LA FUSIÓN DE IMÁGENES DE TELEDETECCIÓN: UNA AYUDA PARA LA INTERPRETACIÓN DE ENTORNOS URBANOS

Juan F. Reinoso Gordo, Carlos León Robles

La fusión de imágenes que interesa en la interpretación de entornos urbanos es aquella en la que se une una imagen pancromática (PAN) y otra multiespectral (MS). La PAN aporta una gran resolución espacial pero sólo en color gris mientras que la MS aporta el color producido por varias bandas (normalmente las tres bandas fundamentales: rojo, verde y azul). El resultado es una imagen fusionada con la máxima resolución espacial y espectral. En este trabajo exponemos un ejemplo de los métodos tradicionales como es la fusión mediante la transformación IHS con indicación de sus problemas de distorsión del color, a continuación se ejecuta una fusión mediante técnicas de multi-resolución basada en wavelets que soluciona los problemas de distorsión. Finalmente se tiene en cuenta uno de los algoritmos recientes que además tiene en consideración la anisotropía de la imagen. Para ello hace un análisis multidireccional de las imágenes a fusionar. La calidad de la fusión debe ser analizada desde un punto de vista cuantitativo, para ello se han empleado aquellas medidas que, en las referencias actuales, han mostrado mayor utilidad. Un examen visual de la fusión también es necesario para establecer conclusiones sobre cada uno de lo métodos. En nuestro estudio hemos empleado imágenes procedentes del satélite QuickBird por ser uno de los que proporciona mayor resolución espacial y por tanto una mejor identificación de los objetos del entorno urbano.

Introducción

Las imágenes de teledetección (procedentes de satélites o aéreas) son usadas a diario por cartógrafos, planificadores del territorio y en general por todas aquellas disciplinas englobadas bajo la denominación de Ciencias de la Tierra. Especial interés para el Análisis Urbano tienen aquellas imágenes de la ciudad procedentes de satélites con alta resolución espacial como es el caso de las que se utilizan en nuestro estudio (satélite QuickBird). La imagen PAN tiene un tamaño de píxel sobre el terreno de 0,7 m, mientras que el tamaño de la MS es de 2,4 m. Por otra parte la resolución espectral de QucikBird es de 4 bandas pertenecientes a las longitudes de onda del infrarrojo, rojo, verde y azul. En este trabajo sólo se han empleado las bandas del espectro visible: rojo, verde y azul (RGB). Por su parte la PAN es una única imagen pero que registra el ancho de banda correspondiente al espectro visible. Existe una gran cantidad de trabajos que estudian la fusión de imágenes de satélite p.e.: Núñez, 1999; Zhang, 1999; Li et al. 2002; Zhang et al. 2005. Y en todos ellos se parte de la premisa de que debe existir un buen registro entre la PAN y la MS, entendiendo por buen registro la diferencia posicional entre PAN y MS con valores inferiores al subpixel.

Amolins et al. (2007) clasifican los métodos de fusión en clásicos, basados en wavelet e híbridos, a los que habría que añadir los multidireccionales que recogemos en este trabajo (Lillo, 2004) por su capacidad para detectar la anisotropía de la imagen. Los métodos clásicos son capaces de detectar muy bien la geometría de la imagen PAN e incorporarla a la MS pero tienen el inconveniente que durante el proceso de fusión introducen distorsiones del color. La distorsión del color implica la asignación de colores, a zonas de la imagen fusionada, que no existían en la MS original. Esta distorsión se acentúa cuando la longitud de onda de las bandas MS no está cubierta por la longitud de onda de la banda PAN, como es el caso de la ban-

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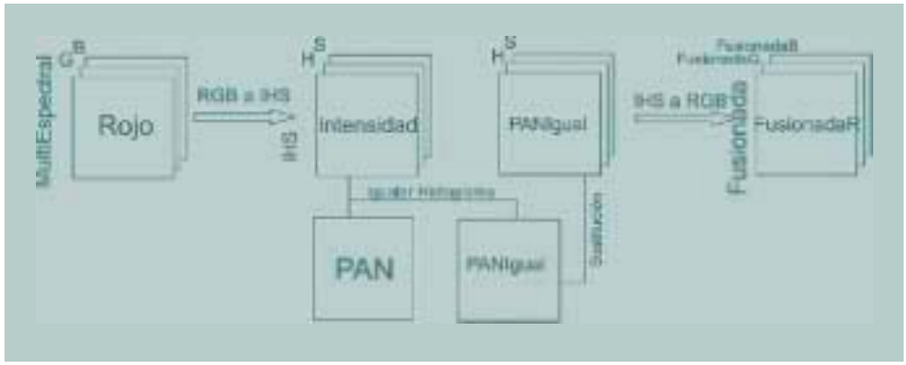
da infrarroja en el caso del satélite QuickBird. Una solución a la distorsión del color se logró con el método multirresolución basado en wavelet (Núñez, 1999), el cual era capaz de extraer de la PAN los detalles de la geometría e incorporar sólo dichos detalles con lo que se conservaba en gran medida el color original de la MS. La técnica de descomposición wavelets en principio estaba basada en el algoritmo de Mallat (1989), pero producía problemas de anillo en torno a los objetos singulares de la escena como consecuencia del efecto Gibbs. Este efecto de anillo se debe a que el algoritmo de Mallat es 'diezmado': en cada etapa reduce el tamaño de la imagen a 1/4 de la imagen en la etapa anterior (Yocky, 1996). El efecto anillo se elimina mediante el uso de algoritmos 'no diezmado' como es el caso del algoritmo 'à trous' (Shensa, 1992), que significa con agujeros. Entre los métodos multidireccionales más recientes se encuentran algunas extensiones de las wavelets como son las técnicas curvelets (Càndes et al. 2000), contourlets (Cunha et al. 2006) y otra desarrollada por Lillo y Gonzalo (2004).

La evaluación de la calidad de la fusión ha sido un tema ampliamente estudiado desde los inicios hasta la actualidad. Se han desarrollado medidas que evalúan tanto la calidad espacial como espectral de la imagen fusionada (Zhou, 1998; Wald, 2000; Wang, 200, 2004). Estas medidas que cuantifican la calidad se ven complementadas, generalmente, por un examen visual que conduce a la emisión de un juicio sobre los resultados.

A continuación se presentan los métodos de fusión (IHS, wavelet y multidireccional), las medidas empleadas y una imagen QuickBird sobre la que se aplican los mismos junto con un análisis de resultados.



1: Esquema de fusión IHS.

Fusión IHS

La fusión IHS se fundamenta en la posibilidad de definir una imagen en color mediante dos sistemas de coordenadas diferentes. El sistema más habitual es el que almacena en tres matrices diferentes cada una de las bandas de color componentes rojo, verde y azul (sistema RGB); el otro sistema que nos interesa también almacena la imagen en tres matrices que representan la intensidad, tono y saturación (sistema IHS). En el sistema IHS la intensidad almacena la estructura espacial de la imagen, mientras que tono y saturación almacenan la estructura espectral. Aunque la imagen PAN se muestra en una escala de grises, también es posible descomponerla en el sistema IHS y como su resolución espacial es mayor, su componente intensidad (I) conservará dicha resolución. La transformación consiste en sustituir la componente I de la MS por la componente I de la PAN y la nueva imagen fusionada se vuelve a expresar en el sistema RGB. Para minimizar las distorsiones del color, antes de realizar la sustitución la imagen PAN se modifica mediante la igualación de su histograma al histograma de la MS, y con dicha PAN modificada se hace la transformación IHS (Fig. 1). El paso del sistema RGB a IHS se expresa por las ecuaciones (1) y el paso de IHS a RGB se expresa por las ecuaciones (2).

$$\begin{pmatrix} I \\ v1 \\ v2 \end{pmatrix} = \begin{pmatrix} \frac{1}{\sqrt{3}} & \frac{1}{\sqrt{3}} & \frac{1}{\sqrt{3}} \\ \frac{1}{\sqrt{6}} & \frac{1}{\sqrt{6}} & \frac{-2}{\sqrt{6}} \\ \frac{1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} & 0 \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix}; \quad H = \tan^{-1}\left(\frac{v1}{v2}\right) \quad S = \sqrt{v1^2 + v2^2}$$

(1)

$$\begin{pmatrix} R \\ G \\ B \end{pmatrix} = \begin{pmatrix} \frac{1}{\sqrt{3}} & \frac{1}{\sqrt{6}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{3}} & \frac{1}{\sqrt{6}} & \frac{-1}{\sqrt{6}} \\ \frac{1}{\sqrt{3}} & \frac{-2}{\sqrt{6}} & 0 \end{pmatrix} \begin{pmatrix} I \\ v1 \\ v2 \end{pmatrix}; \quad \begin{aligned} v1 &= S\cos(H) \\ v2 &= S\sin(H) \end{aligned}$$

(2)

Fusión Wavelet

La transformada wavelet puede descomponer una señal (en nuestro caso una imagen) en dos partes, una correspondiente a un aproximante (parte grosera de la imagen) y otra correspondiente a los detalles (geometría de los objetos singulares). Matemáticamente se puede expresar la imagen *f(x)* como en la ecuación 3:

$$f(x) = \sum_{k} c_{jk}\varphi_{jk}(x) + \sum_{j=1}^{J}\sum_{k} d_{jk}\psi_{jk}(x)$$

(3)

Donde c_{jk} y d_{jk} son los coeficientes de aproximación y detalle de las funciones de escala ($\Phi_{jk}(x)$) y wavelet ($\Psi_{jk}(x)$) respectivamente. *J* indica el nivel de resolución hasta el que se ha llegado en la descomposición de la imagen. Las funciones de escala $\{\Phi_{jk}(x)\}$ y wavelet $\{\Psi_{jk}(x)\}$ forman bases ortonormales de subespacios V_j y W_j que a su vez son complementarios entre sí.

Las formas de la wavelet madre y la de la función de escala, expresadas ambas en forma diádica, son las de las ecuaciones (4)

$$\Psi_{j,k}(x)=\sqrt{2}\Psi(2^j x-k);\quad j,k\in Z;$$
$$\Phi_{j,k}(x)=\sqrt{2}\Phi(2^j x-k);$$

(4)

$\Phi_{j,k}(x)$ tiene el efecto de un filtro de paso bajo mientras que $\Psi_{j,k}(x)$ tiene el efecto de un filtro de paso alto.

El algoritmo de fusion wavelet sigue los siguientes pasos:

1. Para cada banda (R, G y B) de la original MS se obtiene una nueva PAN (PAN_R, PAN_G, PAN_B) mediante la igualación de su histograma con las referidas R, G y B.

2. Se descompone mediante la transformación wavelet cada banda de la MS original en detalles ($R_{Detall.}$, G_{Detall}, B_{Detall}) y aproximantes ($R_{Aprox.}$, $G_{Aprox.}$, $B_{Aprox.}$) para un nivel de resolución *j*, en nuestro caso *j=2*.

3. Se descompone mediante la transformación wavelet cada PAN_R, PAN_G, PAN_B en detalles ($PAN_{R\text{-}Detall.}$, $PAN_{G\text{-}Detall}$, $PAN_{B\text{-}Detall}$) y aproximantes ($PAN_{R\text{-}Aprox.}$, $PAN_{G\text{-}Aprox.}$, $PAN_{B\text{-}Aprox.}$) para el mismo nivel de resolución *j* que en el paso 2.

4. Por cada banda se crea una nueva banda fusionada formada por los detalles de la pancromática ($PAN_{R\text{-}Detall.}$, $PAN_{G\text{-}Detall}$, $PAN_{B\text{-}Detall}$) y los aproximantes de la MS ($R_{Aprox.}$, $G_{Aprox.}$, $B_{Aprox.}$). Lo cual da lugar a la fusionada color definitiva (ecuación 5).

$$RGB_{Fusionada} = [\, R_{Aprox.} + PAN_{Detall.},\ G_{Aprox.} + PAN_{Detall.},\ B_{Aprox.} + PAN_{Detall.}\,]$$

(5)

Véase el proceso gráfico en la Figura 2; para no aumentar excesivamente el tamaño de la misma se ha omitido la representación de ($PAN_{R\text{-}Detall.}$, $PAN_{G\text{-}Detall}$, $PAN_{B\text{-}Detall}$) y ($PAN_{R\text{-}Aprox.}$, $PAN_{G\text{-}Aprox.}$, $PAN_{B\text{-}Aprox.}$) y sólo se ha puesto a modo de ejemplo $PAN_{Aprox.}$ y $PAN_{Detall.}$ que se han extraído de la PAN original.

El algoritmo empleado utiliza la función de escala de las B-Spline cúbicas que se traduce en el filtro bidimensional de la ecuación 6. Dicho filtro se ha aplicado con arreglo al algoritmo no diezmado 'à trous' (Shensa, 1992).

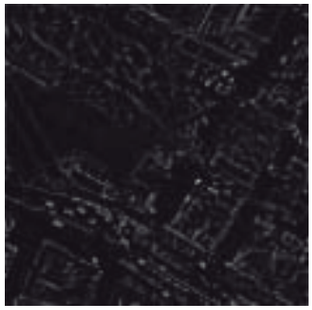
$$Filtro = \frac{1}{256}\begin{pmatrix} 1 & 4 & 6 & 4 & 1 \\ 4 & 16 & 24 & 16 & 4 \\ 6 & 24 & 36 & 24 & 6 \\ 4 & 16 & 24 & 16 & 4 \\ 1 & 4 & 6 & 4 & 1 \end{pmatrix}$$

(6)


MS color Original


PAN Original

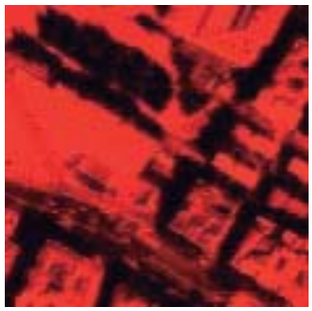

$PAN_{Aprox.}$ *j=2*

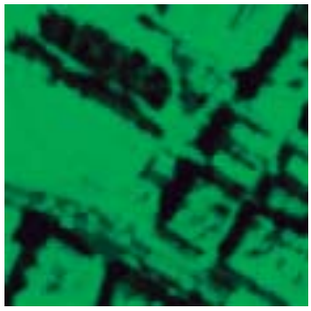

$PAN_{Detall.}$ *j=2*

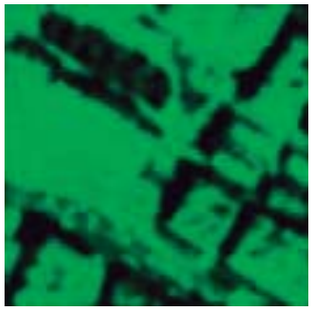

R Original


$R_{Aprox.}$ *j=2*

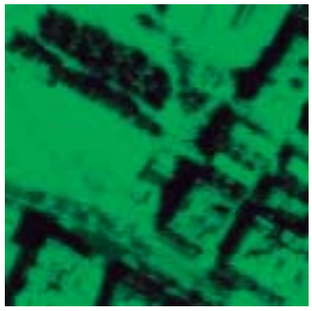

$R_{Detall.}$ *j=2*


$R_{Aprox.}$ + $PAN_{R\text{-}Detall.}$


G Original


$G_{Aprox.}$ *j=2*

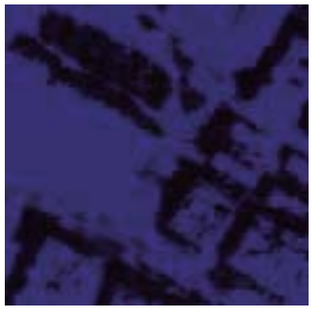

$G_{Detall.}$ *j=2*


$G_{Aprox.}$ + $PAN_{G\text{-}Detall.}$


B Original


$B_{Aprox.}$ *j=2*


$B_{Detall.}$ *j=2*


$B_{Aprox.}$ + $PAN_{B\text{-}Detall.}$


$RGB_{Fusionada}$ =[$R_{Aprox.}$ + $PAN_{Detall.}$, $G_{Aprox.}$ + $PAN_{Detall.}$, $B_{Aprox.}$ + $PAN_{Detall.}$]

2. Secuencia de Fusión de imágenes mediante técnica wavelet

Fusión Multiresolución Multidireccional

Con este algoritmo se pretende detectar con más precisión los detalles que no tengan orientaciones horizontales, verticales o diagonales, si no que ocupen otras direcciones de la imagen (Lillo y Gonzalo, 2007). En este sentido aventaja al algoritmo del apartado anterior, que sólo podía tener en cuenta las tres direcciones mencionadas. En el aspecto de la ejecución sólo se diferencia respecto del algoritmo wavelet anterior en la forma de obtener los detalles, existirán tantos niveles de resolución como direcciones se deseen analizar. Cada aproximante se consigue mediante el filtro elipsoidal *H(u,v)* ecuaciones 7.

$$H(u,v) = H_1(u) \times H_2(v) - \alpha u H_1(u) \times v H_2(v)$$

$$\text{donde} \quad \alpha = \frac{(a^2 - b^2)\sin(2\theta)}{(a^2 b^2)}$$

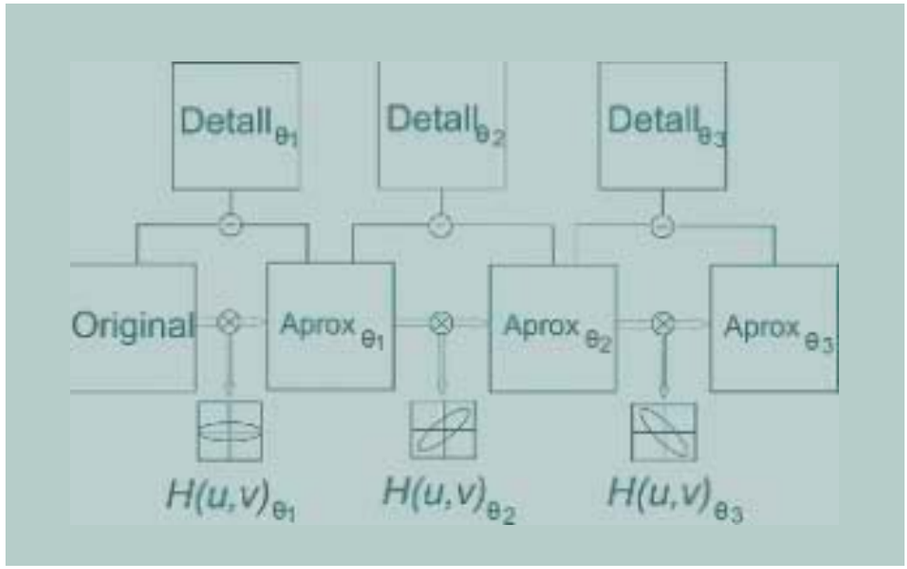
$$H_1(u) = \exp\left(-u^2\left(\frac{\cos^2\theta}{a^2} + \frac{\sin^2\theta}{b^2}\right)\right)$$

$$H_2(u) = \exp\left(-v^2\left(\frac{\cos^2\theta}{a^2} + \frac{\sin^2\theta}{b^2}\right)\right)$$

(7)

Donde θ es la dirección considerada, *a* es la escala y *b* es la elongación.

La Figura 3 presenta el esquema de obtención de aproximantes y detalles del algoritmo multidireccional. Una vez obtenidos detalles y aproximantes las fases son las mismas que en el algoritmo de la sección 3.



3. Esquema de fusión multidireccional.

Medidas evaluadoras de la calidad

Las medidas evaluarán la calidad tanto espectral como especial. Para ello se suele comparar la imagen fusionada, bien con la original en color, lo que da idea de lo bien que se ha conservado el aspecto espectral, bien con la pancromática que dará información sobre la cantidad de detalles geométricos que se han incorporado a la imagen fusionada. Teniendo en cuenta esos condicionantes se han seleccionado 7 medidas de forma que cumplan con los objetivos de la evaluación.

La notación empleada es la siguiente:

i: *i*^{esima} banda

O_j : *j*^{esimo} pixel en la *i*^{esima} banda original. También puede ser la PAN

F_j : *j*^{esimo} pixel en la *i*^{esima} banda fusionada

NP: número de pixeles

$\bar{F}$: valor medio de los pixeles en la banda fusionada

$\bar{O}$: valor medio de los pixeles en la banda original

Las medidas son las siguientes:

• Indice de Calidad Universal (ICU) (Wang y Bovik, 2002):

$$ICU = \frac{4\sigma_{OF}\bar{O}\bar{F}}{\left(\sigma_O^2 + \sigma_F^2\right)\left[\left(\bar{O}\right)^2 + \left(\bar{F}\right)^2\right]}$$

• Coeficiente de Correlación (CC):

$$CC(n_s) = \frac{\sum_{j=1}^{NP}(O_j - \bar{O})(F_j - \bar{F})}{\sqrt{\sum_{j=1}^{NP}(O_j - \bar{O})^2 \sum_{j=1}^{NP}(F_j - \bar{F})^2}}$$

• Índice de Similaridad Estructural: mide la información estructural en la imagen fusionada (ISE) (Wang et al., 2004):

$$ISE(O,F) = \frac{1}{M}\sum_{i=1}^{M} SSIM(O_i,F_i);$$

$$SSIM(O,F) = \frac{(2\bar{O}\cdot\bar{F}+C_1)(2\sigma_{OF}+C_2)}{(\bar{O}^2+\bar{F}^2+C_1)(\sigma_O^2+\sigma_F^2+C_2)}$$

M= número de ventanas locales de la imagen

• Discrepancia (DC):

$$D_i = \frac{1}{NP}\sum_j |O_i - F_i|$$

• ERGAS (Wald, 2000):

$$ERGAS = 100\frac{h}{l}\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\frac{RMSE_i^2}{IMG_i^2}\right)}$$

donde *IMG* es *PAN* o *F*
h y *l* son las resoluciones espaciales de la PAN y MS respectivamente

• Zhou index (Zhou et al., 1998)

$$Zhou = \frac{\sum_{j=1}^{MP}(F_j-\overline{F_j})(PAN_j-\overline{PAN_j})}{\sqrt{\sum_{j=1}^{MP}(F_j-\overline{F_j})^2\cdot\sum_{j=1}^{MP}(PAN_j-\overline{PAN_j})^2}}$$

donde $\overline{PAN}$ y $\overline{F}$ son las imágenes PAN y la fusionada filtrada por el laplaciano respectivamente

• Mapa Angular Espectral (SAM) (Nencini et al. 2007):

$$SAM(O,F) = \arccos\left(\frac{\langle O,F\rangle}{\|O\|_2\cdot\|F\|_2}\right)$$

Para analizar y comparar los métodos de fusión se han construido tres tablas:

- Tabla 1 (Medidas espectrales): se calcula cada medida entre bandas homólogas (p.e. las bandas rojas) que pertenecen a la imagen fusionada y a la imagen MS. La medida se calcula para cada una de las tres bandas, lo que produce 3 medidas por cada imagen fusionada, con esas tres medidas se puede calcular la media que será el valor que se usará para comparar la bondad entre los métodos. Cuanto mayor sea el valor de la medida (excepto en el caso de la medida discrepancia) mejor se habrá transmitido el color desde la MS original hasta la imagen fusionada.
- Tabla 2 (Medidas espaciales): las medidas se calculan de manera similar a las de la tabla 1 pero en este caso cada banda de la imagen fusionada se compara siempre con la PAN. El valor de la medida indica el grado con el que los objetos de la PAN (con mucho mayor nivel de detalle que en la MS) se han transferido a la imagen fusionada. Cuanto más alto es el valor de la medida mayor resolución espacial ha conseguido la fusionada.
- Tabla 3 (Medidas globales espaciales y espectrales): las medidas que aparecen en esta tabla no realizan un análisis banda a banda, sino que proporcionan un valor global de la calidad de la fusión. El aspecto espacial es medido por la medida ERGAS espacial, mientras que el aspecto espectral es medido por las medidas SAM y ERGAS espectral. En esta tabla a diferencia de las anteriores, cuanto más pequeño es el valor mejor es la fusión.

		Medidas Espectrales		
		IHS	Wavelet	Multidir
Calidad Universal	Rojo	0,798	0,953	0,955
	Verde	0,811	0,952	0,954
	Azul	0,792	0,953	0,953
	Media	0,801	0,953	0,954
MSSIM	Rojo	0,487	0,581	0,603
	Verde	0,480	0,584	0,605
	Azul	0,472	0,563	0,578
	Media	0,480	0,576	0,595
Coeficiente de Correlación	Rojo	0,825	0,953	0,955
	Verde	0,820	0,952	0,954
	Azul	0,826	0,953	0,953
	Media	0,824	0,953	0,954
Discrepancia	Rojo	34,105	15,987	15,872
	Verde	31,320	15,998	15,993
	Azul	34,535	16,542	16,836
	Media	33,320	16,176	16,234

Tabla 1: Medidas Espectrales

		Medidas Espaciales		
		IHS	Wavelet	Multidir
Calidad Universal	Rojo	0,961	0,908	0,917
	Verde	0,991	0,906	0,915
	Azul	0,965	0,864	0,876
	Media	0,972	0,893	0,903
MSSIM	Rojo	0,940	0,849	0,860
	Verde	0,973	0,849	0,860
	Azul	0,936	0,808	0,822
	Media	0,950	0,836	0,847
Coeficiente de Correlación	Rojo	0,985	0,912	0,920
	Verde	0,996	0,908	0,917
	Azul	0,986	0,868	0,880
	Media	0,989	0,896	0,906
Zhou	Rojo	0,995	0,989	0,986
	Verde	0,998	0,984	0,982
	Azul	0,995	0,976	0,975
	Media	0,996	0,983	0,981

Tabla 2: Medidas Espaciales.

	Medidas Globales Espectrales y Espaciales		
	IHS	Wavelet	Multidir
Espacial ERGAS	0,766	1,111	1,082
Espectral ERGAS	1,328	0,931	0,925
SAM	3,769	3,244	3,482

Tabla 3: Medidas Globales Espectrales y Espaciales.

Nótese cómo todas las medidas no se aplican para las evaluaciones espectrales y espaciales, pues en algunos no tiene sentido hacer una interpretación de la medida.

Análisis y discusión de resultados

De la observación de las tablas 2 y 3 se tiene que los mejores valores espaciales los obtiene el método IHS; sin embargo tras la evaluación visual de las imágenes de la Figura 4, en el método IHS se aprecia distorsión del color, especialmente en los árboles y en tejados cuyo color es anaranjado en la MS original. También se observa una pérdida de intensidad del color rosa en la zona de la plaza. Los métodos Wavelet y Multidireccional tienen unos valores muy similares, tanto en su faceta espacial como multiespectral, aunque de la observación visual, parece que las Wavelet reproducen con un poco más de fidelidad los colores. En cualquier caso, estos dos últimos métodos reúnen las cualidades que se le pide a la fusión de imágenes: integración en una única imagen de la mayor resolución espacial de la PAN y la mayor resolución espectral de la MS.

7. Conclusiones

Los métodos de fusión de imágenes que se han presentado en este trabajo se muestran útiles en la integración de información geográfica, concretamente urbana, procedentes de imágenes de diferentes resoluciones PAN y MS. Particularmente permiten la discriminación de objetos que si se observasen en las imágenes PAN o MS separadamente no sería posible asignar correctamente a la categoría que pertenecen. Esto implica una ayuda considerable a aquellas personas que han de interpretar los entornos urbanos basándose en la observación de imágenes urbanas (en nuestro caso imágenes procedentes del satélite QuickBird).

4. Resultados de la Fusión. De izquierda a derecha y de arriba abajo: MS, PAN, Fusionada IHS, Fusionada Wavelet y Fusionada Multidireccional.





Referencias

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18 / "In the visual arts there is no such thing as a Romantic style if by this we mean a common language of visual forms and means of expression comparable to the Baroque Rococo. *There is not a single work of art that embodies the*

1. Education and the background to the tour of Spain

David Roberts (1796-1864) was born into a poor family in Stockbridge, near Edinburgh: his father was a shoemaker and his mother a washerwoman. Roberts had to struggle to make his way in his profession. At the age of twelve he entered as apprentice in the workshop of painter and decorator of Scottish country houses, and after struggling for seven years he found employment as a painter of stage scenery in a travelling theatre, which allowed him to travel and paint scenes on a large scale and to draw the places he visited. According to the author himself, it was while drawing York Cathedral that he discovered his true vocation as a painter-traveller[5].

From 1816 until around 1830 Roberts devoted himself to scene-painting and worked in the most important theatres in Scotland and England, executing numerous graphic compositions with great inventiveness, immediacy and expressive intensity, all of which allowed him to mature as an artist. As his financial circumstances improved, he was able to devote himself to painting. In 1824 he became a member of the newly formed Society of British Artists[6], where he exhibited many paintings relating to his travels. After exhibiting *West Front of Notre Dame, Rouen* at the Royal Academy, painted for Lord Northwick, one of his first and most generous patrons, Roberts received a number of very attractive commissions and in 1831 the Society of British Artists elected him as their president.

Among the reasons that inspired his journey to Spain were Roberts' own personal circumstances. He married in 1820 and his only daughter was born a year later. The failure of his marriage and subsequent separation led him to seek a change in both his personal life and artistic direction[7]. Around 1830 Roberts was in an ideal condition, physically and financially, as well as in terms of age and travelling experience, to undertake an adventure in Spain. Some of his friends and contemporary British artists such as David Wilkie, John Frederick Lewis, or other figures, like Richard Ford had done the same. The opportunity to stand before works by masters such as Velázquez, Murillo or Zurbarán exercised an obvious appeal. At the time Spain was in vogue and there was considerable public demand in England for all things from Spain, then little known or considered exotic. This convinced Roberts that the substantial effort and expense involved in the journey would be amply rewarded by the sale of his Spanish work on his return, as indeed was the case.

2. A prolific painter of landscapes and architecture

Roberts embarked on his journey with the intention of making the fullest possible use of his time, and had pencil or paintbrush always to hand. After scarcely six weeks in Spain, in a letter written from Córdoba, Roberts could write: "*My portfolio is getting rich, the subjects are not only good but of a very novel character. I begin to doubt whether I shall be able to paint half of them, they already amount to over 100, and I have yet six towns to visit, from which I expect many fine subjects*". In another letter two months later, while passing through Gibraltar, Roberts remarks: "*many of the drawings are very original, I have no fewer than two hundred and six finished drawings, the greater part coloured, in addition to others in my small sketch-book*"[8]. It has been estimated that in Andalusia alone Roberts made as many as 250 views[9]. However, he would not paint oils in Spain, with the exception of two in Seville, on account of the obvious difficulties involved in transportation to England. Given that his sketch-books were "pocket-sized" (10 by 17 cm.), Roberts' ability to use them to create complex and detailed scenes is remarkable. According to Katharine Sim, "*what is astonishing in these sketches, the majority in pencil or wash on lightly tinted paper is not only the simplicity and delicacy of the line, but also the surprising accuracy of subtly rendered details*"[10].

According to Ballantine, who was a personal friend of the painter, "*He seemed to have the power of photographing subjects on his eye, for I have again and again been with him while he was sketching very elaborate structures or very extensive views, and he took in a large mass at one glance, not requiring to look again at that portion until he had it completed in his sketch. Other artists caught small bits at a time, and required to be renewing their glances continually. Roberts, by this extraordinary faculty, either natural or acquired, got over more than double their work with half their labour*"[11]. The rapidity required in the scene-painting of his youth would explain how Roberts came to have such facility in capturing and recording his images.

Following his extended visit to Spain Roberts produced numerous views of the same scenes, reproducing again and again those most in demand from his clients, with variations which, like a proper graphic architect, he introduced with great precision, with the aim of satisfying the requests he received. Arguably the distortions or manipulations of the views were the result not of a "taste for the fantastic" or an allegedly "Romantic" character, which has been the object of so much speculation[12], but of the requirements of those who paid him for works that were unique and exclusive, elaborated on the basis of small sketches, sometimes long after the journey itself (1833), as was the case with a view of Carmona, dated 1853, which Roberts gave as a present to his dentist[13].

According to Sim, the painter's biographer, "what interested him was always to take advantage of his extraordinary ability as draughtsman, rapid and faithful to reality"[14]. Nevertheless, like the excellent scene-painter he was, he had no hesitation in sometimes removing and adding elements of architecture or landscape in the faithful travel sketches, with the aim of accentuating theatrically the effects of the composition, or contrasts of outdoor and indoor light (evenings, night views …), sometimes reconstructing lost architecture[15], skewing proportions, altering the scale of the human figures, or inventing elements that were not included in the sketches because of a lack of time. In spite of all this, Roberts was always true to the essence of what he represented. To use an old adage applied to the skilful bullfighter, in his drawings Roberts sometimes "deceives but without lies".

It is therefore inaccurate to state of the views, with Calvo Serraller, that: "in these representations of Spanish cities the fantastic predominates over the real …"[16], since exactly the opposite is the case, the real predominates over the fantastic. This is of great importance when consideration is given to the documentary value of the illustrations, the details of which need to be analysed one by one with an unprejudiced eye. Likewise open to question is the opinion of Galera Andreu on Roberts: "objectivity, realism or accuracy are not values much taken account of in this way of looking at and reflecting landscape or scenery"[17]. Among the numerous examples which demonstrate the opposite are lithographs of the Giralda or the Tower of Comares (1837) (*fig.6*), which despite containing certain alterations, are among the most beautiful and faithful representations of these monuments prior to the advent of photography. Thus "labels" or inappropriate generalizations should be avoided and greater rigour applied to the views taken individually and compared with other drawings of the 19th century (Laborde, Ford...) or – where possible, with photographs – so as to be able to make precise judgements in each instance on their veracity or otherwise.

In any case if one had to sum up Roberts and his work, it can be affirmed that he was a great painter of landscapes and architecture, a graphic architect with expressive points of view and sophisticated resources in his scenes, a true landscape artist, and not a Romantic, since such a label implies a partial vision of a rich body of work. The term "Romantic" has proved productive in literary research but is questionable when applied to the graphic arts, according to Honour[18]. Roberts never engaged in literature, unlike other "Romantic" travellers who wrote with a teeming imagination, and sometimes gave picturesque or antiquated versions of reality. An entry of 16 March 1833 in the diary of the British Consul in Malaga, William Mark, personal friend of Roberts', who accompanied him around the city, states clearly: "*Mr Roberts has come to Spain to make a faithful study and to distance himself in his*

objectives and ideals of the Romantics ...". HONOUR, H.: *El romanticismo*, p. 15-16, 1981; QUESADA, L.: *Pintores españoles y extranjeros en Andalucía*, p. 72, 1996.
19 / GIMÉNEZ CRUZ, A.: *La España pintoresca*…p. 185-186, 2002.
20 / ROSCOE, T. (text) / ROBERTS, D. (art.): *The tourist in Spain*, R. Jennings, 4 vols. London 1835-38. Among the numerous editions there was a French edition of the volume dedicated to Granada entitled "*L'Espagne. Royaume de Granada*", 1835.
21 / A copy exists in the Barbican Art Gallery. GIMÉNEZ CRUZ, A.: *La España pintoresca*…p. 369-70, 2002.
22 / GUITERMAN, H. / LLEWELLYN, B.: *David Roberts*, p. 48, 57, 107-108 (cat. 81, 82, 83, 84), 1986.
23 / MESONERO ROMANOS, R.: *Manual de Madrid*, p. 13-26 (2ª ed.), 1833.
24 / GIMÉNEZ CRUZ, A.: *La España pintoresca*…p. 83, 2002.
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27 / GIMÉNEZ CRUZ, A.: *La España pintoresca*…p. 141-143, 2002.
28 / FORD, R.: *Gatherings from Spain*, p. 293, Madrid, 1974.
29 / Towneley Hall Art Gallery and Museum, Burnley. Pudo basarse en dibujo de R. Ford conservado por la familia Ford.
30 / GIMÉNEZ CRUZ, A.: *La España pintoresca*…p. 173-177, 2002.
31 / It appears to be based on a drawing by R. Ford in the possession of the Ford family. The watercolour is reproduced in SIM, K.: *David Roberts R. A., 1796-1864. A Biography*, 1984. GUITERMAN, H. / LLEWELLYN, B.: *David Roberts*, p. 109 y 110 (cat. 96 y 97), 1986.
32 / GIMÉNEZ CRUZ, A.: *La España pintoresca*…p. 215, 2002.
33 / GUITERMAN, H. / LLEWELLYN, B.: *David Roberts*, p. 109 (cat. 90), 1986.

work from the merely picturesque, and is in this regard unsurpassed"[19].

3. The itinerary in Spain and the views executed

In what follows, an account is given of Roberts' itinerary in Spain and the views he executed, first the published illustrations followed by the known originals. It should be mentioned that the whereabouts of many of the originals are unknown or they were reworked for publication as the twenty-six lithographs of "*Picturesque sketches in Spain. Taken during the years 1832-1833*" (1837) and the approximately seventy steel engravings (smaller vignettes, omitted here for reasons of space) included in the four volumes of "*Landscape Annuals*" edited by R. Jennings with the title "*The tourist in Spain*"[20] (1835, 1836, 1837 and 1838). For this project the finest engravers of the time were employed and use made of original drawings not by the author himself, as we shall see.

Regarding the route followed by Roberts on his journey through Spain, many details can be gleaned from his letters as well as from a personal diary known as the "Record Book"[21], in which he noted down various matters, such as the paintings he was working on, buyers and sellers etc. The diary records the first stages of this trip in 1832, which was marked by disastrous epidemics: "*On October 18th, I left London for Spain and after some days in Paris, continued on my journey, passing through Orleans, Tours and Bordeau, remaining in this last for some time. From there I proceeded to Bayonne where I was detained in quarantine for twenty days. I was finally allowed to leave and continue my journey and enter Spain. On arriving in Irun, the first Spanish town, I was in a lazaretto for fourteen days on account of the cholera, then very prevalent in France. In the month of December I crossed the Pyrenees and after passing through Vittoria, came to Burgos*".

There is little information concerning the initial stages of Roberts' journey. Volume III of "*The Tourist in Spain*" (1837) contains three engravings of the Basque Country: *Fontarabia from St Jean de Luz*, a *View on the Bidassoa looking towards Irún*, and the *Great Square of Vitoria,* where Roberts spent a night. En route to Burgos, Roberts made a view of Miranda del Ebro and another of the Pass of Pancorvo. A delicate original drawing, reproduced here (*fig.2*), is preserved in a private collection in Seville. It depicts an unidentified landscape resembling that of Pancorvo and was no doubt executed with the intention of producing an engraving, although this was never actually published.

