dorrian and Pousin (2013) is an excellent introduction to a social understanding of aerial photography but the collection is generally exploratory, with a focus on the visual history of

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<sup>2</sup> In an era in which aerial photography is moving entirely into digital acquisition, the data gathered can extend far beyond the bounds of the visual spectrum out into other areas of the electromagnetic spectrum in what is known as multispectral remote sensing. Extending the term 'aerial photograph' to include such a multispectral 'picture' merely takes the next logical step from that initial grasp of the importance to improving one's understanding of the terrain before one that impelled history's first hunter or soldier to seize the high ground.

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the genre, rather than an analytical treatment of aerial photography as a social product. Wickstead and Barber (2012) has an excellent survey of the two positions one might take towards aerial photography, the technical and the critical, and seeks to offer a social view of aerial photography, though this reduces to no more than the outcomes of "fragmentation" and "attention to detail" as points of importance. However, no frontal attack on aerial reconnaissance as in some sense 'subjective' is hinted at.

### ***5.3 Reasons for immunity of aerial photography from attacks***

So why have aerial photos not been subject to critical treatment as "propaganda"?

#### ***5.3.1 Unfamiliarity***

The first reason is that most theorisation of photos by media researchers deals with their use in mass media and/or political communications rather than in 'dry' empiricist research in "other fields of studies" like geology or ecology. It is probable that such theorists may not have focused on, or even have been significantly aware of aerial photos or of the scientific use of them. As such this paper may serve as a basis for them to exploit, bettering the works of the much cited works by Cosgrove (1994); Castro (2009); and Amad (2012) which focused on *individual* aerial photos massaged for war-time publicity purposes.

#### ***5.3.2 Disinterested mass of data***

The second reason is that aerial photos exist in a databank as a "disinterested" data source. As long as they are not "published" or rendered for specific purposes, they are not placed in any context explaining this or defending that, so represent no threat to anyone. In this sense of the mere physical existence of a repository of aerial photographs (let us say, the entire aerial photographic survey of Hong Kong of 1963 and 1964, or

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any of the thirteen specific collections held by NCAP in the UK) it is accordingly likely to be considered as less inherently 'biased' or 'interested' than, for example, released census statistics, as little obvious manipulation is apparent.

That any government may have kept aerial photographs as "secret", "confidential" or "restricted" in the past, denying access to the public, or charging at prices beyond reach of an average student may be seen to pose some difficulty for the claim of absolute neutrality. To understand why that might not be the case, it is necessary to distinguish between the photographic image and the information it contains. What motivated governments to restrict access was not the bias of the aerial photographs but, surely, the very absence of bias. And that cut two ways. On the one hand the aerial photographs, as a record of what was there at the moment the image was taken, may have recorded what the government would not have wished would be seen had it known what the photograph could reveal.<sup>3</sup> On the other, the aerial photographs, in recording what was there at the moment the image was taken, may have recorded what the government did not know about but could have been expected to know and so would be embarrassed to see revealed as evidence of its incompetence or indifference. Either way, the problem is not one of bias but, if anything, its opposite.

To pursue the census analogy further, the aerial photographs so understood are to be understood as we understand the raw data of a census. Even there, however, the analogy is less helpful than it immediately appears.

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<sup>3</sup> See, for example, the 2005 *New York Times* story "Governments tremble at Google's bird's eye view", <http://www.nytimes.com/2005/12/20/technology/governments-tremble-atgoogles-birdseye-view.html? r=0> accessed on 13.6.2017

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We can come at why this might be so by noting an important difference that can be put this way. A census sets out to enumerate a population, but in fact does more than that. It is not merely a head count, since for census data to be useful the 'heads' need to be more fully understood in terms of which heads count, where the heads live, how young or old the heads are, what sex and gender they consider themselves to be, what ethnicity they claim, their education levels attained, their occupations and so on and so forth. But these questions are not entirely 'innocent', perhaps more in respect of the qualitative discriminations that are omitted as in the qualitative distinctions that are recorded (the literature is vast but, for example, Mezey (2003)). In short, there are presumptions as to what the 'facts' are about a citizen body that a census ought to gather and these presumptions inform the format and the questions on the census form.

By contrast an aerial photograph is simply the mechanical outcome of the passage of a camera-equipped aeroplane passing across a territory in multiple, overlapping sweeps, taking images at set intervals. In that sense there are no prior 'questions' that have to be formulated. What is captured is what is there at the time. That is everything visible to whatever bands of the electromagnetic spectrum the imaging device covers that falls within the footprint of the succession of sweeps of the aircraft or satellite.

It might be objected that there are still choices with respect to the quality of camera, lens and film chosen, the height at which the pass is made and so forth and that these are, in some sense 'subjective'. On one level one can agree with that objection because clearly any such survey must have competed for funds with other public or private projects. It follows that even if the protagonists of an aerial photographic survey would have wished for the best possible equipment available that would yield images

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with the best possible resolution, a political or business judgment may have been made that prioritized some other project over the survey, reducing the funding available. That would evidently in turn require cost-saving compromises, perhaps a lower quality camera and film, a higher flight path increasing the 'footprint' of each photograph thereby reducing the number of shots taken and, hence, the resolution of the resulting images. That would entail less information (in the technical sense) in each photograph, so in some attenuated sense we could see this as a probably indirect rather than deliberate 'bias' imposed on the resulting photographs: they tell us less than they could have done.

But in most cases this would have been an accidental outcome rather than a deliberate one. In the example above, the intention was to save money in order to spend it elsewhere, not to reduce funding to make sure that photo resolution was so poor that some object or objects could not be identified. This is not to deny that such an intention is possible and that where there is evidence of such an intention, we have grounds for supposing some sort of 'bias' in the resulting images. But this bias is not something inherent in the photographs themselves.

We can see that this is so by considering the distinction between "man-made image" and "the machine made image" by Gombrich (1980) Gombrich used how an image is lit before being photographed as an example of a 'man made image'. That is how it can be 'made' to 'look' one way or another in the resulting developed image by manipulation of the appearance of the image that the camera subsequently captures. Gombrich could have added the additional 'man made' elements of the choices of the graininess and colour bias of the film, the depth of field and shutter speed of the camera and, in the development phase, how long the film is developed and how the image is cropped.

