

HISTORIC PHOTOPLANES

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ABSTRACT

The first photoplanes realised in Italy between the end of the 1800's and the beginning of the 1900's are a rather important instrument in urban analysis. Often they have been considered as only a document for the archives, from which to extract information for the urban and territorial analyses of a qualitative nature. The photoplanes are born with the intention of being concurrently instruments for the documentation, interpretation, and transformation of the city. They are not only photographs, but also charts, with an easy readability even though of a more difficult interpretation.

It has often happened that the metric aspect of these photoplanes has been neglected, not considering them as cartography but rather, as simple images. Applying procedures of geo-referencing studied in relation to their methods of production it is possible to recover the metric content, as in the case of the work conducted for the photoplane of Venice from 1911. Linear plane global transformations have been utilised, modifying the initial image according to a law valid for all the pixels, and local transformations through operations of feature-based warping, modifying within the image itself some parts and leaving unaltered others.

From the study done in this occasion, which has brought about a critical reading of the technical manuals from the beginning of the twentieth century, the capacity of the scientific, technical and cultural fields to use the techniques put in place is highlighted, such as aeronautics and photography, for the documentation of the historic patrimony. These are witness to this fact, together with the operations of survey exclusively military or topographic, such as the survey of the Tevere in 1908, and those of Venice and Chioggia in 1911 – 1913, the first experiences of photoplanes in the archaeological zones of Foro Romano, Pompei, the excavations done in Ostia Antica, all realised as soon flight was available.

1 INTRODUCTION

The photoplane, a cartographic representation whose basis is made up of the photographic image, today in digital form, is a widely used type of instrument since it offers the possibility of reducing times and costs for the realisation of territorial scale representations, allowing for the necessary timeliness in the understanding and intervention in the control of the territorial dynamics.

From this standpoint, it is important to consider the idea of the recovery of the metric aspect of the photoplanes realised in Italy between the end of the nineteenth and the beginning of the twentieth centuries, at the same re-evaluating the importance of the photoplanes as historic and cultural documents. The critical reading of the manuals from this period, drawn up by the Lieutenant Ranza in 1907 and by Captain Tardivo in 1911, offered an opportunity to study the technical knowledge of survey that they had in those years as well as the cultural circles in which the first steps of aerial photogrammetry were made.

2 FLIGHT AND PHOTOGRAPHY

Flight and photography in the nineteenth century very soon were in the spotlight in the world of innovations, influencing and stimulating each other.

Toward the middle of the century, thanks to the success obtained by Daguerre, photography began to become a means, an instrument to make available to whoever, offering realistic descriptions of the world and especially the ability to document moments which would otherwise be indescribable.

The first journalistic reports documented began to come out, especially those on the wars, such as the War in Crimea or during the American Civil War with the description of the terrible reality and seriousness of war, creating a new form of communication.

But alongside the images of war, the first postcards illustrating landscapes emerged, as did photography for portraits and for urbanistic purposes in the great European cities, such as Paris, Rome and London.

It is in this context that photographers began to think about taking their equipment onto the aerostats in order to take pictures from up high.

The aerostat is essentially a balloon filled with a gas which is lighter than air and which, keeping in mind its own weight, its passengers and what it must transport, has a lesser weight than the difference between the mass of air moved and the mass of gas contained.



Figure 1-2. Photoplans of Venice: the balloon near the Scalzi's church and in St. Marco square

Theorised in 1670 by the Jesuit priest Father Francesco Lana, intending it for military purposes, the aerostat was used in 1793 by the first French Aerostat Corps at Maubeuge, which had been invaded by the Austrians. The advantages offered by the new means for a vision of the Earth from the sky were immediately evident. In Italy, it was used with good results during the battle of Solferino in 1859. In 1862 President Lincoln put together a corps of aerostat-photographers who, during the War of Secession, successfully experimented on two techniques, at the time considered avant-garde, for observation and the transmission of messages: respectively, photography and the telegraph.

It was however, the French Nadar who first, imagining the extraordinary possibilities offered by photography, used the new method of recording by executing a series of photographs from the balloon near the city of Paris. Alongside the applications for civil use, its use in military and as observation developed from above increasingly became a common method of use.

Due to the influence of the aerostats used in Europe, Italy began to consider this orientation as well. In 1884 an aerostatic section was instituted, under the 3rd Regiment of Engineers, commanded by Giraldo Pecori.