Roberts spent a week in Burgos and volume III includes five engravings (1837): *Entrance to the city of Burgos*, *Ruins of the Convent of the Carmelites*, *West Front of the Cathedral* (*fig.3*), the *Staircase in the North Transept* and *Tower of the Chapter House*. The British Museum contains a water-colour of the exterior of the Catedral (1836) basis of the engraving of 1837; and in a private collection there is another outdoor view in pencil (1836), which gave rise to a lithograph in 1837 (pl. VII). There is an oil of the *Staircase in the North Transept* (1835) in the Tate Gallery,and a water-colour (1836) in the Whitworh Art Gallery[22], on which two variant engravings are based. A drawing of the Chapel of the Condestable (1845) can be found in The Courtauld Institute of Art, and an oil-painting on the same subject in the Prado in Madrid.

Roberts arrived in Madrid on 16 December 1832 and spent the Christmas period there. According to Mesonero Romanos[23], the city had a certain small-town charm, in comparison with European capitals such as London, Paris or Rome. In a letter to his sister "*the town consists almost entirely of churches and convents and I have made a number of sketches*"[24]. Perhaps he missed a large cathedral like that of Burgos. Roberts enjoyed the great Spanish masters in the Prado (Velázquez, Jusepe de Ribera…), met painters of the period such as Federico Madrazo or Vicente López, and was critical of the state of landscape painting in Spain at the time: "*it's an insult to give it that name*"[25]. His three-week stay gave rise to six engravings (1837): *Entrance to Madrid by the Gate of Fuencarral*, *Street of San Bernardo*, *Street of Alcalá*, the *Royal Palace*, the *High Altar, Church of San Isidro*, and the *Fountain on the Prado*. In addition he made two lithographs (1837): the Gate of Alcalá (pl. XVIII) and Bridge of Toledo on the Manzanares (pl. XX). Two original drawings are known: one of the Bridge of Toledo in The Royal Collection, and a water-colour of the Fountain on the Prado, basis of the above-mentioned engraving in the Denver Art Museum.

Roberts left Madrid on 9 January 1833 and arrived in Córdoba on 12 or 13 January. He remained there three weeks and fruit of his labour were four engravings: (1836): *Cordova: Looking down the Guadalquivir*, *Interior of the Great Mosque*, *The Alcazar or Prison of the Inquisition*, and *The Tower of the Church of St Nicholas*; also five lithographs (1837): a general view of the bridge and the river with the Mosque in the background (pl. XXIV), a watermill and the bridge over the Guadalquivir (pl. XXII), the entrance gate to the city (pl. XII), the portico of the Courtyard of the Mosque (pl. XXI), and the chapel of the Mosque (pl. XIII). Later he recorded another general view of the bridge and the Mosque. A total of twelve originals of Córdoba by Roberts are known, of which seven are outdoor views: a water-colour of the Alcazar in Dudley Museum; another of the Alcázar, basis of the above-mentioned engraving, in the Whitworth Art Gallery; a drawing of the Albolafía belonging to a private collection in Granada; an oil of the Tower of Calahorra in another private collection; three more versions of the Church of St Nicholas, a water-colour (1835) in the Fitzwilliam Museum, another in the National Museum of Wales, and an oil (1834) in Wakefield Art Gallery. The other five originals are devoted to the Mosque: the portico of the Courtyard (1833) basis of the above-mentioned lithograph, and "the chapel of Mahomed" (1833) together with another similar water-colour in private collections; "The Sanctuary of the Koran" (1849) in Leicester Galleries; and an oil in the Prado (*fig.5*)[26].

From Córdoba Roberts continued his journey and drew views for engravings (1835) en Luque, and Alcalá la Real, arriving in Granada in February 1833. He remained there two weeks. Awed by the city, its position and the Alhambra, he remarks in a letter to his sister that "*there are so many beautiful objects that I am at a loss which to take first. My breakfast is generally over by eight o'clock, when I go out to draw. I dine at two, and out to work again. Although I have nobody to speak to, I never feel the time long; indeed, if I feel inclined to grumble at all, it is at the shortness of the days.The architecture is so peculiar and elaborate that it would take months to do it justice" […]. "And now I am going to smoke a cigar and go to bed, to dream of Moors and Christians, tournaments and battles, painting and architecture. In the morning I go to the Court of the Lions […]and I mean to finish a drawing of it which has already taken me all this day*"[27].

Granada was the Spanish city that inspired the greatest number of engravings (1835), a total of fifteen: a general *view of the Alhambra*, *Granada from the banks of the Xenil*, the *Palace of the Generalife*, the *Vermillion Towers*, *Descent into the Plain and View of Granada*, *Tower of Comares*, the *Gate of Justice*, the *Court of the Alberca*, *Remains of the Old Bridge across the Darro*, the *Casa del Carbón*, the *Tower of the Seven Vaults*, the *Hall of the Abencerrages*, *Moorish Gateway leading to the Viva Rambla*, *Court of the Lions and the Hall of Judgement*. There are in addition five lithographs (1837): *Entrance to the Ferdinand and Isabel* (plate I), the *Casa del Carbón* (pl. IX), the *Tower of Comares* (pl. X) (*fig.6*), *Old Buildings on the Banks of the Darro* (pl. XI) and the *Tomb of the Catholic Monarchs* (pl. XVI). There is a rare engraving of the *Courtyard of the Lions* (*fig.7*) and other original views, the subject of a forthcoming monograph by the present author.

Roberts was forced to leave Granada when he was prevented from continuing a panoramic view of the city and the surrounding country from the Alhambra. This was the only setback Roberts encountered on account of the intransigence of the military authorities, which was frequent in the period, as the following graphic comments of Richard Ford make clear: *"Nothing throughout the length and breadth of the land creates greater suspicion or jealousy than a stranger's making drawings, or writing down notes*

34 / QUESADA, L.: *Pintores españoles y extranjeros en Andalucía*, p. 88, 1996.
35 / Reproduced in the central pages of SIM, K.: *David Roberts R. A., 1796-1864. A Biography*, 1984.
36 / ARIAS ANGLÉS, E.: *El paisajista romántico Jenaro Pérez Villaamil*, C.S.I.C., Madrid 1986
37 / CATÁLOGO: *La Sevilla de Richard Ford 1830-1833*, p. 64-65, 69, 288 (cat. 123, 125, 126), 2007.
38 / VARIOS: *Iconografía de Sevilla, 1790-1868*, p. 159, 178, 188, 189, El Viso 1991.
39 / GUITERMAN, H. / LLEWELLYN, B.: *David Roberts*, p. 107 (cat. 80), 1986.
40 / QUESADA, L.: *Pintores españoles y extranjeros en Andalucía*, p. 88, 1996.
41 / GIMÉNEZ CRUZ, A.: *La España pintoresca*…p. 109-115, 2002.
42 / "*I have made many sketches – which are perhaps not up to much, but they are true to reality – of the majority of the places you have not visited, which you may use to make your own drawings*". GIMÉNEZ CRUZ, A.: *La España pintoresca*…p. 342-343, 2002.
43 / ROSCOE, T. (text) / ROBERTS, D.: *The tourist in Spain*, prefacio, p. V, 1838.
44 / SIM, K.: *David Roberts R. A., 1796-1864. A Biography*, p. 64, 1984.
45 / GUITERMAN, H. / LLEWELLYN, B.: *David Roberts*, p. 56 y 110 (cat. 98, 99), 1986.
46 / SIM, K.: *David Roberts R. A., 1796-1864. A Biography*, p. 63 y ss., 1984.
47 / GUITERMAN, H. / LLEWELLYN, B.: *David Roberts*, p. 50 y 111 (cat. 106), 1986.
48 / Reproduced in CATÁLOGO: *La Sevilla de Richard Ford 1830-1833*, p.39, 2007.
49 / Drawings in the possession of the Ford family.
50 / Reproduced from CATÁLOGO: *La Sevilla de Richard Ford 1830-1833*, p. 40, 2007. Roberts' drawing of Santiago de Compostela is held in The Wallace Collection.

in a book: whoever is observed sacando planes, "taking plans," mapeando el pais, "mapping the country," – for such are the expressions of the simplest pencil sketch — is thought to be an engineer, a spy, and, at all events, to be about no good. The lower classes, like the Orientals, attach a vague mysterious notion to these, to them unintelligible, proceedings; whoever is seen at work is immediately reported to the civil and military authorities, and, in fact, in out-of-the-way places, whenever an unknown person arrives, from the rarity of the occurrence, he is the observed of all observers."[28].

Roberts left Granada for Málaga on 25 or 26 February, and must have passed through Loja, since there is an engraving of the town and its Alcazaba as well as an original drawing[29]. Of Málaga there are two egravings (1836): a view from the *Moorish Fortress of Gibralfaro*, and another of the *Cathedral*; also a lithograph (1837) of the fortress and the port (pl. XIX). He also produced an engraving of the English Cemetery[30].

On his way to Gibraltar, Roberts passed through Ronda, whose mountain setting Roberts said was one of the most extraordinary in Spain and the world. He depicted it in two engravings (1835): a general view of the walled town and another of its remarkable bridge over the gorge (Tajo). A watercolour antecedent to the general view (1834) is preserved in the Tate Gallery[31] and an oil (c. 1835) from a similar perspective in the Huntington Library and Art Gallery, California. Another engraving (1836) includes the town of Gaucín looking towards Gibraltar.

Having arrived in Gibraltar on 19 or 20 March, Roberts crossed the Strait to visit Tangiers, Tetuán and other cities of North Africa. On his return to Gibraltar, he remarks in another of his letters that the governor "*insists on taking charge of my drawings and sending them direct to England to avoid the risk of their passing through Spain, and this offer I gratefully accepted as my sketches now exceed two hundred*"[32]. In Gibraltar he produced a vignette converted into an engraving (1836) and a lithograph (1837) of *Gibraltar from the Neutral Ground* (pl. XXV) (*fig.8*). There are also references to an oil-painting of Gibraltar from Ronda (1853)[33].

Roberts set off in the direction of Cádiz on 23 April; there is an engraving of Tarifa (1836) and another of Cádiz (1836). There are three engravings of Jerez (1836), *Xerez, from the Ramparts*, the *Interior of San Miguel*, and *Monastery of the Cartuja*; also two lithographs (1837), the Interior of San Miguel (pl. IV) and another of the church of Santiago (pl. VI). There is a drawing of the entrance to Jerez in Agnew and Sons[34]; an original of views of San Miguel in the British Museum[35]; also a drawing of the tower of the Atalaya attached to San Dionisio in the National Gallery of Scotland.

At the beginning of May Roberts arrived in Seville, where he remained five months. There he met young painters and exercised a notable influence on the landscape painter Jenaro Pérez Villa-amil[36]. Seville was the subject of seven engravings (1836): *Plaza Real and the Procession of the Corpus Christi*, *Seville from the Cruz del Campo*, *Moorish Tower called the Giralda*, *Entrance to the Court of the Orange Trees*, *Entrance to the Hall of the Ambassadors of the Alcázar*, the *Golden Tower*, and the *Bull Ring*. In 1837 another engraving of the interior of the Cathedral was published. And in 1837 four lithographs: two of the High Altar of the Catedral (pl. II y III), the Giralda (pl. XIV) (*fig.9*) and a bullfight (pl. XXVI). Roberts painted two oils in Seville, today in Downside Abbey, an interior of the Catedral and another of the Giralda. There is a water-colour of a bullfight in the Maestranza in Windsor[37]; a view from the Cruz del Campo in Leeds; an interior of the Catedral in Birmingham; a gouache of the Torre del Oro (Golden Tower) in New York[38]; and an oil of the same subject in the Prado.

In the surroundings of Seville, Roberts made a sketch of the *Ruins of Italica*, later coverted into an engraving (1836), and a drawing in pencil and a water-colour is preserved of the castle of Alcalá de Guadaira[39] (1833) which would result in a spectacular oil-painting of a sunset, today in the Prado (*fig.10*). There are also sketches of *Two Spanish Peasants* of the same town (1833), in Denver Art Museum, similar to others of the Royal Academy of Arts. For Carmona there is an engraving of the entrance to the town (1836), based on a water-colour with another sunset (1833) which is today in the Museum of Fine Arts in Oviedo; there is evidence of a similar oil-painting (1853) already mentioned, which Roberts gave to his dentist. There are also two lithographs (1838): on the chapel of the Virgin (pl XV) and the marketplace (pl. XVII), a prior sketch of which is preserved in Dudley Museum. There is also water-colour of the *Alcázar de Carmona* in the Victoria and Albert Museum[40].

While he was in Seville, Roberts had to leave the country hastily, as his "Record Books" indicate: "*the cholera epidemic was declared in Seville, and this put an end to all my activities. I intended then to go back and take up again my journey through Spain, but a cordon having been thrown up, I succeeded with great difficulty in obtaining a passage aboard an English ship. After a long and troublesome crossing of five weeks I arrived in Falmouth at the end of October of 1833*".

4. Views based on views by other artists

Given that Roberts was unable to complete his journey, for the third and fourth volumes of of "*The Tourist in Spain*" he decided to use other travellers' sketches of places he had not visited himself, described in what follows. It should be borne in mind that Roberts' name appears beneath all the engravings in Volume III; but there are serous doubts in three instances: Segovia, El Escorial y Toledo. Although he might have visited these places from Madrid, Giménez Cruz[41] believes it is unlikely, since they are not mentioned in the "Record Book", and in the letter written from Córdoba he expressed his intention to visit them on his return journey, which he finally made by ship. This suggests that he did not actually go to these places himself. It should be pointed out that it was Richard Ford who offered Roberts his own drawings, which he was able to use in Volume I (1835) for the engravings of Loja and Ronda already mentioned[42].

In volume IV (1838) the following authors of the sketches for the engravings are cited[43]: Richard Ford; Colonel Harding, and another two military men, Smith and Edridge, of the Royal Engineers. According to Katharine Sim "*it is very likely that one of his more sensitive friends – perhaps the resourceful Richard Ford – mentioned* [to Roberts] *these omissions in the Annual corresponding to 1837* [vol. III] *and suggested that it would be more sensible to include the due acknowledgements*"[44].

Three engravings were published of Segovia in volume III (1836), *City of Segovia*, the *Great Roman Aqueduct*, and the *Alcázar*, and another view in volume IV (1838). The following originals by Roberts are known: a water-colour of the Alcázar (1836) in Birmingham City Museum, a water-colour of the Aqueduct in the British Museum, and another on the same subject in the Whitworth Art Gallery[45]. With regard to the El Escorial, an engraving was published (1836) and a lithograph (1837) (pl. XXIII). According to Sim[46], the views of Segovia and El Escorial contain incongruities that lead one to believe he did not make them directly himself. Regarding the engraving of the view of Toledo (1837), his preparatory drawing belongs to the Ingram Family Collection, and seems to have been inspired by a sketch by Sir Edmund Head[47]. There is a variant of this engraving (*fig.4*) with alterations in the foreground.

Other engravings appear in volume IV (1838): Salamanca, *from above the River Zerguen*, on an original by Richard Ford[48]; a view of Plasencia also based on sketches by Ford[49], although Roberts' original, the basis of the engraving in the British Museum, survives; the same occurs with the engraving of Santiago de Compostela (1838)[50]. As is indicated in the engravings themselves, on the basis of sketches made by the army officers already mentioned three views of Valencia were executed: *Plaza Cathedral*, the *Gate of the Serranos*, and *Tower of Santa Catalina*; together with the view of the *Leaning Tower* at Zaragoza.

5. The great success and popularity of the views

David Roberts would never return to Spain, though on his return to England, at the height of his powers as a person and an artist, and until 1838, he devoted five years to exploiting his travel sketches. Roberts received an astronomical sum for "*The Tourist in Spain*" (1835): for twenty drawings and the cover, with

his own choice of engravings to text by Thomas Roscoe, he received ?420. According to Giménez Cruz, with the exception of Turner, this would be the highest price paid in the period for drawings of this type. It was a similar story with the lithographs published in 1837, which Roberts supervised and perfected over six months. After their publication, 200,000 copies were sold and they were still being printed twenty years later[51]. His views were the object of countless reeditions and imitations.

This phenomenon meant that many Spanish cities emerged as tourist landscapes, drawn and disseminated among an ever-expanding public. Thus, before the arrival of photography illustrations put on the map areas of Spain which had until then been remote and exotic. The world became smaller and more accessible from the parlours of European middle-class households. Even today no respectable engraving shop would be without its stock of Roberts lithographs or engravings.

In 1838 Roberts embarked on the second great adventure of his life, his famous trip to Egypt and the Holy Land, from which he returned in 1839 with 272 sketches and drawings, which were to serve him in the decade to come as the basis for his passionate and sophisticated work. Between 1842 and 1849 six volumes were published entitled "The Holy Land, Syria, Idumea, Arabia, Egypt and Nubia", with a total of 247 lithographs magnificently executed by Louis Haghe.

Out of his conviction that "*the effects of light and shadow [are] all that is great in art*"[52], David Roberts would reach the height of his career in 1841 when he was elected member of the Royal Academy, the highest accolade to which a British painter could aspire. Roberts continued to work until his death in 1864.

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Fig.2. Unidentified land (pencil drawing). Private coll. D. Luis Lara, Sevilla.
Fig.3. The Cathedral of Burgos (engraving). Author's private collection.
Fig.4. View Toledo (engraving). Author's private collection.

51 / GIMÉNEZ CRUZ, A.: *La España pintoresca…*p. 346-348, 2002.
52 / Letter of 2 July 1833 from Seville. Quoted in GIMÉNEZ CRUZ, A.: *La España pintoresca…*p. 273, 2002.

THE OTHER

by Joaquín Arnau Amo, Elia Gutiérrez Mozo

Hermosa compostura
Desta inferior y varia arquitectura
Que, entre sombras y lejos,
A la celeste usurpas los reflejos.[1]
Pedro Calderón de la Barca.

The work of Javier García Solera is impregnated and sustained with a sort of *basso continuo*: or *beautiful composure*. This beautiful word, which in Spanish describes the difficult balance between *posture*, which is something natural, and *composition*, which is inevitably artificial. The word connotes a polite, friendly, serene and graceful manner together with a firm, determined and very personal, highly unusual and almost arrogant posture. This *beautiful composure* of architectural technique is founded on the impeccable execution of this architect (from whom we have been led to expect nothing less) whose art is expressed in the form of buildings.

A combination of elegance and attention to detail is a constant element in the work of this architect, whose career has included many awards, the latest being from the 10th Spanish Architecture and Urbanism Biennial for the building of 40 apartments under the Official Protection of the State.

In surroundings such as those of Benidorm, a sort of *warriors' garden,* a parody of that which covers Gaudí's *Pedrera*, there suddenly appears a UFO, supported only by clouds and the sun, with a little disturbed earth at its base with the occasional bush in the garden that is soon bound to appear. And he, the *rara avis,* gratefully responds to the elements with noisy metallic reflections and opaque concrete silences, in a perfect replica of Calderon's metaphor.

But the others, the warriors, assault it. Because they are warlike and because they are where they are. They are like the forces (in war, as in war, and in the market as in the market) that impose a (false) peace by war. They threaten and are ridiculously arrogant. They all have different gestures, but all display the same aggressiveness that is magnified by their ominous shadows. And on viewing this city-fiction, the newly arrived traveller perhaps is reminded of that redeeming parallelepiped which, in *2001 Space Odyssey,* was a symbol of human reason.

By the geometry in the sand of the apparently deserted island, Vitruvius has the shipwrecked Aristippus recognise that intelligent beings live in that place. If they are geometricians, Aristippus says to himself, the inhabitants must be human (it was Euclidean geometry and of course not fractal geometry). Today's traveller now remembers that there was once a civilisation, or perhaps more than one, who knows? And there was architecture to sustain it. The proof is that it still exists, even if it is a little strange. We refer to strict, sober architecture, which keeps its spells (and it has many of these among its resources) to itself, in the warmth of its peace-loving interior and in the secret whisperings of its contented neighbourhoods. This is the architecture that rescues the ground on which it leaves its trace and restores it, but not on the roof, as did the master, but at the appropriate height, where those who live above meet those who live below, and to which public spaces are no strangers. The residents of the upper floors are in the majority (there are more floors above), but those who live below are no fewer, since the next floor down includes passers-by and neighbours. And that which is common to them is neither up nor down, at the beginning or at the end, but halfway up, at the crossroads which acts as a neighbourhood *landing*. Neither too high (because they are not looking to admire a view) nor too low (because neither do they wish to meet at ground level).

This collective third floor, between the second and the other private ones, stands out, as is only natural, in the geometry of the block. It bites, but not too hard. This is the effect that the common good always has on individuals when they move into the heart of well chosen company.

Other services, the laundry and its surroundings, not shared, but connected, promote contact between those who live on the same floor and invite to play in the corridors. These are semi-private spaces that encourage community living in the abstract domain known to lawyers as *horizontal property*.

With these and other services, a whole community of people, but not too many, organised with common sense but also with their own individual sense (both of which are indispensable) lives, moves and exists in an economic space (in the real sense of being subject to domestic and social norms that rule out both want and waste) to which architecture fits, in each case, the discreet scale which it knows better than anything else in the world. We are not in either a closely restricted space or in the unlimited space of those who suffer from delusions of grandeur. We have, after all, to live within our means.

Thus, the block of officially protected flats, abstract in the best sense, that is to say concise, satisfies from within modern discipline the classical Albertian ideal of the *conncinnitas*, which Lozano translates as *composure* (Calderón): " Let nothing be in excess and nothing lack and everything be in its place". Which, in surroundings with mad figures and dreams of commercial fantasy is provocative (like Ulysses within range of the Sirens, or the ardent Baptist in the presence of the chaste Salome). The zeal of this quiet and discreet architecture, measured and pondered, simply modern, stokes the fires of the post-modern images that dispute its name.

1 / Beautiful composure of this lower and varied architecture, which, between shadows and distance, usurps these heavenly reflections.

Because the warriors are there and do not seem disposed to leave the field, in their frenzied and grotesque tribal dance. Only that, as in Amenábar's films, those that seem to be always there, installed in perpetuity, are *The Others*. They, and not the one supposed to be out of the ordinary, are the UFOs. They are the newcomers from another planet (perhaps uninhabitable). They dazzle our eyes and shout at us. And meanwhile among them there is real architecture that is almost invisible (which is what we are at present dealing with), which takes up its ration of space, no more than it needs, and manages it for the benefit of its protected buildings. Because it itself is the protector.

Its arrangements serve but are not servile (the caprice that perverts the right use of liberty have been banished from it: everything in this building is coherent and thought out). In their own way they provide the best and the most silent protection. Careful architecture that cares: refined and behaves with refinement.

And its protection proposes peace as a premise: a peace that stands out by not standing out, that attracts attention by not attracting attention, in the jungle, not the garden, of the warriors. It is earthly, in a place that puts on interplanetary airs, real among the shadows, active and alive among richly decorated mausoleums. However, after a long quiet talk in the midday sun, the landscape we see is transfigured. The urban scene (can we really call it that? Or is it co(s)mic?) moves on (as in the old time theatre). The warriors disappear into the black holes, taken away in the mother ship.

We are at home and we are not alone.

There are neighbours that protect themselves from the sunlight, poke their heads out, go in and out, wander around. They think, perhaps, that the others watch them, because they do not know that although they seem to be there they are not really there. Neither do they know, who knows? that the sockets of the other eyes are empty. They did not come to see, only to be seen. And they are like smoke, that can be dispelled by the slightest sea breeze. As Loos would say, this, and not the other, is architecture. But he says it from a simple tomb, which this is not, although it appears to be simple. This is the house, common and individual, turned into the protector of a common life.

A certain tradition has it that architecture descends from the sedentary crop-planter Cain, fratricidal brother of the shepherd and nomad, Abel. The architect, who builds to be permanent, belongs to the race of Cain. But the architect García Solera turns around this sinister tradition, which is not very favourable to the profession. To the question, "*Am I my brother's keeper*?" he firmly answers "Yes". We all look after each other in an architecture, which, for a start, looks after us. And when one is older, this is not only desirable but essential to a fuller life.

This architecture is solid but seems light, strong, but seems fragile. It is as firm as an oak but as elegant as a reed. Its severity hides its delicate elements, which expand it. Its reason is the outer coat that protects dialogue, the only activity safe from fanatical outbursts. And here they are, one and the other, reason and dialogue, constructed and (we could say if the word did not sound like the cheap morality of another age) *edifying*. They are not so in this outdated sense that wishes to see architecture as a school of good customs. But they are so inasmuch as they consent, and even *protect*, a certain life in common.

And a final note. "Protection" (*tutela*) and "protector" (*tutor*) are words that now seem confined to the field of learning and which maybe we should make more use of. Both are from Latin, in which the matrix of the family is a verb, *tutari*, in turn derived from another, *tueor*, which means "to see" in the sense of to care for, to pay attention to, to be alert to …..

The 40 protected apartments for the elderly in the La Cala district of Benidorm, Alicante*, were awarded the Officially Protected Housing Prize in the 10th Spanish Biennial of Architecture and Urbanism.*

Date of Project: September 2005.
Work finished : September 2008.
Architect: Javier García Solera.
Collaborators: Lola Pérez Payá (architect).
Domingo Sepulcre (structure).
Quantity surveyors: Marcos Gallud and Javier Mateu.
Promoter: Instituto Valenciano de la Vivienda.
Construction Company: Sedesa Obras y Servicios S. A.
Total Budget: 3,085,892 euros.
Constructed area: Buildings: 5,240 m².
Urbanisation: 1588 m².
Cost per sq. metre: 589 euros/m².

INTERVIEW WITH JAVIER GARCÍA SOLERA

WITHOUT GOING INTO THE USUAL CLICHÉS (CRISIS, SUSTAINABILITY, ETC) BUT WITHOUT IGNORING THE BURNING QUESTIONS, IN YOUR OPINION, WHERE IS ARCHITECTURE HEADED IN THESE TIMES OF ECONOMIC RECESSION?

It is difficult to say what future projects will be like, those which perhaps will be derived from a process of reflection due to this general crisis. To be honest, I think that the view that will be heard most will again be the most superficial or falsely committed, which will know how to handle the situation in order to once more generate surprising architecture easy to sell. I think that the sheer manipulation that is constantly made of terms such as sustainability by architects that seek refuge under its protection provides sufficient grounds for my doubts.

YOU OBVIOUSLY BELIEVE IN ARCHITECTURE, SINCE YOU CREATE IT. APART FROM YOURSELF AND A FEW MORE, WHO ELSE IS INTERESTED IN WHAT WE PRODUCE?

I think Architecture as an activity that seeks to establish links with real life is of interest to more people than we think. They probably would not say so, but they are happy with what we do. The problem arises when we use architecture to speak about ourselves and establish a different identity to others. When we "artistise" it, then we create an abyss between the architect and everybody else. It is probably true to say that what I would call architecture is of no interest either to those in power or to big business.

IN ANY CASE, TO WHAT DO YOU ATTRIBUTE THE NECESSARY CREDIBILITY OF OUR WORK, OR ON WHAT SHOULD IT BE BASED, IN ORDER TO CARRY ON WITHOUT PROBLEMS?

On thinking that every opportunity that turns up is the one we have and is real; on the unconditional position of defending the dignity of this work and of everybody involved in it; on the commitment we have (or should have) to give an authentic social service; on knowing that it is not we who should be talking about our architecture and on having the necessary strength to say no and to carry on without being discouraged.

YOU HAVE WRITTEN THAT YOUR INTEREST AS AN ARCHITECT HAS CHANGED WITH TIME FROM DRAWING TO BUILDING, IMPECCABLE IN YOUR PROJECTS. IN AN IMAGE-BASED CULTURE LIKE OURS, WHICH IS SUPERFICIAL BY DEFINITION, HOW IS THIS STRATEGY TURNING OUT?

Architecture is nothing without the physical reality of building. Drawing is and always has been very useful to us in our continual learning process but means nothing to all the others who are the final consumers of all architecture. Oíza said that the best architect's drawing is the one given to the worker to help him carry out a job. I am convinced, and I know what I am talking about because I have had the experience, that every job whispers into the architect's ear how it wants to be done. Building can live without architecture but architecture cannot live without building.

HOW DO YOU SEE THE PROFILE OF THOSE WHO ARE THE USERS IN THIS CASE (PROTECTED APARTMENTS IN BENIDORM) OF YOUR ARCHITECTURE? HOW DO YOU PROTECT, IN FACT, THE ELDERLY WHO LIVE IN THESE APARTMENTS? CAN ARCHITECTURE CONTRIBUTE TO THE CARE OF OTHERS WITH TOTAL RESPECT FOR THEIR INDEPENDENCE AND WAY OF LIFE? SHOULD IT DO SO?

I have always said at the best thing about private jobs is to build for "somebody" in particular and that the great and beautiful responsibility of public jobs is to imagine that person and work for him. To get close to the life, see without being seen, get involved and understand, try to understand…anything that will bring you closer to an answer that contains the many

2 / The Benidorm project was based on two competitions for two sites on different sides of the same street, one a home for the elderly and the other for young people. We proposed a joint project for both sites that even had a bridge to join them. We obtained the first place for the old people's residence and the second for young people.

ways of occupying, of living in that space. All I do is try to offer possibilities in such a way that architecture is present but is never the protagonist.

YOU HAVE SAID THAT YOU DO NOT WANT TO ACCEPT JOBS OUTSIDE YOUR "RADIUS OF ACTION" SO THAT YOU CAN PAY FREQUENT VISITS TO THE WORK SITE. BENIDORM OBVIOUSLY COMPLIES WITH THIS REQUISITE, BUT COULD YOU TELL US IF THIS DECISION HAS LED TO YOU HAVING TO REFUSE IMPORTANT CONTRACTS? IN THE GLOBAL VILLAGE, DO YOU NOT FEEL TOO CONFINED TO ONE LOCALITY? AND IF YOU CAN TRAVEL TO GIVE LECTURES, WHY NOT FOR REASONS OF WORK?

It happens that I need to be pretty close to the building work in order to hear the latest whispers from the job telling me how it wants to be done. This means I try to look for work within a radius of action that allows me to go there frequently. I do not actually look for work outside this distance, but this does not mean that I would refuse a contract a long way away. If the case arose, I would make sure that the distance was no obstacle to continuous visits.

WE HAVE ALSO HEARD YOU SAY THAT YOU CARRY OUT PROJECTS " AGAINST CIRCUMSTANCES". IN THE CASE OF BENIDORM, WHAT CIRCUMSTANCES DID YOU HAVE TO FIGHT AGAINST?

In Benidorm we had to work against the conventional idea that public and private jobs are different, that the city is only drawn on the ground, that limits have to be physical and rigid , that the common practice is not possible, with the old with the old and the young among them, that the street is a frontier, that concrete is a hard, cold material, that metal is hard and cold, that a building has a back and a front, etc.

YOUR PROPOSAL FOR THE PROJECT INCLUDED A TOWER (FOR THE YOUNG) AND A BLOCK (FOR THE OLD PEOPLE). DO YOU THINK THE DEFINITIVE SOLUTION OF THE BLOCK WITHOUT THE TOWER HAS BEEN DETRIMENTAL TO THE PROJECT?

Benidorm has become quite famous but for me it will always be a frustration. The wide recognition that it has received reassures me that it has been a success, but I think that the complete project had so much in social and urban terms, technical possibilities…, I mean in architectural terms it could have been much wider. It pains me to think we were only one step away[2].

YOU USUALLY WORK WITH VOLUMES NO GREATER THAN THREE STOREYS. IT COULD EVEN BE SAID THAT A MIESIAN SPACE OF A SINGLE FLOOR IS YOUR "NATURAL MEDIUM" IN WHICH YOU SEEM TO FEEL AT HOME. HOW DID YOU TACKLE THE 11-STOREY BLOCK IN BENIDORM?

It is true that I feel at home with fluid, horizontal space and also with the efficacy of two planes (floor and ceiling) to create valid interior-exterior and natural-artificial relationships, apart from their excellent functional performance. In Benidorm, all we did was to explore the vertical repetition of the many variations of this arrangement.

BESIDES THE GROUND AND FIRST FLOORS, YOU ALSO INCLUDED THE THIRD FLOOR FOR COMMON USE: THE SECOND AND THE REST OF THE FLOORS CONTAIN THE 40 APARTMENTS. WAS THERE A PARTICULAR REASON FOR PRECISELY THIS FLOOR, AND NOT ANOTHER, TO INTERRUPT THE VERTICAL CONTINUITY OF THE BLOCK?

This floor maintains a very intense relationship with the space of the street, which reinforces its public character. The fact of being between floors of apartments gives the feeling of being inside a private area and so helps to welcome those who enter in company with those who live there.

ORTHOGONAL GEOMETRY GOVERNS ALL PROJECTS WITH ABSOLUTE PRECISION, HOWEVER, THERE IS SOMETHING IN THE BUILDING THAT STRIKES US AS HIGHLY SIGNIFICANT. WHY ARE THE HANDRAILS INCLINED AT AN ANGLE?

A close look at the section will explain how these handrails try to overcome the condition of forming a limit, which they normally do. It is an invitation to sit down facing inwards using the handrail as a support with part of the body on the outside. Also, this configuration will help people when tending their plants which we expect to see on the metallic trays that act as sunshades over the windows on the front.

THE LAUNDRY SPACE RECEIVED SPECIAL TREATMENT. COULD YOU TELL US HOW IT IS ARRANGED?

The laundry is a communal service, so what better than to put it on this floor where people can meet, sit out in the fresh air and talk while they are waiting for the washing cycle to finish.

AMONG YOUR PROFESSIONAL COLLEAGUES WHO ARE STILL ACTIVE, FAMOUS OR NOT, IS THERE ANYONE YOU PARTICULARLY ADMIRE OR WHOSE CONVICTIONS YOU SHARE?

I am always more interested in the work than the architect. Some almost always have something to teach me: the simplicity of Kazuyo Sejima, the economy and technical precision of Lacaton-Vassal, the identification of architecture, construction and structure of Paulo Mendes da Rocha…..

WHAT WOULD YOU SAY TO THE YOUNG, OR NOT SO YOUNG, STUDENT WHO HAS JUST RECEIVED A GOOD GRADE FOR HIS FINAL PROJECT?

You are an architect, nothing can be indifferent to you. And do not be in any hurry.

"La traducción de este trabajo ha sido financiada por la Universidad Politécnica de Valencia."

"The translation of this paper was funded by the Universidad Politécnica de Valencia, Spain."

1 / In a strict sense, we should not speak of survey in all of the cases, as one of the edifications studied no longer exists.

RESTORING, REDRAWING, VENTURING. STRATEGIES FOR GRAPHICALLY DOCUMENTING THREE MONUMENTAL GATEWAYS OF MADRID

by Aitor Goitia Cruz

The venerable exercise of surveying presents the double fascination of being imperishable as well as in constant renovation. As ancient as the need for learning and as personal as the interests or abilities of those who practice this art, its utility and beauty have played a leading role in essential moments in the history of architectural drawing. Andrea Palladio, Paul Letarouilly, or Luigi Canina –to mention only some of the most famous masters of documental drawing – have allowed us to know not only the forms of older architectures, but to also understand their composite and tectonic keys.

All of this is possible thanks to the mediation of drawing as an indispensable instrument in attaining and transmitting knowledge. This perceptive aspect of graphic expression is found present in other applications of architectural drawing, but, without doubt, is exercised in each phase of elaboration of an architectural survey: from the first sketches to the final drawings, through gathering data, general constructions, analyses, comparisons or fine adjustments of forms and dimensions. In recent times, certain scientific and technical advances have completely transformed the manner of obtaining and processing data extracted from constructed works. The traditional rules, tape measures, and plum lines, are now complemented- not substituted- by analogical and digital land photogrammetry, total stations, or by 3D laser scanners. However, independent of the availability of these means, the principal task of the draughtsman resides, as long ago, in the adequate interpretation of the architectural work chosen and the correct manipulation of the data obtained, in order to finally determine a graphic model analogous to the tectonic one. For this reason, whichever the objectives, the models chosen, the techniques of inspection and measurement, or the graphic solutions adopted, the interpretative quality of architectonic drawing requires a conscious investigative attitude in the exploration and determination of the elements composing the object of the study.

As an example of practical applications of these techniques and attitudes, I present three *surveys*[1] of three monumental gates in Madrid, which are also the object of other deeper and longer studies than those included here. These are the three gateways from Toledo, Alcalá and Atocha, which correspond to situations different from the initial data. I also discuss the means we disposed of to approach each of these graphic determinations. These gateways were chosen as the

2 / The construction of the enclosure was initiated in 1625 by order of Felipe IV. With diverse modifications in the walls and gateways, it remained standing until the demolitions that began after the approval of the widening projected in 1860 by Carlos Mª de Castro.
3 / Archive of Villa de Madrid ASA 1-201-28: Puerta de Segovia. 1, External face: Ground plan and Elevation. 2, Internal face towards Madrid: Elevation, 1703.
4 / Archive of Villa de Madrid ASA 1-204-9: Puerta de Fuencarral. Ground plan and Elevation, 1642.
5 / Archive of Villa de Madrid ASA 1-201-6. Dossier with the document of Gutiérrez to the Town Hall, which accompanied the design of Antonio López Aguado, since lost.
6 / José I abandons Madrid on March 17, 1813, entering France on June 27 (after the Battle of Victoria), immediately renouncing the Spanish crown.
7 / Archive of Villa de Madrid ASA 6-384-6.
8 / Archive of Villa de Madrid ASA 1-201-6. Register cited.
9 / Archive of Villa de Madrid ASA 1-201-11.
10 / The restorer used was Adam MPS2, along with an AutoCAD 12 application, from the Departamento de Ideación Gráfica de la Escuela Técnica Superior de Arquitectura de la Universidad Politécnica de Madrid..

object of study because of their singular monumentality and due to a lack of trustworthy graphic documentation, which would permit both understanding them individually, as well as their comparative analysis.
These three gateways were located along the wall that withheld the growth of the city for more than 200 years[2] and were situated in strategic points of the city, as they led to three of the five so-called *royal* roads. The other two roads were presided over by the gateways from Segovia, to the west, and Fuencarral, to the north of the city. Of the latter, which disappeared many years ago, the original drawings made by their authors, Teodoro Ardemans[3] and Juan Gómez de Mora[4] are conserved today. To the contrary, neither the drawings that gave birth to the Toledo Gate (Puerta de Toledo), nor those that correspond to that of Alcalá seem to adjust to the monument that was constructed. In the case of the Atocha Gate (Puerta de Atocha), both the absence of drawings and edification aggravate the lack of documentation, which requires redress.
In light of these antecedents, the basic objective of the *surveys* undertaken has been focused on rendering new graphic documents which might mitigate, at least in part, the architectonic definition contained in the drawings of the lost projects. Although the intention and essence were alike -obtaining data and graphic elaboration- the peculiarity of each case has influenced the work strategies and the graphic solutions, which are set out below.