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In our case, where issues of subjectivity are clearer, a typical 'man made' image is one taken by photo-journalists, official or corporate photographers, etc. But consecutive photos taken by an automatic camera from an aeroplane flying along a survey path are perfect examples of Gombrich's 'machine made image'. The light is what it is. The imaging equipment and the height of the survey are the best that funding can pay for and so on. In short, the intention is always to remove the 'man' in the image capturing process. Put simply, there is no one looking through the viewfinder.

### *5.3.3 Upstream data*

The third reason is that in many fields of study or industries, aerial photos from dis-interested sources are used primarily for GIS purposes as part of a larger big data project. This is too far 'up stream' in any publicity or propaganda production line. By contrast, ground level site photos could be used to serve far better propaganda functions as they show images "on the spot", down to earth and, by definition, are examples of Gombrich's 'man made' images. Aerial photos, as noted above, are structured to remove the 'photographer'. Theirs is not an earthbound human's view, but that of the disinterested, mechanical bird.

### *5.3.4 Remoteness from any one: two thought experiments*

The fourth reason which conditions the above factor is the density of information in a series of high-level (say above 3000 feet) aerial photos taken automatically along a set flight path by a reconnaissance aeroplane. It is hard to find any particular "gaze" or "frame" for such data compared to say a ground photo taken only a few metres way from a photographer in the agony or thrill of the moment, especially when the photographer has either been able to pre-select a shooting position or is able to move to an 'optimal' spot as an event unfolds. The aerial photos taken are by contrast "unfocused" sources of information. Where the ground photo



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is itself a message about the object or person, event or moment, the aerial photo is simply what it is, displaying what was there at the time.

We can make that contrast more vivid by a *thought experiment* in which, at the very same moment, a photographer on the ground is recording an event and the highest quality imaginable aerial survey is passing overhead. By definition the event will appear on both resulting photographs. Yet it would seem reasonable to argue that were we to use the extremely high quality of the aerial photograph to zoom in on the 'event', so that it is revealed at the same scale as it is in the photo-journalist's 'scoop', we would have two very different images. One would be the news image, full of intention and meaning that speak immediately to us if, perhaps, with ambiguities and uncertainties. The other would be a curiously bland juxtaposition of viewed objects that are unlikely immediately to be obvious. If we came upon the aerial photograph with no knowledge of its simultaneity with the 'scoop', would we recognize what we are seeing? After analysis and perhaps contextual research in archives we would begin to be able to 'decode' what we are seeing. But, quite unlike the 'scoop' image, the aerial photograph, taken without any intention to record THAT moment, has to be interrogated closely using resources external to the photograph, to release this unexpected and unintended additional meaning.

This brief thought experiment reveals the very different stances we understand as between the two images (Dennett, 1998, 43-68), the photo-journalist's image in terms of the intentional stance, the aerial photo image more in terms of Dennett's physical stance. This view can be argued to be supported, with respect to aerial photographs, by the institutional contexts in which they are used. An example would be how the common law courts in Hong Kong and elsewhere readily accept expert interpretation of government aerial photos sold by the Survey

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and Mapping Office, or its equally authoritative equivalents in other jurisdictions, which are adduced by parties in adverse possession and in planning enforcement prosecutions. To overcome challenges in Hong Kong that these photos are hearsay evidence in criminal proceedings<sup>4</sup>, the *Town Planning Ordinance* was amended to deem them to be "public documents" to save the trouble of calling the reconnaissance plane pilot, the photographer, the film developer and other technical officers as prosecution witnesses.

We might indeed take this Dennettian 'stance' approach to a further extreme by extending the idea of a photograph understood from a physical stance from the aerial photograph to any photograph. For when, as historians for example, we look at a photograph of a streetscape, building or landscape, what matters to us is precisely not the message the photographer may have intended. In short, we are not, or not necessarily interested in the intentional stance the photograph inheres. Rather we approach the photograph *as if* it were an aerial photograph: merely a record of what was there.

We may engage in a second thought experiment to illustrate the point here. In the previous thought experiment, we had a single event and two photographs. In this thought experiment we have a single event and a single photograph. But that photograph of event X has two ways in which we may look at it. We may understand it as in the previous thought experiment, namely as a photograph of event X. On that understanding our eyes are drawn to all elements of the scene relevant to X that may help further understanding of the event, which of course exposes us to the possible biases inherent in the photographer's 'view' of X. But we can

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<sup>4</sup> The aftermath of *Keen Lloyd Limited and Cheung Kam Tong v. A.G.* (1996, Magistracy Appeal No. 266), in which the Defendant raised the issue.

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alternatively simply see it, as we saw the aerial photograph in the previous thought experiment, as just a photograph of WHERE X took place. We see it, that is, *as if* that X is happening is irrelevant such that our eyes switch to identifying things in the image that may be irrelevant to X but full of information about the location as it was at that time. That is, once one has grasped via aerial photographs the possibility of approaching a photograph from the physical stance as something machine made, then with more or less facility *any* photograph can be approached similarly.

To clarify, in such an approach to a photograph of X in which X per se is ignored, what our eyes focus on would be such things as the variety of makes of car in the scene, the haircuts and clothing of any people in the scene, the names of any shops in the scene, the streetscape in general, etc. That is, we treat the photograph, as we treat an aerial photograph, as a repository of information that, by interrogation, we can extract and put to such non-X related purposes as putting a date on the image, if it does not come with such data, and with such a date understanding traffic flows in that place at that time, identifying a moment in the evolution of a streetscape, identify the state and use of a specific building of interest at that moment and so on.

In summary, what aerial photographs represent, other than what in and of themselves they may be used for, to which we shall turn next, is a way of seeing that any photograph inheres in it, namely both the qualities of the man made and the machine made image. That this is so may well be the underlying explanation for why aerial photographs have not been deemed inherently subjective. This is a 21<sup>st</sup> century echo of the perceived promise of photography in the decades after its invention and before the advent of the more skeptical temper of the late 20<sup>th</sup> century (Mnookin, 1998, 1-7 and especially 4). Aerial photography reminds us of how a

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photograph can be read as other than the product of the intentional stance.

## **6. Use of government held aerial photo data in environmental management and land use planning & enforcement: the case of Hong Kong**

Because aerial photographs are machine made images replete with information about the surface of the world we inhabit, they have great significance for our decision making with respect to our lived environments. It follows that where there are repositories of aerial photographic images of our home territory – whether we understand that restrictively as the territory of our polity or expansively as the territory of our species – there is a presumption that access to those repositories should be open to all.<sup>5</sup> Unlike China, the government of Hong Kong makes available to the public all aerial photos and survey maps for free inspection and, given its belief in the 'user pays' principle,<sup>6</sup> duplicates them as required according to a published price list.