In 1896, the Photographic Section of the Corps of Engineers of the Italian army was established, at Forte Trionfale in Monte Mario. Panoramic photographic instruments were constructed offering a great optic yield and easy transport. The section was equipped with tents and portable laboratory cars to follow the troops, in addition to their responsibility of survey of the land for public use, such as the survey of the coastal areas, for example. The Section, along with the Specialist Brigade from the early years in the twentieth century, began to become involved in photogrammetry. The photographic documentation of the terrain from above with real topographic intent, directed towards map making, practising the first photographic interpretation, and finding a powerful reconnaissance means in the territory in the rectified and scale photography, became the object of study and experimentation.

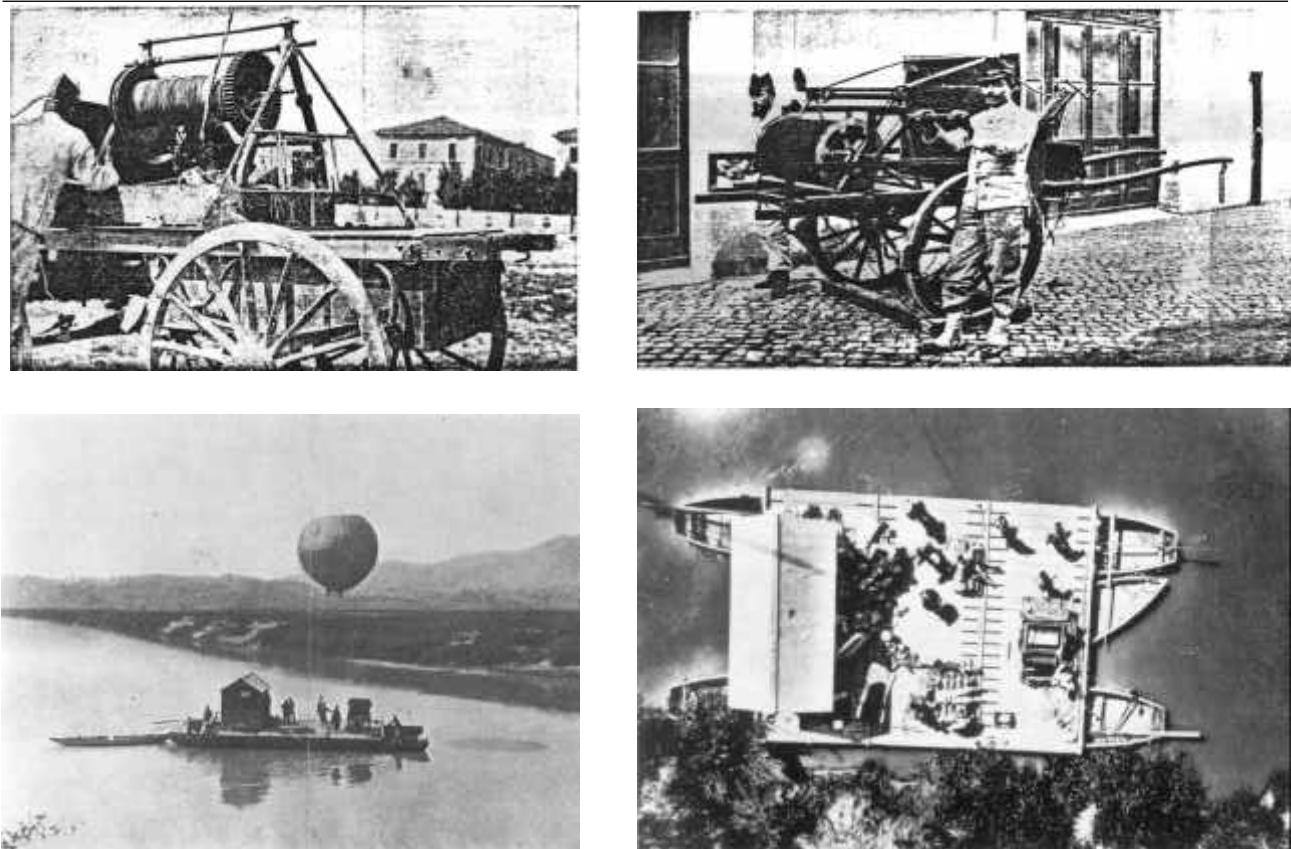


Figure 3. The beginnings of the aerial photographic technique



Figure 4. The photoplanes realized by the Specialist Brigade, Photographic Section: Roman Forum 1899, Tevere River 1902-03, Venice and Lagoon 1913.