GATE OF TOLEDO (PUERTA DE TOLEDO)

Some facts

The monument, concluded by Antonio López Aguado in 1827, would be the last gateway constructed in Madrid. As its surroundings have been totally altered, today the Puerta de Toledo appears isolated and incomprehensible because it must be viewed from so close up. This incomprehension extends back to the very same history of the monument, having been taken as a certain false interpretation that historians and chroniclers repeated, attributing the initiative of its construction to Jose I or Fernando VII—whom it was finally dedicated to.
The first documentation of the work of Aguado, which should have included his design plans[5], is a document directed to the Ayuntamiento Constitucional on November 13, 1813, by the governor Santiago Gutiérrez. He proposes the erection of the new Puerta de Toledo to welcome the Soberano Congreso Nacional, which would renew in Madrid the sessions which were celebrated in Cádiz since its beginning in September 1810. The foundation stone was placed on December 22, 1813, months after the definitive flight of the French king[6], and before the return of Fernando VII, which was not effective until the spring of the following year. The prolonged history of the construction of the gateway is replete with economic difficulties and political upheavals - the return of Fernando VII, Riego's pronouncement, a liberal three-year period, an ominous decade - which the gate is witness to, and also object of continuous speculations and changes in the documental databases and dedications. Once completed, the construction would continue to undergo new manipulations and proposals, such as its demolition, solicited by various councilmen who maintained this initiative[7] between 1879 and 1881.

Existing graphic documentation. Strategy adopted

In spite of the importance of this work, its enclave and historical significance, the search for graphic documentation relative to the Puerta de Toledo situates us before a most singular case. The disappearance of Aguado's drawings, contained in the records[8] of his proposal, and the total absence of references to their possible location, suppose an irreparable loss. This misfortune is repeated with the plan that the architect elaborated in 1824 for the execution of the registers and modification of alignments[9] of the ensemble. However, drawings and engravings in which the monument appear are abundant, although lacking adequate fidelity to the reality of the gateway, as well as to its definition as to ground plans and elevations. On the other hand, plans carried out for other entrances executed in the city have been conserved: along with the aforementioned *royal* gateways of Alcalá, Segovia, and Fuencarral, ornamental gateways such as Recoletos and San Vicente or the gates of Gilimón, Embajadores, or Valencia count on original or redrawn plans. It is only the absence of similar documentation which equates the case of Atocha to that of the Puerta de Toledo.
As a consequence of such a lack of documentation, approaching the survey of the Puerta de Toledo supposed, in a certain way, a compromise with history. With the aid of only the monument itself, the strategy and the procedure adopted have been directed towards the graphic determination of the original state of the monument, dispensing with the registry of associated deformations or pathologies, more proper to studies leading to architectural intervention. Therefore, certain defects in form or fractures that some parts present have not been borne in mind, as we have opted for the regularization of the elements that intervene in the monument, looking for a certain dimensional and formal idealization which reflects the supposed state projected by Antonio López Aguado.

Gathering data and graphic construction

The work involved in the gathering of data began with a direct measurement of all of the accessible elements using a measuring tape, which, given the size of the work, hardly led to the true knowledge of the lower base and the immediate area of implantation in the roundabout. The lack of scaffolding or auxiliary structures which would allow continuing with direct measurements of the construction, obliged us to use a photogrammetric restorer[10]. The normal method in the use of this instrument, - pairs of photographs taken "in situ" under the necessary conditions of distance and convergence, adapted to the difficult conditions of surrounding traffic, was employed. It is necessary to specify, however, that the photographs used for the three-dimensional restitution of the model were obtained with a conventional a 35 mm-negative reflex camera. Although it is not the most precise method that this technique might facilitate, we must point out that it was the only one possible at the moment of the execution of the survey.
Most of the dimensions and the principal distances were obtained with the restorer. The proportions of the minor elements of the cornices, bases, capitals, etc., were established by the larger dimensions that fixed them, the photographic information, the correlation between metric systems, and the comparison with Vignola's rules of order of Architecture, with which the work of Lopez Aguado systematically coincides, except for some ornamental details.
The drawings elaborated for the definition of the Puerta de Toledo were obtained by computer, using AutoCAD. The reference scale for the paper edition was estimated at 1:50, so that the formal details of the different elements of smaller dimensions could be appreciated. The drawings which accompany this text are adjusted reproductions, and therefore, the relationship between the size of the drawings and their definition are not appropriate. Grouped in ordered sets, the following documents were produced:

Elevation facing the exterior of the city. Ground plan
The elevation towards the exterior of the city is more ornamental, bearing in mind the apparent austerity of the gate. Its graphic representation has also been considered as the most emblematic image among those obtained in this survey, therefore deserving a complete treatment, more elaborate than the rest. We included all of the lines of projection that restore the forms of the unit; the arrangement of the masonry work; and the most impeccable image of the sculptural works of Barba and Salvatierra, as this is the façade in which they offer all their symbolic impact. The ground plan accompanying the main elevation clearly transmits the different composition of the façades towards the interior and exterior of the city by means of a group of columns and pilasters.

Elevation facing the city. Ground plan
The secondary elevation, frankly, is something more

11 / The gateway conceived by Sabatini put an end to the succession of names, localities and factories that populated the main entry to the Villa along the road from Alcalá: Arco de Santa María (Arab wall), Puerta de Guadalajara (Christian wall), Puerta del Sol (wall surrounding the poorer quarters), Puerta del Sol-Alcalá (Wall of Felipe II, 1566), Puerta de Alcalá (1580, 1599 -Patricio Cajés-, 1636, 1691 -Teodoro Ardemans-, 1702).

12 / National Archives of París, series NN 23. This album contains, among others, four sheets relative to the Puerta de Alcalá, with Ground plan and Elevation on the side facing the city, Ground plan and Elevation on the side facing the exterior, Ground plan, Elevation and Transversal section, and a view of the perspective.

13 / The works were projected and directed by Pío García Escudero. Thanks to the intervention of Enrique Echevarría, I was given a few reduced copies of the survey, which had been drawn by the draughtsman Francisco Sebastián.

14 / Archive of Villa de Madrid CO 1-47-6 and ASA 1-201-3.

15 / Antonio Joli: *Vista del paseo de Atocha*, around 1750. Fundación Casa de Alba, Madrid.

16 / Antonio López Aguado signed, among others, the Project of the *Adorno de la Puerta de Atocha* for the entrance of Fernando VII, the 13th of May, 1814 (Museo Municipal de Madrid, IN. 2054) and, in 1819, the *Arco triunfal que… se va a construir en piedra, por orden de S. M. in la Puerta de Atocha* (Archive of Villa de Madrid ASA 1-201-7).

17 / *VIEW OF LA PUERTA DE ATOCHA with the fountain located in the surrounding area in the Paseo del Prado* (Museo Municipal de Madrid, IN. 1952).

sober than the main one. Aguado did away with columns and used a combination of double pilasters. The imposing presence of the coronation on the anterior façade is notably reduced in intensity on this side. For this reason, the representation chosen refers us exclusively to its size and apparent shape, through the silhouettes of the sculptural groups. The elevation is related to a ground plan oriented to it in a coherent way, taking the direction of the projection in ascension, offering the superior part of the openings so that one can appreciate the vaulted or trabeated character, in each case.

Lateral elevation. Transversal sections

This document gathers a series of projections in the transversal sense of the construction, beginning with the lateral elevation towards the Ronda de Toledo, later reflecting the cross section through the nearest trabeated opening, and ending with the section half-way through the central arch. We have disregarded the representation of the group of figures that crown the monument (none was conceived with this viewpoint in mind), conceding all the protagonism to its architectural definition. The obvious elevation of the Ronda de Segovia has not been reproduced, given the total symmetry of the unit, except in the small variations that are found in the joining of the base and the ground, discussed in the rest of the documentation elaborated.

GATE OF ALCALÁ (PUERTA DE ALCALÁ)

Some facts

The main entrance to the Villa is well-known by both natives and outsiders as a symbol of Madrid. The solemn moment of its birth is also remembered: Carlos III chose the third proposal that Francisco Sabatini presented in 1769, which competed with the presently missing one of José de Hermosilla, and the five plans of Ventura Rodríguez, creator and continuer, respectively, of the Salón del Prado, main urban route with which the new gateway should harmonize.[11] The construction was carried out between 1770 and 1778, according to the specifications written by Sabatini himself hardly ten days after the royal decision.

Its borderline position between the hamlet and the road to Alcalá—with its topography descending towards the capital- and the narrow roundabout outside the city walls near the Buen Retiro and the Pósito never lent the monument the isolated aspect that we know today. Nevertheless, the dignity of the new entrance came to characterize the external vision of a capital renewed by the initiatives of Carlos III.

Existing graphic documentation. Strategy adopted

Immediately recognized as the emblem of the city, the Puerta de Alcalá is present in a multitude of engravings, drawings, and oil paintings of the most diverse artists. Furthermore, we fortunately have the drawings of Sabatini, whose definitive design was reflected in the so-called Álbum de París[12], dated 30 March 1777, and dedicated to Prince Kaunitz Rietberg, to show him his *works of embellishment completed or begun in the last few years*.

At first sight, the general proportions of the finished work seem different from those in the drawing, which seem more slender. To evaluate this probable difference, the survey of the Puerta de Alcalá offered the added possibility of establishing a precise comparison between the documents obtained and the drawings of the Italian architect. A third element of comparison, the survey undertaken by the Empresa Municipal de la Vivienda[13] for the restoration works carried out in 1993-94, could arbitrate the occasional divergences sought. Contrary to the case of Toledo, the fundamental objective of this *survey* was not to fill any documental void, but rather to evaluate the fidelity of the constructed work with respect to the original plans of the architect.

Gathering data and graphic construction

Once again, the inalienable physical contact with the monument and its direct measurement needed to be complemented with advanced methods which the measuring tape could not undertake. On this occasion, with the inestimable help of my workmates Miguel Alonso y Ana López, readings of key points of the gateway with the total station of the Departamento de Ideación Gráfica of the ESTAM were taken. I must also mention the collaboration of Elena Alcolea in the posterior graphic reconstruction.

With a practically inconsiderable error of measurement, we have constructed the ground plan and main elevation of the Puerta, with the caution proper to metric relations, proportional between sustained gathering of data in the decimal system and the original definition in Castilian feet.

Once the graphic determination of the architectonic model was established, its comparison with the documents of municipal surveys and, most specially, with the drawings conserved in Paris, the following interpretations are suggested: the drawings facilitated by the EMV basically coincide with ours, although there are some notable differences in the horizontal dimensions. Given that we could never compare the original gathering of data or drawings, these distortions could be caused by the photomechanical processes which affected the small-sized copies that we disposed of.

The comparison with the drawings of Sabatini showed, on the other hand, the definitive confirmation of a greater slenderness in the monument constructed than in that seen in his drawings. This quite appreciable difference seems to affect both the general proportions of the work as well as the particular proportions of singular parts, such as the upper unit crowning the composition. Why such pronounced divergence exists opens the doors to new investigations of the records of its construction[14] or to more or less risky conjectures. Regarding this, I dare to suggest that, given that the drawings in Paris were sent -and most probably re-drawn- on dates very close to the conclusion of the gate, perhaps Sabatini himself wished to dote this work with the magnitude that it is lacking and the slenderness that many engravers falsified, to enlarge the relative modesty of its presence in the most important entrance to the capital of Spain.

GATE OF ATOCHA (PUERTA DE ATOCHA)

Some facts

Although it is one of the main entrances to the city, adjoining such important routes as the Salón del Prado and the Tridente de las Delicias, the Puerta de Atocha was recurrently depreciated. Its predecessors were only discrete brick gates next to the Castellana watercourse -and the sewer- until Pedro de Ribera succeeded in obtaining (in 1736) the appearance created by Joli on one of his well-know visits to the city.[15] Because of its peculiar style, or of the difficult conditions of construction and maintenance, it underwent ephemeral interventions, projects not executed, and a long list of attentions, with the object of improving its aspect. Fernando VII, on his successive entrances to the city, would be the main promoter of these acts, and Antonio López Aguado, the architect that would give form to royal desires.[16]

Other triumphal entries through this gateway would demand new reformations, such as those carried out in 1828 and 1829 by Francisco Javier de Mariátegui, who felt that the gateway was in *the most beautiful and visible location of the Court.* Later projects of Custodio Moreno (1830) or Sánchez Pescador (1844) could not be converted into reality. In June 1850, demolition was begun, as its construction was to be substituted by a barrier under the line of the railway dock. This plan was never carried out, either.

Existing graphic documentation. Strategy adopted

Having disappeared one hundred and sixty years ago, the possibility of recreating the image of the Puerta de Atocha now solely depended on the existing graphic documentation, although the low esteem for this gate seemed to affect artists of that time, who ignored it, even when they depicted its surroundings. This Puerta is, with considerable difference, the royal gateway to the Villa with the fewest illustrations referring to its construction. Only two exceptions allowed us to imagine its aspect with certain assuredness: a lithograph drawn and engraved by Camarón[17] in 1829, which reflected the immediate state of the interventions of Mariátegui, and another, corresponding to the collection of Madrid Artístico, dating from approximately 1845, suggesting the permanence of singular ornamental details.

18 / *Adorno de la Puerta de Atocha (Adornment for the entrance of Fernando VII, 13th May 1814), by Antonio López Aguado. Museo Municipal de Madrid, IN. 2054.*
19 / The Gates of Atocha and Recoletos are the only ones in Madrid that present almost identical exterior and interior façades. Without doubt, this is because the habitually less ornamented elevation facing the city provides, on this occasion, the setting for the esteemed Salón del Prado.

Gathering data and graphic construction

Without the physical presence of the monument or its plans, the adoption of a rigorous and formal basis in metrics was sought in the *Adorno de la Puerta de Atocha*[18] of Aguado (1814), where the plan of the *original* gateway appears, object of short-lived decoration. Thanks to this drawing and to its graphic scale of 50 Castilian feet, we could initiate a reasonable approximation of the forms and dimensions of the monument. Comparing these drawings and estimating the supposed trustworthiness of the engraving of Camarón, something began to take shape, which, although far from being called a survey, is rather a proposal of formalization of the missing gateway.

Once the basic sets of the ground plan and elevation were elaborated, and given the basic symmetry of the gateway[19], it made practically no sense to complete the information of the rest of the elevations and cross sections. Since the monument had disappeared, it was of greater interest to opt for a three-dimensional recreation. Therefore, this proposal was modeled by the application of Rhinoceros 4.0, parting from the drawings made with AutoCAD. In this way, we can imagine the corporeal nature lost in this gateway, suggested by a virtual model which permanently remits us to the original idea proposed–escaping from the temptations of a feigned graphic realism.

COROLLARY

The three experiments set out in the preceding text aspire to illustrate how drawing intervenes in the processes of acquisition and transmission of knowledge. Starting with expectations, data, means, and different attitudes, drawing has permitted us to make decisions relative to each of the tectonic structures and to translate them into graphic models expressed with basically uniform criteria. The reflection of the structures by means of orthogonal projections (according to the traditional representation of plans and elevations) permits, in turn, the comparable observation of these three elements, submitted to the discipline of the same scale and homogeneous graphic attributes.

Quantitative and qualitative readings of these three gateways may suggest new reflections, which are possible thanks to the reality imagined in three monuments distant in time, yet re-united in the same space, after a specialized practice of architectural survey, essential in restoring the Puerta de Toledo, redrawing the Puerta de Alcalá, and venturing as to the aspect of the Puerta de Atocha.

FIGURES

Fig. 1. Gates of Segovia (Ardemans, 1703) and Fuencarral (Gómez de Mora, 1642).
Fig. 2. PUERTA DE TOLEDO. Manual gathering of data, location of photographic pairs and Adam MPS2 restorer of the ETSAM.
Fig. 3. PUERTA DE TOLEDO. Elevation towards the exterior of the city. Ground plan. Drawings by the author.
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Fig. 10. PUERTA DE ATOCHA. Project of Adornment, by López Aguado, and engravings of Camarón and Madrid Artístico.
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Fig. 12. PUERTA DE ATOCHA. Three-dimensional recreation by the author.
Fig. 13. Gates of Toledo, Alcalá and Atocha. Drawings by the author.

MODERNITY MADE TO ORDER

by Alberto Bravo de Laguna Socorro

Alvar Aalto left the academic drawing upon entering the field of modern architecture; on its new architectural drawings Helena Iglesias[1] writes: *"It seems then mandatory to use pen and ink, rather than watercolour and crayon, just as it seems also required, when one has become 'modern', to use cars or planes in the drawings."* This could be a quick inventory of some features of the modern architecture design, while being aware of the breadth of this term and the various trends it covers; and thus it obviously can not be limited to a single way of drawing. An artistic director of the classical Hollywood, Edward Carrere (Mexico 1906-1984), made good use of these components of the drawings, and other sources, for setting a 1949 film that revolves around modern arquitecture, directed by King Vidor (Texas, 1894-1982) and based on the novel by Ayn Rand (St. Petersburg, 1905 -1982), *The Fountainhead*, 1943.

The first image of the film *The Fountainhead* is a drawing; a conic perspective of a house with a unique appearance for the time. This drawing is disqualified by the academic institution where a future architect, main character of the action, studies, being that the reason of his expulsion. The perspective is presented as an exponent of a new architecture that is not considered appropriate for the ideals of the institution and, therefore, rejected.

This approach, whose appearance brings us to Wright's or Neutra's drawings, has not been executed by an architect; it is Edward Carrere's[2] work for *The Fountainhead*. Carrere was its Art Director[3] and he would have the same task in other assorted films such as *Camelot* (1967), *Taras Bulba* (1962) and *The Adventures of Don Juan* (1949). In view of the marked theme setting differences among them, Carrere would have a multifaceted career, in line with what the big studios demanded from a Hollywood Art Director. Edward Carrere was also responsible for the artistic direction, as shown in Fig. 2, of *Helen of Troy* (1956), for which he produced a series of drawings that were really different from the perspective of the modern architecture initiated by *The Fountainhead*.

The series of designs, drawings and subsequent sets made by the author to create an image of Troy described in detail and thoroughness what the city would look like; that was its function. Among the drawings, a range of perspectives give guidelines for locating the action, the building of sets, the actors' costumes and all items appearing on the scene. The drawing fits the performance –if it is Trojan architecture now, seven years before it was modern architecture; the Art Director's mission is to complement the script. Apart from the architectural elements,

1 / IGLESIAS, Helena, "Dibujar el rigor a sentimiento. Los dibujos de Alvar Aalto", *Arquitectura COAM*, no. 315, Madrid, 1998, p. 22.
2 / GOROSTIZA, Jorge. *Arquitectos en el cine*. Arquíthemas. Fundación Caja de Arquitectos. Barcelona, 1997, p.115. They have always written that Roark's character is directly inspired by Frank Lloyd Wright and, in fact, producers offered him to design the sets of the film, but Wright asked for twenty-five thousand U.S. dollars and producers found it an excessive figure. Edward Carrere was then elected; a young (42) Art Director with little experience."
3 / ETTEDGUI, Peter."Introducción" in ETTEDGUI, Peter. *Dis-*

eño de producción y dirección artística. Cine. Editorial Océano. Barcelona, 1999. p.7.
"In recalling his time at the Paramount Art Department, Henry Bumstead says: "We used to build everything. In the studio, we got up sets of London, Paris, New York.... One day you had to build something in Gothic style and the next day it was *art nouveau*."
4 / RAMÍREZ, Juan Antonio. *La arquitectura en el cine. Hollywood, la Edad de Oro*. Hermann Blume. Madrid, 1986, p.276
5 / BALDELLOU, Miguel Ángel. "Cine y arquitectura. La vía láctea." *Arquitectura COAM* No. 305
6 / BALDELLOU, Miguel Ángel. "Cine y arquitectura. La vía láctea." *Arquitectura COAM* No. 305
7 / AGRASAR, Fernando. "Arte por el Arte. El manantial." *Arquitectura*. Colegio Oficial de Arquitectos de Galicia, February 1997, p.14
8 / EMIGHOLZ, Heinz."Las películas, arquitectura imaginaria en el tiempo." Los Angeles, April 1998. http://www.goethe.de/hs/bue/seminare/pdf/arqimag.pdf
9 / RAMÍREZ, Juan Antonio. *La arquitectura en el cine. Hollywood, la Edad de Oro*. Hermann Blume. Madrid, 1986, p.276
10 / IGLESIAS, Helena, "Dibujar el rigor a sentimiento. Los dibujos de Alvar Aalto," Arquitectura COAM, No. 315, Madrid, 1998, p.25
"(...) although I'm not a staunch supporter of that so repeated banal play of visually comparing two heterogeneous things (...) comparisons between dissimilar things are very fashionable and there is no book of architecture that does not surprise us with the most unusual images placed next to each other."
This play is posed in search of formal similarities, just seeking relationships, epidermal and superficial if you will, between drawings belonging to modernity and those belonging to the ideal catalogue of the film. A further comparison of this play would need further elaboration and an extension of the compared cases; indeed, not being aware of it would be banal.

characters, vegetation, backgrounds and even the look or modernity of the drawings for *Troy* are different. The Art Director has to adapt himself to the assignment; the drawing reflects it.
In both cases, *Helen of Troy* and *The Fountainhead*, drawings are made to order. Part of the work of the Art Director and Production are drawings designed to create allegedly real situations; notably in the case of *The Fountainhead*, to give credibility to a fictitious architect. The interest of these drawings is most assuredly not its architectural value, but the approach developed by a professional cinema draftsman to present the commissioned subject, to which he is alien; a new architecture[4].
In the case of *The Fountainhead*, Carrere's inventions resulted from drawings created by some experts of the modern movement. We see similarities in the way of tackling the perspective as well as in the graphic treatments. The fictitious architectures adapt to new forms and new materials, essentially created to accompany the actors' action. Despite its clear role, we can find numerous derogatory qualifications around those drawings that generally go beyond what was intended with them. The artistic direction has been treated as: suspiciously obvious[5], Wrightian pastiche[6], *"conveniently stylized and refined"* poor copy *"of Wright's work,"*[7] *" absurd parodies and variations of improbable beauty of Louis Sullivan's, Lloyd Wright's and Louis Kahn's buildings"* or *"a rehash of modernity, served cold as a ruthless intellectual kitsch."*[8]
Ratings are perhaps too harsh in judging those designs, somewhat blurred by endpoints imposed on a product that was not specialized.
Carrere did a proper research for *The Fountainhead*, *Troy* or *Camelot* and, in the first case, he chose the ones he considered the best authors –who undoubtedly represented modernity at that time– as a basis for his designs. The created designs can be more or less successful, even of dubious architectural value, but they are undoubtedly recognizable as modern architectural designs. The drawings and models, regardless of their unintended quality as pieces of architecture, effectively fulfilled the role assigned.
The sequence of pictures and models make a modern, *ideal catalogue*[9] proposed by Carrere, with identifying elements. A deliberate view of these designs permits a play of comparison[10] between them and some of the modern masters' productions that inspired them; a play that evokes the research supposedly carried out by Carrere to create them and make them convincing. New forms and new materials were used; a *modernity* applied by a Hollywood Art Director, suitable for *popular consumption*[11].
Wright, Mies, Gropius, Mendelsohn, Neutra, among others, could be part of the documentation material.
At least in the selected cases, similarities in design, approach and graphic technique seem obvious; designs that went against the current of that time[12] *"in a country where fashion demanded country houses, Neogothic or Arabesque small palaces and mansions inspired by the Spanish colonial style. The nearby Hollywood, with its dream world of cinematographic inspiration, helped to foster the illusion of the dream home using grandiose decorations that illustrated the wealth and glory of their owners."* The *ideal catalogue* for modernity of the film is well differentiated from other designs that Carrere devised at *The Fountainhead* to represent the *opposition*, the other eclectic architecture, the one that is attached to tradition and denies the new times.
Viewed together, the *modern* models and drawings designed by Carrere show a consistent resolution, with common resources such as the use of rotund volumetrics, materials such as concrete and glass, the appearance of cars and vegetation in the setting and, regarding the graphic aspects, the perspective view chosen as a characteristic of the new architecture design.
Before them, Carrere distinguishes the traditional architecture drawings, embodied by an eclectic, neoclassical appearance. Their representation reinforces the opposition between tradition and the modern option; they are shown in front elevation, in well-kept plates where the architecture drawn contrasts with a black background. This architecture is described differently[13] in the novel by Rand. The anti-modern critic makes a declaration of principles, obviously contrary to the thesis of the novel and, therefore, the author chooses to radicalize this position in an exaggerated way:
"It has a white serenity, eloquent testimony of the triumph of classical purity and common sense. The discipline of an immortal tradition has served here as a consistency factor, coordinating a structure whose beauty can reach, simply and lucidly, the heart of the average man. There is no extravagant exhibitionism here, nor perverted efforts for the novelty, or an orgy of unbridled individualism (...) It is worth to emphasize in passing that the dogmatic discipline is all that makes possible originality."
Carrere may have resorted to *The Chicago Tribune Tower Contest*, 1922, for the anti-modern architecture designs –which is neither extravagant nor exhibitionist or individualistic orgiastic... as the modern one– and thus to be able to graphically translate Rand's description. In that contest, he found the source for solving two issues: how to design a skyscraper from Gropius's proposal and the way of representing the *anti-modern* architecture. That was a juxtaposition of trends present in that contest, at which proposals were likely to be aligned in two groups: on the one hand, the ancient beauty and, on the other hand, the ultramodern. The observation of the proposals submitted to the contest by both trends let us observe the different graphic looks and the use of perspectives instead of elevations. The graphic strategy changes to serve the ultra-modern[14] or ancient beauty, involved in creating drawings for one or the other architecture in *The Fountainhead*.
Extravagant exhibitionism, perverted effort for the novelty and orgy of unbridled individualism confronting *white serenity, common sense and discipline of an immortal tradition.* Both trends, ignoring the radical, Manichaean descriptions, can be linked in the graphic field to a *modern graphic determination, an innovative nature and formal testing facing up the classical attitude in the graphic representation, bright and splendid, but bounded to a variety of intentions*[15], as Uria stated in his view of this graphic contrast.
This duality is modestly captured in Carrere's designs[16], using these mechanisms to strengthen the new illusion of modernity against the decrepit; graphic experimentation against repetition of the same.
An image of modern architecture designed for a general audience was sought, *"Edward Carrere had to invent for* The Fountainhead *those buildings that are so vaguely delineated on the novel by A. Rand. Some Wright's or Mendelsohn's examples, along with some others by Mies van der Rohe used to provide a true picture of modern architecture suitable for popular consumption."*[17] For this ideal catalogue, we distinguish, on the one hand, the architectural design and, on the other, the graphic expression; the representation by means of drawings or models.
On the subject of architectural designs, we already noted their *cinematographic*[18] *status*, being part of the staging with sets and costumes, but with a greater degree of architectural specialization –given the focus of the film based on written descriptions such as[19]: *"(...) the form of a building must be adapted to its function, that the structure of the building is the key to its beauty, that new methods of construction require new forms, that he wanted to build according to his tastes and only that way. But others could not pay attention to him while they were talking about Vitruvius, Michelangelo and Sir Christopher Wren "*, or[20] *" my rules are these: what can be done with a material should never be done with another. No two materials are alike. No two places on earth are alike. No two buildings have the same purpose. The aim, the place, the material determine the shape. Nothing is rational or beautiful if it is not made according to a central idea; the idea provides all the details. A building is alive, like a man. Its integrity is to follow its own truth, its only issue and to serve its own unique purpose. A man does not ask for rendered pieces for his body. A building does not borrow pieces of its soul. Its constructor gives it a soul that every wall, every window, every staircase expresses."* They offer a number of designs in which modern architecture is represented by formal resolution –compo-

sitions of pure volumes, glass cloths, concrete, structural bravado–, by the use of buildings –detached houses with experimental appearance, bank, warehouse, industrialized farm, office building, *adapting form to function*; the spirit of the times, and a view in perspective that varies the point of view and framing depending on the displayed architecture, in contrast with the static view in elevation of the opposite architecture.

About the drawings, the novel Rand writes[21]:

"Roark walked to the drawings. They were the first things to pack. He lifted one, then the next, then another. He stared at the large sheets. They were sketches of buildings that never existed on the face of the earth. They were like the first houses built by the first men, the ones that had never heard of the former existence of buildings. There was nothing to say about them except that each building was inevitably what it should be. They did not give the impression that the artist had been carefully meditating on them, collecting doors, windows and columns as dictated by his whim or as prescribed by books. It seemed like the buildings have sprung from the earth by the work of a living force, complete, unchanging, correct. The hand that had drawn the lines with fine strokes of pencil still had much to learn; but no line seemed superfluous, none of the required plans had been omitted. The buildings were severe and simple, but when analyzed closely that work was understood: what complexity of method, what tension of thinking would have been necessary for obtaining that simplicity. Not even the simplest detail was due to a rule. The buildings were neither Classic nor Gothic or Renaissance. It was only Howard Roark."

The first drawing introduces the architecture that will appear in the film, defined as *'modernist'*[22] by a dean of the school. The main character of the novel defends this architecture. His ideas about it determine his full, personal journey inside his career, starting from his expulsion from the School of Architecture *Stanton Institute of Technology*, whose dean reproaches him by saying that *"(...) all projects he had to draw... he has made them... with his incredible way, contrary to the principles we try to instil in him, against all established precedents and artistic traditions. You believe you are what is called a 'modernist'... that is pure madness,"*[23] but eventually consecrates himself as a successful professional.

The initial sheet contained a drawing of a blueprint for a house of glass and concrete. There was a signature of fine, sharp features in one corner: "Howard Roark", the director chides him:

- How do you expect to pass after this?

- I do not expect to pass.[24]

This first drawing of the film will be followed by others, visible in the footage with different importance and presence in the action, usually a glimpse of a few seconds. As mentioned before, there were prospects of architecture for easily identifiable purposes related to modernity, store, factory-farm, office building, factory and a singular single-family house.

The appearance of some of the drawings reminds of Neutra and Schindler in the formal and technical aspects, without prejudice to other possible influences. Neutra, an excellent draftsman, a prototype architect of the modern movement, also created a characteristic graphic work of the times[25].

(Neutra) He really handled pencil or crayon with the same skill than ink. He already had the ability from a young age, in an era when every architect who prided himself as exquisite should also be a virtuoso in the pictorial arts. He was a brilliant draftsman and watercolourist. In his expressive drawing folders –that is, the ones that survived the fire in his house in Silverlake, California (Los Angeles)–, models can be easily recognized: Egon Schiele, Gustav Klimt and Oscar Kokoscha. His paintings are beautiful, pleasing on the eye, expressive and powerful. They also state –apart from his first watercolours with idyllic romantic motifs, performed under the influence of modernism and of his disciples–, the bold, angular, curved stroke of the Expressionists. Rudolf Schindler shared that same passion. Both might have probably survived well as independent artists.

Fine, factual lines, economy in representation, elimination of the superfluous, lineal, clean drawing with sharp contrast of shadows and treatment of the surface texture of the volumes, incorporating a stylized vegetation and vehicles of the time[26].

Neutra's graphic work, an architect close to Hollywood with pieces of work in Los Angeles, may have also influenced Carrere. His drawings can be recognized as modern; his graphic style[27], a set of formal and technical aspects, is close to the designs used in the film. Similarities are limited to this point; there is no place for a more fundamental analysis.

Ayn Rand, writer and philosopher, was born in St. Petersburg, 1905, and died in New York in 1982, the city where the action unfolds in the novel. Apart from the graphic similarities in *The Fountainhead*, there is another match between Ayn Rand and Neutra: she would live in the forties and fifties in a house designed by the architect, in a mansion built in 1935 for the actor and film director Josef von Sternberg, with an eccentric, aerodynamic front and steel structure and cladding.

Carrere's drawings and models fulfilled with solvency their role of setting, providing an modern *ideal catalogue*, as stated by Juan Antonio Ramírez. Maybe this production is *obviously suspicious or a rehash of modernity, served cold as a ruthless intellectual kitsch,* but we prefer to emphasize in this article its values, rather than its weaknesses.

In conclusion, Ayn Rand's work and Vidor's film have a place in the sequence of the modern graphic imagery and, within it, Carrere's designs for *The Fountainhead* confirm the condition of modernity as a distinct field, since they have been recognized as part of it. A particular modernity made to order and determined, in this case, by the devised architecture and the graphic strategy used in the drawings, mapping, models and photographs that emerged from an adequate documentation on the characteristic production of some outstanding architects of modernity.

11 / RAMÍREZ, Juan Antonio. *La arquitectura en el cine. Hollywood, la Edad de Oro.* Hermann Blume. Madrid, 1986, p. 276.
12 / SACK, Manfred, "Richard Neutra: racionalista, misionero, amante de la naturaleza y filántropo", *Richard Neutra*, Gustavo Gili, Barcelona, 1994, p. 12.
13 / RAND, Ayn, *El Manantial*, Editorial Planeta, Barcelona, 1958, p. 48.
14 / *The Chicago Tribune Tower Competition. Skyscraper Design and Cultural Change in the 1920s*, Cambridge University Press, 2001.
15 / URÍA, Leopoldo. "Más palabras sobre el dibujo. Hacia una teoría de la infidelidad gráfica" en *Arquitectura COAM* No. 313, 1st quarter, 1998. Madrid, 1998, p. 58.
16 / JOHNSON, Donald Leslie, *The Fountainheads. Wright, Rand, The FBI and Hollywood*, McFarland & Company, Inc. Publishers, U.S.A., 2005, p.138.
"Vidor, Carrere and probably Tuttle have inspected (according to Vidor) all Wright's buildings in Los Angeles and read 'everything that has been published' about him (...) We know that Vidor, Loeb and Carrere planned to visit Wright in 1948, but Jack Warnwr withdrew at the last minute (...) fearful of any complaint or subsequent veto from the Architect due to predictable changes in the cast, sets and designs considered "theft of his ideas."
17 / RAMÍREZ, Juan Antonio. *La arquitectura en el cine. Hollywood, la Edad de Oro.* Hermann Blume. Madrid, 1986, p. 276.
18 / RAMÍREZ, Juan Antonio. *La arquitectura en el cine. Hollywood, la Edad de Oro.* Hermann Blume. Madrid, 1986, p.11.
19 / RAND, Ayn, *El Manantial*, Editorial Planeta, Barcelona, 1958, p. 42
20 / RAND, Ayn, *El Manantial*, Editorial Planeta, Barcelona, 1958, p. 17.
21 / RAND, Ayn, *El Manantial*, Editorial Planeta, Barcelona, 1958, p.11.
22 / That was a question of dubbing and translation of the novel. On the other hand, it is quite a common confusion in the popular usage of the definition of modern architecture.
23 / MIROLI, Alejandro, "¿Arquitectos como artistas? Una crítica de la filosofía de la arquitectura de Ayn Rand", *Asterion*, No. 5, Buenos Aires, November-December 2002.
24 / RAND, Ayn, *El Manantial*, Editorial Planeta, Barcelona, 1958, p. 15.
25 / SACK, Manfred, *Richard Neutra*, Gustavo Gili, Barcelona, 1994, p. 14
Richard Neutra: rationalist, missionary, nature lover and philanthropist.
(...) Schindler is described as an emotional artist who projects guided by his intuition and who acts spontaneously; and who also exteriorizes his way of being through his loose hair and casual clothes, always without a tie. Neutra, on the contrary, is regarded as an analyst who seeks clarity and effectiveness above all else and who considers the building's structural integrity as the prerequisite for his artistic expression.
26 / FRAMPTON, Kenneth,"El Estilo Internacional: tema y variaciones," *Historia crítica de la arquitectura moderna*, Gustavo Gili, Barcelona, 1981.
"The House of Health, built in Los Angeles in 1927 for Dr. Philip Novell following Richard Neutra's design –an Austrian emigrated architect–, can be seen as the apotheosis of the International Style; its architectural expression derives directly from a steel frame wrapped in a lightweight synthetic leather."
27 / Note: the term *graphic style* (*estilo gráfico*) has been taken from SAINZ, Jorge. El dibujo de arquitectura. Editorial Nerea.

ALGORITHMS, GENERATIVITY AND PARAMETRIC ABSTRACTION

by Carlos L. Marcos

Computer tools used in architecture or more generally speaking in the graphic media, in their ultimate stage, can develop geometries generated from programming languages. This means the modelling of those geometries is non-graphic, instead it is parametric. For example, scripting languages developed in programs like Rhino, Autocad or 3dMax, such as the RhinoScript, Autolisp or 3DMaxScript, and even open software used in specific graphic media such as Processing. These languages are, in fact, metalanguages because they have their own internal logic and grammar but are designed towards the manipulation, editing and development of graphic inventiveness, as well as the representation of architecture itself.

The use of *algorithms* to define formal structures and complex geometries has emerged as a new field within digital architecture, a field rather different from what are traditionally expected to be core issues in architectural design. Kostas Terzidis[1] has referred to the use of algorithms in architecture as follows:

> Algorithms can be used to solve, organize, or explore problems with increased visual or organizational complexity. In its simplest form, a computational algorithm uses numerical methods to address problems [...] random variables or conditions can be inserted into an algorithm, further increasing the degree of unpredictability of the final outcome and magnifying the level of complexity. Contrary to common belief, algorithms are not only deterministic processes developed to explain, reason, or predict a humanly conceived problem, but can become venues for addressing complexities that exceed human ability to explain, reason, or predict.

Algorithmic architecture can be used to take advantage of the computers' potential to analyse a casuistry impossible to deal with the inherent limitations of human beings. Obviously, algorithms are not able to automatically design an architectural project; however, they can be used to develop and explore an extraordinary wide range of formal solutions. In this sense, the use of algorithms fully enters into what we call *digital consciousness*. María Fullahondo[2] has referred with this term to the use of digital tools not as a mere substitute of traditional drawing tools and for the representation of architecture, but as a new paradigm in the pursuit of an architectural language:

> Probablemente, desde el nacimiento de la perspectiva, no haya existido ninguna época en la que la herramienta utilizada condicione la producción arquitectónica de una manera tan determinante.

The representation of architectural space since Renaissance has greatly influenced architectural language itself; both perspective and press were two breakthroughs that transformed architecture considerably. In addition, the concept of space as a receptacle with the qualities of geometrical space has determined architectural production over the centuries until very recently. Kerchove and Tursi[3] have addressed this issue on the following terms:

> However, to understand time as composed of aligned, regular elements and space as a void and neutral container required a process of significant abstraction of the bodily experience. Not the body in terms of the totality of its senses, but that part of it that defines what it sees –the eye- has determined the experience of modern man. Perspective represented an immediate demonstration of the working of this process of abstraction, based as it was on the complete mathematisation of space. In this way, it established an indisputable "symbolic form".