### **6.1 History of government aerial photography 1924 to 1962**

All the earliest examples of such photos had a military origin and were taken by the British Royal Navy's Fleet Air Arm. The first territory wide air survey of this kind in what was then a British colony occurred in 1924. It was taken by four Fairey IIID seaplanes equipped with aerial cameras aboard HMS *Pegasus*, eventually producing the new 1:20,000 topographic maps of 1930 (Empson 1992). Intermittently, the US Air

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<sup>5</sup> Reference has already been made to Google Earth, which in the light of the argument in the text must stand as a global instantiation of this belief in our right to see with the bird's eye what our landbound species would otherwise be denied. The high ground is always an advantageous spot and its denial to others always a hostile act.

<sup>6</sup> <http://www.fstb.gov.hk/tb/en/policy-programmes.htm> accessed on 13.6.2017.

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Force took reconnaissance aerial photographs of Hong Kong also during the Second World War (Empson 1992). Thereafter the Royal Air Force took over the role and was responsible for the second exercise 21 years later, in winter of 1945, after the surrender of Japan in World War II. The third was undertaken by low-flying planes in 1949 when China became communist in the wake of the Cold War in a context of uncertainties over border security. The last major British military aerial survey exercise was taken in 1956.<sup>7</sup>

## **6.2 R.C Hunting aerial survey of 1963 and 1964 and subsequent mapping**

The rapid development of aviation as a result of the two major global conflicts in the first half of the 20<sup>th</sup> century resulted in the explosion of civil aviation. Whilst for most of us the impact of this has been felt in passenger transport, its effects also transformed aerial photography (Mott, 1963). In Hong Kong, this was coupled by an amazing pace of change ranging from public/private housing for the fast growing population to industrialization, especially in the new town developments of its former agricultural areas. Maps were surely needed but the conventional ground survey simply could not cope with the speed of change. Accordingly, only in 1963 and 1964 did the colonial government daringly commission the private British aerial surveying firm Hunting Air Survey Co. to conduct a low altitude (mainly 2700 to 3900 feet) aerial photo survey of the whole of Hong Kong to map it in a short span of time. This successful survey from January 1963 to February 1967 was one of the largest contemporary aerial surveys in the British Commonwealth

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<sup>7</sup> The photos produced were rectangular.

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and cost the Hong Kong Government HK\$2 million in 1962/1963 financial year<sup>8</sup>.

This set of photos<sup>9</sup> was used to calibrate the first large scale (1:600 in urban areas and 1:1200 in the New Territories) survey maps of Hong Kong (Cooper 1968 and Empson 1992), an earlier large scale survey having been made in the years before the publication date of the complete survey map set in 1922. Cooper (1968) and Dawe (1969) attribute the Hunting survey's success to the excellent ground control points provided by the Crown Lands and Survey Office and Public Works Department. The Photogrammetric and Air Survey Section of the Survey and Mapping Office, set up in 1972 (Ho, King, Wallace 2006), provided services for engineering design/calculations, environmental studies, assistance in the investigation of flooding, air crashes and other emergency situations (Hong Kong Government 1990). The year after they were able to instal a Wild RC10 camera on a Royal Hong Kong Auxiliary Air Force Short Islander aircraft (Hong Kong Government 1973). At that time it was the British military which held copies of all these photos and maps. Thereafter all aerial photos were taken by the Hong Kong Government<sup>10</sup> for civilian and security purposes and for updating the survey maps for land use and development control purposes. Before the turn of the millennium, advanced digital photogrammetry equipment replaced the 70s analogue stereo-plotters, enabling the mapping office to produce orthophoto-maps, 3D modelling and image analysis (Hong Kong SAR Government 2000). Orthophotos are mosaics of vertical aerial photographs wherein geometric distortions have been

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<sup>8</sup> Sub-head 316 "Photogrammetric Survey of Hong Kong and the New Territories", Accountant General Annual Report 1962/1963 (Hong Kong Government 1963).

<sup>9</sup> This set had photographs square in shape.

<sup>10</sup> Until 31 March 1993 by the Royal Hong Kong Auxiliary Air Force, thereafter by the Government Flying Service. (Hong Kong Government 1993)

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rectified to a uniform scale. A complete set of High Resolution Orthophotos using aerial photos taken by the 1963 Hunting aerial survey were published in 2013 (Hong Kong SAR Government 2013).

### **6.3 Security classification of government aerial photos**

Throughout the period from the earliest aerial photographs until recently there had always been some concealment of data on public security grounds. Photos that had been taken over, and maps that covered military land were classified as "Restricted" documents and were not made available to the general public till the 1990s. This policy has not entirely ceased. Since 1997, photos taken in any years of the area across the border in Shenzhen have not been available for public consultation, indeed their existence was not publicly made known, likely for political reasons. With those exceptions, instances indeed of a 'bias' though not one of the photographs but of their accessibility, the aerial photos and the maps produced according to them have been used in day to day development work and in litigation as noted (Tang and Zhang 2012).

### **6.4 Use of government aerial photos for engineering, land use & environmental planning**

Aerial photographic surveys of Hong Kong have also been used for public policy and academic research purposes.

In land use planning for new towns in the New Territories and renewal projects in the old urban cores of Hong Kong, aerial photos and survey maps have been used by town planners and their surveyor officers as a basic input since the early 1970s. The engineers use these photos for site formation and highway construction purposes according to the administrative plans prepared by planners. In the 1990s, the Geotechnical Control Office started to use aerial photos systematically

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for detecting earth movements in actually and potentially problematic hillside areas (Franks 1999) and planning preventive or remedial measures.

In a 1982 exercise the government used helicopter aerial surveys for the identification of marine squatters before assigning licences to them to regularize a rising primary industry under the *Marine Fish Culture Ordinance* (Lai, Chua and Lorne 2014). These photos were taken by hand held cameras and can be inspected and purchased from the Information Services Department by the public. Local researchers used them for their specific thematic studies (for instance Lo 1979 on squatting; Franks 2009 on geology; Lai, Davies, Tan and Yung 2009 on military relics).