2.1 Survey from above: the first photoplanes

Among the first examples of the use of aerial photography from a balloon for studies of a non-military nature, we must list archaeological use. In 1899, on the occasion of an excavation which was being carried out on behalf of the government, some images of the Roman Forum were realized, thanks to the intuition of the archaeologist Giacomo Boni, from a fixed balloon stabilized at an altitude of about 360 meters.

Some series of photographs from the ground, having the purpose of documenting various phases of the operation, today have contributed to deepening our understanding of the monument concerning the very beginnings of the aerial photographic technique.

The first experiment on topographic planimetric survey was performed in Rome in the winter of 1902-03, by Lieutenant Ranza, who photographed a section of the course of the Tevere River. This experiment, which was the first of its kind by the Specialist Brigade for this type of operation, was followed by the one by Captain Tardivo, done on behalf of the Civil Engineers of Rome, which surveyed an area of fifty kilometers of the course of the Tevere in 1908, with photographs taken on a 1:3500 scale.

At the International Conference of Photography, held in Brussels in 1910, Tardivo presented the surveys performed in order to illustrate the technique of Topography from the balloon, which created great admiration for the precision of the attachments between the various images and the clarity in the details. In 1913, the Photographic Section participated officially at the 1st International Conference of Photogrammetry, held in Vienna, where after first introducing the information concepts of the work, showed the works done, in contrast to the other presenters, who merely presented mainly works of a theoretic nature.

Alongside the other operations of a largely military nature, we must note the survey of the ruins of Pompei, those in Ostia, the city of Venice and the Venetian Lagoon, as highly important from an historic-documentary nature. The photographic images of the city of Venice, culminating in the photoplane from 1911, which began in 1906 with a balloon dragged along the canals, are works of great technical and cultural importance.

2.2 The manuals of Lieutenant Ranza and Captain Tardivo

The experimental successes of the survey from above led to the desire to codify the new survey technique. Some important texts were given to the media which testified to the interest and the dynamism present in the Italian technical environments of the era. It is important to emphasize that the reference to the survey of monuments is consistent in these books, demonstrating how right from the beginning of the century in Italy there was an understanding of the importance of joining the technical knowledge with the historic-artistic understanding. Among the various texts cited in the documents of that period, only two were found, and with great difficulty, which were studied and found to be an extremely important source of information for the study of the photoplanes which we have from that era.

In the text by Ranza “*Fototopografia e fotogrammetria aerea, nuovo metodo pel rilevamento topografico di estese zone di terreno*” from 1907 the general principles of this “new complete and regular method for quickly obtaining topographic charts of extended geographical areas” were described.

In the book there are mainly practical instructions given for the aerostats, on the methods of photographing, on the orientation and the chaining of more than one photograph, right up to the description of the experiences attained in those years. With this work, as Ranza himself affirms in the introduction, a road towards this new application was paved, affirming the importance and the possibility of development.

The writing of the Tardivo *Manuale di fotografia, telefotografia e topografia da pallone* from 1911, the result of years of study and experience in the Photographic Section of the Specialists Brigade, is considered to be the most complete work of the period and bears witness to how, at this point, a new survey discipline was being developed. In the text, ample space is given to the studies of photographic chemistry, photographic optics, stereoscopy, topography from the balloon and telephotography, going so far as to even offer instructions on emergency measures provide to the personnel who must work far from the populated centers.

In particular, the descriptions and the technical prescriptions of Captain Tardivo were invaluable in the study of the Photoplane of Venice in 1911, which was the subject of an in-depth study both for questions inherent to the history of the survey techniques as well as for its fundamental importance in the history of the city.

3 THE PHOTOPLANE OF VENICE IN 1911

The visual and analytical comparison between this photoplane and the one realized in 1982, shows us how the photoplanes of today allow for new and more precise analysis and interpretations of that complex phenomenon that is this city, but it also confirms the capacity of the scientific, technical and cultural environments to use the techniques set up, such as aeronautics and photography, in order to reach enterprises such as the photoplane of 1911.

The methods of execution of the photoplane of 1911 have not been discovered through direct methods, but it is possible to go back to the instruments and the techniques adopted through the *Manuale* by Captain Cesare Tardivo, surely the designer and possibly the executor of the survey of Venice.