The modern conception of space that has characterized architectural modernism in the twentieth century -and perhaps is at present getting a greater identification with today's *avant-garde* architecture- lies on the idea of space as a field. That is to say: as a dynamic system constantly permeated by forces and with a much closer connection to time; hence, with the distinctive flow of life found in the material world. Parametric architecture can constitute a new paradigm in the conception of architectural space and is likely to establish a closer affinity with such notion of modern space. Kerchove and Tursi[4] describe this conceptual shift as follows:

> Space is no longer an empty and neutral container that can be described on a flat surface using the arithmetic-geometric relations of perspective. Rather, it is continuously generated and regenerated by the networks that structure it, by the conflicts that vivify it, by the living beings that inhabit it. This new definition of space is naturally tied to the development of 20th-century physics and its notion of the 'field': space becomes a field of forces and counter forces, a field that emerges from the actions taking place within it.

The formalization of geometries generated from algorithms can more easily take on a dynamic characterization of space and, therefore, an architectural representation of the notion of space as a field or of the space-time based in modern physics. Marcos Novak has coined the term *transarchitectures* referring to the new architectural imagery generated in cyberspace, a new frontier to explore within architecture: perhaps a new formal abstraction architecture-borne. Novak[5] has written regarding the parameterization of architectural geometry constructed from algorithms on the following terms (the earlier images by Marcos Novak refer to this text):

> The algorithm that produces these forms works as follows: data is interpreted as two sets of points in 3D space in body-space, an instance of output of the algorithm becomes a form of a material architecture […]

This represents a further and radical step in the evolution of architectural language that is originated out of the digital world. We are not referring here to the relationship between drawing inventiveness and the unlimited plastic possibilities of three-dimensional modelling. Indeed, in this case, the editability as an attribute of the virtual is derived from its immateriality. Virtual constructions are unlimitedly plastic to the extent that their constitution from *bits* is not material and therefore their formalization acquires real existence only during the time the code is being executed by a computer program. For the same reason conventional computerized drawing programs are somewhat limited for the architect who uses them but does not have direct access to the code of a language developed by others. Thus, they introduce a certain distance between the architect and the object of his design -perhaps the distance Gehry bothers about-; the architect is no longer in control of his design in the way he had been in the past with conventional tools, used as he was, to the materiality of his own production. Polyxeni Mantzou[6] points out this problem in these terms:

> El hecho de que el arquitecto depende de otros para suministrarle medios para proyectar [*software*], es decir, se encuentra alejado de la creación y la estructuración de un nuevo metalenguaje el cual sirve como base para su trabajo, crea una nueva condición de distanciamiento, igual de importante como aquella que en el pasado le apartó de la obra y le trasladó al estudio. El dibujo como lenguaje ha estado enteramente en las manos del arquitecto mientras que el *software* puede ser abierto a la utilización pero viene como un lenguaje hecho por otros y a cuya estructura él no tiene acceso.

In conventional CAD programs the architect virtually draws and models on the computer display the architecture he is designing. The display is thus an interface which graphs the architectural object as it takes shape, and therefore it is what stands between the architect and his design. It can not be otherwise because of the virtuality implied within the process. However, the architect either *draws in 2D* or *builds 3D models on* the computer screen either by entering commands through the keyboard or the mouse (and in the near future by other procedures currently in pilot phase).

Nevertheless, programs that do allow writing scripts that are graphically transcribed such as those cited above introduce a new opportunity for the development of architectural design that can be then referred to as "algorithmic". That is: the drawing is not any longer a graphical act in the sense of the correspondence between the order given to the computer (marking of traces) and what is displayed on the screen (a support). The drawing is more the formalization of a script written in a computer language capable of generating parametric designs. In his brief but concise text, *Algorithmic Architecture*, Terzidis[7] has referred to this qualitative change in the design process as follows:

> By using scripting languages designers can go beyond the mouse, transcending the factory-set limitations of current 3D software. Algorithmic design does not eradicate differ-

1 / Terzidis, Kostas,, "Algorithmic Complexity: Out of Nowhere", in *Complexity. Design Strategy and World View*, Ed. Gleiniger, Andrea y Vrachliotis, Georg, Birkhäuser Verlag AG, Berlin, 2008, p. 79.
2 / Fullaondo, María. "Conciencia digital". XI Congreso Internacional EGA, Sevilla 2006.
3 / Kerchove, Derrick y Tursi, Antonio, "The Life of Space", Architectural Design, V. 79, I. 1, p. 49.
4 / Kerchove, Derrick y Tursi, Antonio, "The Life of Space", Architectural Design, V. 79, I. 1, pp. 49-50.
5 / Novak, Marcos, *"Transarchitectures and Hypersurfaces: Operations of Transmodernity in Hypersurface Architecture"*, AD, 133, 1988.
6 / Mantzou, Polyxeni y Bitsikas, Xenofon, "*Proyectar en la era del código digital"*, Actas Congreso Internacional EGA XII, Madrid, 2008, p. 490.
7 / Terzidis, Kostas, *Algorithmic Architecture*, Architectural Press, Oxford, 2006, p. xii.

8 / Pareyson, Luigi, *Conversaciones de Estética*, Ed. Antonio Machado (Visor, Colecc. La balsa de la medusa), Madrid, 1987, pp. 130-131, (Tit. Orig. *Conversazioni di Estetica*, Ed. Mursia, Milán, 1966).
9 / Dollens, Dennis, *De lo digital a lo analógico, Ed. Gustavo.Gili,Barcelona, 2002* (Tit. Orig. *D·2·A Digital to Analog*, Ed. Sites Books, Lumen Inc., Santa Fe, 2001)., p. 104.
10 / Berlinski, David, *The Advent of the Algorithm: The Idea that Rules the World, Harncourt, Brace, Nueva York, 2000,* cit por Dollens, Dennis, *Op. cit.*, p. 98.
11 / Guattari, Felix, "*On machines", en The Journal of Phiilosophy and Visual Arts,* no. 6 ("Complexity"), ed. Andrew Benjamin, cit. por Eisenman, Peter, *Written into the void: selected writings*, 1990-2004/Peter Eisenman.
12 / Eisenman, Peter, *Written into the void: selected writings*, 1990-2004/Peter Eisenman, p. 57.
13 / Terzidis, Kostas,, *"Algorithmic Complexity: Out of Nowhere"*, en *Complexity. Design Strategy and World View,* Ed. Gleiniger, Andrea y Vrachliotis, Georg, Birkhäuser Verlag AG, Berlin, 2008, p. 75.
14 / Terzidis, Kostas, *Op. cit.*, p. 76.

ences but incorporates both computational complexity and creative use of computers. For architects, algorithmic design enables the role of the designer to shift from "architecture programming" to "programming architecture"[…] For the first time perhaps, architectural design might be aligned with neither formalism nor rationalism but with intelligent form and traceable creativity.

This is indeed a revolution of revolutions because the *scripts* are as abstract as the language we use to communicate may be; at least in this sense, we may speak of *parametric abstraction.* Algorithmic architecture can hence be seen as the most advanced stage in the field of computer aided architectural inventiveness. To a certain extent it constitutes an *abstraction* of abstraction.
Definitely, the inevitable mediation of the drawing or of the three-dimensional modelling –in the virtual space- introduces a distance between the architect and his object of design, however the architect has control over something that he is able to see and manipulate on the computer display regardless of its virtual existence. Thus the control over the architectural form is equivalent to what happens when conventional tools for graphic representation are used; there is a change of the tool but the design process is alike. The achievement of form involves in both cases a generative development in which the designer and his production is established on a dialectic basis which leads to the gradual definition of form itself. Pareyson[8] writes regarding this subject:

…cuando propongo el término "formatividad", no pretendo aludir solamente al arte como actividad de formar o a la esencia del proceso artístico en la que creo que reside el aspecto más propiamente original […] Esta teoría es la distinción-unidad de forma formante y de forma formada, por la que la obra misma, aun antes de existir como formada, actúa como formante, guiando el proceso de su formación, sin que por ello se pueda decir que la forma formante sea algo distinto de forma formada, sino que, por el contrario, son absolutamente la misma cosa.

However, the *scripts* that generate architectural geometry are neither graphic nor plastic entities. Therefore, they are not equivalent to a drawing or a model, that is: they do not hold a generative relationship between the designer and what is designed by him, between their own structure –that of a written code in a scripting language- and the resulting geometrical shape. In other words, the two-dimensional computer drawings or the virtual 3D models currently used in architectural offices at present are not very different from an *emulation* of conventional design tools the architect has traditionally made use of: drawings and models. In contrast, parametric drawing is a non-graphical tool because it lacks graphicness. Dennis Dollens[9] has referred to this not very intuitive new tool introduced by digital architecture:

Un impedimento para el desarrollo de una arquitectura electrónica híbrida o puramente digital es la necesidad de que los arquitectos reorienten, al menos parcialmente, la base conceptual de la arquitectura que practican; en concreto, la necesidad de que acepten la programación por ordenador como un acto de colaboración arquitectónica y de que se adapten al espacio y a la producción virtuales como lo han hecho al espacio físico en 2D y 3D. Cuando la comunión entre los procesos de proyecto y electrónico sea más firme, el acto de escribir, proyectar y utilizar un código electrónico para generar formas podrá conceptualizarse totalmente como parte del papel creativo del proyectista.

The parallels between the imagery found in some of the proposals by Novak and Schiwtters' *Merzbau* are certainly striking (compare the images by Novak - *Variable Data Forms* - and the work by Schwitters). But it is still more surprising if we consider the fact that Novak's work was generated from algorithms and the *Merzbau* (half sculpture-half architecture) was built with his own hands and was therefore perfectly material. This gives us a preliminary idea regarding the fact that algorithms may be formally driven, something which justifies how algorithmic formal investigations can be *lead* in certain directions. That is to say, anyone using algorithmic procedures does not lack of a formal criterion, instead he will drive the formal search implicit in the code or script trying to explore new possible geometries. But, what is really an algorithm? David Berlinski[10] has defined it generically as follows:

Un algoritmo, por decirlo de algún modo, es un grupo de reglas, una receta, una prescripción para emprender una acción, una guía, un mandato vinculado y dirigido, una adjuración, un código…

This means algorithms constitute a language completely foreign to architecture -at least as we understand it today-, it is in fact the language of computers and of the *machinic.* Being machines related to mechanisms and the mechanical to the repetition of the activity for which it has been designed as they are, the computer as an open system follows a machinic conception. Its constitution allows openness because it is based on codes and these may differ from one another as much as we want to; they may even generate iterations and certain randomness. Guattari[11] writes about this variability of the machinic:

Rather than having an opposition between being and the machine [that is, between being and becoming], or being and subject, this new notion of the machine now involves being differentiating itself qualitatively and emerging onto an ontological plurality, which is the very extension of creativity of machinic vectors.

Eisenman[12] adds to this distinction his own interpretation in regard to the contemporary idea of an architectural space that is closer to the idea of field in physics:

Thus, in architecture such a process might be iterative, might have directions and energy, and might, deal with forces and flows which could be multiple, reversible, and deformative rather than linear and transformative.

Provided algorithms define formal structures generated from a code or script that are then graphed and modelled virtually, the idea of order required in all architecture is implicit in the structural design of the algorithm itself. Indeed, this is a property of algorithms that opens new perspectives for architectural research. Unquestionably the mechanical inherent to the iterative logic of an algorithm may generate certain repetitiveness but it just depends on the complexity of the algorithm itself, and to its embedment within other algorithms that can transform the formal structure previously defined. Obviously, once the model is generated, the architect can manipulate it at his will and may introduce in the algorithmic model some degree of "subjective imperfection", perhaps to leave a slight imprint of "humanity" into the otherwise perfectly structured and repetitive design.
Parametric form in architecture introduces a degree of variability unimaginable to be achieved through conventional means. A slight variation in the code can entail a huge change in the final form. And what is even more important: introduces randomness as a new factor into the design, something which involves a double paradox. Firstly, because random architecture makes no sense since it would imply a lack of order. Secondly, because the intention of generating a completely random code is a self-referential paradox. Terzidis Kostas[13] has referred to this issue as follows:

Randomness is a term used to describe a lack of an identifiable pattern, purpose, or objective. In its formal manifestation, randomness can also be defined as a meaningless pattern. While this definition can be applied to the description of a pattern being random, it becomes problematic when it is applied to the act of creating a random pattern. The claim itself involves a self-referenced paradox: how can one create something that is meaningless? Wouldn't the mere act of creation assign meaning automatically? […] In other words, the creation of randomness involves intention, which is contrary to randomness. However peculiar this may sound, by definition one cannot create randomness.

Thus, algorithms have the potential to create an enormous quantity of different formalizations but all of them must be governed by a certain order implicit within the algorithm itself, its intrinsic structure. All the forms generated by the algorithm will have some sense, will be formally oriented and, therefore, will have a common order. Kostas Terzidis[14] has associated complexity and randomness on the following terms:

Complexity, as defined earlier, is associated with randomness as follows: if a pattern is very regular, it is easy to describe, and so it is simple. In contrast, if it is irregular, then it is difficult to describe, and so it becomes complex. If it is so complex that the information it contains can not be compressed at all, we say that it is random. So randomness is characterized as the maximum of complexity, and the opposite of regularity and simplicity.

However, the relationship established by Terzidis between randomness and complexity is not necessar-

15 / Actually the basic units are preceded by a sugar-deoxyribose- and succeeded by a phosphate serving as a link with successive respective links in the chain. Since the sugar and phosphate are only the necessary attachment parts and they do not qualify the link only 4 elements determine the quality of the link (adenine, thymine, cytosine and guanine -A, C, T, G-), in turn their position and their constitution within the chain determines the genetic key in the code.
16 / http://www.mh-portfolio.com/ (visitado el 10_05_2009)
17 / Eisenman, Peter, "*Process of the interstitial*", El Croquis: Peter Eisenman 1990-1997, 83 , 1997, p. 30.
18 / "In a similar, almost humorous fashion, the *Dada Engine* is a computer algorithm that produces random text based on recursive rearrangement of elements in a grammar. The resulting text, while allegedly based on random processes, is readable, occasionally makes sense, and is sometimes surprisingly intelligent", Terzidis, Kostas, *Op. cit.*, p. 77.
19 / Leach, Neil, *"Digital morphogenesis"*, Architectural Design, V 79, I 1, p. 34.
20 / Leach, Neil, *Op. cit., Ibidem.*
21 / Novak, Marcos, *"Transarchitectures and Hypersurfaces: Operations of Transmodernity in Hypersurface Architecture"*, AD, 133, 1988, p.89, cit. por Dollens, Dennis, *Op. cit.*, pp.110-111.
22 / Marcos, Carlos L., *Espacio material: la arquitectura como extensión topológica*, Tesis Doctoral, E.T.S.A.M., 2009.
23 / Pallasmaa, Juhani; *Los ojos de la piel*; G. Gili; Barcelona; 2006; (Tit. Orig. *The eyes of the skin*, Wiley-Academy, Chinchester (West Sussex), 2005), p. 43.

ily biunivocal. Algorithms as operators of form can generate highly complex geometries as their degree of randomness is greater. Nevertheless, complexity does not necessarily need to be measured in terms of randomness; there can be found complex architectures whose order and regularity is more or less straightforward. The very structure of the DNA molecule is based on the combination of four different elements constituting the nitrogenous base[15]. -the basic link in the chain-; repeated systematically but altering their order they can define something as complex as the architecture of human beings. [16]
Eisenman[17], has referred to hypercomplexity in the definition of architectural space generated by *spacing* strategies implicitly recognizing the difficulty in explaining concepts like *spacing* or *conceptual blurring;* thus he has written:

Normal complexity is one that can be understood through a logical consistency. A cube is a simple form, but a hyperbolic paraboloid is a more complex form. It requires a more complex explanation. Hypercomplexity is something that is not explainable through the normal complex of logical mathematical equations. Spacing can be explained, but it requires a level of complexity not in conventional geometries. It is already another realm of description.

Moreover, the complexity involved in algorithmic systems has no apparent limits. The geometries we can handle, therefore, neither do. Randomness and complexity are the opposite of regularity and simplicity; this means that the simplicity modernity imposed as a Miesian paradigm in architecture is not a valuable attribute of algorithmic architectures. The variability of form is related to a certain randomness factor within the algorithm; considering the fact that it is a code designed according to a pattern -a particular order- it can also be used to pursue a formal search taking advantage of the enormous machinic capacity of computers to process codes and obtain results. Consequently, we can explore many possibilities simply modifying the starting parameters as an aid to formalize our design. Since the computer is capable of producing a countless number of results the work of the architect will then shift to choosing and discarding the computer output. Just as the *Dada Machine*[18] is capable of generating an endless amount of correctly articulated sentences from a grammatical point of view -most of them meaningless- there will be some of them that -by combinatorial chance- may have meaning. Analogously, parametric design in architecture introduces the opportunity to solve problems beyond the human capacity of analysis over time.
Accordingly, the architect's role becomes that of analyzing and evaluating the obtained geometry rather than directly generating the architectural form. It is in this sense that the control over form is no longer generative. Neil Leach[19] has addressed this issue in the field of *morphogenesis:*

Used initially in the realm of biological sciences, the term refers to the logic of form generation and pattern-making in an organism through processes of growth and differentiation. More recently it has been appropriated within architectural circles to designate an approach to design that seeks to challenge the hegemony of top-down processes of form-making, and replace it with a bottom-up logic of form finding. The emphasis is therefore on material performance over appearance, and on processes over representation.

From a literal standpoint, the analysis of certain forms in nature and the application of such forms as shape optimizations for a particular problem in the field of architecture would imply a certain figuration understood as simple imitation; this attitude falls squarely within what has been termed *Biomimetics*[20]. However, if the order of nature is what it is sought to imitate, i.e. the capacity to develop generative patterns, then the path is closer to abstraction from the pre-existent, that is: a process of abstraction triggered out of the material reference found in nature. *Morphogenesis* properly applied to architecture would then enter in the realm of algorithmic architecture as a mimesis of nature's generative processes instead of plain verbatim copies of the natural form for the sake of it or simply because the consideration of nature as a source of beauty.
In this way, we face the challenge to generate algorithms that may have an architectural sense in some context, thus addressing architecture on the basis that there is a degree of arbitrariness in the choice of architectural form as Moneo or Tafuri have argued. Marcos Novak[21] accustomed as he is to the use of algorithms to define his *trasnarchitectures* writes:

Construyo maquetas matemáticas y procedimientos generadores que están limitados por numerosas variables sin relación inicial con preocupaciones pragmáticas […] Estos modelos son matemáticos y algorítmicos. Si la maqueta se alimenta de datos temporales, la forma se vuelve animada, la arquitectura líquida […] Una vez que la arquitectura de los objetos se ha apartado a favor de una arquitectura de relaciones, los conceptos de hiperespacio e hipersuperficie se vuelven naturales.

The problem is then circumscribed to the articulation of the algorithm so that it becomes a meaningful architectural form. It is just a matter of time before programming becomes another tool of architectural design. The ability of computers to "seek" formal solutions based on algorithm definition is extremely agile; we can not compete against it. On the other hand, the discernment of computers nowadays is not yet well developed. Consequently, a large number of formal investigations developed from a given algorithm must be critically examined by the architect. In this sense Terzidis[21] has written:

Dannenberg and Shusta developed an algorithm that produces all possible combinations of skyscrapers for a given site. Their strategy involves physical and geometric parameters to script a computer modelling code that builds, renders, and organizes an infinite number of skyscrapers possibilities, from which emerges a formal pedigree categorized in texture and performance. What is remarkable about this –or any other combinatorial analysis- is that they are able to produce computationally any possible form ever created or any yet to be created.

In all, algorithms give us a chance to handle higher levels of complexity as compared to those we would be able to manage through more conventional design strategies. The traditional imposing of form by the designer greatly contrasts with the enormous variability of generative systems based on algorithms. Like Eisenman's *diagrams*, algorithms involve openness, but unlike the process of extracting the shape from the diagram that we find in the case of Eisenman, the computer has a virtually unlimited ability to generate forms from algorithms depending on the level of complexity that they contain and their degree of randomness.
In any case, once built, architecture will remain a *topological extension* defined by a *material space*[22]; the sensory experience of architectural space cannot be replaced. As technology evolves and the forms we are used to experience in the architecture may vary the invariants of architectural language will remain. Accordingly, the architecture of the future cannot ignore the problem of order, or that of scale, or the relationship between space and the matter that conforms it, neither will architecture be able to unleash itself form the fatality of gravity and its ineluctable verticality, nor will its elements cease to remain cohesively bonded by such gravitational field, it will necessarily raise from the ground, will have to protect us from weather, and shall connect its inner space with the *locus* becoming part of it as another architectural object. We affirm together with Pallasma[23]:

In the memorable experiences of architecture, space, matter and time are merged into a single dimension, the basic substance of being which permeates our consciousness. We identify with this space, here, right now, and these dimensions become ingredients of our very existence. Architecture is the art of reconciliation between us and the world, and this mediation takes place through the senses.

FIGURES

Fig. 1. Marcos Novak, *Trans Terra Firma,* 1995
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IDENTIFICATION OF ARCHITECTURAL DRAWING AND DESIGN (*) AS METHODOLOGICAL PROCESSES OF SCIENTIFIC RESEARCH IN ARCHITECTURE

by Javier Fco. Raposo Grau

(*) In Spanish, the usual term applied to designing architecture is the verb form *proyectar*. It means "to plan", "to project", "to cast", "to throw", and "to design" (T. N.).

1 / Ernst Mach (1838-1916) and Pierre Duhem (1861-1916) were prominent physicists. They could be considered parallel figures, although there are some important differences between them. Both lived during the same time period, they passed away in the same year, they carried out research within the field of history of science, and they linked their work with their conceptions about philosophy of science. As if it were not enough, they both asserted that scientific theories are not true or false.

E. Mach is one of the most important empiricist authors who ever existed. From the beginning of his career, his research was focused on psychophysical problems. He considered them fundamental to determine the value of knowledge in general and of science in particular.

2 / Pierre Duhem's interest was always focused on psychophysical problems, that he considered fundamental to determine the value of knowledge and science. The German edition of his *The Aim and Structure of Physical Theory*, where he defended his general epistemological views, was published in 1908. E. Mach wrote the foreword to the book, which largely contributed to qualify Duhem as a positivist physicist. The Austrian author had already mentioned the book in the preface to one of his works, pointing out that he had added some footnotes in the text with references to related works which had been published simultaneously or a bit later. Two other works were briefly mentioned, and the rest ? almost a half ? of the introduction was devoted to Duhem's book, which had been published in the same year. He wrote that he had experienced great pleasure from reading it and that he did not expect to find himself in basic agreement with a physicist's position. He gave special value to the concordance with the French author because both of them independently had reached the same conclusions. He

Introduction

The present essay is focused on the question of what is and should be considered research in architecture, and more specifically in architectural design. The aim is to clearly identify the graphic processes inherent to the practice of architecture, particularly to research activities linked with higher education, and to prove that the nature of such activities remains constitutive of the character of scientific inquiry.

Background. Research. Scientific Method.

It seems appropriate to begin by making a few points about concepts in the traditional approaches to scientific research, their validity nowadays and their application to architecture-related activities. We will examine the work of professionals involved in architectural training, more precisely in architectural design. The main objective of this essay is to promote reflection on the way research is and should be conducted in schools of architecture, and on the connections between inquiry/education and practice, so as research may be clearly distinguished and determined particularly in this field.

First of all, let us analyze the etymology and current meaning ? both general and restricted to our domain ? of the Spanish word for research. *Investigación* is the action and effect of researching. The term comes from Latin *investigatus,* past participle of *investigare*, and means to search for, to inquire, to investigate, to track, to follow by vestiges, to find out, to discover. Etymologically, the word traces back to *in-* + *vestigium*, footprint, track, trace or sign, the vestige of someone or something. In an etymological sense, research is thus an activity that leads us to acquire knowledge about something.

Every inquiry arises as the result of a process with precise goals and a purpose. In general terms, research is as a process where the scientific method is applied in the quest for relevant and reliable information that is useful in order to understand, to verify, to correct or to put knowledge into practice. A series of steps towards a determinate end must be followed to get the intended goal. Scientific inquiry is a systematic method of continuing investigation of phenomena. This form of knowledge includes a body of techniques for observing evidence, rules for reasoning and prediction, some principles on planned experimentation, and ways to share both experimental and theoretical results.

Scientific inquiry is the intentional quest for knowledge or solutions to problems of scientific nature. The scientific method indicates the path to follow and techniques show the precise way to do it. The process allows us to get in touch with reality so this can be deeper known. It also stimulates creative intellectual activity, and it helps us developing an increasing curiosity about solving specific problems. There are two levels of inquiry, namely, everyday or common inquiry, and rational or critical inquiry. The former is related to the search for knowledge and is inherent to human activity. It is based on questions that are answered through daily mechanisms of investigation, and on their corresponding solutions. The latter is the reflective, systematic and methodic activity of questing aimed at acquiring knowledge and solving scientific, philosophical or empirical/technical problems. It is fulfilled through a process, it has some specific goals and it is intended to formulate new theories or to change the previous ones to make knowledge advance.

Research is a kind of reflective activity that involves the profound, careful and exhaustive analysis of different elements: the knowledge sources or empirical evidence, the assumed problems, the models in hypothesis testing, and the plans to develop each and all related activities.

Research is systematic because the most important goal is not to find isolated data, but to link our thoughts with the information derived from the critical examination of the knowledge sources. The acquired knowledge gets connected through coordination or subordination relations, and it gets integrated within the body of organized knowledge or existing verified theories.

Research is methodic because logical processes are required to gain, to systematize and to share knowledge. The study of some objects of inquiry makes it necessary to develop specific ways, i.e. methods to properly investigate phenomena.

From the structural point of view, any inquiry has four elements, as follows: a subject, an object, a medium and a purpose. The subject ? the researcher ? develops the activity. The object is the matter or topic of investigation. The medium is everything required to fulfill the activity, that is to say, the set of appropriate methods and techniques. Finally, the aim or purpose lies in the solution of specific problems.

Research is pursued through a process that arranges a series of activities in several stages: 1. Selection of the subject matter and preliminary bibliographic consult. 2. Formulation and definition of problems. 3. Formation of hypothesis. 4. Data collection and recording. 5. Testing of hypothesis. 6. Publication of results.

A properly conducted inquiry involves the development of reflective thought and undoubtedly requires persistence. This kind of quest allows us to search and find our own and original answers to the questions formulated by ourselves, therefore to generate new knowledge. It provides suitable methodologies to approach reality in different ways, it stimulates creative and intellectual activity, and it helps us developing an increasing curiosity about solving a variety of problems. This feature is inherent to the scientific mind, which considers that research never comes to an end because results have to be constantly reviewed.

It should be emphasized that some of the qualities of a good researcher are inherent personality traits, while other skills are gained by education and training. The researcher must be aware of his/her strengths and weaknesses, so as the latter may be overcome through work and determination.

Researchers should pay attention to the following issues: dogmatic positions must be set apart; the supposition that the researcher is in possession of the absolute truth should be avoided, it is necessary to keep a constant and insatiable desire for searching the essence instead; ignorant attitudes should not be assumed, a moral position allows the researcher to be honest and responsible in the exercise of his/her duties, as well as to value the contributions of individual members of the research team; a critical attitude should be held on analysis and hypothesis verification; new approaches to future research should be proposed; impartiality and lack of prejudice and preconception are indispensable to judge information and reasoning of others; self-criticism is important to recognize and correct mistakes; skills to manage methods and techniques, and the ability to adapt them to processes under way are necessary; the researcher must be a very willing worker and also a persistent and patient person to face the difficulties that may arise.

The studious inquiry or examination is pursued through a methodology or process determined by the context itself. This fact must be taken into account to assure the dissemination of research results. The outcomes have to be reported and published to be fully considered scientific knowledge, and to become a real contribution to the general knowledge of society and of other researchers in particular.

Crisis in the traditional model of scientific research

It can be proved and justified that the classical concept of scientific research in the framework of Natural Sciences is in question nowadays. It should also be accepted that a new approach to research has been introduced from a methodological point of view, and architecture-related activities are clearly ascribed to this view.

There are remarkable constraints on scientific research in natural and even social sciences. Limits on each and all fields of knowledge are imposed by

stated that Duhem had shed new light on the relationship between ordinary and scientific knowledge, and he finally recommended the book as a complement and elucidation for his own work.
Pierre Duhem is especially popular in philosophy of science for his formulation of the labeled Duhem-Quine thesis.
3 / Willard Van Orman Quine (1908-2000) was an American philosopher. He is recognized as a world leader in mathematical logic. He also made relevant contributions to pragmatism as a theory of knowledge.
4 / Thomas Samuel Kuhn (1922-1996) was a distinguished American epistemological philosopher. His most influential book was *The Structure of Scientific Revolutions*. His indebtedness to Alexandre Koyré, Jean Piaget, Benjamin Lee Whorf and Willard van Orman Quine is well known, as well as his strong opposition to Karl Popper's thought. As a historian of science, he was especially motivated to tackle the problem of scientific change. He outlined its revolutionary condition, and he argued that science does not progress via a linear accumulation of new knowledge, but undergoes non-cumulative developmental episodes where an older paradigm is replaced by a different and incompatible new one.
5 / Paul Feyerabend (1924-1994) rejected any method containing firm, immutable and absolutely binding principles to which scientists should subscribe. He produced vigorous critiques of the most influential theories in contemporary epistemology, from Rudolph Carnap's logical empiricism to K. Popper's critical rationalism, including Imre Lakatos's methodology of scientific research programs. He described science as an essentially anarchistic enterprise that cannot be subjected to any kind of prescriptive methodology intended to gather the rich material provided by its own history into one and only model. Scientific revolutions occur when great scientists retain theories and hold positions incompatible with the evidence, and the criteria of rationality

the scientific model itself, since investigation and results are reduced to absolute truths. The process is supported by linear systems of validation that unavoidably lead to formulate goals of universal truth exuded from the inquiry outcomes. The resulting lack of flexibility is not shared by other methods of scientific research that are increasingly demanded by society.
Certainly there is no key enabling to distinguish what is scientific inquiry from what is not. Also, nothing may guarantee that the validity of the so-called scientific truth has been tested and then considered better than other forms of knowledge. This conclusion is related to the crisis of the classical model and to the social studies of science. At the same time and maybe paradoxically, it does not mean that traditional methods are not important any more.
The model transmitted through natural sciences textbooks has collapsed. Actually, it is deliberately used to set apart arguments that we do not want to hear. The downfall has reached the fields of Philosophy, Epistemology and Scientific Thought for different reasons.
Some basic and logical concerns of the traditional model have not been solved yet and they probably never will be. It was presupposed that there was something in the research method which made the sciences a higher form of knowledge. For 200 years, philosophers tried to unravel the secret which afforded some apparent advantages to science in relation to alternative paths. The progress of such discussion throughout the years (particularly in the 20th century) has showed that all proposals and models suggested as synthesis of the scientific method have collided with certain fundamental issues.
The problems come from the validation of the theoretical knowledge through experience or empirical evidence, because pure theories are never used without auxiliary hypotheses. Nonetheless, the normative approach lacks empirical adequacy about observable phenomena. The behavior of scientists in action does not usually follow the good scientific practice of simple models that may be found in textbooks.
The first matter regarding the validation of knowledge through experience may be associated with the philosophers Ernst Mach[1], Pierre Duhem[2] and Willard Van Orman Quine[3]. Scientific theories or hypotheses in general never confront empirical evidence directly, and a set of auxiliary assumptions is inexorably required for this encounter. These become part of the theory; as a consequence, the empirical testing cannot be ever conclusive as to the theory's validity because both hypothesis and auxiliary assumptions are subjected to testing. When the results do not match up with our predictions, the blame can always be put on faulty auxiliary hypothetical assertions.
The second matter regarding this issue makes us recall works of Thomas Kuhn[4] and Paul Feyerabend[5] on the influence exerted by theoretical commitments on observation. There is no impartiality on the different theories either, so that the scientifically valid assumption could be distinguished from others. A concrete theory is needed for observation, hence there is always a factor biasing the result in one direction. Another a priori problem arising within the context of scientific testing could be added to those fundamental logical issues. The problem of induction, that is to say, the inferring of scientific generalizations ? usually "general" and intended to be infinite ? from finite and empirical truths presents a logical gap that has not been solved yet and it probably never will be.
As mentioned above, the lack of empirical adequacy of the observable phenomena is related to scientists. Scientists' activity rarely follows the good scientific practice of the simple models that is found in textbooks; either other more sophisticated schemes, such as the models proposed by Karl Popper[6] or Imre Lakatos[7]. In fact, in laboratories, congresses or meetings where experiences are exchanged, scientists do not do what K. Popper prescribed or what Lakatos supposed, but a bit of each of them. They rather resort to Feyerabend's approach, and they usually apply a wide combination of techniques and resources.
Thus, and taking the abovementioned philosophical views into account, it could be stated that, far away from the normative approach, "scientific research" should promote some changes in scientific work. New questions should be tackled, such as inference-based issues (it is not purely theoretical research) and others aimed at constructing knowledge on the empirically observable reality in all its complexity; and also, issues regarding the management of a degree of uncertainty, since inquiry dynamics themselves provoke inferences. This raises the possibility of uncertain conclusions, but it simultaneously puts more emphasis on the applied method (the methodological processes) than on the outcomes. Such aspect is particularly valuable in creative processes related to artistic production like architectural design. Finally, another issue to be tackled is the necessity to publish results, thereby allowing other inquirers the opportunity to verify the scientific truth derived from our research on their own. In this respect, the method is much more important than the achievements. All these matters require the development of both education and research based on a new perspective of scientific knowledge evolution, and not only on scientifically proven truths, to meet the challenges to come.

The graphic processes of architectural drawing and design as methodological processes of scientific research in architecture

Architecture does not seem to fit into the scientific world due to its own specificity. This situation is shared by some artistic disciplines and in general by those areas of knowledge that have been formulated through nonlinear methods. They are supported by artistic production processes that cover clearly creative or imaginary and technical-scientific aspects to perform shaping operations.
The practice of design by both architecture professionals and students is definitely scientific research. However, the peculiar nature of the processes involved makes it different from the inquiry based on the normative approach to science. The impulses to demarcate science from non-science should be avoided and above all, architectural research should go on through "procedures and methods supported by action", this being mainly linked with the graphic processes inherent to the production of architecture.
Let us admit that all inquiry is developed through a process organizing a series of activities to complete in stages related to diverse matters, such as topic selection and preliminary bibliographic consulting, problem definition, hypothesis formulation, data gathering and reporting, hypothesis testing, and publication of results. We should wonder at which stage the practice of architecture may be considered research, that is to say, when some kind of original reflection makes the work develop under the same requirements than any other kind of inquiry.
According to Javier Seguí de la Riva[8], there are several exploration models describing actions or behaviors in architectural design. All of them share a number of dynamic elements. "All intentional action is made up of a prompt situation, an anticipated goal, the elaboration of an action plan, its effective implementation, the evaluation of results and comparison of the achievements with the initial goal, and the sequence conclusion, which may bring the action to an end or to unavoidably start anew after adjusting the goal, the plan and the implementation"[9].
Praxiology is the general theory of efficient action, i.e. the study of practices and procedures providing good results. It is based on the analysis of the scope where action takes place. Schemes showing the best way to meet implementations adjusted to the intended goals, or generalizations synthesizing procedures, are drawn. This involves the development of a real inquiry mainly supported by the research processes and "methodology" described above.
Praxiology attempts to analyze and later give an abstract formulation of action and of the way it occurs, thus offering keys useful and applicable to any real situation. It has been frequently said that action is

controlled through thought: this arises from action, and action is managed by it.
Nonetheless, a number of psychological studies have investigated learning processes to improve the ways children gain knowledge. The results show that mechanisms are as important as the sequential order of learning; in fact, learning procedures can be explained and justified through their arrangement.
Apparently, the process of architectural design is made up of unavoidable periods or scenes, as follows: prompt situations characterized by self-stimulation and infinite possibility, a stage devoted to organizing inputs or ideas, a stage of graphic exploration where organizational and formal schemes are set according to experience and available construction methods, and a stage where some requirements or partial solutions are prioritized in the direction of the final design.
Drawings are the architect's tool to acquire knowledge, to design architecture. If drawings, design and architecture in broad terms are considered to be a kind of artistic production, it should be accepted that they form part of a creative process involving poetry- and technology-related activities[10], and grounded in experience[11]. This is the basis to progressively transform action and procedures, which in turn are essential to define the above-mentioned "paths of action and signification of the different teaching strategies and methods in architectural research" that make "architectural design" a real and methodologically articulated "scientific inquiry".
The term applied to designing architecture (in Spanish) and the practice of design can get identified with drawing. The creative nature of both activities gives rise to their developmental and dynamic features, and problem solving is determined by the suitability of cognitive and operating sequences. Hence, the validity and explanation of an architectural project is never justified by the specific solution or static answer formalized at a particular stage, but it is qualified by the development process itself[12].
Consequently, "the only way to change outcomes is by changing processes", these finally leading to different results. In the field of architecture, the abovementioned experiences were almost forgotten in the past and have always come from solitary undertakings. They were exclusively supported by some studies in Genetic Epistemology[13], Giulio Carlo Argan's works[14], Ernst Gombrich's writings and some developments on design methodologies[15]. Other achievements within Environmental Psychology and works exploring artificial graphic languages, the dynamics of imagination, and architectural design theory have added to this approach thereafter.

Conclusions

In light of the aforementioned and supported by the philosophical arguments exposed above, it is concluded that the graphic processes inherent to architectural "drawing" and "design", both in education and professional practice, can be identified as "methodological processes of scientific research in architecture" with a contemporary slant. They allow us to adopt goals such as the validation of inferences to construct from observable phenomena, the management of a certain amount of uncertainty and uncertain conclusions, the significance given to the applied method (methodological processes) rather than to the conclusion, and the necessity to strive for the dissemination of research outcomes.
In consequence, a veritable inquiry in architecture is closely related to the mechanisms and processes linked with architectural design. This is the main duty of architects in practice and spreads over all stages of the architectural project, from the commencement when purely imaginary aspects are explored to later developments covering functional, aesthetic and technical matters.
All the abovementioned questions refer to providing education and also research with a new approach to the evolution of scientific knowledge rather than solely with scientifically demonstrated truths. This would be essential to face the challenges to come and would also definitely make clear the mechanisms of scientific and methodological research, as well as their application to architecture-related activities like the work of professionals involved in architectural training, more precisely in architectural design. Our reflection is thus aimed at distinguishing and determining what research is and should be, particularly in the field of architecture.