## **6.5 Use government aerial photos in planning enforcement**

A typical use in planning enforcement is a good illustration of the use of aerial photographs, highlighting at the same time the 'neutrality' of an aerial photograph, albeit one subject to bias in interpretation.

Under the *Town Planning (Amendment) Ordinance* 1990, any owner or occupier of land who is found to have carried out work or development on land or has changed its use without planning permission, if such permission is required by the plan, is liable to enforcement action. This provides the "teeth" of town planning law in Hong Kong much desired by planners. In the run up to that amendment to the Ordinance, New Territories' land interests had become agitated, so to pacify them, the government assured them in the legislative process that 'existing uses' up to a 'certain date' (as defined) were exempted and this concept was imported into the Ordinance. It can readily be seen that this is a perfect occasion for the invocation of aerial photographs. Would an "existing use" as shown in an aerial photo really protect the rural interests?



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Let us assume that the 'certain date' is date D and that the plan makes use U a use requiring planning permission. Aerial photographs of a tract of land  $T_L$  at dates  $D_{-1}$ , D and  $D_{+1}$  give unequivocal evidence of the use of  $T_L$  ( $D_{-1}$ ),  $T_L$  (D) and  $T_L$  ( $D_{+1}$ ). If at  $D_{-1}$  the use of  $T_L$  is E and at D it is also E, then at  $D_{+1}$  U can be determined to be an existing use at D and therefore exempt. **Table 1** shows the sequence of events on lot  $T_L$ .

**Table 1: Two scenarios of planning enforcements in Hong Kong**

<b>Time code (Date: event)</b>	<b>Scenario 1 on Lot <math>T_L</math></b>	<b>Scenario 2 on Land <math>T_L</math></b>
<b><math>D_{-1}</math> (30 June 1997)</b>	Use interpreted to be E from an aerial photo taken on that day	Use interpreted to be E from an aerial photo taken on that day
<b>D (1 July 1997: Non- existing use becomes one that needs planning permission)</b>	Use interpreted to be E from an aerial photo taken on that day	Use interpreted to be non E, for example F, from an aerial photo taken on that day
<b><math>D_{+1}</math> (2 July 1997:</b>	E needs no planning permission	F needs planning permission

<b>decision about a use on <math>T_L</math> )</b>		
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That is the theory. In practice, in cases in court where such issues are deliberated, the prosecution typically adduces aerial photos taken on divers days as evidence to show that such work, development or change occurred. But contrary to theory, this is not always simple, as defendants discover, given that is they who bear the onus of rebutting the evidence.

On a series of days when such aerial photos were taken, two key days are important. The first 'relevant day' is "immediately before the date of the plan" first made under the ordinance: so for a plan published in the *Gazette* on 2 July 1990, the first 'relevant day' would be 1 July 1990. What is shown on a first 'relevant day' photo is therefore the 'existing use' of land. The second 'relevant day' is the day of the most recent photo that is produced in court by the prosecution. This by definition would be a day after 2 July 1990, the day the plan was published and the requirement for permission for alterations, etc. came into force. It is this second photograph that the prosecution relies on to compare with the first to convince the court that the work that had been done (for instance pond filling or excavation), constituted a development or change in use, because it is contended that what the photograph on the second relevant day shows was not present on the photograph taken on the first 'relevant day'. This sounds reasonable and scientific, and it is unless the target of the prosecution is a use that is not always photographically manifest.

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For example the typical prosecution target in such cases in Hong Kong has been the use of land for open storage, especially of containers (as back up for the Hong Kong's international container terminal at Kwai Chung). But 'storage' is not a simple visual entity like, for example, a pond. It is a use that naturally *fluctuates* in turnover. We can see the problem by looking at a simple and a less simple case.

The simple case is where, in 1990, the land was vacant farm land or a fish pond but in 1997 a container yard. The photographic evidence is unequivocal and the case is straightforward: there was a field or a pond, there is now a storage yard. The judgment will go against the defendant.

However, the case is more complicated where the site was a storage yard with containers in 1990 and also in 1997 but in the second instance had more containers. In such a case the prosecution could submit that there was an "intensification" of use. Here again there is a simple and a difficult situation.

The simple situation, readily resolved by an aerial photograph, is if the site has expanded in area. Here again the photographic evidence will be unequivocal. Before the storage footprint was  $F_p \text{ m}^2$ , afterwards it was  $F_{p+n} \text{ m}^2$ .

But there could be a situation in which the site did not change in size but the level or "intensity" of use fluctuated. For example the number of containers identified on a 1 July 1997 image,  $F_t$  may be fewer than on aerial photos taken on 1 July 1994 ( $F_n$ ) and 1995 ( $F_o$ ), but the number on those intermediate days may be greater than those on the site on the 1<sup>st</sup> relevant date, 1 July 1990 ( $F$ ). In that case, even if the level of use on 1 July 1997 happened to be the same as 1 July 1990 ( $F_t = F$ ), the prosecution would hold that because of the evidence of there having been more after the first 'relevant day', even if all of the more were not present on the second 'relevant day', there had been intensification, meaning that the

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"existing use" as of 1990 was no longer useful in defence. A summary of the scenario is shown in **Table 2**.

**Table 2: "Intensification of use" in planning enforcement in Hong Kong**

<b>Relevant data</b>	<b>Amount of containers interpreted (Scenario X)</b>
<b>1 July 1990</b>	(F) 150 units
<b>1 July 1994</b>	(F <sub>n</sub> ) 200 units
<b>1 July 1995</b>	(F <sub>o</sub> ) 250 units
<b>1 July 1997</b>	(F <sub>t</sub> ) 150 units

This thinking, as used in the unreported magistracy case FLS 6333/95 (December 1995)<sup>11</sup>, is an example of how the use of aerial photographic evidence, whilst in one sense manifest (given use -> greater/intensified use since the first relevant day) may actually be unreasonable because the photographic evidence itself is insufficient to elucidate the point at issue. The use of a magistracy court decision was conditioned by the availability of cases. Though aerial photos were used by the prosecution to establish its case, as there was no appeal to the High Court concerning

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<sup>11</sup> In this case, the defendant was acquitted of the charge "pond filling" based on evidence as shown on government survey maps.

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the admissibility or interpretation of photo images. It is for this reason that we have resorted to magistracy cases known to the second author.