Essentially, he dictated the standards to follow in order to execute the survey of the plane territory with photographs from the balloon. The instructions are absolutely up to date, except for the difference in the instrumentation available from then to today.

The *Manuale* by Tardivo defines the topography from the balloon as the survey of a portion of the territory or the city performed using a balloon.

Two types of aerostats could be used as a means of raising the photographic chamber: the spherical balloon or the *drachenballoon* (or balloon-kite). Up to 1,000 meters could be reached, but it was unusual to arrive at such a height for the difficulties tied to the maneuverability of the aerostat and the sharpness of the imaged thus obtained.

The retention cable, in addition to guaranteeing a connection to the ground, was used also as a electromagnetic remote control of the shutter of the camera. This was attached by chains to the balloon and had a oscillating movement in flight. The moment of the shot was chosen by the surveyor, equipped with binoculars, to be at the moment of the passage of the optical axis of the camera to vertical.

The camera had a 150 mm lens and had a photographic plate of 21x21 cm². The whole circular area of the lens was left inscribed on the plate (that is, a complete section of the luminous cone), differing from what happens with present day cameras in which only the rectangular portion of the field of vision is left impressed upon the film. The useful field was considered to be not the circle with the 21cm diameter (tangent to the edges of the plate) but rather the concentric circle of 16cm diameter. This reduction was dictated by the necessity to use the central part of the most geometrically correct photograph since the aberrations of the lenses were not corrected in any way.

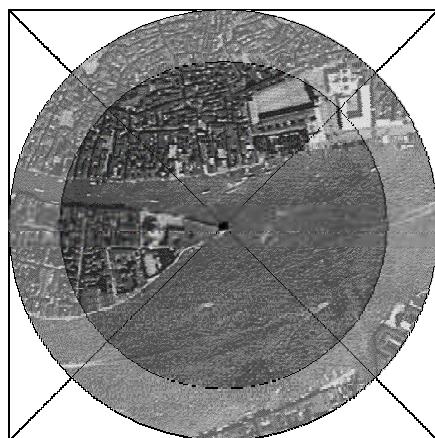


Figure 5-6. Simulation of a aerial photography from aerostat from 750m with a 150mm camera. At left, the image on the plate with the total field and the usable field marked; at right a recovery hypothesis.

The work in the campaign was lengthy and laborious. The photographic camera was generally raised and recalled for every shot. An attentive preliminary recognition was done for the selection of the setting points, but usually the positions were not prefixed because the condition of the setting could vary with great ease. The result of the setting operations was a grouping of circular images that together completely covered the areas of interest.

The control points surveyed for the triangulation of the terrain were at least three points for each plate. These points served to reduce the plates to the same scale and for their subsequent union.

The work in the laboratory, considered the most difficult part, consisted in reducing those sheets to the horizon that for some reason were obtained in a position of the axis of the camera different from the vertical. Such an operation is therefore the rectification of the photographs to non-vertical axes. This operation, done for control points or for prospective lines, is applied only in specific cases.