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Translation by Maria Jesús Uzquiano

accepted by most of them are violated.
6 / Karl Raimund Popper (1902-1994) made fundamental contributions to philosophy, sociology and theory of science. In 1928, he completed his doctorate with a strongly mathematical dissertation under the supervision of the linguist and psychologist Karl Bühler. In 1929, he was qualified to teach mathematics and physics at the "high-school level". He became acquainted with the so-called Vienna Circle around these years, although he was never invited to become a full member due to his critical attitude toward some of its main tenets. Although K. Popper's grounded criticism influenced the group, his book *Der Logik der Forschung* (*The Logic of Scientific Discovery*) was first published within a Circle's series in 1934. In consequence, the work was reviewed as the outcome of the group's discussions, and its author was mistakenly qualified as a positivist philosopher. This book was his major contribution to theory of science, and also articulated a moderate criticism to the positivism of the community where it was brought to light. K. Popper focused on the problem of the limits between science and metaphysics, and he advocated a "criterion of demarcation" to distinguish what is from what is not genuinely scientific as objectively as possible. It should be emphasized that such criterion does not assert that a proposition is true or false, but it merely settles if the statement should be examined and argued within science or, on the contrary, it belongs to the speculative field of metaphysics. As the author represented it, a theory is scientific only if it is refutable by conceivable events or it may be subjected to tests to be refuted, regardless of the number of positive outcomes that confirm it at the level of experimental testing.
7 / Imre Lakatos (1922 – 1974) was a philosopher of mathematics and science. In his early years, he joined K. Popper's school. He attempted to develop a so-called sophisticated falsificationism to tackle the difficulties to avoid falsification and other problems concerning the empirical basis, which had not been solved through the older views of science, i.e. both dogmatic and naive falsificationisms. I. Lakatos adopted some Kuhnian approaches, for instance the significance of history of science, and he challenged K. Popper's view that falsification forms part of everyday scientific inquiry. He also stressed the necessity of confirming scientific hypotheses to keep them valid. He held that falsifiability is a three-way confrontation of rival theories with a body of data. Both rival paradigms are confronted with reality; one of them is accepted and the other is refuted, and the failure of one theory implies the total success of the other.
His writings are full of comparisons of his own ideas with others' views. He highlighted these relations and recognized that he was indebted to K. Popper. He claimed that he was extending K. Popper's ideas and defended a more developed version of falsifiability. Nevertheless, his approach was obviously influenced by the incisive arguments of other philosophers questioning Popperian epistemology.
Besides, I. Lakatos offered the notion of research programme (RP) as an alternative "unit of analysis" in studying science. An RP is a succession of slightly different interrelated theories; some of them develop over time and generate others. They all share some common idea or "hard core" (HC), which is surrounded by a protective belt (PB), a set of auxiliary assumptions that can be changed, suppressed or replaced by new hypotheses to prevent HC falsification. There are two kinds of heuristics in an HC, namely, the positive heuristic ? "rough guidelines" instructing on what paths to pursue ? and the negative heuristic ? protecting the HC from refutation. When one RP is confronted with empirical and theoretically unpredictable anomalies, it gets replaced by a rival RP. When there is no competing RP that provides solution to the new challenges and simultaneously conserves the non-refuted elements present in the previous

RP, this remains in a regressive stage until it becomes progressive again. There are two kinds of RPs: degenerating RPs (which do not predict new phenomena for long) and progressive or successful RPs.

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9 / See Miller, George A., Galanter, E., and Pribram, Karl H.: *Plans and the Structure of Behavior*. Holt, Rinehart & Winston (HRW), New York City (NY), 1960.

10 / See Pareyson, Luigi: *Conversazioni di estetica* ("Conversations on Aesthetics"). Spanish edition: *Conversaciones de Estética*. Visor Libros, Madrid, 1988; see also Fiedler, Konrad: *Escritos sobre Arte* ("Writings on Art", originally published as *Schriften zur Kunst* in 1971, 2nd enlarged edition in 1991). Visor Libros, Madrid, 1991.

11 / See Ferrater Mora, José: *Diccionario de Filosofía de bolsillo* ("Pocket Dictionary of Philosophy"), Vol. 1 (A-H), p. 328. Alianza Editorial, Col. El Libro de Bolsillo, Madrid, 2002.

12 / See Raposo Grau, Javier F.: *Teaching Report* (Exams for Spanish Official Faculty Accreditation). Accreditation Code: 2/300/2005. Academic Rank: Professor. Area of Knowledge: Graphic Expression of Architecture. Madrid, 2005.

13 / See Piaget, Jean: Studies in Genetic Epistemology, Vol. 18. French edition: Études d'Épistémologie Génétique, Vol. 18: L'Épistémologie de l'espace. Presses Universitaires de France (PUF), Paris, 1964. The Child's Conception of the World. Spanish edition: El juicio y el razonamiento en el niño. Editorial Guadalupe, Buenos Aires, 1975. The Origins of Intelligence in Children. Spanish edition: El nacimiento de la inteligencia en el niño. Ediciones Morata, S. L., Madrid, 1971. The language and thought of the child. Spanish edition: El lenguaje y el pensamiento del niño pequeño. Ediciones Paidós, Col. Educador, Madrid, 1984. Science of Education and the Psychology of the Child. Spanish edition: Psicología y Pedagogía, Editorial Sarpe, Madrid, 1983. Six Psychological Studies. Spanish edition: Seis estudios de psicología. Editorial Seix Barral, Barcelona, 1979. Biology and Knowledge. Spanish edition: Biología y Conocimiento. Siglo XXI, Madrid, 1969. Psychology of Intelligence. Spanish edition: Psicología de la inteligencia. Ediciones Psique, Buenos Aires, 1964. Structuralism. Spanish edition: El Estructuralismo. Ediciones Orbis, Madrid, 1985.

14 / See Argan, Giulio C.: Progetto e Destino ("Design and Destiny"). Spanish edition: Proyecto y Destino. Universidad Central de Venezuela (UCV), Caracas, 1969.

15 / See Gregory, S. A.: The Design Method (proceedings of a symposium, Birmingham, UK, 1965). Butterworths, London, 1966.
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DRAWING AND RHETORIC OF THE CHIROGRAPH OF S. ANDREA AL QUIRINALE

by Francisco Martínez Mindeguía

Drawing is the architect's wordless discourse, or as Giambattista Marino could have said, is the architect's "silent prose"[1]. It is a silent speech that can paradoxically be more eloquent than words if *listened* carefully. It is a visual speech that must be understood visually, without the intervention of any written word; even if words may elucidate some issues not rendered by the drawing. As Paul Claudel suggested, drawings must be *listened with the eye*: in silence[2]. Written information may round off comprehension of the drawing, or it may discover unnoticed aspects that are not evident, but finally its discourse can only be that which the drawing is able to communicate.

It seems evident that if drawing is the architect's language, the way to communicates what he thinks, what the architect makes when he draws is to build a discourse. He describes with it a project so that another understands it. He can give precise instructions, but also can show the qualities that validate his project. In this case he must be capable of explaining the idea correctly, but besides has to convince the recipient of its interest, even predisposing him for an adequate reception. All this singles out the importance of rhetorical quality in architectural drawing, if we manage to understand this *art* without the negative connotations rendered to us in time. According to James Ackerman, in order to understand rhetoric one must have in mind that "the aim is not simply to represent as faithfully as possible an architectural space or mass, but to present it to the viewer so as to emphasize the particular goal of the design; in short, to persuade"[3]. Or as Marc Fumaroli understands it: "the art of making others see and understand, which is different to inform"[4]. To make visible, to persuade or to convince. Mistrust against the intervention of rhetoric in the architect's graphical discourse derives from the fear that persuading, moving or delighting may overcome the goal of describing and then pervert the message, reducing its aim to simply pretend what is not. Alberti had already denounced this dilemma, as he warned the danger of constructing too attractive models, because "it indicates that the architect does not simply try to represent his project, but he pretentiously means to attract the observer's look with guise, distracting the mind from a careful examination of the model's different parts, to instead fill it up with wonder. It is better when we do not make impeccably finished models, nor elegant or shiny, but naked and simple, showing the accuracy of the conception, rather than the ability of the execution"[5]. With similar arguments also Vincenzo Scamozzi denounced to "some of little understanding" that made beautiful drawings "to hide his stupid inventions"[6]. Nonetheless, every discourse is rhetorical, even the graphical one. Rhetoric misuse should be avoided, and not its usage.

Tradition has hitherto accepted the rhetorical use of drawing in perspective views, whereas the subjectivity of the point of view makes its intervention inevitable. Nevertheless, it can be found in technical drawing of plans, sections and elevations, which tradition itself seemed to have kept apart. Nowadays, it is quite evident in most drawings for competition confined to explain a certain project in a limited number of sheets. In order to best convince the jury of the project's qualities, this limitation forces a careful selection of the information, a proper articulation and discourse modulation. In the past, before the 19th century, these qualities were to be found in many prints published to divulge antique and modern architecture. But also were in some singular drawings by Vignola, Borromini or Bernini. The latter is the author of one peculiar and admirable drawing known as the *first chirograph of S. Andrea al Quirinalle*, dated October 26, 1658. The Pope Alexander VII signed in it the acceptance for building the project of San Andrea al Quirinale, a church to be built in front of the Quirinale Palace by the Jesuit Noviciate (Fig. 1).

OBJECTIVE DATA

This is comparable to what we understand today as a presentation for obtaining a building permit, classified therefore as a technical drawing. History of Architecture has demeaned this type of graphic media, partly because of the process of simplification that took place in early 19th century and the mystifying veil that has surrounded it in late 20th century. Contemplating this drawing allows checking the clarity of the reasoning of Bernini and his capacity for transmitting the importance, the aura, of his small project. Bound in a codex, next to other drawings, it is preserved in the Vatican Apostolic Library[7]. It measures 29.1 x 20 inches wide, and it presumably was kept half-folded (folding marks are clearly seen). In time, the first folding ended up breaking the paper, and presently the separate parts are glued together to a central piece of paper that binds them to the volume. The sheet was also cut through the margins to adapt it to the codex size.

The drawing was carefully made: beneath the inked outline lies a base of graphite pencil lines, still seen in some parts. It is composed by a ground-floor, a section and some text. In the ground-floor, sectioned walls are differentiated: a yellow ink filling corresponds to Bernini's project, and dark brown filling for the existent building. In the cross-section, a supposed lateral lighting casts a shadow inside. Depending on whether there was light or shadow, the cross-section was darkened or not to reinforce the interior outline. The marks of the compass, used to draw the initial oval trace in plan, are also still visible. This was not the drawing used by Bernini to show his project to the

1 / According to Giambattista Marino in *Dicerie sacre* (Turin, 1614), poetry is "talking painting" as painting is "silent poetry". Hence, architectural drawing could be understood as "silent prose", for its contents are more precise than poetry, lacking ambiguity within a synthesis that aims for a clearer and more direct message.

2 / Paul Claudel, *L'oeil écoute*, Paris, Gallimard, 1946.

3 / James Ackerman, "The Conventions and Rhetoric of Architectural Drawings", *Origins, Imitation, Conventions*, Cambridge (Mass) & London, The MIT Press, 2002, p. 299.

4 / Marc Fumaroli, *L'école du silence. Le sentiment des images au XVII^e siècle*, Paris, Flammarion, 1998, p. 9

5 / Leon Battista Alberti, *De re aedificatoria*, book. II, ch. I.

6 / Vincenzo Scamozzi, *L'idea della architettura universale*, 1615, book. I, p. 48.

7 / Biblioteca Apostolica Vatinaca, Fondo Ghigiano, P VII, 13, 40v-41r.

8 / Christoph Luitpold Frommel, "S. Andrea al Quirinale: genesi e struttura", in: Gianfranco Spagnesi, Marcello Fagiolo, et al., *Gian Lorenzo Bernini e l'architettura europea del Sei.Settecento*, Roma, Istituto della Enciclopedia Italiana, 1983, vol I, p. 211-253, p. 217.
9 / Maurizio and Marcello Fagiolo dell'Arco, *Bernini, una introduzione al gran teatro del barocco*, Rome, Mario Bulzoni, 1967, p. 61.
10 / This theme is developed in the article: Francisco Martinez Mindeguía, "S. Bibiana, la perspectiva como predisposición", *Revista EGA, Revista de Expresión Gráfica Arquitectónica*, n. 8, 2003.
11 / The *Ecstasy of St.Theresa*, in the Cornaro Chapel in the church of Santa Maria della Vittoria; the *Ecstasy of the Beata Luvovica Albertoni*, in la Paluzzi Chapel in the church of San Francesco a Ripa, and the *Equestrian Statue of Constantino* at the feet of the Royal Staircase, in the Vatican City, all of them in Rome.
12 / Baltasar Gracián, *El Criticón*, Madrid, 1651, crisi II
13 / This absence of the façade already gave place to the well-known deductions of Heinrich Brauer and Rudolf Wittkower, in *Die Zeichnungen des Gianlorenzo Bernini*, New York, Collectors Editions, 1969, p. 110-111, of Timothy Kaori Kitao, in "Bernini's Church Façades: Method of Design and the *Contrapposti*", *Journal of the Society of Architectural Historians*, 4, vol. XXIV, dec. 1965, p. 263-284, and of Franco Borsi, in *La chiesa di S. Andrea al Quirinale*, Roma, Officina Edizioni, 1967.
14 / According to the approaches of John Dewey, in *Art as Experience*, New York, Minton, Balch & Co., 1934.
15 / Filippo Baldinucci, *Vita del Cavalier Gio. Lorenzo Bernino*, Florence, 1682.

pope, but the drawing that materialized the agreement (Bernini had already shown the oval ground-floor to the pope the 15th of that same month[8]). It was the "staging" of that agreement, constructed with the drawing, the agreement text and the pope's signature.
The drawing is filled with tension, since the ground-floor occupies almost exactly the upper half of the sheet. The margins left by Bernini were so small that, when the sheet was trimmed, the patio was sectioned through the left margin, and so was de Novitiate building in the opposite margin. It is logical to think that the sheet was folded in half, and it seems that the plan scheme's façade was drawn slightly separated from the folding line so as not to be deformed by it. Thereupon, an astounding void surprises us in the lower half of the sheet. The width of the surrounding patio is half the width of the complete ground-floor, and therefore equal to a half of the sheet. This may have not been willingly designed, but from this point on, one can also divide in two the lower part of the sheet. In its left side, Bernini places the cross-section of the church; below the ground-floor (one can still see the pencil lines traced to align both drawings). Another horizontal pencil line, drawn to locate the flooring level in the cross-section, is preserved. This line coincides with half of the lower part's height of the sheet, matching up with the composition criteria, and it leaves the inferior segment vacuumed to hold the author's name: *Disegno del Cav. Bernini.* The right lower side is filled with the text signed by the pope.
By accumulating the drawing in the upper side of the sheet, Bernini signals the void that envelopes the section and thus its importance. There is some theatricality in this action, since it creates a silence to draw attention to what is said afterwards. That is, in a certain way, a dialogue between the section that conjures up the image of the church, and the text that refers to it. The text reaches very closely to the right edge of the sheet, just as it happens with the ground-floor, stressing the isolation of the cross-section. However, the tension caused by the silence is related with the way Bernini orders the building itself and how it presents an access to the oval interior space.

THE PROJECT

There is no direct entrance from the street to the church, but through an intermediate patio, located on both sides and not in front of the church. In an unfamiliar way, the church's doorway is not aligned with the patio's entrance and is placed instead in front of a wall, 24.61 ft away from it. This length is equivalent to half the width of the façade. One can pass from this exterior space of 49.21 by 24.61 ft to the interior vestibule, equally proportioned, but smaller; then from the latter to the central oval space enclosed under the dome, shown in cross-section. Hence, Bernini reduces progressively the entrance space, stressing the expansive effect of the sight of the central space, lit by the dome's ten windows. This dome has been concealed by Bernini behind a vertical perimeter, a passage that ends up in the surprising interior space. From the vestibule, one can contemplate the symmetrical space of the altar, possibly darkened alike the vestibule. Amidst the two of them, remain the light and the expanded space of the oval room. A light that appears as a "revelation"; in a mystical experience that was later on consummated with the lighting of the altar's interior, and the saint's ascension through the broken pediment that frames the altar (fig. 2). Nowadays, one can contemplate from the vestibule the painting by Guglielmo Cortese, the crucifixion of Saint Andrew. As one looks up, our eyes come across the saint, ascending in glory towards the dome, surrounded by angels. Apparently, the ascension takes place behind the broken pediment, from the altar. The light that illuminates the altar appears to emerge from the dome, and pass through the pediment's fracture. Bringing together both painting and sculpture helped Bernini to resume a mystical content that seemed ambiguous in the first design, and stated that "the entire Bernini church was in fact based on the double drama (martyrdom and ascension) suffered by Saint Andrew"[9]. Clearly, the preliminary passage pursued this very aim. In the course of time Bernini tended to fix and to control the experience that the observer had of his works; he noticed that the excessively abstract resources could not be interpreted correctly by the receiver.
As it happens in some other projects of sculpture or in Saint Bibiana's façade, Bernini constructs here an esthetical experience, made possible only from the observer's point of view[10]. This experience depends not only on what is seen, but also on both the incising light and the point of view. Given that, architectural language is more abstract than the sculptural; Bernini hereby builds a work comparable to the Ecstasy of St. Theresa, the Albertoni's Altar of Beata Ludovica, or the equestrian statue of Constantine the Great[11]. In all these cases, the character seems surprised by the observer in a moment of mystical excitement, under particular conditions in which light gives spiritual qualities that bring sense to the scene: reality reinforces fiction. The experience is rapidly perceived, without time left for rational analysis of the situation. In the case of San Andrea al Quirinale, the progressive reduction of the entrance intends to prepare the observer for the astonishment aroused by the interior space, and then predispose him to comprehend the spiritual experience built by Bernini under the dome. Baltasar Gracián used to say, "when the eyes see what they have never seen, the heart feels what it has never felt"[12]; Bernini strives to surprise the observer so, that the experience becomes a sudden, unexpected revelation. One that moves the observer and makes him feel *what he has never felt.* Obviously, this is a scenographic arrangement that Bernini builds to be experienced from a precise situation, in some suitable conditions of lighting and after having predisposed convenient to the observer.

DRAWING AND RHETORIC

That is the reason why the form of the façade in the project, not shown in the sheet, is not as important as the representation of the interior space[13]. And for that reason, the attention is focused in the cross-section, although the plan scheme would have been enough for the request. The ground-floor is the structure of the project but this section is the synthesis of the aesthetic experience that starts in the access to the courtyard and finishes in the discovery of the interior space[14].
In the upper part of the sheet, we find the project and in the inferior part, the "idea" of the project plus the pope's signature. Every element in the sheet stretches near the edges to enhance the importance of the free space around the cross-section. The colour filling of the ground-floor, the singular form of the church and the composition axis, are elements that establish relations between plan and section. However, under the section and in the same axis, Bernini writes his signature "humbly" separated from it, but rather isolated in comparison. Had the pope's signature been placed aligned to Bernini's, it would have been evident they were both protagonists in the project.
In the conception of drawing as a discourse, the relation between parts and the differences established among them holds great importance. The value of each drawing composing the sheet derives from its location, as well as from the relations held between them. As Bernini said: "parts are not beautiful only by themselves, but in relation to other parts"[15], [...] "one of the most important issues is to have a good eye to judge well contrasts, because things not only appear as they are, but in relation to what is next to them; this relation changes its appearance"[16]. Consequently, it is the eye who judges, and not reason or logic. At any rate, an esthetical reason defines the composition, rather than a logical, codified one. It is likely that the structure of this sheet may have changed if the patio's width had not coincided with half-total width of the plan; or if the text with the pope's signature had not been longer enough as to fill the right side of the sheet. On the other hand, it is not a matter of coincidence that the composition is structured dividing by 2 each one of the parts, or that the proportion of spaces in the project is 1:2.
To allow discourse existence, its reading must be activated necessarily by something calling for attention and claiming an interpretation that brings sense to it. According to Gracián, *awareness* is necessary, and then something *new*[17] to call upon it: something sudden, that may disrupt law or may be incoherent, but that may never be dismissed as a mistake. Discourse is constructed from the tension caused in the drawing by these alterations of order; its comprehen-

16 / As appended in: Massimo Locci, *Gian Lorenzo Bernini. Scena retorica per l'immaginario urbano*, Turin, Testo&Immagine, 1998, p. 13, n. 10
17 / Baltasar Gracián, op. cit., crisi II.
18 / Carlo Adelio Galimberti, "*La troppa luce non illumina*". *Grafica d'arte*, N.49, XIII year, January-march, 2002, p.2.
19 / Filippo Baldinucci, op. cit.
20 / Ray, Stefano, *Raffaello architetto. Linguaggio artistico e ideologia del Rinascimento romano,* Rome-Bari, Laterza, 1974, p. 67.

sion will depend on the observer's interpretation. The observer will also need *a good eye to judge well contrasts* and, differently from other kind of discourse, its appraisal will not be linear or precise; nor will its comprehension be always the same.

Making clear distinctions will allow the discourse to exist, but if they are too many, there will probably be only confusion left. What is said is equally important to what is kept from saying; more information is not necessarily better if the main theme dilutes in it. Carlo Adelio Galimberti said," too much light does not illuminate, because it annuls the shadow's nuances"[18] as he referred to the excessive information that often restraints or hinders comprehension beyond mere data. The drawing's intent is not to represent reality, but only a fragment of it, a fragment chosen to explain or describe. Therefore it is important to decide what one wishes to say, instead of trying to say as much as is grasped.

The singular position of the section in Bernini's drawing, points out the difference in contrast with the sheet's composition order; an ensemble apparently balanced, finished, beyond the process of construction or improvement. The aesthetical balance within the sheet sways us to understand that there is a reason for the different position of the section. Bernini uses beauty as a resource to call the observer's attention and transmit the aura of his project. As Baldinucci described Bernini, "whether it was a great or a small work, he tried, as much as he could, to highlight the beauty of conception achieved in that work"[19]. In this case, he rather endeavoured to transmit the idea of the project more than the project itself.

When using non-objective resources, the message may be misunderstood or not understood at all. But this is common in all languages. Stefano Ray, in reference to Rafael's architecture, highlighted the importance of "the confusion caused by the apparent contradiction between image and structure on the observer". According to him, it has "the function to induce the observer to ulterior thinking"; it is likely that only the impression of the *scandalo* remains, but it is also possible to ultimately grasp "the message the architect intended to transmit"[20].

Bernini's drawing eloquently proves that there are no procedure drawings. It reveals that *graphic design* is not alien to drawing architectural *plans*, and that clarity and beauty are qualities compatible to architectural drawing. Drawings are documents that must be *read* and *understood*. Drawings must therefore be made based on their purpose and on the receptor. In such interaction the *how* is said is as important as *what* is said.

The Tower of Shadows. Syncretic Utopia and Cosmological Symbols in Le Corbusier's Chandigarh

by José Calvo López

The Dominion Column closes the endless perspective of the King's Way from the gardens of the Viceroy's House in New Dehli. An epigram by Edwin Lutyens and Lord Irwin is inscribed in its pedestal, reflecting the ideals of colonial civil servants:

In thought faith
In word wisdom
In deed courage
In life service
So may India be great

Of course, Gandhi thought that India could be great on its own; twenty years later, the last Viceroy, Lord Mountbatten of Burma, left the House, which at present is named Rashtrapati Bhavan and is the residence of the President of the Republic of India. However, Gandhi's successors had to face a herculean task. A thousand million citizens, twenty-two languages, eight religions, hundreds of sects. To create a state according to the Western model, to construct a national awareness starting from this mess was simply impossible. Some years before the independence of India, Gandhi built a temple to Mother India in Varanasi, bare of any symbol; only a giant map of Hindustan covers the floor of the sanctuary.

A pragmatic statesman rather than a heroic martyr, Nehru searched for the emblems of the new state in a number of syncretic episodes in Indian history, so that all citizens of the Indian Union, either Hindu, Muslim, Jainist or Christian, could identify with them. In a number of letters written to her daughter Indira from British jails, Nehru quoted Ashoka as a source of inspiration. This semi-legendary ruler of protohistoric Hindustan unified the subcontinent after a number of bloody battles; in the wake of his triumph, he converted to feminism, pacifism and religious tolerance. In the manuscript of *The discovery of India*, smuggled from the gaol by Indira, Nehru refers to the political career of Akbar, a Muslim prince of Timurid descent. This great-grandchild of Genghis Khan joined under his rule the greater part of Hindustan, married daughters of maharajas, showed his interest for the *Ramayana*, limited the power of ulemas and sought the advice of scholars of all branches of Islam, Hindus, Jainists and even Jesuits. To celebrate the birth of his son, he laid the foundations of Fatehpur Sikri, a city in the desert; the architecture of this phantom city combines Timurid arches and Far East cantilevered beams.

Ghandi's dream of tolerance was brutally broken on Independence Day: East Bengal and Western Punjab, two areas of Muslim majority, were segregated from the Indian Union to create the Land of the Pure. Among the blood of slaughters, the chaos of migrations and the crumble of utopia, an administrative problem arose: Lahore, the historical capital city of Punjab, fell on the Pakistani side of the border; a new capital was needed for the Indian part of the region.

At the start, the design of the new city was left in the hands of Albert Meyer, Matthew Novicki and P. L. Varma. However, Novicki was killed some months later in a plane crash and the Punjabi bureaucracy asked Jane Drew and Maxwell Fry to take charge of the project. They understood at first glance that they were facing a unique job, an exceptional opportunity, a task for The Master. However, at this moment Le Corbusier was busy denouncing the plagiarism of his project for the United Nations by Wallace Harrison, and did not give much importance to this commission in a remote provincial capital of an exotic country. He tried to solve the problem from the Rue de Sèvres, he was not free to travel frequently to India, it was not easy to reach an agreement about his fees. At last, he accepted the post of architectural counsellor, in charge of the general town-planning layout and the design of the buildings at the head of his anthropomorphic city.

Both Chandigarh's Capitol and Imperial Dehli have been described as architectural emblems of power. However, it is easy to see in the plans of both cities that the pieces are the same, but are placed on different squares. In the capital of the British Dominion, the Secretariat blocks flank the King's Way, which culminates on the Viceroy's House, while the Parliament, including the Assembly, the Council of State and the Council of the Princes, is placed in a secondary position; a perfect metaphor of colonial ideology. By contrast, in Chandigarh the Assembly is placed beside the main road, in front of the Palace of Justice, while the administrative building stands behind the Assembly. Quite significantly, in the first stages of the project the Governor's house was to be placed at the end of the main road, in an obvious parallel with Imperial Dehli; however, later on Nehru was involved with the project and considered such a scheme as anti-democratic. The focal point of the new city was to be occupied by the emblems of the syncretic utopia that Nehru conceived in jail. Thus, it is true that both Imperial Dehli and republican Chandigarh materialize images of power, but we are talking about quite different conceptions of power; as different as a colonial Dominion and a multicultural democracy.

In Chandigarh, both the Assembly and the Palace of Justice feature huge concrete roofs flanking the city axis, quite useful under the Indian sun. However, William Curtis remarked that the function of these verandas is rather symbolic than utilitarian. Their ends resemble the horns of bovids, a multicultural symbol, cherished by Le Corbusier for a long time, maybe

through the influence of Picasso and their common fascination for the French Midi. On the other hand, at the unborn Governor's House, the Assembly and the Palace of Justice, these roofs seem to be modelled also on the *bangala*, an emblem of authority akin to the baldachin of the Catholic Church. The mausoleum built at Agra by Shah Jahan, a grandchild of Akbar, for his wife Mumtaz Mahal, is universally known. Not so well known is the throne built by this sultan at the Public Divan at the Red Fort in Shahjahanabad, his new city beside Dehli, covered by a canopy in the shape of a sail vault. When Nehru declared the Governor's House antidemocratic, Le Corbusier immediately saw that these emblems of power should greet the legitimate owners of power, the representatives of the people, when arriving at their Assembly.

Quite remarkably, the roof of the throne at the Red Fort was decorated in *pietra dura* by Florentine craftsmen; its central panel represents the myth of Orpheus. As the empire of Shah Jahan, Nehru's India struggled to be deeply Hindustanic, and at the same time truly learned, tolerant, educated and cosmopolitan.

Another frequent comparison confront the plan of the Assembly with Schinkel's Altes Museum in Berlin. However, such Germanic analogies seem unnecessary, since French precedents are easy to find; after all, Le Corbusier was born at the *Suisse Romande* and spent most of his life in Paris. In particular, some plates in the *Précis de leçons d'architecture* by Jean-Nicolas-Louis Durand furnish a convincing precedent for the plan of the Assembly. A well-known one reduces architecture to four straightforward military operations: layout of the main parts, layout of the secondary parts, drawing of the walls, placement of columns. The design of the Assembly resembles such neoclassical traits of Durand's didactical compositions as the presence of the rotunda or the ubiquity of columns, but also such abstract concepts of his treatise as the parallel disposition of bays and the regulating role of the grid. However, in Le Corbusier's hands, the model melts like a chocolate tablet, breaking, bending, enlarging or shrinking the column grid where necessary, placing the round hall at a decentred position or twisting its axes to align them with the cardinal points, as the wheels of the cart of Chakravartin, a Buddhist symbol of the sun and the rule over the four parts of the Universe, connected with Ashoka and placed by Nehru on the flag of the Republic of India.

Durand was a professor at the École Polythechnique, an institution created by the French Revolution that gave a basic scientific education to the students in civil and military engineering. Amongst the first promoters of the new school was Gaspard Monge, an ardent revolutionary, admirer of Napoleon, which carried on a huge number of tasks during the Revolution and the Empire: he was Minister of Marine, he measured the quadrant of the meridian, he conducted the scientific expedition that went along with Napoleon's campaign in Egypt. Meanwhile, Monge's students brought to the presses the notes taken from his courses at the École Normale; thus, the first *Géométrie Descriptive* was published, including only double orthogonal projections. Later on, his disciples, quite frequently from his chair at the École Polytechnique, enlarged the realm of the discipline including perspective, axonometry, or shadow theory.

Le Corbusier thought that the concepts and the ideals of the École Polythechnique could shatter the outdated tradition of the École de Beaux-Arts. This explains his interest in Descriptive Geometry, the use of paraboloids in the Electronic Games Pavillion, the warped wall in Ronchamp, or the hyperbolic hyperboloid, cut by an oblique plane, over the roof of the Assembly. By contrast, the metallic pieces over the hyperboloid are not easy to explain. Just like the ends of the umbrellas in the Assembly and the Palace of Justice, they resemble the horns of oxen, but the doors in the same building furnish another interpretation, since the path of the sun in winter, spring and summer is painted over them. Of course, this image was cherished by Le Corbusier from the twenties, when he argued that the solar twenty-four hour cycle rules the days of men; he planned to inscribe this diagram on the pavement of the Capitol. Thus, we may conclude that the metal appendixes over the Assembly derive both from the horns of the bovids and from a solar chart.

In this way, a long series of solar symbols of the order of the Universe intermingle at Chandigarh, linking together Western science and Indian tradition. An Ashoka column was to be placed on the presidential platform in the Assembly, in such a position that solar rays would light it the day of the annual aperture of Parliament. The wheel of the flag of the Republic, one of Nehru's syncretic symbols, belongs to Chakravartin's solar chart, an Indo-European archetype that is linked with Apollo and Phaeton at the other end of the continent. A number of petty kings had built observatories in Jaipur and Dehli: strange constructions based on an abstract geometry, a planetary logic, such as cylinders cut by oblique planes, ramps playing the role of gnomons or a weird hollow sphere violently shredded by the hours.

These universal symbols of power are joined to the well-known emblem of the Indian National Congress, or rather of the dream of Nehru and Gandhi: the Open Hand, a symbol of tolerance between different communities, but also an image of the material prosperity that the new state was to bring to a population starved for centuries, erected after the death of Nehru and Le Corbusier. Another symbol built after Le Corbusier's death, the Tower of Shadows, has not been used on the covers of the histories of modern architecture; however, it furnishes a clear synthesis of a number of directing lines in his work. Three sides of a square plan hall are protected by the sun with open *brise-soleil* screens; another square hall, inscribed on the first one and aligned with its diagonals, plays the role of a roof. The paths of the sun determine the infinitely varied shadows of the screens; each day in the year plays a different performance, as if the *pans-de-verre ondulatoires* of the Secretariat and La Tourette had mutated their frozen music in a mathematical dance.

It is worthwhile to remark that the drawings of the Tower of Shadows are placed in Le Corbusier's *Oeuvre Complete* beside a solar chart and a number of shadows problems in orthogonal projection and perspective, which would fit perfectly in any Descriptive Geometry manual. In particular, a scheme in double orthogonal projection employs an exact graphical procedure to determine the projections of solar rays in elevation, starting from their plan projection and performing a rotation around a vertical axis. All this recalls the invectives that Chastillon, a predecessor of Monge at Mézieres, directed against architects, remarking that they employed sun rays whose projections form an angle of forty-five degrees with a horizontal line, an impossible angle in northern façades. Such an exacting practice contrasts with a small detail that may pass unnoticed: the longitude and latitude used by Le Corbusier correspond to a location in France, not in India. Rather than a hasty patchwork, we should see here a subtle allusion to the universal character of the solar path.

Ubiquitous bovids, Indo-European canopies, abstract geometry, solar paths: it seems that Nehru and Le Corbusier were looking for universal emblems, independent from all races, all languages and all religions, fit for a planetary community. After all, the Master thought that this global community was his real client, at least from the days of the Society of Nations competition. The buildings at Chandigarh, in particular the Assembly, the Open Hand and the Tower of Shadows, embody as no other work in the 20th century a central issue in modern architecture: the need to find new emblems that are fit for the ideals of our age. New emblems since they must represent new realities, as the machine-age palaces Le Corbusier designed in the twenties; new emblems since they must be independent from this or that culture and represent a community of planetary dimension, such as the Society of Nations, the United Nations or the overwhelming complexity of the Indian Union.

However, these symbols are not easy to decipher, since any language depends on convention; this explains the strange look of the Assembly at first sight. In the seventies, Charles Jencks mocked the image of the Ronchamp chapel, compared to a pair of nuns in a survey among an uneducated sample. However,

the alternative solution, the reuse of the old morphemes, is even less efficient: Post-Modern architecture has left little more than a number of cartoons. By contrast, it seems that one of the few sensible paths is that of the last decades in Le Corbusier's career: to create new transcultural symbols, melting the old emblems of all architectures; in fact, they are closer than we may think at first sight. In Indian architecture, we can see Greece and Rome overlapping with Persia and Uzbekistan, an end of the Islamic belt that reaches Iberia at the other extremity, or British Palladianism mingled with Mughal architecture in Lutyens' work.

Chandigarh has survived fifty years of monsoon, but many ideals have been tarnished since its creation. Nehru, far from Western capitalism or Soviet Marxism, was a founder of the Non-Aligned Countries movement, but the phrase coined to refer to this block is now a synonym for poverty. Indian Punjab was divided again, and the Capitol buildings house three administrations: Hindu Haryana, Sikh Punjab and the Union Territory of Chandigarh. Nehru transformed Gandhi's National Indian Congress into a political party that fell prey to corruption. Troops sent by Indira Gandhi stormed the Golden Temple at Amritsar, the Sikhs sacred city, and Nehru's daughter was murdered in revenge. Just a few years ago, the Open Hand and the Tower of Shadows were deserted, a pair of ruins surrounded by barbed wire and machine guns. The terrorist attacks of a few Muslims took control of Western media for weeks; by contrast, when a mass of Hindus tore down with their hands a mosque dating from the period of Akbar's grandfather Babur, the news were sent to the back pages of newspapers. In Republican France, the Islamic veil is prohibited paradoxically for religious tolerance's sake, while national identity is under discussion and Sarkozy intends to open a back door for the sons of Maghrebi immigrants in the École Polythechnique and other Grand Écoles. The ideals of Modern Movement have waned; the aesthetics of the avant-garde have been dissociated from social ethic, and any allusion to Minimal Housing brings about wild derision. But now, when the idea of a planetary community is no longer a theoretical construction of a few diplomats, but rather a reality quite visible in the streets and the stores of the First World, Chandigarh's project, the hard and obscure task of putting forward universal symbols, remains as pertinent as the first day.

SPACE, TIME AND PERSPECTIVE IN THE CONSTRUCTION OF THE CONTEMPORARY ARCHITECTURAL GAZE: FROM HOCKNEY TO MIRALLES

by Montserrat Bigas Vidal, Luis Bravo Farré, Gustavo Contepomi

INTRODUCTION

In "Space, Time and Architecture", Sigfried Giedion emphasizes the validity of the Renaissance conception of the world during the whole development of the western artistic tradition previous to the beginnings of the twentieth century revolution. The perspective concept of the Renaissance would be – according to Giedion- one of the discoveries that better expressed a way of understanding space as a reflection of a global conception of the structure of reality: "by inventing perspective, the modern notion of individualism came upon its artistic equivalence. In a perspective representation, every element is related to one and only one point of view which is that of the viewer.[1]"

That conception of perspective was the perfect metaphor which enthusiastically expressed the artistic, philosophical, scientific and religious paradigm of a whole era. Authors like Filippo Brunelleschi –who was a jeweller, linguist, mathematic, engineer, sculptor and architect- or Leonardo Da Vinci, may be illustrative examples of a world vision which could integrate in the same individual a kind of knowledge simultaneously embracing the domains of pure science, philosophy, technology, craftsmanship and the main creative arts.

Renaissance art of painting established the main principles of a new kind of vision way before Architecture, thus anticipating what would happen again five hundred years later in modern revolution.

Departing from this point, and after a quick journey along architectural history always related to the evolution of technology and the discovery of new building materials, Gideon will reach the modern revolution with its new space-time conception. As it happened at the very beginnings of the renaissance, several new trends in painting appeared at the time, preceding architecture; among them, Cubism was specially outstanding.

The determining innovation in this global and new human knowledge conception, is the consideration of industry and technique as new realities that were only related to practical, material and physically functional aspects of existence, so consigning art and humanistic knowledge to the domain of thinks that are useless, a territory which, supposedly, is autonomous and isolated of the material problems of our daily existence.