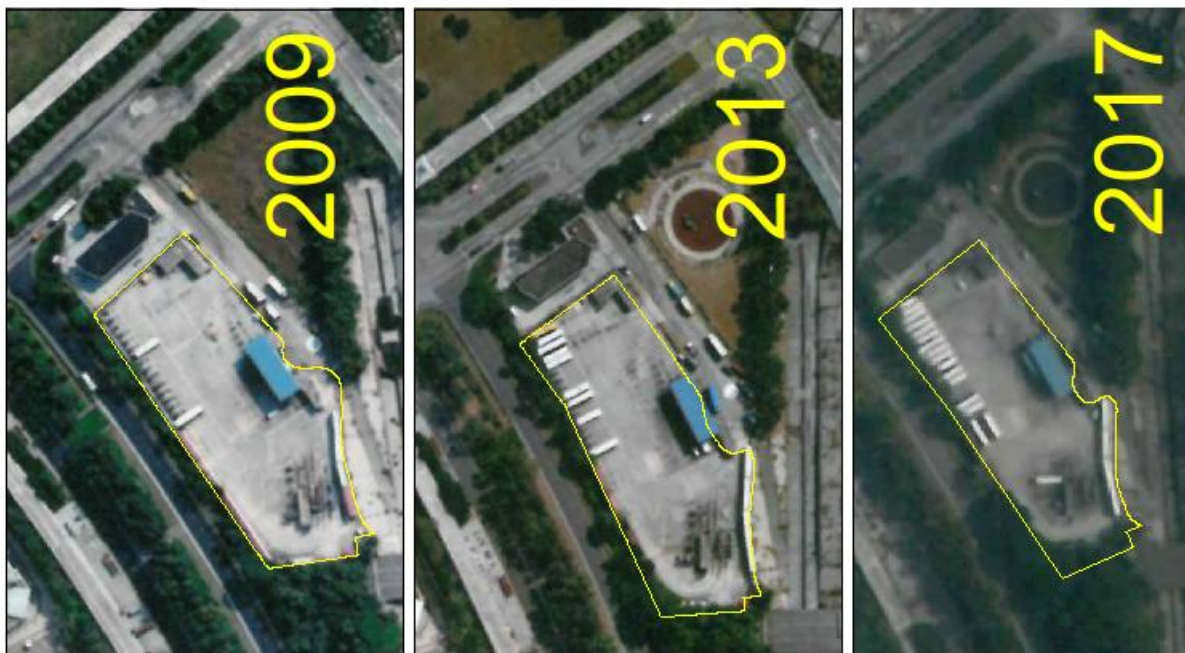
The simple point is that storage varies in amount as a matter of business life and a 'use' as a storage facility at time T does not entail a use of that facility at T for a fixed quantum of goods stored  $G_{q(T)}$ . The quantum of goods stored at T will have been a function of market demand at T and, had the market at T been at a peak, then the quantum of goods shown by the photograph taken on the first relevant date would have been  $G_{q+n(T)}$ . So a crude enumeration from aerial photos, whilst in one sense 'accurate', in this case fails to allow for a normal variation of business on a site of a given location. "Use" is not always a simple visual quantity.

To illustrate, shown in the Figure 2, we have three aerial photographs taken of the same Citybus bus depot, held under a short term tenancy in a "Government, Institution or Community" ("GI/C") zone in the statutory town plan. Those taken by government's Surveying and Mapping Office in 2009, 2013, and 2017 have been compared. . The first photo of 2009 shows only 6 buses (including 4 which were used as a noise screen). In the photo taken about 4 years later, the same site had 13 buses. The more recent 2017 photo shows 21 buses parked. Following the simple enumeration logic described in the previous paragraph, this increase in the number of parked buses would have been deemed an "intensification" of use and the occupier liable to planning enforcement prosecution but for the fact that there is no enforcement provision in the relevant statutory town plan. But let us assume that the town plan has enforcement provisions. In that case, should enforcement follow the narrow 'intensification' logic, the depot would not be viable in planning terms as it is quite normal that the number of buses in a depot varies from time to time within the quanta the three photographs reveal,

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depending on such variables as the time of day, route changes, shifting demographics and employment locations, the economic cycle, etc..

**Figure 2: Aerial photos of a bus depot at diver dates**



The aerial photos in such cases would thus be produced to the court as if they told a story that in fact they cannot tell. Here the issue is not any bias in photos but a bias in *interpretation*. A contrast between the diachronic evidence provided by an aerial photograph and the synchronic evidence required for the 'proof' needed in this particular case makes this point clear. In our container yard example synchronic evidence would be a motion picture taken from 1 July 1990 to the date

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of prosecution. This would show clearly, supposing this to have been the case, that the site had been continuously in business and that the number of containers on site was never constant, rising and falling from what was on site on 1 July 1990 (and may possibly have been on the site before that date) through peaks and troughs of business, as the fortunes of the logistics market changed, to the state of affairs on 1 July 1997. The temporally disjunct, diachronic 'snapshots' provided by aerial photographs cannot 'prove' anything so complex as 'intensification' in this sense. The same argument obtains with our bus station example. The problem here is the same which led De Jong et al (2000: p.64) to consider "aerial photos a suitable medium to study the dynamics of the city of Ouagadougou" in Africa. There, aerial photos are only taken every 10 years.

Equally, however, there is a diachronic response to this. For were there to have been presented in court a set of aerial photographs covering, say, a full year of operations if not day-by-day, then at sufficiently close time intervals to ensure the capture of *normal fluctuations in business*, then such a judgment could be arrived at whether in favour of prosecution or defence.

## **Discussion**

In daily life, aerial photo imagery and data, whether taken by balloons, planes, satellites or drones, have become ever more accessible. They have become widely used and accepted as credible data by the public and various businesses and industries as well as in evidence in legal proceedings<sup>12</sup>.

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<sup>12</sup> In a recent US case *Unites States v Jones*, the Fourth Amendment was invoked as a police GPS to follow a suspect was challenged for digital trespass.

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The vehicle by means of which a 'neutral' aerial photo is taken should not affect our analysis. What matters, and has been the case since fairly early days, is that the 'decision' to take a 'shot' is entirely automated as, after the initial decisions for the photographic sortie have been made, are the 'settings' (shutter speed, focus, depth of field, distance from subject, film speed). An aerial photograph platform piloted by a human pilot is in this sense conceptually no different from a drone. Had early aerial photographers been able to use drones, they would have done, q.v. the early use of unmanned balloons to carry cameras.