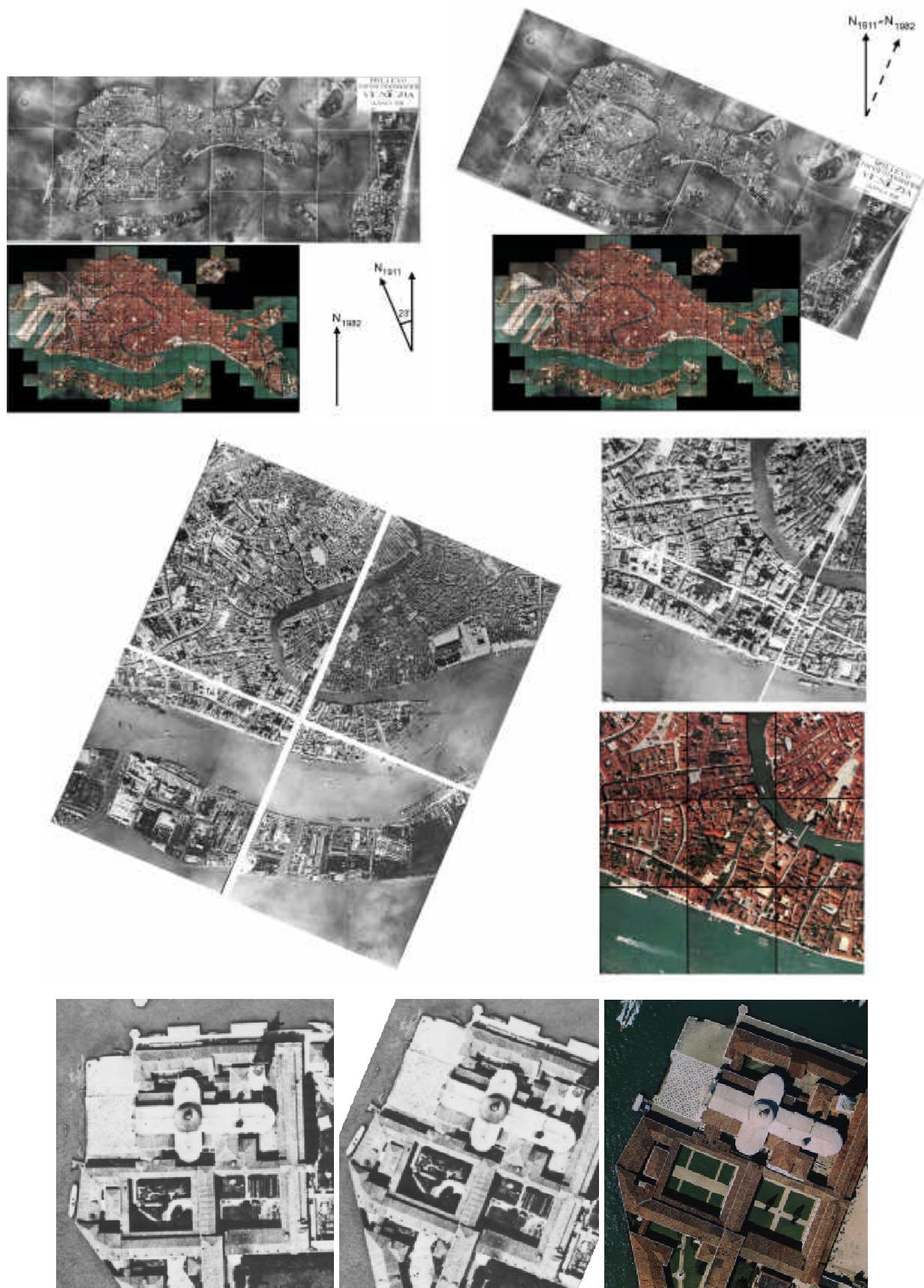


Figure 7. Transformation and geo-referencing of the 1911 photoplan: global and local transformations.

The last phase of the survey was making a mosaic of the circular images for which care was taken to execute cuts only in the areas in which it was possible to hide them.

The figures show how the area of the Piazza S. Marco has been represented by the use of more than one image. Once finished mounting, the reproduction of the mosaic with plates (generally 40 x 50) was called for, for the convenience of successive reproductions and to give regular cuts to the whole photo-plan. Out of all this, it results that the cut of the photo-plan from 1911 does not come from projective necessities or from the choices of cartographic representation: the elements were cut according to the possibility of reproduction from that era. The final sheets constitute the *original* of the photo-plan.

3.1 Transformation and geo-referencing of the 1911 photoplan

The work done can be synthesized in the following steps:

- digitalization,
- radiometric treatment for the homogenization of the images,
- preparatory mosaic making,
- global geometric transformation for the geo-referencing
- local geometric transformation for the completion and the readiness of the final images

3.1.1 The geo-referencing: global transformation.

The geo-referencing of the pretreated images was realized with a linear plane transformation. The choice of the type of transformation is tied to the distribution of the control points and to the geometric characteristics of the image. It is important not to forget that the sheets of the photo-plan from 1911 are the result of making mosaics of many images. The application of the transformation in some cases derives not so much from the projective considerations as from the research of the transformation which minimizes the remainders on the control points. If it is in fact true that a prospect of a prospect is still a prospect, regulated by 8 parameters (combination of 16 total), it is likewise true that in the case studied, the initial image is not a photograph but a mosaic. The control points have been extracted from the 1982 photo-plan paying great attention to the identification of the homologous points of the two photo-plans. The result of the operations is a series of new images at 300 dpi of the photo-plan from 1911, having the same scale, the same cuts and the same orientation of those of 1982. The rotation between the photo-plans, extracted by the averages of the images is about 23°.