That kind of dissociation leaves –to Gideon- no doubts about the seriousness of its negative consequences: emotion and reason –that´s to say, the main themes associated to art- are inevitable parts of human action; they use to be, precisely, its unique, proper and necessary driving force.

The twentieth century –says Gideon- justly claims the recovery of that common spirit that architecture, painting, mathematics and philosophy used to share in baroque times: "we need to discover harmonic relations between our intimate condition and our developing environment. And by no way can we hold a high performing level when it be kept apart of emotional life. In that case, the whole machine collapses.[2]"

The recovery of traditional integration of symbolic reality and the needs of our strictly material existence is what explains–according to Gideon- that the cubism of Gris and Picasso and the purism of Le Corbusier had mostly dealt with objects and situations which were related to everyday life. Those Le Corbusier called "objects a reaction poetique". The mission shared by architects and painters will be then to open new worlds of sensibility, that is to say, to unveil the emotional meanings of the social and material world where human life takes place:

"The artist acts in the same way the inventor or scientific explorer does; the three of them are seeking new relations between men and their world. For an artist, these are relations of emotional nature instead of a practical or cognitive one. The artist doesn´t mean to copy everything that surrounds him but he doesn´t mean either to be watched by us. He is a specialist that shows us in his work as in some sort of mirror, something that by ourselves we would not understand: the condition of our own spirit.[3]"

A CONTEMPORARY VISION

Cubism could be understood as a new way of expressing the space-time relation between objects and a movement which also responds to a new scientific and cultural context; it reveals the existence of a new paradigm and a new collective mood, though it might not be totally –and necessarily– a conscious one. In this way, the foundations of a new vision are set, which will substitute the old system which derived from the principles of the renaissance.

Actually, though it could appear to us as a system the whole world has accepted from the very age-old times, three dimensional renaissance perspective conception has been ruling for no more than five centuries and been limited as well to the western cultural domain. It relates to Euclidean geometry whose main virtue -and its main limitation- is the easy way it can be dealt with by human intuition and imagination. Physics and mathematics, however, are studying -since the nineteenth century- the existence of more-than-three dimensional realities which are long way beyond the possibilities of imagination.

Nowadays we positively know that the reliable description of an object from one main point of view is

1 / SIGFRIED GIEDION, "Espacio, tiempo y arquitectura", Editorial Dossat s.a., Madrid 1980.

2 / SIGFRIED GIEDION, Op. Cit., p. 33.
3 / SIGFRIED GIEDION, Op. Cit., p. 450.

no more possible: space, in modern physics, is always linked with the idea of a moving changing observation point, which no longer can have that independent, absolute, objective and stable condition that Newtonian baroque was about.
Cubist artists based their work on the crisis of the vision that gave priority to a single point of view (that of photography, for example). They tried to achieve a deeper knowledge of the structural qualities of the objects constitutive reality and of any relations between them. They experienced the integration and the articulation of diverse observation settings within a single ´theme the same way it usually happens in our spontaneous perceptive way, so enlarging the territory of meaning in their field of action. Renaissance perspective is superseded, and no longer exists that previously stated hierarchy of a prevailing centre which would structure predetermine and condition the reading and expression of reality. In only one description several visions can be integrated –from within, from outside- using different moving points of view. Ultimately, a fourth dimension –time- is to be added to the three of the classic universe conception, one which can no longer be understood as separated from the others and which shares with them the same degree of relational interdependence.
The crisis is concerned with the very concept of representation; colour and form will no longer aim to accurate reproduction of reality appearances. They will now be the expression of new –different, parallel- levels of perception with its own autonomous existence and with the capacity of expressing aspects, relations, tensions, essential structures and underlying working patterns that so will widen our conceptual range and –definitely- our understanding depth.
Despite the undeniable scientific solidness of the new paradigm and its substantial impact in the artistic and humanistic domains, as far as architecture and its new forms of expression are regarded, new graphic approaches corresponding to the radical condition of the new conceptions –as neoplasticist deconstructions, suprematism, radical functionalism or constuctivism- will coexist with the utilization of traditional mono-focal perspective. That is what happened to figures like Le Corbusier and Mies Van Der Rohe, even though they were both enthusiastic of modern revolution; new modern architecture, therefore, is more close to an evolution based on the heritage of the past than the *tabula rasa* or the radical break which were claimed by some *manifestos* published at the time. The great change in Architectural principles in order to approach the new cultural and scientific paradigm which Gideon talks about, is something that did not occur as radically and fast as it did in the domain of artistic avant-gardes. The change began in the first half of the twentieth century and has been developing ever since, at different rates and always following a non linear trajectory.
There is no doubt, however, about the significant advance represented by Aalto´s organicism. It included such concepts as thematic fragmentation, influence of the context, the vernacular, conglomerate order and the rejection of neoclassical hierarchical schemes as well as of any theoretical concept trying to impose specific formal patterns or conditioning the natural dynamics of the project generation processes. In Aalto´s drawings, the expression of compositional freedom still coexists with the use of perspective though the role of the context is progressively increasing. Following the same track, one of the main features of Venturi´s architecture –which outstands in his drawings- is his unconditional acceptation of the contemporary urban context –no matter what level of quality it shows- as an integrant element of the architectural reality we are going to transform. Therefore, the evolution leading to a genuine new way of expressing architecture in a way which should be really harmonious with the new world conception will be a slow and a gradual one. The line connecting a wide range of architects as Aalto, Asplund, Kahn, Venturi, the Smithsons and more recent supporters of a new organicism like Enric Miralles, may be understood as the evolutionary way of modern ideas in a laborious process of getting rid of the old paradigm´s ballast.

DRAWING, PERSPECTIVE AND ARCHITECTURE IN ENRIC MIRALLES: A CURRENT PROPPOSAL

In our present times, the graphic track of the working processes of architects like Enric Miralles, for instance, are a good sample of proper coherence between a specific architectural option and the way it is graphically expressed. Among the most relevant influences in Miralles´ method of drawing, we can quote the architect Albert Viaplana, in whose office Miralles collaborated during his formative years; other references are the drawings of Mario Ridolfi and the work of the English painter and draftsman David Hockney.
Juan Antonio Cortés and Rafael Moneo, in a commentary about the architectural drawings of Mario Ridolfi, pointed out what to them was one of his most typical features, which was the great amount of graphic information he condensed in the less space he could, and his ability to relate the many different elements and levels of information included in a drawing: "In the same document he fits the situation plan, the roof, the construction, etc. The weight of the figurative, accounts for more than a mere description of reality and that´s the reason for the need to see this project at a glance, like a builder would do, because for him, execution and project can not be separated.[4]"
The architect acts as a constructor trying to eliminate all differences between architecture and representation; drawings pretend not only to represent -as would do a substitute for reality- so to be perceived prior to its real existence; they are themselves construction, an analogous and parallel reality constructed according to its owns rules and meanings. In these drawings, big scale details, the plan or the labelling itself are not part of a hierarchically structured discourse, but seem to belong to an organic indivisible whole which can be understood only by looking to the entire joint as well as observing any minor element (figs. 1 and 2). Miralles, who admitted the influence of Ridolfi´s drawings in his own way of representing architecture, made the following comment about the object of several perspectives he made when he was working at Piñón – Viaplana´s studio: "In these perspectives, the precision of the drawing, its construction, must be seen as an equivalent of the architectural construction itself. We were not looking for an image as a substitute for a future built reality but a precise construction in itself."
In Miralles´s drawings, whether those of his stage at Viaplana´s (fig. 3) or those of later periods (fig. 4), we recognize that same capacity shown by Ridolfi, who was able to relate items that were apparently heterogeneous or belonging to unconnected parts of speech. The architectural conception of Albert Viaplana perfectly fits in such a form of expression as the later work of Miralles will produce an equivalent in his graphic design. Says Viaplana: "…architecture is only a particular case of Architecture. I am interested in Saint Peter in Rome in the same way I am in San Juan de Dios in Esplugas (Barcelona) or in the Sierra del Tormo rushing into the river Ebro. The same happens in cinema and in literature. A few days ago I watched *Sacrifice,* by Tarkowsky. The plot is structured in some hidden way upon the kind of relation an artist establishes with his work. The main character himself, a theatre actor, is his own work; to him, disappearing of that work is the same as self-immolation, the *sacrifice* in the title…[5]"
Built architectures are no more inspiring or stimulating, according to Viaplana. To appeal to the classical mimesis which is based in canonical patterns doesn´t show any interest to him, and the same happens with the current institutional culture. The culture he stands for is that which comes from experience with simple things nearby: "I used to think that some ideas were of an architectural kind and others weren´t. What I think now is that it is just my lack of ability what prevents me from seeing the architectural essence in all things and ideas.[6]" In that same interview, Viaplana establishes the roll of intuition in the design process, as well as that of critical attitude, reason and order: "The hardest work takes place before birth. Making a decision about a form of life, creating a world without betrayal, where everything can fit -although not always with residence permit- that is difficult stuff". In Castelldefels, at breakfast, I use to draw projects on table napkins the same way I´d do listening to a dictation…there is a time for absolute freedom and a time for the most rigorous criticism. These are two moments

4 / JOSE RAFAEL MONEO Y JOSE ANTONIO CORTES, "Comentarios a los dibujos de veinte arquitectos actuales." Monografía nº 14, Cátedra de elementos de composición, ETSAB. Barcelona, 1976. p. 60.

5 / ALBERT VIAPLANA, "Obra Viaplana/Piñon". Col.legi d´Arquitectes de Catalunya, Barcelona, 1996. p. 114 (traducción de los autores).
6 / ALBERT VIAPLANA, Op. Cit., p. 117.

7 / ALBERT VIAPLANA, Op. Cit., p. 120.

8 / DAVID HOCKNEY, "Hockney Fotògraf" (Exhibition catalog), Fundació Caixa de Pensions, Barcelona 1985. p. 20 (traducción de los autores).
9 / DAVID HOCKNEY, Op. Cit. p. 20.
10 / DAVID HOCKNEY, Op. Cit. p. 21.

11 / DAVID HOCKNEY, Op. Cit. p. 19.

we must not confound and as long as we are getting more trained, they get closer in time. Otherwise, I don´t believe in order in architecture, or at least in the terms most of architects use to understand it. Several rocks spread by down a slope show me a kind of order. I don´t need to know all the circumstances they were through until finally set in that way, to know for certain that there is an order. Most of the laws they followed before this final moment remain unknown to me or their track is kept out of my sight, but yet every one of them is transmitting me, with its only presence, his particular story, and the story of its relation with all the other rocks and the rest of the environment. Presence is a concept that remains at the basis of our architecture…the presence of a face, a person, an object, a building, generates a whole system of relations around, departing from the specific story which first gave form to them. I want my architecture to have the quality of the living, and to me it doesn´t matter if it is beautiful, imperfect or ugly. What really does matter is each work living all things imaginable until its disappearance. Only after its total destruction can we thing of construction. Only then, if at all, and with the strictest geometry.[7]"

Drawings, therefore, are more about constructing that way of looking for the architectural condition in "everything and every idea" than about advancing the representation of an object to be built in the future.

The drawing process itself is a continuous search for the nature of this gaze, a development of this capacity. In the plans of Miralles´ projects (fig 5), different information layers are arranged together so to produce a great number of interactions and relations. He took from Viaplana that peculiar scaled drawing which uses only one thickness in all lines, no matter what they are representing –plans, elevations, details or even letters in titles or labelling; the profiles of a single letter are not less significant here than those meaning a wall, a piece of furniture, a path or a pavement slab.

In the first stages of Miralles´ working process –as in other current authors that use this kind of approach- a lot of trial sketched plans and differently scaled models are produced, exploring simultaneously a wide range of possibilities and always shown up in bird-eye views. In the design stage, cross-sections are systematically avoided; perspectives, either showing environmental pre-existent or design elements, give place to photographic mosaics in David Hockney´s way; in those, you can not find a dominant structuring point of view, but a trip of the eye following what could be the spontaneous exploration route all over the place made by an observer. This temporal quality of the sight with variable durations that depend on each occasion of the attitude and state of mind of the viewer, is what makes the main difference between photography and, on the other side, painting or drawing; this the base of the modern artistic evolution we have quoted at the beginning of this article.

Time and the intensity of the gaze in the progressive exploration of subjects is what we recognize in an accumulation of serial images giving shape to a whole with many possible attention focuses. We can so move forwards or backwards, stop o linger on our perception spot depending on our receptivity and our sate of mind. Including track of the time we spent looking is the clue of the true advantage of drawing over instant photography. Photography comes from the perspective of the *camera obscura* and so does the mainstream of western painting; painting and drawing, however, are always superior in intensity and richness of observation, for even in the case of Canaletto´s *camera*, looking process delays for a while both in observation and realization stages.

In a classical perspective framing the object seems to be seen through a window or, in other words, the observer is located outside the depicted reality; that is, according to Hockney, its main shortcoming. Today we know how impossible it is to achieve that objectivity because the observer is always part of the subject he is looking at and he is conditioning and transforming it with this action. In eastern tradition –Hockney affirms- this was never the case: views are global, they are not focussed in a single point. The observer looks up and down as he would through a big door: there is continuity between both territories and the limit is easy for the observer to cross. Let´s quote Hockney: "When you draw from a model you don´t need to frame it, differently from the photographer. You are looking with both eyes and you can include anything you want within the paper surface, whether it be the hole room or just a little fragment, it´s just the same: the choice is up to you"[8]. He tells how he made a photographic composition trying to recall a cubist painting by Picasso or by Gris: " I discovered that cubism can only be about things nearby…I knew I was making a sort of photos that could not be looked at just by fixedly staring, they could –and so must- be observed otherwise. Your eyes could wander by and around and so look at them in many different ways: each time you look, it seems a different theme. I realized how big a number of permutations things can adopt"[9]. In our way of seeing things there´s never an out-of-focus area, and that is the main difference with a classical photograph, where you previously decide which area will be in focus. Our eye moves always focussing in everything it meets, it is always interested in something no matter where you point it: "the meaning of this is that what is really interesting for us is the very fact of looking, something that tells you that you are alive; you enjoy that experience and the pleasure is not in the subject you look but in the very act of looking"[10].

If we analyze cinema, the other modern invention about visual narration or sharing ways of vision, we realize how movement and time are included too, but the time is there previously set by the film director and it is, therefore, the same for everybody; and so are the sequence and priority of attentions and shape of the frame. Cinema is thus closer to perspective or instant photography than it is to drawing, to cubist painting or to the photographical mosaic collage where we can always choose time, order, sequence, rhythm and intensity for our observation. We, in our lives, "never experience such thing as still time; if time ever stood still, it would mean that we are dead. We experience duration and we experience it constantly: it just happens"[11]. There is no possible experience of space unrelated to time.

Richard Estes is another author who worked on the same theme using realistic painting. Within anyone of his pictures, we can follow his eye lingering in the foreground objects while projecting to the infinite distance without limitations to move all over the landscape and including such wide angles of vision that no human eye could cover if remaining still. In Estes painting, also, everything is in focus; his paintings seem at first glance to respond to one classical framing, but observing them in a deeper way we can see different glances accurately united, multi-focal perspectives where there is not any difference of focus between near and far areas. The aspect of these paintings, apparently realistic in a quick appreciation, unveils its pictorial, contemporary and non-instant looking nature when we spend more time looking. We then notice the existence of many different welded points of view and an impossible and absolute transparency of the air in his landscapes (as if the same winter, a windy and sunny weather, was the permanent companion of our artist in his continuous travelling through such diverse climates and destinations). That transparency avoids any possible feeling of perceptive hierarchy that distance could cause; foreground details are given the same value in terms of sharpness and colour than the skyline of landscapes or the horizon of the sea (figs. 4 and 5).

No wonder that Miralles adopted Hockney´s photocollage technique from the very moment he discovered it. In these kind of composition all elements seem to count the same as happened with the architectural line drawings made all with just one thickness. These compositions always show the context of the project in a total continuity with the proposal. It is no more a matter of figure against background. They speak about continuity of reality and seeing. About the special quality of things un-finished, about work in progress. They don´t talk us about the metrics or the exact proportion of the objects, they consciously are hundred per cent subjective. But one of those collages allows you to take home, to the intimacy of your personal workspace, many visual and tactile sensations of a specific faraway context, something that could never be achieved

either with traditional data taking systems nor using classic photography. The architectures resulting from that kind of procedures are conceived to be lived in a similar way. It will be impossible to resume its main features in a principal image or a special best framing. Its labyrinthine and multidimensional quality will naturally include all variations that occur in the creation process or in the course of its further use. They always show a consubstantial continuity with the context where they were to be built.

Learning to draw in order to design architecture has much to do with the architect learning to construct a human way of seeing, according to the specific cultural context in which he has to live. It is essential to incessantly explore new and effective perceptive approaches and graphic records that allow us to understand that objective of architecture which is harmonious with our current reality. Otherwise, conformist inertia and obsession about the deceptive security flowing from the repetition *ad nauseam* of the well known, would surely neutralize the power of imagination and with it any hope for progress: "imagination, that wonderful ability, if left out of control, does nothing but to rely on memory. Memory will once more bring to light well known things, seen or heard, the same way ruminants regurgitate grass. Chewed it may be but never properly digested or transformed.[12]"

Our pedagogical experience with these means of expression has taught us that architecture students assimilate and most easily adapt this way of looking at the various stages of their design work, in opposition to what happens with other techniques like traditional perspective, which they often forget immediately after they had learnt it (despite its undeniable usefulness to represent specific kinds of architecture in the process of project). This could probably happen due to the un-intuitive nature of perspective conventions when we compare them to the natural way of looking at things, despite the evident analogies between perspective and photography.

The graphic strategies used in the graphical process of project design, are bound to the specific nature of the architecture produced. If we initiate the work using conceptual diagrams and tensional sketches , exploration directions and referential qualitative intentions, trying different models changing attention focus and considering that process as an open dialog, all this work will produce a kind of architecture far away of the one that would result from the use of the classical strategies of mimesis and previously stating an idea as an advance of the final figurative approach. When the action of thinking is preceded by a constructive trial and error open receptive process, the graphic track notoriously differs from the use of an abstract idea as origin of the construction. In the first case, the coherence of the project comes out of the mechanisms employed in its articulation process, it has nothing to do with the recurrent use of images or representations.

There is not neutral teaching of drawing in architecture: depending on what systems of expression we use, what kind of graphic project process we start with, a determinate architectural response will emerge. Learning to use perspective in one or another way or the volume modelling workshop, the correspondence between concepts and their graphic approaches, knowing the proper moment for the use of the metrics, geometry and precision, the roll and the importance we give to the mimesis in the act of design…all this items form the corpus of a graphic discipline that can not be understood apart from the very bulk of the graphic ideation of architecture. The best for learning this it is to perform these processes, also trying to understand the methodology of those which constantly try to open new dialog and experimentation as a way of constructing a knowledge and comprehending the true nature of their way of doing.

FIGURES

Fig. 1. Mario Ridolfi. Proyecto Casa H.D.B.: FRANCESCO CELLINI, CLAUDIO D´AMATO, "Mario Ridolfi". Electa, Milano, 1997. p. 45.

Fig. 2. Mario Ridolfi. Casa De Bonis: FRANCESCO CELLINI, CLAUDIO D´AMATO, "Mario Ridolfi all´Accademia di San Luca". Graffiti Editore, Roma, 2003. p. 390.

Fig. 3. Viaplana/ Piñón arquitectos. Plaça dels Països Catalans. COL.LEGI D´ARQUITECTES DE CATALUNYA: "Obra Viaplana/Piñón". Ed. COAC, Barcelona, 1996. p. 6.

Fig. 4. Enric Miralles y Carme Pinós. Instituto de bachillerato La Llauna: BENEDETTA TAGLIABUE, "Enric Miralles. Obras y Proyectos". Electa, Milano, 1996. p. 49.

Fig. 5. Enric Miralles y Benedetta Tagliabue. Carrer Avinyó 52: BENEDETTA TAGLIABUE, "Enric Miralles. Obras y Proyectos". Electa, Milano, 1996. p. 6.

Fig. 6. Enric Miralles y Benedetta Tagliabue. Nueva sede de Gas Natural. . EL CROQUIS nº100/101. "Enric Miralles Benedetta Tagliabue 1996/2000". El Croquis editorial. Madrid, 2000. p. 291.

Fig. 7. Enric Miralles y Benedetta Tagliabue. Frankfurt: EL CROQUIS nº72. "Enric Miralles". El Croquis editorial. Madrid, 1995. p. 12.

Fig. 8. David Hockney. George, Blanche, Cèlia, Albert y Percy: "Hockney Fotògraf (catálogo)". Fundació Caixa de Pensions, Barcelona, 1985. p. 46.

Fig. 9. David Hockney. David Graves mirando hacia Bayswater. "Hockney Fotògraf (catálogo)". Fundació Caixa de Pensions, Barcelona, 1985. p. 45.

Fig. 10. David Hockney. El escritorio. "Hockney Fotògraf (catálogo)". Fundació Caixa de Pensions, Barcelona, 1985. Cubierta.

Fig. 11. Richard Estes. Vista de Florencia (óleo sobre tela): JOHN ARTHUR, "Richard Estes. Paintings & Prints". Pomegranate Art Books, San Francisco. 1993. p. 92.

Fig. 12. . Richard Estes. Tren D. 1988. (impresión sobre tableros laminados): JOHN ARTHUR, "Richard Estes. Paintings & Prints". Pomegranate Art Books, San Francisco. 1993. p. 128.

12 / PIERRE BOULEZ, "Le pays fertile. Paul Klee". Éditions Gallimard, Paris, 1989. p. 147 (author´s translation)

PEDAGOGY OF THE INITIATION IN ARCHITECTURAL CREATION: IMAGINARY IMMERSION AND EMERSION, MATRIX SPACE AND INCIPIENT PROJECT. APPROACHES TO A POIETIC PEDAGOGY

by Pedro Burgaleta Mezo

Learning to draw must be for architecture students an initiating experience in architectural creation –as opposed to a mere propaedeutic discipline, a skill to be learnt independently of that of projecting itself. Consequently, in order to successfully draw as a way of initiation, both drawing and projecting are needed to be learnt concurrently. Most of the existing misunderstandings about the drawing-projecting relationship disappear when studied simultaneously; it is then when they get rid of those artifactual aspects that distort them. Indeed, the kind of drawing that enables to invent architecture is the one that has to be practiced; and the resulting architecture is conditioned by the drawing skills acquired at each learning stage. The relation between drawing and projecting is a never-ending dialogue that must remain active during the whole education of an architect.

Initiating in creation can be understood as experiencing a series of translations between different vital situations –productive, cognoscitive situations- or spheres of significance. These translations involve meaning transgressions and, therefore, can be considered of poietic nature –since poiesis can be understood as the transgression of a given, established meaning and the proposal of a new one.

At the beginning of the initiation in creation, students will move from a situation characterized by conventions and recognition, to a different one charaterized by indetermination and exploration, and eventually from the latter towards a situation where proposals can be finally made. Students translate from the conventional world –known through socialization- to a sphere of uncertainty where that world is diluted through critic and productive actions. At that point, the possibility to propose a new world arises. This is a cyclical process that takes part along the whole education of the students, reaching new levels of consciousness, growing up in parallel with their own maturing process.

Creating is, therefore, a constant and progressive process, and its roots cannot be determined. It takes place along different stages of the displacement between the conventional-world and the no-world, and between the latter and the new-world[1]. It must be noted that this constant activity –switching between worlds- is also a feature of our own mind since early childhood, and the intitiation in the process of creation takes advantage on it, making it explicit, serving as a guideline and structure. So this is not an issue

1 / In relation to this see: Bruner, J.. *Actual mind, possible worlds*. Harvard University Press, 1985. See also: Trías, E.. *Lógica del límite*. Destino: Barcelona, 1991, and: Trías, E., *Los límites del mundo*. Destino: Barcelona, 2000.

about setting up a starting point but, about making explicit the latent, creative activity that is present in every individual. In order to structure this experience, placements and displacements must be identified and understood from a sociocultural perspective, allowing the individual's practice to be connected with other cultural and productive practices.

There is a particular way to draw –and to project- for each of the situations that are part of the creative process and, consequently, of each stage of the personal maturation process. The pedagogy of the initiation in creation requires a map of those situations/places/activities relevant to the productive action. We can provide access to that map by helping the students to gain access to the corresponding stage and its associated situations, placements and displacements, and by promoting and monitoring those creative operations that suit in each stage. However, when we try to implement this pedagogy in the academic world, a first problem arises: motivation.

Indeed, students' motivation is one of the main issues that must be taken into account during the initiation in creation. The academic world –especially that of the architecture- is a simulation of social productivity, where assignments are fictitious; in such a context, it is difficult for the student to trigger the required motivation –perhaps because of his lack of interest on activities proposed by others, or because there does not seem to have a chance to develop what is really aimed to. There is always a minority among the students though with a high load of internal motivation: unfortunately, the most generalized situation is that in which students' process of learning gets blocked as a consequence of their lack of motivation. This problem is, undoubtedly, one of the most outstanding limits of those creativity-oriented pedagogies.

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To teach someone to create is to make him behave in a highly individualized manner, but socially oriented as well. However, how can anybody be taught to behave in a way that only can be specified by no other but himself? It is, how to teach anyone to be himself? This problem recalls an anecdote: Matisse opened up a painting academy to teach creativity, but he had to quit after concluding that he could only teach to paint like Matisse would paint. Perhaps the only way to deal with this issue is to activate the background of creative procedures and attitudes that students have developed during their lifespan experience –often out of the school. Now, in order to gain access to a cultural dimension, certain essential poietics must be studied –through the interpretation of those implicit procedures that can be discovered in certain well known high-quality works. This enables the student to be placed into a cultural coordinate system where his own poietic world can be put in context. It must be noted though that facing others' work can quite easily become an 'academic' activity –in a pejorative sense-, leading to a practice of mere imitation and, therefore, to forget their condition of cultural models and triggering factors to creation. Indeed, in order to hold a critic perspective of others' procedures –it is, to intellectually dissociate oneself-, a vast cultural knowledge is required; otherwise, this approach can get corrupted.

However, what has been said so far is not enough to let the creation happen. In addition, it must be noted that the creative process takes into account the own body as well. The 'standard state' of the body is the result of an intense process of socialization, so that a set of gestures, positions and stances are acquired and, along with them, certain kinds of attention, perception and cognition. To be initiated in creation implies to alter, to reset this pattern of body-mind behaviour so that new ways to perceive and to understand were acquired[2]. A good example of this is the traditional learning of calligraphy, in which the body gets immobilized and the hand is restricted to a set of predefined movements. In this case, the initiation process would comprise –following Deleuze- releasing the hand and, in sum, removing conventions. Therefore, scrawling would be the antiparadigm of calligraphy, the same way wandering around or moving without restrictions would be ways to get rid of socialized movements and postures. In summary, promoting unusual body movements –and their associated ways of thinking- is a key way to activate creative behaviours. Creative drawing needs specific manual skills that involve the orchestrated usage of all our fingers, our hand, our arm and our whole body. Exploring the right pressure over the surface, the amplitude and the rithm of the stroke are part of a complex behaviour full of emotional and cognitive subtleties, not present during our daily usage of the world. In order to move from the conventional world to a creative situation, certain body behaviours are required, so that their corresponding graphic traces are produced.

Besides altering the body behaviour, we can also modify our environment, paying attention to those aspects that make it just 'normal'. For instance, adding music or sounds, or removing them at all. Or, perhaps, adequately changing the lightning design: drawing under variable conditions of light deprivation. These situations alter our perception of the environment and, therefore, make it difficult to detect usual shapes, leading to the extraction of new ones.

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At this point, the student must accept the uncertainty of the situation –the no-world- and experiment with those different configurations or possibilities that arises from this new environment and through this new attitude. The drawer is now able to put himself between figure and ground, between the world and the no-world, experimenting with configurations. Figures are understood as emerging from a generator ground, whereas the ground is considered to be made of potential emergent figures. Once the process of drawing has begun, cyclically alternating between un-drawing and re-drawing will define this creative stage[3].

The work is gradually defined through doing and undoing, and a matrix situation –understanding 'matrix' as a generator space- is enabled. From this matrix situation will emerge the final configuration. Moving one step further in complexity, drawing is not only a dialog between figure and ground, but transparency is also added to the equation. Indeed, all the strokes –preparatory strokes, figure-defining strokes, etc- made from the beginning to the end of the work's process can be perceived simultaneously. The drawing is, then, like a *khora*, or matrix. That matrix aspect of the work, though, can only be noticed when the figures-solution are specified or formed.

In this line, Deleuze[4] writes about creation as the transit between three consecutive stages. The first stage is that of the cliché, those prejudices that have been internalized through socialization. The second stage corresponds to the making of the 'diagram': the result of an unleashed hand that is able to produce random strokes, dissolving inital figures. At this point is when the chaos-germ comes up. If chaos is overcomed, then those latent figures that make visible the invisible emerge (stage 3). Deleuze's diagram would fit what we refer here as matrix space or matrix situation. The creator's goal is to reach this situation. In the specific context of the architectural project, these figures must also be habitable –in an imaginary fashion first, and physically next-, and have the potential to evolve into a buildable artifact with a real usefulness in the empirical world. Indeed, a vital aspect of the architectural experience is to feel immersed, surrounded –physical and pshychologically speaking- by what has been built. It is then when the subject feels protected, "under the gloom and shelter", and becomes 'hominized' –following J.R. Morales[5]-, being then able to dream and to recover his mind after the daily experience. That immersion must be simulated by the architect during the process of projection.

The same way any other artist would proceed, the architect sets up the place, through his own productive action, where he will submerge to create that place itself. So, it is the process of immersion itself what defines the place through the architect's action. The drawings that are produced while projecting are twofold: they are opened to the imaginary, but to reality at the same time, standing in that intermediate, undefined situation between-figure-and-ground

2 / Sobre la socialización del cuerpo: Crary, Jonathan. *Suspensions of perception. Attention, spectacle, and modern culture.* The MIT Press: Massachusetts: 2001. See also: Jay, M. *Downcast Eyes: The Denigration of Vision in Twentieth-Century French Thought.* University of California Press: Los Angeles, 1994.

3 / An example of this can be found in the work of Georges Seurat, where figures are both emerging and immerging in the ground at the same time.

4 / Deleuze, G.. *Pintura. El concepto de diagrama.* Cactus: Buenos Aires, 2007.

5 / Morales, J.R.. *Arquitectónica. Sobre la idea y el sentido de la arquitectura.* Biblioteca Nueva: Madrid, 1999.

and in the presence of transparency. This is the place that Eugenio Trías calls Space Light[6], with an extraordinary example of it in Octavio Paz's vision of Duchamp's 'The Large Glass'[7]. To see an illustration of this kind of drawing, we refer the reader to Piranesi's 'Le Carceri'. These series indeed urge us to immerge into them, to explore and to develop their potential places until they reach the empirical world. In sum, those evolving, habitable figures that take shape progressively during the development of the project will necessarily have two main features: first, to enable the imaginary immersion; and second, to enable the emmersion back to the real world. It is, they must make possible an inventive activity in order to create the world that is aimed in the project, but they must also be feasible and plausible.

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Initiating in creation involves managing the situation of uncertainty that we are describing here. The matrix space is reached when it supplies germs of final solutions. This is related to the paradox that J.L. Pardo[8] refers to as 'posterior anteriority'. To be trained as a creator implies to set up our own matrix space, our own poietic. This is achieved by consolidating procedural habits, work after work; by practicing imaginary immersions and emersions –it is, our specific ways of drawing, un-drawing and re-rawing. This has to be taken in a literal, but also in a metaphorical way, given that these are operations in which meanings are transformed. The matrix space is also made of 'significative materials', gathered and kept by the creator in a fragmentary, symbolic state. These materials can interact among them in a specific way thanks to the specific stimulation that a project means.

The different stages of the development of creativity can be defined as completed cycles of normal-world-no-world-new-world translations. A good pedagogical method must make these stages possible. In order to reach this, the student must consolidate his creativity, making sure that he is able to generate incipient proposals. These are the kind of proposals that can be made by whom is not able to develop a full project yet. The issue of the incipient proposal refers us to the matter of the germ.

Sainz de Oiza holds that projecting is based on two main metaphors: the 'germ' and the 'palimsest'. The creative process would be understood as the expansion of a germ, activated by a series of configuring operations. These operations are conceived as a superposition of transparencies: a simultaneous, synchronic comprehension of all the stages that are part of the architectural configuration. This is complemented with Pareyson's approach[9], in which the artistic practice is an execution that lacks a project, since the latter arises from the former –not the opposite. The project takes shape of productive actions like sketching; thus, the artist faces the problem of 'finishing' a work but having no clue of what has to be done to conclude. This state of uncertainty has no other guidance than the expectation of a discovering and the hope of success.

An artist's work is , therefore, both product and producer; a combination of the creator's action and the own work's wishes. The creative process can be compared to an organic process: an univocal series of events ranging from the germ to the ripe result. The artist faces multiple choices during the creative process; however, there is only one valid option. The way the work can and must be made is unique. Despite it looks like the result of an organized, calculated sequence of steps, its real nature is that of the spontaneity and maturation.

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What kind of proposal can be made by the student at each stage of his education? This is one of the main questions that are to be answered in the context of the pedagogy of creation. Obviously, a freshman will not be able to conceive a fully feasible project and his proposal will be closer to a germ than to a finished solution. Therefore, forcing a student to work at an unreachable level will lead to block his creativity. On the other hand, it must be noted that a germ can only be fully identified when it reaches its last stage of development –the final solution. Again, the posterior anteriority paradox arises. However, the pedagogy of creation operates at a level where paradoxes are allowed, and eliminating them would result in a banalization of the pedagogy itself.

The notion of incipient proposal focuses on that paradoxical space where an architectural germ is defined, but where the latter does not necessarily need to be developed into a project. An incipient proposal works as a matrix situation, belonging to that intermediate space between the imaginary and the real world. It is opened enough as to allow for different options of formalization, yet closed enough as to work as a feasible proposal in the empirical world. It can be developed and it means a cualitative change with respect to the conventional state of things.

6 / Trías, E.. *Los límites del mundo*. Destino: Barcelona, 2000.
7 / Paz, O.. *Apariencia desnuda*. Alianza editorial: Madrid, 2003.
8 / Pardo, J.L.. *La regla del juego. Sobre la dificultad de aprender filosofía*. Círculo de lectores: Barcelona, 2003
9 / Pareyson, L. *Conversazioni di estetica*, Milano: Mursia, 1966.

A PLACE IN MADRID FOR FILIPPO JUVARRA'S ROYAL PALACE

by María José Muñoz de Pablo

The Royal Palace designed by Juvarra is probably the most ambitious piece of architecture planned for Madrid during its history. The grand building conceived by the Italian architect, with its gardens and squares intended for parade grounds, was going to integrate a palatial complex which would serve as an emblem of the Bourbon dynasty. Its matchless magnificence in this town during the second third of the eighteenth century would transform the city, conditioning its further development. The project was never carried out and we have no accurate information about its foreseeable location. These two negative facts lead us to speculate, searching on the city map the places where it could have been erected and imagining on the paper a different urban evolution of the city from what it actually came to be.

It is well known that Philip V's decision of building a Royal Palace was caused by the fire of the Alcázar, the ancient fortress, occurred on Christmas Eve in 1734. Nevertheless, it would be more accurate to say that this unlucky sinister only accelerated the decision of the monarch. He immediately requested Friar Filippo Juvarra's services to the Savoy's court. The architect answered quickly to the summons and moved from Turin to Madrid in April 1735. Only a year after the fire had destroyed the old fortress partially, he had concluded the project of a new royal residence. He didn't live very long, and after his death, in January 1736, his pupil and successor, Sachetti, took charge of the works of the Palace. He made other plans and began the long process of construction. Juvarra's plan did not go ahead, but not all of it fell into oblivion. Sachetti's palace inherited some concepts from Juvarra's one, and in the built palace we can see some features which remind us of the original design.[1]

Although the New Palace was finally erected on the ruins of the old Alcázar, this was not the site Juvarra had thought for it. However, before speculating on its possible location and the consequences of it on the subsequent urban grid, it is useful to know what the documentation which has come to us says about the building and its dimensions, because although the formal composition only presents slight modifications in the different sources, its size is radically different, and the location was conditioned by the dimensions of the building and the accompanying gardens.

1. Sketches for the New Royal Palace of Madrid done by Filippo Juvarra in 1735.

Three outlines, in which Juvarra considered the plan of the Palace, have been preserved.[2] In these drawings he not only studied the building itself, but also the spaces outside it which would complete the pala-

1 / For the building of the Royal Palace and the transformation of its surroundings is greatly interesting the rigorous and exciting research carried out by Ángel MARTÍNEZ DÍAZ, *Espacio, tiempo y proyecto. El entorno urbano del Palacio Real de Madrid entre 1735 y 1885*, Artes Gráficas Palermo, S.L., Ayuntamiento de Madrid, 2008. The author also studies the Alcázar and gives an account of the several options to the project of the New Palace made before and during the execution of the works.
2 / AGP 6152, 6153, 6154. They are reproduced in the catalogue of the exhibition held at Madrid from October 29, 2002 to January, 26, 2003: Several Authors, *El arte en la corte de Felipe V*, Fundación Caja Madrid, Patrimonio Nacional and

Museo Nacional del Prado, 2002, p. 460. They had been published previously by some of the researchers interested in Juvarra's project. Among them, Durán, Iñiguez, Plaza, Gärms, Botineau, Gritella, Delfín Rodríguez, Correa and Esquivias, Sancho and Barbeito can be mentioned; here we will only refer to the comments on the location of the building made by these authors, especially those graphically expressed.

3 / The drawing of the location of the Palace on the plot of the Alcázar can be found in José Manuel BARBEITO DÍAZ, "Juvarra y el proyecto de Palacio Real de Madrid", *Academia*, nº 89, 1999, p. 13. The plan of Madrid with the fragments of the city including the different projects made for the Royal Palace form a part of the graphic documentation gathered by Javier Ortega Vidal, Aitor Goitia Cruz, Ángel Martínez Díaz and María José Muñoz de Pablo for the above mentioned exhibition on Philip V and it is recorded in the catalogue.

4 / ARABASF 43- 1/1, "Memorial de Juan Bautista Saqueti, Architecto y Maestro Mayor de las Obras Reales de V. M. sobre ciertas objeciones presentadas a su proyecto para el Palacio Real", reproduced in F. J. DE LA PLAZA: *Investigaciones sobre el Palacio Real Nuevo de Madrid*, Valladolid, 1975, doc. VII, pp. 357 and 358, and reviewed by J. M. BARBEITO, "Juvarra...", op. cit., 1999, p. 13.