Any discussion of the use of aerial photos in planning may profit from an examination of the terms of art in geography education at secondary school and degree level as planning schools have a good supply of students from geographers and have geography as one of its learning pillars. (See for instance in Beauregard 1989)

In geography education, the rise of human geography promoted by such scholars as Hall (1977) has marginalized the teaching of aerial photogrammetry and mapping in upper high school curricula, which leads to some difficulties for spatial analysis by university students as the authors have discovered in their own teaching. However, the pendulum is swinging back. Education psychologists (e.g. Lewis 1991, Plester, Blades and Spencer 2003, 2006; Kolukisa and Aladağ 2006) have found young children learn a lot from aerial photos used as learning aids.

## **7. Conclusion**

This paper offers four reasons why any critical attack on aerial photos in the land use, environmental and planning study arena as 'subjective' or 'biased' would be an uphill battle for those who would mount it. To recapitulate, aerial photos are taken by mechanical means operated by disinterested parties, are neutral in data presentation, and show things



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"from above" rather than here on ground. They lack the 'intentional stance' that informs any 'man made' photograph taken at ground level.

The Hong Kong study on planning enforcement is illustrative of the fact that aerial photographs, as static records of given moments, can be asked to prove no more than they can prove, which is a state of affairs at the moment the image was taken. Within those constraints, their 'machine made' objectivity holds good. What we learn is that between a given photograph's 'moment' until the next photograph's 'moment' there is silence and the photographs themselves can tell us nothing determinate about what occurred during that lapse. Something may have done, and the photographs will tell us what that something has resulted in. What they cannot tell us is when change occurred, who was responsible for it, why it happened, and so on. The human dimension is missing and in an important sense, in that lies the objectivity of the photographs.

Aerial photographs have to be understood for what they are. When they are so understood they can be used in the manner the Hong Kong government and other governments, businesses and individuals have sought to use them. But they can only be used within the restricted sense we have outlined. Should any information more than that given by a 'freeze frame' moment in time be sought, aerial photographs can provide it if and only if there are sufficient aerial photographic sets to establish the diachronic case that needs to be made. At that point, however, we can see a critical step occurring from the coldly objective world of a frozen frame to the warmer and more problematic domain of human interpretation. The photographs are what they are. It is in the story we tell to weave them together that their objectivity may be compromised.

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## **References**

1. Amad, Paula. "From God's-eye to camera-eye: Aerial photography's post-humanist and neo-humanist visions of the world." History of Photography 36, no. 1 (2012): 66-86.
2. Arijs, Hilke. "Images of value: Why assessing the value of image collections is worthwhile." In Arijs Hilke ed. CoMa 2013: Safeguarding Image Collections, New Castle upon Tyne, Cambridge Scholar Publishing, 2014, 21-45.
3. Aswani, Shankar, and Matthew Lauer. "Benthic mapping using local aerial photo interpretation and resident taxa inventories for designing marine protected areas." Environmental Conservation 33, no. 03 (2006): 263-273.
4. Beauregard, Robert A. "Between modernity and postmodernity: the ambiguous position of US planning." Environment and Planning D: Society and Space 7, no. 4 (1989): 381-395.
5. Bell, Scott. "Spatial cognition and scale: A child's perspective." Journal of Environmental Psychology, Vol.22, Nos.1-2 (2002): 9-27.
6. Bielsa, Isabel, Xavier Pons, and Bob Bunce. "Agricultural abandonment in the North Eastern Iberian Peninsula: the use of basic landscape metrics to support planning." Journal of Environmental Planning and Management 48, no. 1 (2005): 85-102.

Davies, S.N.G., Lai, L.W.C. and Chua, M.H. (2018), "Seen from Above: the Theoretical Future of Aerial Photos in Land Use, Land Use Policy, Vol. 78, pp. 19-28.

7. Bocking, Stephen. "A Disciplined geography: Aviation, science, and the cold war in northern Canada, 1945–1960." Technology and Culture 50, no. 2 (2009): 265-290.
8. Bryson, Mitch, Stephanie Duce, Dan Harris, Jody M. Webster, Alisha Thompson, Ana Vila-Concejo, and Stefan B. Williams. "Geomorphic changes of a coral shingle cay measured using kite aerial photography." Geomorphology 270 (2016): 1-8.
9. Capowski, John J., "China's Evidentiary and Procedural Reforms, the Federal Rules of Evidence, and the Harmonization of Civil and Common Law." Texas International Law Review 47, no.3 (2012): 455-504.
10. Carolan, Michael S. "'This is not a biodiversity hotspot': the power of maps and other images in the environmental sciences." Society and Natural Resources 22, no. 3 (2009): 278-286.
11. Castro, Teresa. "Cinema's mapping impulse: Questioning visual culture." Cartographic Journal 46, no. 1 (2009): 9-15.
12. Corson M.W., and E. J. Palka "Geotechnology, the US Military and War," Ch.18 in S.D. Brunn, S.L. Cutter and J. W. Harrington Jr., Geography and Technology, Springer Nature, 2004, 401-430.
13. Cooper, J.T. "The large-scale mapping of Hong Kong by air-survey." In Report of Proceedings of the Conference of Commonwealth Survey Officers 1967, London: Her Majesty's Stationery, 473-479, 1968.

14. Cosgrove, Denis. "Contested global visions: One-World, whole-earth, and the apollo space photographs." Annals of the Association of American Geographers 84, no. 2 (1994): 270-294.
15. Culver, Jerry B., and Arlin D. Fentem. "The effective use of cartographic aids in economics research." Land Economics, Vol.29, No.4 (1953): 302-313.
16. Daston, Lorraine. "On scientific observation. » Isis 99, no. 1 (2008): 97-110.
17. Daston, Lorraine and Peter Galison. Objectivity. New York : Cambridge, Mass: Zone Books, 2007.
18. Dawe, H. G. "Aerial survey: Colony of Hong Kong." The Photogrammetric Record 6, no. 34 (1969): 335-347.
19. De Jong, Steven M., Alain Bagre, Pieter BM Van Teeffelen, and Willem PA Van Deursen. "Monitoring Trends in Urban Growth and Surveying City Quarters in Ouagadougou, Burkina Faso Using SPOT-XS." Geocarto International 15, no. 2 (2000): 63-70.
20. Dennett, D.C. The Intentional Stance (6th printing), Cambridge, Massachusetts: The MIT Press, 1998.
21. Dorrian, Mark, and Frédéric Pousin, eds. Seeing from Above: the Aerial View in Visual Culture. IB Tauris, 2013.