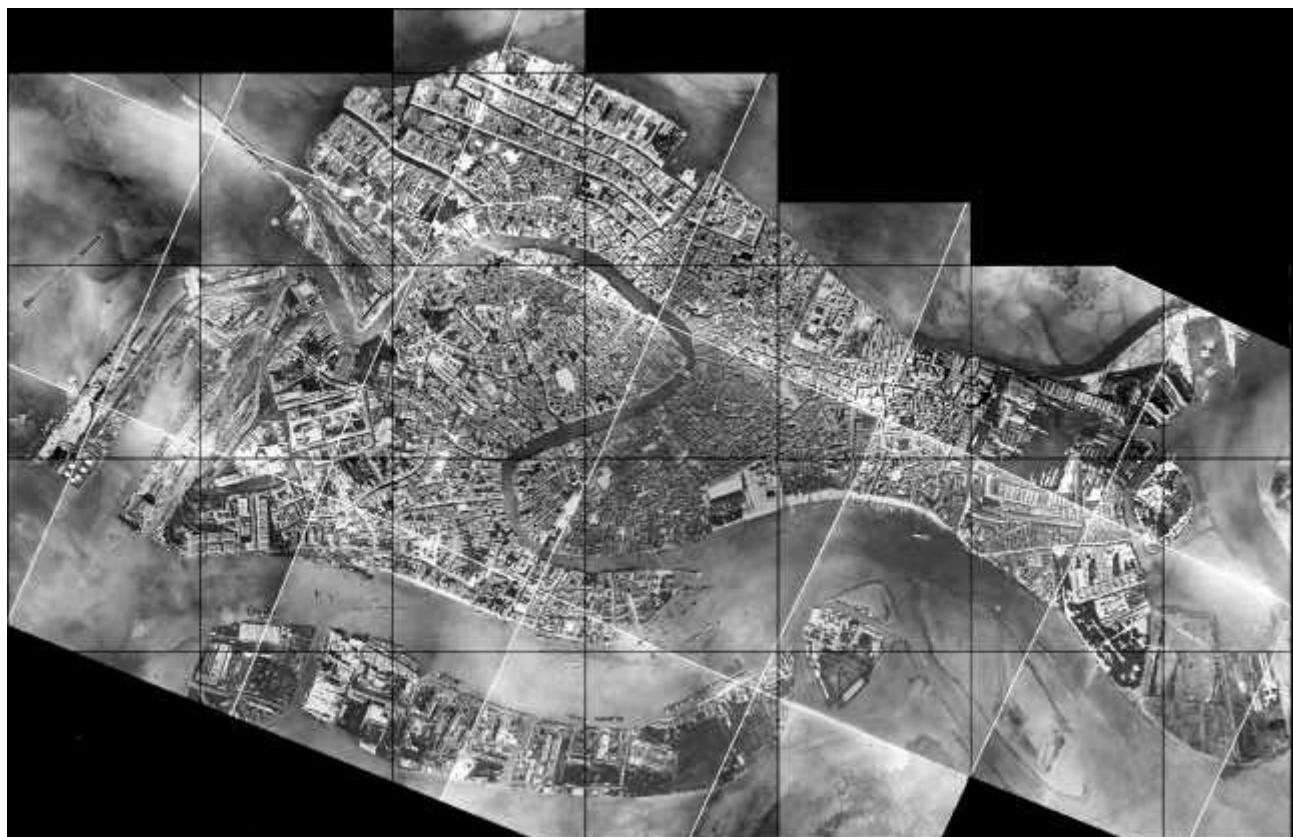


Figure 8. Unified picture of the photoplan from 1911 with the new geo-referencing

3.1.2 Local transformation and restoration of the images.

To place the elements represented on the two photo-plans in precise correspondence it was necessary to operate other local transformations on the singular images already geo-referenced. The technique adopted is *feature-based*. The need for these local adjustments to the general transformation is imputable to the mosaic of the originals from 1911, which does not allow for the exact application of projective rules.

The last operation done was that of the reintegration or the reconstruction of some gaps. Because of the trimming done on the originals from 1911 and because of the scarce care given to the reproductions, some small areas at the edges of the initial 1911 sheets were missing. The restoration was done where possible, recovering the missing portions of the images from other reproductions and where this was not possible, using analogous reconstructions.

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