5 / The plans of Juvarra's project have been exhibited and published many times. Regarding the set of drawings kept at the General Archive of the Palace, see José Luis SANCHO, *Arquitectura de los Sitios Reales. Catálogo Histórico de los Palacios, Jardines y Patronato Reales de Patrimonio Nacional*, 1995, pp. 77 to 79; and Juan José ALONSO MARTÍN and María del Mar MAIRAL DOMÍNGUEZ, "Planos inéditos del proyecto de Filippo Juvarra para el Palacio Nuevo de Madrid", *Reales Sitios*, nº 161, 2004, pp. 3 to 23, among others. The most recent publication on the plans preserved at the National Library is: Several Authors, *Dibujos de arquitectura y ornamentación de la Biblioteca Nacional. Siglo XVIII*, 2009, pp. 50 to 53 and 142 to 144, which included an interesting article by Professor Barbeito comparing the

tial complex: the square before the palace in the first and third sketches, and the gardens in the second one. These sketches are a formal exercise, ruled by geometry and subject to an axial composition, independent from the function of the architecture and which does not take into account the physical support on which the complex will rest. The measures are marked on the last sketch. The established total dimensions, indicated in the left lower angle of the plan, are 144 *toesas* width and 286 *toesas* long, including the palace and the square before it, that is, 280'22 by 556'56 m. Although these measures allowed the palace to be laid on the site of the old Alcázar, its setting up implied the complete restructuring of the surrounding area. Professor Barbeito considered the possibility of locating the Palace there, bringing to the paper this hypothesis about Juvarra's first ideas. Later, in 2002 a team of researchers on historical architecture designed another plan of Madrid in 1745, where the urban range of this and other palaces projected for Philip V was studied.[3]

2. The Royal Palace projected by Juvarra on the location of the Alcázar, José Barbeito, 1999.

3. The Palaces for Philip V in Madrid, 2002. The second drawing in the left strip represents Juvarra's Palace as defined in the first outlines, and the definitive project is represented in the upper one.

The size of the building outlined by Juvarra is much greater than the ancient fortress, and the square situated to the south of the palace would have reached the Calle Mayor. If, besides this, we consider the subsequent gardens drawn in the second sketch, this positioning is practically untenable. The Leganitos's ravine would have separated the palace from the gardens and the latter would have invaded Prince Pío's estate, whose steep topography would have made the arrangement of the flower beds difficult.

The place where according to tradition the new palace should be built was not the one dreamed by the architect. Sachetti told us about Juvarra's refusal to erect the building on the Alcázar plot: *"He never wanted to think about the palace on this very place, saying that its smallness and irregularity would be the cause for the best architect to lose his credit"*[4]. Juvarra discarded this siting and drew a new project without conditioning. The outcome was a magnificent and disproportionate Palace, an ideal object alien to the place.

A plentiful documentation about the definitive project has come to us. We have three series of plans. A set of drawings formed by three sections and an elevation which has been attributed to José Pérez and/or to Ventura Rodríguez is preserved at the National Library. The two other series are taken care of at the General Archive of the Palace. One of these series, which was brought to light at the beginning of the 21th century, consists of the ground floor plan and five vertical cuts. The other group of plans which rest at the Archive of the Palace has been known since old times and consists of eleven drawings attributed to Marcelo Fontón. Besides these, there is a plan in Rome which synthesizes the project in only one floor plan and two fragments of an elevation.[5]

4. Elevation and sections of the project of the Royal Palace drawn by Juvarra kept at the National Library.

5. Elevation and sections of the Royal Palace designed by Juvarra kept at the General Archive of the Palace.

6. Main floor of the Royal Palace designed by Juvarra attributed to Marcelo Fontón.

7. Plan of Juvarra's project for the Royal Palace in Madrid, Gabinetto Comunale delle Stampe, Rome.

We also know that a scale model in wood of Juvarra's project was concluded after his death. This was used for drawing some of the plans which we now have at our disposal. Unfortunately, the scale model has not survived, or at least we do not know where it is, but Antonio Ponz recorded the dimensions of the Palace which can be deduced from this scale model: 1700 Castilian feet (473'68 m) for the façades, 800 Castilian feet (222'91 m) for the projecting pavilion in the main façade, 700 x 400 Castilian feet (195'04 x 111'45 m) for the main court and 100 Castilian feet (27'86 m) for the height of the building to the parapet of the balustrade. A new scale model of the building made in 2002 allows us to get a clear and concise idea of the old one.[6]

8. Scale model of Juvarra's Royal Palace made by Juan de Dios Hernández and Jesús Rey, 2002.

The existing documentation about the palace conceived by Juvarra is not homogeneous. There are differences in the definition of many specific aspects of the building, but they are not significant regarding the subject we are dealing with: to know its shape and size in order to find a place where it could be located. First of all, it is important to highlight the scope of the project. The great size of this palace is more obvious when comparing it with that of the first outlines made by Juvarra or with other palaces by different authors. In the last project, the length of the main axis of the floor is almost twice the length of that of the first outlines, and the occupied surface is four times greater. When we compare the dimensions of the Palace built by Sachetti to those of the palace conceived by Juvarra we get an idea of the grandeur of the latter, which would be even greater if we took into account the park and the spaces outside the building.[7]

9. Comparison between the different projects for the New Royal Palace in Madrid.

If the New Royal Palace outlined by Juvarra hardly fitted in the building site of the old Alcázar, the definitive project was simply impossible for this place, or even for any other place in the city inside the enclosing wall, due to its size.

The most appropriate grounds to erect the New Palace were located at the north of the city, because of their less abrupt topography compared with the ones to the south. Besides this, the north grounds were better communicated with the Buen Retiro Palace and the Casa de Campo, and they opened on more directly to the Royal Residences of El Pardo, El Escorial and La Granja, a usual route of the Royal Retinues. Although there are no precise indications about the foreseeable location of the New Palace, we have two hints which enable us to speculate about it recreating with our drawings the uchronia of what it could have been. The first hint is that the location of the palace would be in San Bernardino Heights, and the second one is that the main façade would look south.

10. Location and graphic analysis of Juvarra's Palace, by Gianfranco Gritella, 1992.

Some authors have situated the Palace on grounds belonging to Prince Pío's estate, to the west of San Bernardino's Gate, a place which nowadays occupies the south part of Argüelles district[8]. Nevertheless, this situation does not seem to be the most probable, because it falls on a private property and the topographical conditions would make the relationship of the palace with the city through the square before the palace difficult, especially if we consider the definitive project, which, as it is greater in size, would constrain the complex into the plateau of Prince Pío's hill.

We have supposed and represented several possible locations into an arched strip of land to the north of the city and outside the enclosing wall. Let us see which would be the advantages and disadvantages of each one, as shown in the drawing we have rendered.

11. Different locations for the Royal Palace planned by Juvarra in northern grounds of the town of Madrid circa 1740, by M. J. Muñoz de Pablo, 2008.

The first location, situated to the east, between the gates of Santa Bárbara and Recoletos, next to the Castellana brook, has direct communication with the Buen Retiro Palace through the promenades of Recoletos and Prado, but these lands are depressed and the situation of both palaces is too near each other. A part of the terrains it occupies in this hypothesis belonged to the so-called *vegetable garden of the valley of the waterwheel*, which was a royal property in the sixteenth century, although in the second half of the eighteenth century it was enlarged and began to be called *vegetable garden of Loinaz,* after the surname of its new landowner.

If we situate the palace in front of the gate of Los Pozos, it would be in a central and well communicated position, on grounds which were a property of the Crown ?or at least a part of them. Otherwise, the road to France would have had to be shifted and the traffic of people and goods through this main communication channel with the north of the country would have blocked the routes towards the palace. These routes were most frequented by the court, the nobil-

drawings of the National Library with those preserved at the Palace.
6 / Antonio PONZ, *Viage de España*, VI tome, third edition, Viuda de Ibarra (facsimile edition, Madrid, 1972), pp. 89 to 91; to accommodate the scale model *a box was fitted on the wall of the War Museum, which overlooks the Palace* although it was later *moved to the workshop under the arch, which communicates with the Garden of the Royal Pharmacy.* Gaspar M. de JOVELLANOS also mentioned this scale model in his *Elogio a Ventura Rodríguez leído en la real Sociedad Económica de Madrid*, Viuda de Ibarra, Madrid, 1790. Both Pascual MADOZ, *Madrid...*, 1848, pp. 248 and 333, and Ángel FERNÁNDEZ DE LOS RÍOS, *Guía de Madrid...*, 1876, p. 230, 484 and 485, recorded the same dimensions registered by Ponz, but Madoz says that the model was kept in the Topographical Cabinet located at the Buen Retiro and Fernández de los Ríos informs us of its removal to the Museum of Engineers. The new scale model was made for the exhibition about Philip V before mentioned.
7 / The comparative study of the different projects made for the new Royal Palace forms part of the graphic documentation gathered by Javier Ortega Vidal, Aitor Goitia Cruz, Ángel Martínez Díaz and María José Muñoz de Pablo for the above mentioned exhibition *El arte en la Corte de Felipe V.*
8 / Gianfranco GRITELLA, *Juvarra. L'Arquitectura*, Modena, 1992, t. II, p. 439.

ity and the municipal authorities, both in their daily activities as administrators and representatives of power and in public festivities and ceremonies. Nor were the surrounding establishments, the Tapestry Manufacture and the Snow Pits, suitable neighbours for a royal residence. In the second half of the eighteenth century, Antonio Carlos of Bourbon projected for these lands royal stables which did not come to be built. At the end of that century a Bleach Filtrations Factory was established there. This was also a royal manufacture, as much as the tapestry one.
The two supposed locations, at both sides of San Bernardino's road, besides their good communication with the Royal Residences, would have maintained a prominent position over the Manzanares river and would have enjoyed the same panoramic views onto the Casa de Campo as they had enjoyed from the Alcázar. Because of their being in raised grounds, they would have had also better views onto the town and to the north they would have enjoyed ample views onto the Sierra de Guadarrama. Even though, it seems more practical to have located the palace to the west of the promenade, between the road and the river where the advantages above mentioned are stressed. There, the smoother relief is to be found at the eastern margin of the promenade, in front of the Seminary of Noblemen and near the Bodyguards barracks.
Any one of the places considered could have housed the new palace, but the two latter are the most likely according to the textual description: a place *situated in San Bernardino Heights*. Finally, we can situate Juvarra's palace in a last place which also observes this requisite: in the axis of San Bernardino's road and a little further away from the enclosing wall, in the lands which formed the large estate of La Florida. This situation seems the most convenient because it joins together the advantages of the previous ones and gives room to the spreading out of the gardens looking onto the north and east proposed by Juvarra in his first outlines, as much as to the laying out of the square before the main façade. The axial composition of this square, the palace and the gardens would be strengthened by San Bernardino's promenade, thus avoiding the ambiguity of the accesses typical of the situation tangential to the road. The Palace would be the crowning element of one of the main streets in the city.
All the sitings we have considered for the building would have changed the shape of Madrid and influenced its growth. In the nineteenth century, the urban grid jumped over the enclosing wall. The first centre of population to be settled in the outskirts of the city was the suburb of Chamberí, a humble quarter situated to the north of the city between the gates of Fuencarral and Recoletos where Carlos María de Castro situated the working quarter in order to preserve the existing houses and small factories when he drafted the Preliminary Plan for the Enlargement of Madrid in 1860.
If Juvarra's Palace had been built in any of the mentioned places, the growth of Madrid would have had other features. The nobility with their palaces and gardens and the institutional and administrative buildings would have occupied this area instead of the dunghills, shanty towns, cemeteries and humble dwellings which formed the suburb originally. The building up of the Palace would have altered the spatial distribution of the social classes and the location of institutions and services in the city. The urban grid and the typology of the buildings would also have been affected.
12. A hypothesis about the location of the Royal Palace designed by Juvarra for the town of Madrid about 1740, superimposed over the present urban grid, by M. J. Muñoz de Pablo, 2008.
When we superimpose the projected Palace and the town existent in the second third of the eighteenth century over the present urban grid, we can see how some of the roads which were later transformed into promenades and later on into the streets which structure the city, would have been erased by the palace complex. This also enables us to imagine a different city, where the structure of the streets would be subject to the laws imposed by the Palace, and the dimensions of the blocks and plots would be greater than the existing ones, a town designed to accommodate the representative buildings and the sumptuous houses of the aristocracy instead of the constructed town, destined to house the working quarters. San Bernardino's asylum, situated where is nowadays the rectory of the Complutense University, would not have been installed in the ancient convent of the same name, because it would have been razed to the ground by the works of the Palace. The Ciudad Universitaria would have had to find another place to be settled, because it would have been occupied by the gardens of the Palace. The present square of Moncloa and the way out of Madrid through La Coruña road would have had a completely different shape… However, the building of Juvarra's Royal Palace in the Heights of San Bernardino, although possible, is only a dream; the actual development of the events followed another course which led to the present city.
Nevertheless, the drawing up of different plans has helped us to learn about forgotten ideas from the past and to speculate about a different present, providing new images to the rich collection we already have about that slipped opportunity. These drawings show the most forgotten aspect of this subject: the plot of the Palace and its relationship with the city. Maybe the knowledge of the past facts and their would-be consequences will allow us to foresee more clearly a future which is always to come.

APPROACH TO THE ANALYSIS OF THE SPANISH 'SISTEMA DIÉDRICO' AS A LANGUAGE

by Víctor Grassa-Miranda
Roberto-Vicente Giménez Morell

The perception of shape is the beginning of conceptualisation.
Arnheim (1998 [1986] 40)

Abstract
The grammar or guiding principles of the Spanish *sistema diédrico* use the projective schema of a model to help structure a student's spatial thinking, while the Anglo-Saxon *direct method* relies on the reconstruction of a mental image of the geometric configuration. The epistemological framework that created classical descriptive geometry has been superseded and this has lead to a progressive abandonment of intellectual speculation and a reorientation towards applied design. Spain's previous cultural isolation meant that educational institutions fell behind advances in the field of drawing and a degree of scholasticism took hold until the second half of the twentieth century.

Keywords: visualisation, three-dimensional design, mental image, geometric drawing.

Introduction
From the viewpoint of constructivist teaching theory, the discredited behaviourist approach ignores the mental processes of students as they learn. The mechanics of *restitution* in the Spanish *sistema diédrico* consider the possibility of recovering the three-dimensional structure of the geometry represented. Such a process has also been applied to justify obtaining the corresponding mental image (Taibo 1966 [1944] 2). This paper aims to show that the grammar or guiding principles of the *sistema diédrico*, inherited from classical descriptive geometry, create learning expectations that are difficult to anchor with respect to the development and structuring of a student's spatial thinking.
Throughout the history of graphic communication, various descriptive variations and hybrids have been developed according to practical drawing needs. During the Renaissance, drawing techniques were used to objectively describe three-dimensional shapes based on the visual synthesis of an object's geometry (Fig. 1).

Spatial concept
A graphic-geometric drawing is simply an expression of the evolution of a specific spatial concept associated with a given scientific context. The epistemological platform on which the classical academic dis-

cipline stands enables us to characterize the syntactic order supporting the projective model as a design-oriented schema that aims to structure the spatial thinking of students (Fig. 2).

We propose two hypotheses with a clear dialectical component. Firstly, it is considered that the epistemological framework that sustains the guiding principles of the Spanish *sistema diédrico* prioritizes propositional representation over the analogue (Ballesteros Jimenez, 1993); and so establishes certain deductive mechanisms from the logical variables arising from the projective operatinality. This doctrine lies outside the psychological process of forming spatial concepts through the construction of mental images. Secondly, it is considered that the Anglo-Saxon direct method solves the problems of the projective model by considering, from the beginning, the assimilation of spatial concepts – and so favouring the construction of a clear mental image of three-dimensional design. The direct method enhances the spatial orientation of the student by producing orthographic views with synthetic perspectives that facilitate an understanding of spatial relationships (Fig. 3).

To validate these hypotheses we will explore the operational methodology of graphical-geometric drawing by dividing the existing bibliography into four sections.

The first section includes the publications that discuss the academic discipline in Spain: Taibo (1966 [1944]), Izquierdo (1956), and Rodriguez de Abajo (1958) being among the most widely distributed (Fig. 4).

In a second section, we consider publications about the *sistema diédrico* that offer a revisionist view, but still remain tied to the spatial concept of the projective model. The main representative of this trend is Sánchez (1997 [1993]). Thirdly, we analyze the Spanish translations of books about the direct method. These books were published in Spain after a delay of 30 years and offered a de-contextualised version of the original fundamental principles: Warner and McNeary (1964 [1934]), Rowe and McFarland (1967 [1939]) and Wellman (1964 [1948]) are among the most relevant authors. Finally, the original publications – practically inexistent in Spanish libraries – about the direct method are considered: Millar (1922 [1913]), Hood (1926), Warner and McNeary (1934), Rowe and McFarland (1946 [1939]) and Wellman (1948), were the founding authors of this alternative trend (Fig. 5).

The literature review of these sections refers, in particular, to the content and the balance between theory and practice, without forgetting the perspective of geometric constructions as a manner of expressing applied spatial concepts. The full version is part of the doctoral thesis of Grass-Miranda (2008).

Analysis versus synthesis

The philosopher and mathematician René Descartes (1596-1650) pioneered analytical geometry and considered the possibility of reconstructing reality deductively from experience. His rationalist worldview had a profound influence on Europe and especially in France. Consistent with propositional reasoning, the founder of descriptive geometry, Gaspard Monge (1746-1818), sought to interpret spatial relationships based on certain logical variables arising from projective operationality(Booker, 2001 [1963] 25). The motivation to extend the legitimacy of such an analysis to the field of graphic drawing was one of the early embryonic stages of this schema (Sakarovitch, 1998, 261) (Monge, 1996 [1803], 90) (Fig. 6).

Monge founded the École Polytechnique and his institutional and political position helped explain the privileged role given to descriptive geometry as one of the academic disciplines of the Napoleonic model of technical university education. The spread of his ideas was further helped by the enormous influence that France exercised over much of Europe (Boyer, 1982 [1968], 598). During the first half of the nineteenth century, the standardization resulting from the projective model caused a reinterpretation of techniques for the description of drawing systems:

We have already mentioned the removal from the École Polytechnique of the gentlemanly perspectives produced by De la Rue. Although this system of representation was genuinely French, it was ignored in France until Theodore Olivier drew attention to the system in his writings. Even fewer have studied the early disciples of the axonometric orthogonal Monge (...). Moreover, in the school of Monge, conical perspective was a mere application of descriptive geometry and was intended as a demonstration of the operational capability of Monge's method rather than as a reproduction of the old procedure of Alberti. De la Gourniere remarked on the imposition of a standardised graphic language and expressed nostalgia for the earlier wealth of graphical procedures produced by the guilds and the variety and nuances formerly found in graphic drawing. His critique includes a demand for a legitimate place for the conical and cavalier perspectives. (Monge, 1996 [1803], 91)

The status of 'system' given to perspective procedures meant submitting spatial cognition to the logical variables of projective operationality. The aim was to interpret the three-dimensional design using deductive mechanics in a rational organization that was independent of experience (Grass-Miranda, 2009). If reality is established at the expense of subjective perceptions, it is not necessary to verify the concepts by empirical observation, and therefore mental images are useless for assimilating projective relations. This introduces a discontinuity with regard to the analogue character that has accompanied drawing since the Renaissance, and the spirit of the observation of nature that gave prominence to the visual image (Fig. 7).

The origin of the direct method

Is it possible to sustain the ability to structure spatial thinking using the Spanish *sistema diédrico*? Nearly a century ago, Professor French at the Annual Conference of the Society for the Promotion of Engineering Education (1976, [1913], 22) outlined the differences between two forms of graphic-geometric drawing:

The methods now in use, with all their variations, may be divided into two general classes:
1. Those which begin with the theory of the point, line and plane, and progress to the solid.
2. Those which begin with the solid, and afterwards take up the analysis of lines and surfaces (…)
In a subject which depends wholly on the clearness of perception, and whose value is entirely lost if the mental picture is confused, the possibility of this condition is most unfortunate.

The first option follows from the traditional projective schema and focuses on theorizing about the abstractions of point, line, and plane. The second option starts with the three-dimensional design visualization as a source for interpreting geometric structure. This proposal considers the fundamental role of mental imagery in the cognition of spatial relations, an aspect that was crucial in the subsequent development of the direct method (Fig. 8).

Adam V. Millar (1873-1960) is considered the first author to make an alternative proposal to the projective model schema (Gonzalez et al. 1977, 3). A few years later George Jüssen Hood (1877-1965) made a comprehensive presentation of the results of applying the direct method. This methodology favoured subject-object interaction through the construction of synthetic orthographic perspectives in order to stimulate the spatial orientation of students. Each three-dimensional design problem has a strategic standpoint from which to approach the solution. This is why the direct method trains the student from the outset in techniques for producing auxiliary views and constructing a clear mental image of a three-dimensional design (Fig. 9).

Developments of the direct method maintain closeness between drawing and visualization that was understood in the Renaissance tradition:

When the engineer draws or reads a view, he visualizes the views as representing the solid three-dimensional object. It is a mistake to think that the object is projected on a plane, or regard the view as flat. (Hood 1946 [1926], 19).

The direct method attempts to deal directly with the spatial configuration – and this means repudiating the deductive Cartesian apparatus of classical descriptive geometry. In the words of Hood 'the direct method deals with the object itself and requires a different mental attitude' (Hood et al. 1979 [1969], 445).

If the viewing perspective is an effective cognitive sup-

port then why not integrate the perspective with orthographic drawing? Combining different orthographic perspectives of three-dimensional design is one of the most prominent features of the direct method –the aim being to facilitate an understanding and analysis of geometrical configuration (Fig. 10).

Conclusion

The status of the grammar and language that expresses the guiding principles of the Spanish *sistema diédrico* as a rational organization aimed at structuring student spatial thinking can be challenged on the basis that it offers an insufficient foundation in the process of constructing a mental image of the geometrical configuration – and this prompts the development of a methodological approach that is distant from accepted practice. Secondly, it is considered that the Anglo-Saxon direct method supersedes the problems of the projective model by considering, from the beginning, the assimilation of spatial concepts – and so favours the construction of a clear mental image of three-dimensional design. Superseding the epistemological framework that created classic descriptive geometry leads to a progressive abandonment of intellectual speculation and a reorientation towards applied design. This renovation was based on an alternative methodology that sought synthetic orthographic perspectives as a manner of enhancing the interaction between subject and object. As Spain had culturally withdrawn from the modern world, the nation's educational establishment remained isolated from these advances in knowledge. This isolation led to a scholasticism that remained loyal to the classical tradition until the second half of the twentieth century.

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FIGURES

Fig. 1. Study of a head using multiple views. Albrecht Dürer.
Fig. 2. Plane alphabet (Gutierrez Vazquez; Izquierdo Asensi; Zuvillaga Navarro; Placencia Valero, 1984, p.121).
Fig. 3. Visualization and drawing process of three-dimensional objects (Bertolino, 1997, 241).
Plate 2 from the Géométrie Descriptive (Monge, 1996 [1803]).
Fig. 5. Direct method. Auxiliary views by Giesecke (1979, 278).
Fig. 6. Caricature of Monge drawn by one of his students in about 1802 (Sakarovitch, 1998, 246).
Fig. 7. Architectural sketch for the *Adoration of the Magi* by Leonardo da Vinci.
Fig. 8. Direct method. The dynamics of representation and visualisation (Hood 1946, 22).
Fig. 9. Direct method. Drawing of an element using various auxiliary views (Warner, 1934, p. 14).
Fig. 10. Direct method. Various auxiliary views of a pyramid (Hood, 1946, 25).

ANCIENT MAPS FOR THE STUDY OF THE LAND DEVELOPMENT: MAPS AND DRAWINGS FROM THE CIVIL DISPUTES IN SPAIN AND THE INDIES (II)

by Pilar Chías Navarro

Abstract

The usual sources of information at a local scale of the American territories conquered by the Spanish Crown during the 16th and 17th centuries are the *Relaciones Geográficas*, as well as the charts, the projects of fortifications or public works, and the maps drawn by the jesuites and the officials of the Crown. But there is another collection of maps that has a great importance because it provides essential data about the land properties or the land users' rights. These were maps drawn for civil disputes concerning the ownership or rights to particular pieces of land, which were judged at the Royal Audiences and Chancelleries. These institutions of justice had been created in Spain in the 14th century, with similar purposes to those already existing in England, France and the Low Countries. They were also soon exported to the Indies with their own singularities.

The article explores those singularities and their contributions to the history of the cartography and to the study of the evolution of the territorial frames, along four centuries. Such interesting cartographic materials still remain almost unknown. The collections are composed by more than a thousand manuscript maps from the 15th to the 19th century, which show the changing image of the Spanish and the Latinamerican territories.

Introduction

The searches that have focused on the Spanish territories at a local scale since the end of the 15th century, have used almost solely the usual sources of the *Relaciones Topográficas* (*Topographical Relations)* for the Iberian peninsula, and the *Relaciones Geográficas* (*Geographical Relations)* for the Indies.

Both *Relaciones* were more or less extended sets of questions derived from an institutional initiative, that took place mainly between 1530 and 1812 at the Indies, and between 1575 and 1578 at the Iberian peninsula. They were usually proposed by the Casa de Contratación in Seville, with the aim of gathering several information about the lands of the different provinces that then composed the vast Spanish Empire (Vilar 1970). But they also looked for reliable information in order to get the taxes.

The collectons of cadastral maps and of those drawn for civil disputes are also essential cartographic sources that are focused on describing the land ownership, the land uses and the duties related to the territories.

Although the Hacienda Real (Royal Estate) was created in Castile at the early 12th century, the first set of cadastral maps was collected in the 18th century among the various activities of the *Catastro del marqués de la Ensenada* (*Ensenada's Cadastre*) (*Catastro* 2002). This arises from a need of the illustrated monarchy to optimize the tax collection through an exhaustive knowledge of the real conditions of the territories, a previous condition for a projected tax reform.
The civil disputes were due to the private iniative, and they offer a detailed information about lots of municipal properties that were spread over the territories of the Spanish Crown (Montes 1988; Soria 1994). At the beginning, the medieval tradition of the written descriptions was followed (Harvey 1987), and those documents were so-called *cartes parlantes,* according to Dainville (1970, p. 99). The early recommendation made by Boutillier in his *Somme rural* (1395) to add an *exemple figuré et pourtraict* to the written depictions, would help to show the judges «the property's conditions as accurate as could it be», so they could grasp a better idea of the place and know about the problem (Pelletier 2007, p. 1522). This practice helped to use the maps increasingly to illustrate the disputes, and created gradually an essential collection of Spanish local maps.

The Institutional Frame

The Spanish discoveries in the Indies were accompanied by the legal imposition about founding new towns, that derived from the laws of Castile. Through this foundation act, the new territories belonged to the Crown of Castile, giving response to an essentially juridical demand.
The rights that allowed to control the territories were based on: 1. The *capitulaciones de descubrimiento* o *de población* (discoveriy's agreements or settlement's agreements), that were a kind of agreements between the Crown of Castile and the individuals; 2. The *mercedes,* considered as gifts of the Crown; and 3. The administrative awardings. The capitulaciones provided lately a framework to agree with the individuals many different activities and enterprises such as the mining exploitation, the search of treasures, etc., whose conditions were *capitulados* (agreed) with the Crown (Vas Mingo 1986).
The organised development of the settlements was the seed of a rational politically organised territory with a hierarchical structure, that helped the internal government of the discovered territories. Tha basic element of this political structure was the province, whose territorial limits ended where no more settlements were founded by the conquerors or *adelantados*. The reference limits were just the seashores, this fact justifies on the one hand that the provincial limits remained undefined for a long time (Brewer-Carías 2006, p. 54), and on the other hand, that maps were not indispensable tools to define the boundaries. The usual practice followed the medieval trend of making a written description of relevant geographic features that could be used as references (Chías 2009; 2009a). Nevertheless, the new great Spanish districts could not be defined without the support of the smaller indigenous territorial units. This older land division was essentially maintained during the creation process of the *encomiendas*, where each indigenous community was assigned to the person of the *encomendero*. He must take care of their religious instruction, as well as of their submission to the Spanish king. But he also perceived the taxes and the benefits of their work (Gerhard 1986, p. 8).
The frecuent abuses led the Crown to introduce since the 1540s the *corregidores* in the administrative structure of the Indies, whose activities related to the definition of boundaries and taxes imposed to the communities were supported by a great amount of new maps.
Simultaneously, the *mercedes* were the usual way to access to land ownerships and to root the Spanish population in the new colonies. They were a sort of reward given by the *virreyes* to the conquerors and colonists on behalf of the king of Castile. They remained then obliged to respect the indigenous properties, to keep and cultivate the plots for more than four years, and to sell them neither to the Church nor to its institutions (Florescano 1971, p. 38).
The *mercedes de caballería* (rewards of chevalry) were more frequent in Nueva España than the *mercedes de peonía* (rewards of labourer). But the problems caused by the different units of measure used to define the surfaces soon emerged. Theoretically in 1537, and later in the *Ordenanzas* (decrees) of 1573, those units were unified and each *caballería* was defined as a surface of 552 x 1.104 square rods -about 43 ha. But in the practice those measures were not strictly applied, and the measurements remained quite arbitrary (Trabulse 1983, p. 35).
Furthermore, often they would not even coincide in their geometry, and although they were usually rectangular in plan, there were also round shaped plots. This variety of shapes caused a great amount of civil disputes about the intermediate plots that remained unaffected between the adjoining *mercedes*.
In the second half of the 16th century, the Spanish Crown needed to increase its funds through a new tax decree that allowed to regularize the situation of the *mercedes*. The new legal frame allowed the growth of large landed estates because lots of plots owned by the indigenous were 'legally' invaded or bought. As many civil disputes were then unleashed, a great number of local maps were drawn during the three last decades of the 16th centruy.
As we have seen, the cartography referred to a local scale in Spain and the Indies was drawn due to the activities of the *corregidores* or to the abuses that followed the decree, and the matters were the disputes about the land ownership or the boundaries between the private and the communal plots.
The Royal Audiences and Chancelleries were the courts of justice that attended civil and criminal cases. Created in 1346 by king Alphonse XI of Castile, the Audiences gradually enlarged their competences and activities as a result of the royal delegation. Since the end of the 15th century, the Audiences were associated to the Chancelleries, that carried out the documents in the courts. They investigated the cases of the towns, villages and places of their district that surpassed the amount of 300 *maravedíes*. The Audience and Chancellery of Valladolid (Spain) also attended to the appeals of more than 1.000 *ducados* from the Audience of Galicia.
This courts of justice were exported to the Indies in the early 1511, but without the characteristics of a Royal Audience. In 1528 the first Audiences settled in Mexico and Santo Domingo (Dominican Republic) and many others followed; the latest being Buenos Aires in 1787. Their composition was not the same in Spain and the Indies, but they acted as completely autonomous courts –excepting the Audience of Nueva Granada, that depended on the one of Mexico.

The Local Maps for the Civil Disputes in Spain and the Indies: types, contents and techniques

More than one thousand maps compose the collections of the Real Chancillería de Valladolid (Spain), and the Archivo General de la Nación (México) also keeps a great number of maps and plans of the Spanish period.
Both collections shared similar contents, and they did not depict vaste territories due to their particular use in the civil disputes, concerning to the land ownership, the boundaries, the water, forest and mining exploitation, the road construction, the placement of villages, the definition of the provincial limits and the civil and religious jurisdictions. They also shared the lack of accuracy compensated by the detailed written descriptions of the accompanying texts that defined distances, areas, and the main existing geographic features, such as roads, rivers, towns, villages or places.
Most of the maps drawn by the indigenous cartographers show the traces of their cartographic inheritance and practice, although the authors usually remain unknown. However, the Spanish, *mestizos* and creole cartographers used to sign up the documents, and their trace can still be followed.
The surveying methods employed in Spain and the Indies were quite similar (Gentil 1990, pp. 8-14). The instruments used were very simple, such as rules, quadrants, *regla status*, *arbalestriles* and even mirrors; they applied also a set of simple traditional rules of surveying, to measure distances, angles, heights, and consequently, to calculate areas (Vicente & Esteban 1991, p. 333). In most cases the

mapmakers do not intended to georeference the geographic features; as Edwards (1969, p. 18) describes, it would suppose to manage some advanced concepts of Geometry, Astronomy and Cosmography, and to use more complex instruments as the astrolabe. Nevertheless, those advanced knowledges were being widely spreading, as shows the fact that the *Libellus de locorum describendum ratione* by Gemma Frisius was translated to spanish in 1548 and printed in Antwerpen; only five years later the same happened to the famous treatise by Oronce Finé *Los dos libros de la Geometría Práctica* (Biblioteca Nacional de España, Madrid, Ms. 9437), where he explained the use of four stocks to measure distances.

The cartographic techniques applied to draw manuscript maps were also similar in both continents, and the Spanish collection, as well as the Mexican ones, watch over some different kind of documents such as: 1. Sketches and diagrams, directly derived from the medieval written descriptions; 2. Views, perspectives and mixed projections; 3. Handcolored plans with or without a consistent scale. The drawing materials are also very similar; there are simple line sketches drawn in ink or charcoal, but also ornamented maps were the distinctions between measuring, recording and picturing were blurred (Alpers 1987, p. 68). The maps were usualy drawn on paper, but there are a few examples that have used a kind of indigenous paper as the *amate paper*.

The essential difference between the maps drawn along the 16th century and the later ones is that the indigenous used to include history and time in their depictions, as genealogies, historical events and even historical celebrities related to their community. Their cartographic and pictorial conventions were quite complex, and the *nahuas* and other indigenous cultures of Nueva España (New Spain) tended to depict the geographical space in a symbolic way rather than in a topographical one. The orientation, for instance, was conceived from a cosmological point of view and depicted according to the main solar positions.

The symbols used to depict the geographical features were also quite different from the european ones, as they used glyphs as complex series of ideographic and pictographic symbols, brightly colored, that represented ideas or concepts.

According to the European cartographic tradition, to delimitate the geographical zones they drew mountain chains, brambles, roads, rivers and woods; they symbolised also the villages as churches with merlons and crosses; and depending on the importance of the geographic features, their size was bigger or smaller. But the links with the indigenous cartography were evident in the orientation, the use of glyphs and of stylised shapes that remember of the ancient Mexican codices.

The topography is depicted through an important set of symbols: the hills and the mountain chains were usually drawn out of scale, bell-shaped and green colored; the indigenous tradition thought that they were alive, and that is the reason why they have two band in the lower part: the red one depicts the blood, and the yellow one the grease, such as a wounded human skin. The green colour could turn into brown or grey depending on its natural appearance or on symbolic means. Two or three hills set together on the borderline defined their hardness. They could also vary their shape by drawing some other elements over or inside the hill symbol; those combined glyphs must be read from right to left to properly identify the toponym of the place.

The hydrography was usually blue colored, with white circles and snails over the waves; the lakes and ponds, and even the sea, were depicted in sectioned containers. Rivers were blue bands with rolling lines and whirlpools, their shapes were modified by adding other features to change or give sense to their toponyms.

The animals were always depicted according to their natural environment or related to the livestock farming. The vegetation included palms, corn plantation, cacti or pinewoods, depending on the regional climate.

The roads and paths were depicted as footprints that lately evolved to horseshoe prints. The roads were brown bands with black footprints inside, alternating the right footprint with the left footprint, as a bare trace.

The toponyms of the villages placed in plains were depicted as rectanges with the denotating glyph inside.

The houses were sometimes similar to the indigenous *callis*, but frequently the mapmakers showed the main different constructive tendencies, as the medieval *donjons*, the roofs and terraces, or even the simple *palapas* (Kagan 2000, pp. 85-113).

Along the 16th century the simmetrical composition of the pre-hispanic maps gradually turns to the depiction of the topologic relationships approaching to a consistent scale.

Shadowed volumes replaced the former flat colored shapes.

Churches and civil constructions appeared, as well as cartouches ornamented with the royal symbols that included explanations in spanish or latin.

The North appeared at the upper side of the maps, replacing the East at the top of the indigenous maps.

Sizes began to change, and the landscape was depicted following the European tradition, introducing the naturalism, the views and the linear perspectives.

The traces of the indigenous mapmakers gradually disappeared.

Conclusions

The maps used in the civil disputes are an essential source of information about the Spanish and Latinamerican territories, and their evolution from the 16th to the 19th centuries. They are a complement of other better known sources such as the *Relaciones Geográficas*, the charts for the coastlines, or the later printed maps.

But the researcher should be aware of the singularities of those maps, in order to identify and highlight their depiction of historical events and cosmological references, as well as to recognise the geographical features and toponyms through the use of glyphs.

The European images invaded since 1519 the universe of the indigenous mapmakers (*tlacuilos*), that gradually changed their way of depicting the territories.

At the beginnig they had no intention to use the European cartographic codes, but they soon began to introduce the naturalist landscapes, the three-dimensional volumes and more abstract symbols that have no relationship with time and space, according to a new interest about transmitting their geographical knowledge.

The differences between the maps drawn by the indigenous mapmakers and the european mapmakers are more important in the 16th century than in the later ones, as in the early times of the Spanish conquer some essential prehispanic features were already being used. By the end of the century they were gradually transformed into a mixture of European features with the symbols and techniques used by the indigenous communities.

As Gruzinsky (1987) explained, at the beginning of the 17th century the indigenous cartographic tradition had assimilated the European cartographic trends, in order to use a common understandable cartographic language.

Once this singularities were lost, it became really difficult to distinguish the maps drawn in the Iberian peninsula from those drawn at the Spanish Indies.

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7 / ROWE, Colin & KOETTER, Fred, *Ciudad Collage*, Gustavo Gili, Barcelona, 1981, p. 80.
8 / COLQUHOUN, Alan, "Desplazamiento de conceptos en Le Corbusier", in *Arquitectura moderna y cambio histórico*, Gustavo Gili, Barcelona, 1978, p. 121.
9 / VENTURI, Robert, *Complejidad y contradicción en la arquitectura*, Gustavo Gili, Barcelona, 1972, p. 131 (revised translation).
10 / LAROUSSE, Pierre, *Grand dictionnaire universel du XIXe siècle*, París, 1866-1877, p. 1217 [Bibliothèque Nationale de France, e-facsimil].
11 / RASMUSSEN, Steen Eiler, *La experiencia de la arquitectura*, Librería Mairea and Celeste Ediciones, Madrid, 2000, p. 46.