Davies, S.N.G., Lai, L.W.C. and Chua, M.H. (2018), "Seen from Above: the Theoretical Future of Aerial Photos in Land Use, Land Use Policy, Vol. 78, pp. 19-28.

22. Eardley, Armand John. "Aerial photographs: their use and interpretation." *Aerial photographs: their use and interpretation* (1942).
23. Empson, Hal. Mapping Hong Kong: a Historical Atlas, Hong Kong, Government Information Service, 1992.
24. Farman, Jason. "Mapping the digital empire: Google Earth and the process of postmodern cartography." New Media and Society 12, no. 6 (2010): 869-888.
25. Fox, Adrian J., and Andreas Cziferszky. "Unlocking the time capsule of historic aerial photography to measure changes in Antarctic Peninsula glaciers." Photogrammetric Record 23, no. 121 (2008): 51-68.
26. Franklin, Steven E., and Elizabeth E. Dickson. "Approaches for monitoring landscape composition and pattern using remote sensing." Monitoring forest biodiversity in Alberta: program framework, Alberta Forest Biodiversity Monitoring Program Technical Report (1999).
27. Franks, C. A. M. "Characteristics of some rainfall-induced landslides on natural slopes, Lantau Island, Hong Kong." Quarterly Journal of Engineering Geology and Hydrogeology 32, no. 3 (1999): 247-259.
28. Gautam, N. C. "Aerial photo-interpretation techniques for classifying urban land use." Photogrammetric Engineering and Remote Sensing 42, no. 6 (1976).
29. Gheyle, Wouter, Timothy Saey, Yannick Van Hollebeeke, Stephanie Verplaetse, Nicolas Note, Jean Bourgeois, Marc Van Meirvenne,

Davies, S.N.G., Lai, L.W.C. and Chua, M.H. (2018), "Seen from Above: the Theoretical Future of Aerial Photos in Land Use, Land Use Policy, Vol. 78, pp. 19-28.

Veerle Van Eetvelde, and Birger Stichelbaut. "Historical Aerial Photography and Multi-receiver EMI Soil Sensing, Complementing Techniques for the Study of a Great War Conflict Landscape." Archaeological Prospection 23, no. 3 (2016): 149-164.

30. Gillispie, C. C. Science and Polity in France: The Revolutionary and Napoleonic Years. Princeton: Princeton UP, 2004.

31. Gombrich, Ernst H. "Standards of truth: The arrested image and the moving eye." Critical Inquiry 7, no. 2 (Winter 1980): 237-273.

32. Goosen, D. 1967. Aerial photo interpretation in soil survey. Roma, Food and Agriculture Organization.

33. Gregory, K. J., Angela M. Gurnell, and Geoffrey E. Petts. "Restructuring physical geography." Transactions of the Institute of British Geographers 27, no. 2 (2002): 136-154.

34. Haffner, Jeanne. The View from Above: The Science of Social Space. Cambridge, Mass: MIT Press, 2013.

35. Hall, Robin. "Teaching humanistic geography." The Australian Geographer 14, no. 1 (1978): 7-14.

36. Hariri, Majdi M. "Aerial photographs: their use in guiding pilgrims and pointers for developing countries." Journal of Environmental Planning and Management 27, no. 1 (1984): 27-33.

37. Hearn, G. J., and R. W. Duncumb. "Using stereo aerial photography and satellite InSAR to help assess slope hazards for a hydropower project in mountainous southern Albania." Quarterly Journal of Engineering Geology and Hydrogeology 51, no. 2 (2018): 265-275.

38. Ho, Hoi-Yan, Jonathan King, and Mark Wallace. A basic guide to air photo interpretation in Hong Kong. Applied Geoscience Centre, Department of Earth Sciences, University of Hong Kong, 2006.
39. Hong Kong Government, *Accountant General annual report*, Hong Kong, Government Printer, 1963.
40. Hong Kong Government. (various years). *Hong Kong annual report* (1990). Hong Kong: Government Printer.
41. Hong Kong Special Administrative Region Government. (various years). *Hong Kong annual report book* (2000). Hong Kong: Government Logistics Department.
42. Kazmierski, Jonathan, Megan Kram, Elizabeth Mills, David Phemister, Nicholas Reo, Christopher Riggs, Ryan Tefertiller, and Donna Erickson. "Conservation planning at the landscape scale: a landscape ecology method for regional land trusts." Journal of Environmental Planning and Management 47, no. 5 (2004): 709-736.
43. Kolukisa, Enver Aydın, and Elif Aladağ. "The use of aerial photographs in geography education." (2006).
44. Lai, Lawrence WC, Mark H. Chua, and Frank T. Lorne. "The Coase Theorem and squatting on Crown Land and water: A Hong Kong comparative study of the differences between the state allocation of property rights for two kinds of squatters." Habitat International 44 (2014): 247-257.
45. Lai, Lawrence WC, Stephen NG Davies, Y. K. Tan, and P. Yung. "The Gin Drinker's Line: Reconstruction of a British colonial defence line

Davies, S.N.G., Lai, L.W.C. and Chua, M.H. (2018), "Seen from Above: the Theoretical Future of Aerial Photos in Land Use, Land Use Policy, Vol. 78, pp. 19-28.

in Hong Kong using aerial photo information." Property Management 27, no. 1 (2009): 16-41.

46. Lewis, Sharon. "Teaching geography using aerial photographs." Teaching Geography, Vol.16, No.3 (1991): 113-115.
47. Lo, C. P. "Surveys of squatter settlements with sequential aerial photography—A case study in Hong Kong." Photogrammetria 35, no. 2 (1979): 45-63.
48. Magnusson, Mattias, Johan ES Fransson, and Håkan Olsson. "Aerial photo-interpretation using Z/I DMC images for estimation of forest variables." Scandinavian Journal of Forest Research 22, no. 3 (2007): 254-266.
49. Matsuda, T., Y. Ota, A. Okada, F. Shimizu, and M. Togo. "Aerial photo-interpretation of active faults—The individual difference and examples." Bulletin of Earthquake Research Institute. 52 (1977): 461-496.
50. McKeown, David M. "Knowledge-based aerial photo interpretation." Photogrammetria 39, no. 3 (1984): 91-123.
51. Mezey, N. "Erasure and recognition: the census, race and the national imagination", Northwestern University Law Review 97, no. 4 (2004): 1701-1768.
52. Mnookin, Jennifer L. "The Image of Truth: Photographic Evidence and the Power of Analogy", Yale Journal of Law and the Humanities 10, Issue 1 (1998): 1-74.



Davies, S.N.G., Lai, L.W.C. and Chua, M.H. (2018), "Seen from Above: the Theoretical Future of Aerial Photos in Land Use, Land Use Policy, Vol. 78, pp. 19-28.

53. Monmonier, Mark. How to Lie with Maps, Third Edition, Chicago: University of Chicago Press, 2018
  
54. Morgan, Jessica L., Sarah E. Gergel, and Nicholas C. Coops. "Aerial photography: a rapidly evolving tool for ecological management." BioScience 60, no. 1 (2010): 47-59.
  
55. Mott, P.G. "Aerial Methods of Surveying for Civil Engineering. (Includes Plates)", Proceedings of the Institution of Civil Engineers 26 no. 4 (1963): 497-512.
  
56. Muehlenhaus, Ian. "The Design and Composition of Persuasive Maps." Cartography and Geographic Information Science 40, no. 5 (2013): 401-414.
  
57. Næsset, E., 1996. "Determination of number of stems in coniferous forest stands by means of aerial photo-interpretation." Scandinavian Journal of Forest Research, 11(1-4), 76-84.
  
58. Nagel, T., 1986. *The View from Nowhere*. Oxford: Oxford University Press.
  
59. O'Connell, Lauren M. "Viollet-le-Duc on drawing, photography, and the 'space outside the frame'." History of Photography 22, no. 2 (1998): 139-146.
  
60. Paül, Valerià, and Matthew Tonts. "Containing urban sprawl: trends in land use and spatial planning in the metropolitan region of Barcelona." Journal of Environmental Planning and Management 48, no. 1 (2005): 7-35.

Davies, S.N.G., Lai, L.W.C. and Chua, M.H. (2018), "Seen from Above: the Theoretical Future of Aerial Photos in Land Use, Land Use Policy, Vol. 78, pp. 19-28.

61. Pelpola, Channa P., and Edward J. Hickin. "Long-term bed load transport rate based on aerial-photo and ground penetrating radar surveys of fan-delta growth, Coast Mountains, British Columbia." Geomorphology 57, no. 3 (2004): 169-181.
62. Phillips, Adam. "Recovered memory." Index on Censorship 28, no. 6 (1999): 92-121.
63. Plester, Beverly, Mark Blades, and Christopher Spencer. "Children's understanding of aerial photographs." Children's Geographies, Vol.1, No.2 (2003): 281-293.
64. Plester, Beverly, Mark Blades, and Christopher Spencer. "Children's understanding of environmental representations: Aerial photographs and model towns." Children and their environments: Learning, using and designing spaces (2006): 42-56.
65. Schlund, Michael, Felicitas von Poncet, Dirk H. Hoekman, Steffen Kuntz, and Christiane Schullius. "Importance of bistatic SAR features from TanDEM-X for forest mapping and monitoring." Remote Sensing of Environment 151 (2014): 16-26.
66. Svenningsen, Stig Roar, Jesper Brandt, Andreas Aagaard Christensen, Mette Colding Dahl, and Henrik Dupont. "Historical oblique aerial photographs as a powerful tool for communicating landscape changes." Land Use Policy 43 (2015): 82-95.
67. Sickel, Hanne, Margareta Ihse, Ann Norderhaug, and Morten AK Sickel. "How to monitor semi-natural key habitats in relation to grazing preferences of cattle in mountain summer farming areas: An aerial photo and GPS method study." Landscape and Urban Planning 67, no. 1 (2004): 67-77.

68. Sterling, C.P. "Rethinking heritage and photography: Comparative case studies from Cyprus and Cambodia." PhD dissertation, University College London, 2015.
69. Tang, Conrad H.W. and H.D. Zhang. "Direct georeferencing and orthophoto correlation with demarcation district" Surveying and Built Environment 22 (2012): 73-86.
70. Taylor, J. C., T. R. Brewer, and A. C. Bird. "Monitoring landscape change in the national parks of England and Wales using aerial photo interpretation and GIS." International Journal of Remote Sensing 21, no. 13-14 (2000): 2737-2752.
71. Tiwari, A. K., J. C. Tewari, and J. S. Singh. "Application of aerial photo-analysis for assessment of vegetation in Kumaun Himalaya. II. Kathgodam to Okhal Kanda." In Proceedings of the Indian National Science Academy. B, 49, 421-435. 1983.
72. Veenenbos, J. S. "Aerial photo-interpretation and analysis for soilsurvey and landclassification purposes." Photogrammetria 12 (1955): 376-381.
73. Wynne, Randolph H. "Forest Mensuration with Remote Sensing." Ch. 11 in H. Michael Rauscher and Kurt Johnsen eds. Southern Forest Science: Past, Present, and Future US Department of Agriculture Forestry Service, 2004, 109-116.
74. Wear, J. F., R. B. Pope, and P. G. Lauterbach. "Estimating beetle-killed Douglas-fir by aerial photo and field plots." Journal of Forestry 62, no. 5 (1964): 309-315.

Davies, S.N.G., Lai, L.W.C. and Chua, M.H. (2018), "Seen from Above: the Theoretical Future of Aerial Photos in Land Use, Land Use Policy, Vol. 78, pp. 19-28.

75. Wickstead, Helen and Martyn Barber. "A Spectacular history of survey by flying machine!" Cambridge Archaeological Journal 22, no.1 (February 2012): pp 71- 88.
  
76. Williamson, Ian P., and Garry Mathieson. "The Bangkok Land Information System Project: designing an integrated land information system for a large city in the developing world." Canadian Institute of Surveying and Mapping Journal, 46, no. 2 (1992): 153-164.
  
77. Wright, John. "Air photographs for small expeditions." Geographical Journal (1973): 311-322.
  
78. Zonneveld, I. S. "Aerial photography, remote sensing and ecology." ITC Journal 4 (1974): 553-560.