POCHÉ OR THE DEPICTION OF RESIDUAL SPACE

by Raúl Castellanos Gómez

Abstract – *Poché* was a habitual term in École des Beaux-Arts ateliers in Paris for the depiction technique of inking in sections of walls in a building. This method, not used explicitly until the 19th century, had already been developing gradually since the Italian Renaissance and Baroque periods. *Poché* was a texture architects used on drawings to abstract residual or service areas and relegate them to the background of the drawing against which the normal figures stood out. This technique was developed considerably in eighteenth-century France being in keeping with the type of plans used for the homes of the aristocracy in the Ancien Régime. Hence *poché* was the expression of residual space: a way of omitting the incidental and providing a visible portrayal of a work of architecture's desire for perfection.

Anyone who has ever produced an architectural drawing, in a project of their own or one by someone else, will have noticed that drawing is not an automatic action that records as accurately as possible a specific, tangible reality, built or designed by the architect. Every architectural drawing entails a thought process prior to the draughtsman's action and the selection, from all possible features, of those to be conveyed by the drawing whilst shading in others that are to remain in that broad spectrum of construction attributes upon which not even the faintest light could be shed.

As Robin Evans said in a leading article about a drawing technique developed in England in the 18th century, "The architectural drawings concerns what might be called the architect's field of vision. It enables certain things to be seen more clearly by hiding others: something is lost and something is gained. Its ability to depict is always partial, always more or less abstract"[1].

This paper analyses several plans of buildings from the past, most of which were drawn by the architects that designed them. The intention is not, however, to address the parts of the building that these draughtsmen wanted to make visible but to elucidate and make sense of everything they left out of their architectural drawings. What follows is merely an attempt to visualise that "something else" which, according to Robin Evans, was left out of all architectural drawings. To do so, we will address both the drawing itself and what it reveals about the nature of the work or its creator's approach. As if we were contemplating a theatre stage, we will take a look behind the scenes at the real nature of the building and find out what underpins the forms we admire. We will look slightly to one side and focus our attention on the residual space that supports the forms in the close-knit relationship between space and shading.

Although the subject of this paper is eminently French, we will begin by analysing several drawings from the Italian Renaissance and Baroque periods because they were forerunners of a certain plan depiction technique whose development peaked under French architects in the 18th century: the virtually seamless incorporation of residual or service spaces into the imprint of the basic structure of the building by means of a regular form of hatching they called *poché*.

It must be said that it was not until the 19th century that *poché* became a specific term in the jargon of Beaux-Arts ateliers. Masters and students then made use of terms such as *poché pur* or *poché dilué* to describe the textures used to fill in solid elements and residual areas on the plans of buildings. Although it had been used as a depiction technique for many years, it required no theoretical formulation and it was not until the 20th century that the concept was defined by the École Polytechnique professor Gustave Umbdenstock in his *Cours d'Architecture* as a "procédé de présentation": "On teinte les sections des murs. On appelle cela le poché"[2].

At that time, *poché* was a graphic medium used by architects to transform a plan into an item pleasant to behold. Not for nothing did architects with Beaux-Arts training dedicate their most masterful skills to drawing *un beau plan* as Julien Guadet called a plan which "enabled and promised beautiful things"[3]. Even before the École des Beaux-Arts was created, during the Ancien Régime, French architects had already demonstrated their mastery of the art of the plan. In the mid 18th century, Jacques-François Blondel, the famous distribution theoretician, deemed it to be "a new art", a discipline, in this author's opinion, exclusively of French domain[4].

However, a plan's aesthetic impression alone, even if it might sometimes be an end in itself (as was undoubtedly the case in the *Grand Prix* competitions held in the École), in no way detracted from its attributes as an abstraction of architectural space. Consequently, as Cornelis Van de Ven posits, the French concept of the plan could legitimately be deemed to be both "ideological and spatial"[5]. The work of architecture rises up from the two-dimensional imprint that outlines the building's solid (or filled-in) elements and uses *poché* to make voids and inhabitable spaces easier to see: the spaces whose elevation or size must be in proportion, in keeping with an elementary sense of economy, to the size of the imprint of the solid construction bearing them. It is in this secret relationship that the plan's ability to abstract a specific spatial or volumetric hierarchy lies[6].

After falling into disuse like many other categories of academic origin in the early decades of the 20th century, the *poché* concept was subsequently revived by some of the most outstanding critics in the latter half of that century. Colin Rowe defined it as "the imprint upon the plan of the traditional heavy structure"[7], whilst Alan Colquhoun deemed it to identify "the hidden service spaces"[8]. Robert Venturi mentioned *poché* too in his passionate defence of complexity and contradiction in architecture[9]. Whilst Rowe's definition was in line with the original or academic meaning of the term, Colquhoun went even further by giving it a spatial meaning which, it must be said, was inherent in the etymology of the word *poché* itself for its root – *poche* – meant basically "something hollow, something swollen"[10]. The semantic breadth of *poché* could, therefore, harbour a sort of identity between two apparently irreconcilable extremes: matter and void.

1

Let's first take a look at a fragment of Bramante's plan for St Peter's basilica, Rome (fig. 4) showing one of the four secondary domes set around the main central dome. The drawing includes a perspective of the interior space, but it is the plan which is of most interest to our field of study. What is unusual about this drawing is that it only depicts the envelope of the interior space, and not the building's exterior silhouette. This makes us instinctively see the plan as an internal area dug out of a solid element extending hypothetically beyond the edges of the drawing. This is interesting because it reveals this to be undeniably a spatial concept typical of the Renaissance, a concept that Steen Eiler Rasmussen believes to have replaced the previous Gothic concept of space: "Just as the Gothic column spread out in all directions in a series of shafts, so did the Renaissance cavity extend outwards by the addition of niches"[11]. The characteristic feature of Renaissance space is the concatenation of hierarchical cavities extending outwards from the centre of the empty space, a concept of space that attributes a residual nature to the solid matter of the surrounding walls. The solid elements lack an autonomous shape, their purpose being merely to provide a backdrop against which the string of shapes that comprise the interior space can stand out clearly.

The detail of St Peter's is not, in fact, a complete depiction of its architecture but an attempt to delimit the shape of the interior space, accurately conveying its outlines and omitting both the building's exterior envelope and the imprint on the plan of the matter that would necessarily have to bear both. This plan depicts just a surface with no thickness: the surface that separates solid elements from empty elements.

When Serlio drew the entire plan of Bramante's study to include it in his treatise (fig. 5), he filled in the interstice between the interior and the exterior (the horizontal section of the building's solid structure) with regular hatching that revealed its residual na-

12 / QUETGLAS, Josep, *El horror cristalizado*, Actar, Barcelona, 2001, p. 90.
13 / PETERSON, Steven Kent, "Space and Anti-Space", in *The Harvard Architecture Review*, vol. I, spring 1980, pp. 101-102.
14 / The idea of deformation is inherent in the meaning of this term in everyday language. The verb *pocher – poché* being its past participle – is associated with "to pressure or hound", whilst *oeufs pochés* are poached eggs and an *oeil poché* is a black eye (caused by a blow). Another interesting use of the term is *écriture pochée*, handwriting "in which all the letters are misshapen and full of ink blots". This final meaning is the same as the definition of *poché* defined in architectural vocabulary in all respects. See LAROUSSE, Pierre, op. cit.; FÉRAUD, Jean-François, *Dictionnaire critique de la langue française*, Paris, 1787-1788; and also *Dictionnaire de l'Académie française*, 1694, 1st edition and ss.
15 / CASTEX, Jean, *Renacimiento, barroco y clasicismo. Historia de la arquitectura, 1420-1720*, Ediciones Akal, Madrid, 1994, p. 262. The author refers to the neologism coined by Robert Venturi, who defined "open-*poché*" as "the residual space that is open". See VENTURI, Robert, op. cit., p. 131.
16 / As Jacques-François Blondel, a master of Ledoux and many other eighteenth-century architects, recommended in his commentary on the plates about architecture in *L'Encyclopédie*.

ture as opposed to the deliberate geometry of the interior spaces. This texture is used on the plan to portray the "negative" space of the building: the place "we will never manage to enter, where entrance is forbidden"[12] and awaits a chance to show its potential. This plan already provides several opportunities: the spiral staircases going up to the dome, for example, hollow out the four central supports and reveal the capacity of the thick walls, or in other words, the literal *poché* of the plan, to contain inhabitable spaces. These staircases are also "the *poché* of the plan, but the *poché* revealed as empty"[13].
If we looked at just one of the four centre piers in St Peter's (fig. 6) we would conclude that its shape is merely a secondary phenomenon of the geometry of the surrounding space. In this instance, a massive solid has been deformed, giving way to the geometric authority of the void. Everything seems to suggest that the meekness of the matter is also that of the shading used to depict it on the plan: the main feature of the nature shared by *poché* and its subject, is that it offers no resistance whatsoever to deformation[14]. The pier in St Peter's has an obviously iconic dimension. One might say that it is the most elementary, graphic expression of the classic idea of space which, as such, was to be crystallised in many other works. When, for example, Francesco Borromini drew a partial plan for San Carlino's church (Rome, 1641), he once again depicted the interior like a cavity dug out of a theoretical solid which abstracted the actual building in which it was located (fig. 7). The meandering, interior perimeter is accompanied by the outline of the main façade alone. The rest is apparently not part of San Carlino's architecture. However, it is not possible to understand how the building is made and the mechanisms the architect used unless everything Borromini omits from his drawing is taken into account.
The site of the church inside the convent is virtually a rectangle with one corner cut off by the wall where one of the four famous fountains is located. Despite this, the church has an extremely complex geometric silhouette in deliberate contrast with the sober regularity of the rest of the convent.
This fact presupposes the existence of a residual area that accommodates both geometries, an area which Borromini omits from his drawing. Just an incipient hatching along the interior outline of the church can be seen, as if the only purpose of this "residue" was to act as a fill-in or texture. We may, therefore, say that *poché* is inherent in the very idea of San Carlino's church, being the only tool at the architect's disposal for imagining shapes totally out of keeping with their intended location, a resource that facilitates the difficult unity and bonding of the whole. It is not the subject of the project and is therefore not depicted but it is an essential tool for draughting the form of the church. In this respect, Borromini's work requires not only the ancillary lines that construct the complex geometry of San Carlino's church but also the passive, deformable support of its perimeter. Although on the plan it is left blank or has just a simple hatching around the edge, the domain of residual space is in fact an area tacitly filled in with matter, or is, at least, in the mind of the architect at some fleeting moment when designing his work, a moment captured in architectural drawings like this one.
Another similar plan (fig. 8) features a superimposed series of different versions of the project. Time and time again the architect's pencil lingers upon the church's silhouette, defining even its tiniest details. The plan is blank in the middle to convey the absolute vacuity of the interior space: the church is a veritable void whose depiction on the plan cannot be mistaken. Towards the perimeter a "vast, unlined area", referred to by the historian Jean Catex as an "open *poché*"[15], spreads out and fills the interstice between the church and the side façade of the convent. Confusion reigns in this area occupied by several minor rooms unable to find their definitive location. The perimeter of the church advances towards the precision of its contours whilst the *poché* moves in the opposite direction, disconcerting beholders puzzled by the combination of solids and voids, as if these two conditions had come to a sort of compromise here. The very essence of these residual rooms is at odds with the stability of their form, unlike the "visible" architecture of San Carlino's church governed by classical norms. How else can the plan of these areas be depicted except by inaccurate, hesitant pencil strokes in each corner of the double-bottomed building? The architect is determined in the centre and hesitant at the perimeter: this place is simply the condition the city imposes on architecture struggling to break free. This drawing awakens even more interest because it seems to represent more than just a specific moment in the design of the building. It may express the passing of time through the work, being a sort of portrayal of the lives of the forms found in it, some of which reveal their permanent nature and others their likelihood of changing, ever-willing to adapt to unending modifications in the future.
Finally, another plan by Borromini (fig. 9), in this instance of Sant'Ivo's church (Rome, 1643-60), invites a similar analysis. Like San Carlino's, the shape of this church does not fit easily into the end of the Della Sapienza cloister. Borromini resorts to *poché* once again to fill in the interstice bridging the geometric differences. Notice how the hatching in this area is less dense than in the church walls: two textures heralding in those subsequently commonplace in the Beaux-Arts school, *poché pur* and *poché dilué*, the purpose of which was to differentiate between the bearing structure and the service areas situated inside or near it.

2
Despite the eloquence of these Italian forerunners, it was French architects of the 18th century who developed the most practical application of the depiction technique under study here, for it suited a type of planning that evolved considerably in France during the Ancien Régime. In the 17th century *poché* was already a frequent feature in the plans of houses by Le Vau, Le Pautre, Franque and Ledoux, amongst others, and in theoretical texts by Savot, D'Aviler, Blondel and Laugier, and later ones by Durand, Reynaud, Daly and Guadet too, who were to demonstrate throughout the 19th century that the codified principles applied by their predecessors to plan layouts were still relevant. Indeed, throughout this period, the art of the plan remained virtually unchanged despite a series of styles or culture changes, thereby perpetuating the graphic technique that was to be a vehicle for the translation of a school of thought into architectural work. Only the subject changed: from Italian Baroque churches to eighteenth-century, French *hôtels* (the urban palaces of the aristocracy) and then to the nineteenth-century, middle-class buildings that sprang up in Haussmann Paris. What had been merely a possibility for the Italian forerunners was to become a reality thanks to French architects: the actual inhabitability of *poché* and how it was used to overcome contradictions of form and use in order to reconcile the regular, symmetrical figure and the inevitable imperfection, and to visualise the desire for perfection that does not rule out a tacit acceptance of the incidental.
One of the most singular examples of the *poché* plan in eighteenth-century France is Hôtel de Montmorency (Paris, 1772) by Claude-Nicolas Ledoux (fig. 10). The *hôtel* plan is a cluster of rooms with specific shapes joined together by the agglomerate material of the walls and hidden spaces, both depicted on the plan by similar hatching of different densities, as in the case of Sant'Ivo's church mentioned above.
The aim of this type of drawing is to clearly depict a spatial sequence through connected, adjoining rooms, dispensing with secondary rooms which are omitted by relegating them to the background of the drawing against which the figures stand out. By focussing attention on the main spatial events, the rest apparently shifts into a secondary visual plane, integrating the set of attributes in the work that fall outside what Robin Evans baptised the architect's "field of visibility". To notice them, we must use peripheral rather than focal vision: something the graphics of the plan aim to avoid at all costs.
Ledoux marks the enfilades – the views linking the suites of rooms in the *hôtel*'s main spatial sequences[16] – on his plan with dots. The homes of the aristocracy were simply a visual mechanism designed to impress. However, like all theatrical devices, they fea-

17 / Augustin-Charles D'Aviler's companion glossary to his 1691 *Cours d'architecture* defines *dégagement* as "a small passageway or small staircase along which we can slip away without having to go back through the same rooms" (v. 2, p. 543).

18 / GUADET, Julien, op. cit., vol. 1, pp. 122-124. These "sacrifices" had governed the French discipline of distribution since Louis Savot's warning in the early 17th century, "Just as it is impossible for any self-respecting art to aim for the perfect fulfilment of all rules (…), sometimes because some rules make others impossible, so are we sometimes obliged to enlarge or reduce a small room in a building in order to make the dimensions of a more important room more perfect". See SAVOT, Louis, *L'Architecture françoise des bastiments particuliers*, Sébastien Cramoisy (ed.), Paris, 1624, p. 208.

tured hidden machinery enabling them to be set in motion and have an effect. It would, however, be naive to think that these were the only ways the architect had designed for moving through the *hôtel*. Far from it, a variety of routes were provided by many shorter, practical connections between main and secondary rooms. Despite the imposing enfilades, it was in fact these *dégagements* (exits or corridors hidden behind false doors)[17] that set the plan in motion. Just as the decoration in the rooms of the completed building would conceal these routes and make them invisible to anyone unaware of their exact location, so did the graphics of the plan avoid making them obvious, as if it were a map designed to encourage people to take roundabout ways or get lost by hiding the shortest, quickest way to the desired destination.

The print of Hôtel de Montmorency in Daniel Ramée's edition of Ledoux's treatise *L'Architecture considérée sous le rapport de l'art, des moeurs et de la législation* (1847[2]) features the three floors of the *hôtel*, a section of the central antechamber and an detailed elevation (fig. 10). It had been published previously in Kraft and Ransonnette's compendium *Les plus belles maisons et hôtels construits à Paris et dans les environ*s (1801-02), but the two drawings could hardly be more different (fig. 11).

Apart from certain contradictions in the *hôtel* layout, the first thing to catch the eye is that Kraft and Ransonnette did not use *poché* to shade in the residual or service spaces. On the contrary, all the rooms in the house are depicted in the same way on these plans, regardless of their rank or purpose. Whilst it is true that these authors applied the same criteria to the other prints in their compendium, what makes Ledoux's case all the more surprising is that in his own treatise he used the same graphic techniques we described earlier to depict all his works: he incorporated into *poché* the spaces that he wanted to make people overlook when glancing at his plans. We can imagine Ledoux, pencil in hand, looking at Kraft and Ransonnette's plan tirelessly marking – as he had done earlier on the plan of the Tabary *Pavillon* (1771-73) (fig. 1) – the areas and places whose main purpose on the drawing was to disappear from the field of vision and merge into the background. The architect would shade the surface meticulously: every effort made in this task would support his argument when contemplating the plan. In doing so, Ledoux provided a graphic version of the "necessary sacrifices" Julien Guadet was to refer to more than a century later as when he summed up the architect's labour as "a series of sacrifices", distinguishing between "what should come first" and what should, on the other hand, "be sacrificed". The *poché* on the plan would conceal these sacrifices and make them invisible and thereby extol the perfection of the work[18].

This different plan concept was accompanied by an even more obvious difference in the way the elevations of the *hôtel* were depicted. Whereas Ledoux produced an unfolded elevation of the three sections it comprised – the two main façades and the corner façade – as if they were a single, completely symmetrical façade, Kraft and Ransonnette depicted one of the building's façades in its actual setting. Ledoux omitted the adjoining buildings and any other detail that might allude to his *hôtel*'s setting, whilst Kraft and Ransonnette provided detailed drawings of the buildings nearby and their drawing is, furthermore, steeped in reality thanks to the human figures that the creators included as a reflection of the lifestyles anticipated in connection with the *hôtel*.

The difference concerns not only breadth but depth. Ledoux's treatise is a scholarly work at the pinnacle of eighteenth-century, architectural theory. Kraft and Ransonnette's book is merely a compilation of houses of the high society of that period that could be examples for new architects or, to be more precise, new customers in society after the Revolution. The approach of these authors is clearly atheoretical. The only text in their compendium is the short descriptions of each of the buildings illustrated. Perhaps this is why their portrayals are far more realistic than Ledoux's, because they aimed not to embody essential principles or high levels of perfection, but merely to provide examples worthy of being followed or imitated.

The case of the Maison d'Evry by Ledoux is not very different (fig. 12). The architect rarely had to deal with such a complicated plot of land. The outline of the courtyard hides the geometric imperfection from sight: we might say rather that the latter is depicted transformed like part of the visual construction of the work without detracting from its wholeness. The shape of many of the rooms in this house reproduces the outline of the courtyard on different scales, whilst *poché* fills in the residual areas of the plan, ensuring a regular shape and hiding any defects that might interfere.

Any search for the intricate networks that wind their way around the heart of Hôtel de Montmorency would be in vain. Nevertheless, the plan distribution method is basically the same, and likewise its desire for perfection, despite the unavoidable circumstances of the site. Indeed, Ledoux's elevation is one of a free-standing building surrounded by leafy woodland (fig. 13). He may, in his mind's eye, have perceived no defects (distorted in the *poché*) and so felt entitled to dream of a building which, thanks to the masterful plan, finally managed to escape from its site and become autonomous.

3

To follow the trail of *poché* through the 19th century would require far more pages than those available here for discussing the mark this depiction technique made on the architectural culture of Europe in recent centuries. If, on the other hand, the intention is to note the different meanings it had during its protracted existence, we need look no further than the peak of this evolution, the logical culmination of a practice which changed considerably in the late 19th century to adapt to new building techniques. One might, therefore, wonder what sense it made at that point in history to carry on using a drawing technique based on the actual matter of the solid walls of another period for depicting the lightweight steel or concrete structures to be used in new buildings. Auguste Perret's work provides a possible answer.

Perret managed to reconcile the traditional French distribution, in which the main spatial concept was the room, with the new building technique of reinforced concrete able to cater for other more open-plan spatial concepts. When looking, for example, at the plan of apartments in the Galtier building (1931-33) (fig. 14) – whose concrete structure enabled each storey to have a different layout – our selective attention is drawn first to the two groups of regularly shaped rooms situated alongside the building's façades. The rest, apart from the main corridors and vestibules, will be overlooked at first sight. The shading that seems to deny their existence is none other than a nod to traditional *poché*, the meaning of which permeates the pattern of the flooring in the flats' service areas. In the absence of the shelter provided by the thick walls of days gone by, it seems reasonable to resort to this ruse to give the same impression of massiveness in the areas of the plan that the architect deliberately seeks to make less visible.

This link reveals Perret's adherence to the old parameters of spatial distribution according to which the main rooms were a sort of cavity dug out of the theoretical solid consisting of the bearing structure and the service rooms. Perret continued to produce variations of the traditional *poché* theme as if the pressure that matter exerted upon void was still present. Even though all this original thickness had been transformed into inhabitable space, the architect depicted it on the plan as a tiled floor that endowed a "pretend" density very similar to that of the hidden rooms in Ledoux's eighteenth-century *hôtels*. As a result, this drawing technique was perpetuated despite buildings becoming gradually lighter, whilst retaining part of their original meaning based on the matter itself.

Identical comments could be made about how the floor surfaces in service rooms are drawn in the Gaut house (Paris, 1923) (figs. 15-16) for, like the thick walls of years gone by, they help identify the main areas and, more specifically, the hexagonal hall in the centre. Their purpose is not to depict a detailed flooring but to reveal a texture.

Like the sites upon which the Gaut house or the Galti-

19 / Architects such as Le Corbusier and Louis I. Kahn, for example, reinterpret in different ways the Beaux-Arts *poché* which endows residual elements with a hitherto unheard of importance in planning, either as a central element in the plastic interplay fostered by Corbusier's *plan libre* or the tectonic translation of the surrounding wall to Kahn's free-standing column. An in-depth analysis of these "semantic shifts" of *poché* is beyond the scope of this paper. See COLQUHOUN, Alan, "Desplazamiento de conceptos en Le Corbusier", in *Arquitectura moderna y cambio histórico*, op. cit., pp. 113-126; LUCAN, Jacques, "Généalogie du poché. De l'espace au vide", op. cit., pp. 42-43.
20 / Hence the reverse chronological order in this epigraph.

er building were erected, the urban plots Perret worked on in the course of his career differed little from the irregular sites built on by eighteenth-century architects. Both sought the same thing: to rid themselves of incidental elements, implicitly assuming the specific characteristics of the site and the function and thereby, and in this way alone, managing to move beyond them. Although it cannot be said that this desire was the result of using a drawing technique such as *poché*, without *poché* it would have been difficult for such plans to have become a vehicle for conveying this desire for perfection, inevitably curtailed by the site's actual conditions and the exacting demands imposed by its purpose. Perret's study was undeniably in keeping with this tradition and paved the way for far more radical interpretations of its basis[19].

In some respects, Perret's career regressed for the ideal and the circumstantial dichotomy culminated in one of his first works: the building on Franklin street (Paris, 1903-04) (fig. 17)[20]. This building slotted into a cramped plot aspired, in fact, to be a tower. Its desire for autonomy is reflected in the cluster of rooms in the middle, moulded to the plan by the *poché* spaces around the edge (the stage wings). The architect does not, however, use a specific type of graphics for them. Quite the contrary. The plan is completely neutral, which draws attention to its apparent spatial fluidity despite not having developed much since the French plans of the eighteenth century governed by the *dégagement* mechanism.

Paradoxically, when Perret shaded in the floorings on the plan of this building (fig. 18), he only left the perimeter of the plan blank. In doing so, he inverted the usual method in which textures were used for residual spaces. This is such a major turnabout that the plan ceases to be seen as a void carved out of a suitable solid, and encourages the eye to see the opposite: a solid keeping its distance from the edges of the plan. This subversion would obviously have made no sense in San Carlino or in an eighteenth-century *hôtel* and the reason why it makes sense here is that it heralds in the shift towards the new spatial approaches that emerged in the opening decades of the 20th century.

In short, the building on Franklin street is the swan song of a secular practice of uncertain origin which only eighteenth-century, French architects consecrated as a veritable art but which was accepted by classical culture as a whole to be the graphic translation of its spatial contents: the *poché* drawing. Like the Kantian dove able to fly ahead thanks to the friction of the very air that is its main obstacle, so was the architecture described here able to thrive upon constraints and lean upon them, making more progress than had they been absent and thereby, thanks to these sacrifices, managing to depict a purer, more distant and inaccessible ideal.

REMOTE-SENSING IMAGE FUSION: SUPPORTING THE URBAN-ENVIRONMENT INTERPRETATION

by Juan F. Reinoso Gordo

Abstract

The suitable image fusion for an urban-environment interpretation is composed of a panchromatic image (PAN) which is merged with a multispectral one (MS). The PAN contributes high spatial resolution which is visualized in grey tones. The MS contributes the colour yielded by several bands (usually the red, green, and blue: RGB). The fusion results in an image which possesses both a high and spectral resolution. In this study a standard method, the IHS transformation fusion, is performed, indicating the colour-distortion problem. We also carry out a multiresolution fusion technique which is wavelet based and solves the colour-distortion problem. Finally, we use a recent algorithm which takes into account the potential image anisotropy. This algorithm adds a multidirectional analysis for fusing images. On the other hand, fusion quality should be studied from a quantitative standpoint, and therefore we have computed some measures which have proved useful in the specialized references. A visual evaluation is also necessary for drawing conclusions concerning the methods. We use QuickBird satellite images because they have very high spatial resolution. This high spatial resolution enables very good object identification in the urban environment.

Keywords

Panchromatic, multispectral, fusion, IHS, multiresolution, wavelet, multidirectional, QuickBird

1. Introduction

Remote-sensing images (from satellites or aerial photography) are used every day by mapmakers, territory planners, and those working in the Earth Sciences. The high-spatial-resolution satellite images, as in our study case (QuickBird satellite), have special interest in the urban-analysis field. The PAN image is 0.7 m size on the ground, and the MS size is 2.4 m. The spectral resolution from the MS QuickBird is of 4 bands belonging to infrared, red, green and blue (RGB) wavelengths. On the other hand, PAN is a single image which records the visible spectrum bandwidth. In this study, only visible spectrum bands from the MS are used: RGB. Diverse works have dealt with satellite image fusion, e.g.: Núñez, 1999; Zhang, 1999; Li et al. 2002; Zhang et al. 2005. The starting point in the aforementioned works is that registration must be accurate, signifying that the positional discrepancy between PAN and MS must be under subpixel size.

Amolins et al. (2007) classified the fusion methods as standard, wavelet based, and hybrids; we believe that multidirectional methods should be added to this classification. We consider the algorithm of Lillo (2004) because its multidirectional capability detects the anisotropy image. The standard methods can detect the PAN image geometry very well and incorporate it into the MS, but these methods produce colour distortion in the fused image. This signifies that wrong colours are assigned to places on the fused image where the original showed different colours. If there is a band for which the wavelength is not overlapped by the PAN bandwidth, the colour distortion is increased. This problem arises when considering the infrared band in the QuickBird satellite. The multiresolution method based on wavelets (Núñez, 1999) achieved a solution for the colour-distortion problem. This method takes the PAN details, incorporates them to the fused image, and keeps the original colour from MS. The wavelet-decomposition technique, was at first based on the Mallat algorithm (1989). When singular objects are present in the scene, the Mallat algorithm yields 'ring' troubles, as a consequence of the Gibbs effect. The cause of the ring problem is the decimated character from the Mallat algorithm: at each stage the image size is reduced 1/4 with respect to the previous stage. The ring effect is eliminated using an undecimated algorithm, such as the 'à trous' algorithm (Shesa, 1992) which signifies with holes. The most recent multidirectional algorithms include some which are extensions to the wavelet based ones: curvelet techniques (Càndes et al. 2000), contourlets techniques (Cunha et al. 2006) and ellipsoidal filter used by Lillo and Gonzalo (2004).

The fusion-quality evaluation has been a broadly studied issue. Several measures which assess both the spatial and the spectral quality from the fused image have been developed (Zhou, 1998; Wald, 2000; Wang, 200, 2004). Additionally a visual evaluation must take place for complementing the quantitative measures. Below, we present the fusion methods (HIS, wavelet and multidirectional), the quality measures and a QuickBird image which is fused by the above methods. A result analysis is also performed.

2. IHS fusion

The capability of representing a colour image by two different coordinates system is the basis for the IHS fusion method. The RGB system is the most frequently used system, which stores the image in three different matrices, each for a component colour: red, green and blue. The other system keeps the image in three matrices which represent the intensity, hue and saturation (IHS). The intensity component maintains the spatial structure of the image while both hue and saturation constitute the spectral structure. Although the PAN image is shown in a grey scale, it can be broken down in the IHS system; as its spatial resolu-

tion is higher than the MS one, its intensity component (I) keeps such resolution. The transformation consists of replacing the I component from the MS by the I component from the PAN. The new fused image is expressed again in the RGB system for visualization. Colour distortion is minimized if before replacing the I component, the histogram PAN image is equalized to the histogram MS. With that modified, PAN undergoes IHS transformation (Figure 1). The transformation from RGB to IHS is expressed by Eq. (1), and the IHS to RGB is expressed by Eq. (2).

3. Wavelet fusion

The wavelet transform can break down a signal (in our case an image) into two parts. One part corresponds to an approximation (a coarse image) and the other corresponds to the details (geometry of singular objects). Mathematically the image *f(x)* can be expressed as in Eq. 3:

$$f(x) = \sum_{k} c_{Jk}\,\phi_{Jk}(x) + \sum_{j=1}^{J}\sum_{k} d_{jk}\,\psi_{jk}(x) \qquad (3)$$

where c_{jk} y d_{jk} are the approximation and detail coefficients from both the scale $(\Phi_{jk}(x))$ and wavelet $(\Psi_{jk}(x))$ functions, respectively. *J* indicates the decomposition resolution level at which the image is broken down. The scale $\{\Phi_{jk}(x)\}$ and wavelet $\{\Psi_{jk}(x)\}$ functions set an orthonormal basis for the subspaces V_j y W_j, which are mutually complementary.

The mother wavelet and the scale function are expressed in dyadic form by the Eq. (4)

$$\Psi_{j,k}(x)=\sqrt{2}\Psi(2^{j}x-k);\quad j,k\in Z;$$
$$\Phi_{j,k}(x)=\sqrt{2}\Phi(2^{j}x-k); \qquad (4)$$

While $\Phi_{jk}(x)$ works as a low-pass filter, $\Psi_{jk}(x)$ serves as a high-pass filter.

The wavelet-fusion algorithm is structured as follows: Three new PAN bands are yielded (PAN_R, PAN_G, PAN_B). This is achieved by matching the PAN histogram to each histogram from the three bands (R, G and B) in the original MS.

Each band in the original MS is broken down by the wavelet transformation. This breakdown yields three detail images ($R_{Detall.}$, $G_{Detall.}$, $B_{Detall.}$) and three approximation images ($R_{Aprox.}$, $G_{Aprox.}$, $B_{Aprox.}$).

Each PAN_R, PAN_G, PAN_B is broken down by the wavelet transformation. This breakdown yields three detail images ($PAN_{R\text{-}Detall.}$, $PAN_{G\text{-}Detall.}$, $PAN_{B\text{-}Detall.}$) and three approximation images ($PAN_{R\text{-}Aprox.}$, $PAN_{G\text{-}Aprox.}$, $PAN_{B\text{-}Aprox.}$).

Each band produces a new fused band which is composed by the PAN details ($PAN_{R\text{-}Detall.}$, $PAN_{G\text{-}Detall.}$, $PAN_{B\text{-}Detall.}$) and by the MS approximations ($R_{Aprox.}$, $G_{Aprox.}$, $B_{Aprox.}$).

This yields the definitive fused-colour image (Eq. 5)

$$RGB_{Fusionada} = [\,R_{Aprox.} + PAN_{Detall.},\ G_{Aprox.} + PAN_{Detall.},\ B_{Aprox.} + PAN_{Detall.}] \qquad (5)$$

Figure 2 shows the sequence involved in the process. The images ($PAN_{R\text{-}Detall.}$, $PAN_{G\text{-}Detall.}$, $PAN_{B\text{-}Detall.}$) and ($PAN_{R\text{-}Aprox.}$, $PAN_{G\text{-}Aprox.}$, $PAN_{B\text{-}Aprox.}$) are omitted so as not to increase the figure size; the $PAN_{Aprox.}$ and $PAN_{Detall.}$ extracted from the original PAN are shown only by way of an example.

The algorithm uses the cubic B-spline functions which are translated in the two-dimensional filter in the Eq. 6. This filter is performed inside the undecimated 'à trous' algorithm (Shensa, 1992).

4. Multidirectional multiresolution fusion

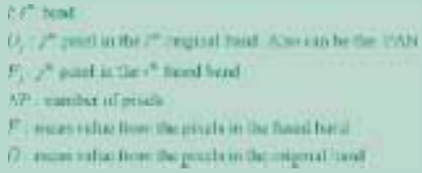
This algorithm captures more precisely the details which are not in horizontal, vertical, or diagonal directions (Lillo and Gonzalo, 2007). This is an advantage, a *priori,* respect to the wavelet algorithm which could take into account only the three aforementioned directions. The performance difference is in the way the details are computed (there are as many resolution levels as directions to be analysed). Each approximation images is achieved by the ellipsoidal filter *H(u,v)* shown in the Eq. 7.

Figure 3 shows the scheme for determining both the approximation and detail images for the multidirectional algorithm. Once the approximation and detailed images are yielded, the remaining phases are the same as in the algorithm from Section 3.

5. Measures for assessing the quality

The measures assess both the spectral and spatial quality. This is achieved by comparing the fused image with either the MS original (which gives an idea of how well the spectral aspect is kept) or the PAN (which gives idea about how the geometrical details were incorporated to the fused image). To evaluate the objectives, we selected 7 measures.

The notation used is as follows:



- Universal Quality (ICU) (Wang y Bovik, 2002). See Spanish version.
- Correlation Coefficient (CC). See Spanish version.
- Structural Similarity Index: this measures the structural information in the fused image (ISE) (Wang et al., 2004). See Spanish version.
- Discrepancy (DC). See Spanish version.
- ERGAS (Wald, 2000). See Spanish version.
- Zhou index (Zhou et al., 1998). See Spanish version.
- Spectral-angle mapper (SAM) (Nencini et al. 2007). See Spanish version.

Three tables have been created for comparing and analysing the fusion methods:

- Table 1 (spectral measures): each measure is computed between homologous band (e.g. the red bands) belonging to the fused and MS image, respectively. The measure is determined for each of the three bands; this implies that three measures for each fused images is yielded; the mean is computed from the above mentioned three measures. This mean enables us to compare the suitability from the methods. The higher the mean value is, (except for the Discrepancy measure), the better the colour transmission from the original MS to the fused image is performed.
- Table 2 (spatial measures): the measures in this table do not yield a band-by-band value but each measure is an overall value for the quality fusion. The spatial aspect is evaluated by the spatial ERGAS measure while the spectral aspect is evaluated by both the SAM and spectral ERGAS measures. In this table, the lower the measure value, the better the fusion performed.

Note that all measures are not applied to both spectral and spatial evaluations because some measures have no spectral or spatial interpretation .

6. Analysis and discussion

The IHS method provides the best spatial values, as shown in Tables 2 and 3; nevertheless, a visual evaluation from Figure 4 detects colour distortion in the IHS method, specifically on both the trees and roofs which have an orange colour in the original MS. An intensity loss is also noted in the pink square. The Wavelet and Multidirectional methods register similar values in both the spatial and the multispectral aspect. However, from the visual evaluation, it seems that the colours yielded by the Wavelet are more faithful than the Multidirectional technique. In any case, the latest method (Wavelet and Multidirectional) have the property for achieving a good fusion: offering a unique fused image with the high spatial resolution from the PAN and the high spectral resolution from the MS.

7. Conclusions

The image-fusion methods presented in this study are useful in the geographic information integration, specifically the urban information from images with different resolutions (PAN and MS). It is possible to assign objects to the correct category, while if PAN and MS are observed separately, this would not be possible. This ability implies great support for people who must interpret the urban environment from examining urban images (in our case images are from a QuickBird satellite).

1 / GREIMAS A. J. y J. Courtés, *Semiótica Diccionario razonado de la teoría del lenguaje*, Tomos I y II, traductor Enrirque Ballón Aguirre, Editorial Gredos, Madrid, Tomo I 1990, Tomo II 1991, p 96-100 y p. 63-69 (respectivamente).
2 / PÉREZ CARABIAS, Vicente, *Grafoaje y creatividad*, Universidad de Guadalajara, Guadalajara, 2006, p. 35. Most of the expressed in the present article has this publication as reference.

3 / ROBADOR, Ohiana, *Georges Rouault, Al margen de las doctrinas*, Ediciones Universidad de Navarra S. A., Pamplona, 2004, p. 182.
4 / Citado por SEGUÍ, Javier, "Notas acerca del "dibujo de concepción"", 1986, en *Escritos acerca del dibujar y el dibujo y del proyectar y el proyecto arquitectónico*, Cuadernos del Instituto Juan de Herrera de la Escuela de Arquitectura de Madrid, Madrid, p. 4.
5 / ROBADOR, O., *op cit.* p. 191.
6 / SEGUÍ, Javier, "Anotaciones acerca del dibujo en la arquitectura" 1993, en op. cit.. p. 11.

7 / ROTHKO, Mark, *La realidad del artista. Filosofías del arte*, Editorial Síntesis, Madrid, 2004, p. 87.
8 / *bid.*, p. 83.

ABOUT THE STRUCTURE OF GRAPHUAGE OR DRAWING

by Vicente Pérez Carabias

The semiotic frames are the visual representations of logic joints. They represent the elementary structure among at least two opposite terms. The binary use under two points of view predominates in simultaneous occasions, generating second generation frames. V. Brøndal sustained the existence of structures with six terms united among them. The semiotic frame can be well compared with Piaget´s INRC group (group of four transformations: identical, inverse, reciprocal and correlative).[1]

With total disregard to the last exposed but considering some aspects established by Claude Lévi-Strauss in his *Antropología structural* in relation to oppositions and transformations, we proposed ourselves the study of drawing as "[….] a system of signs for the representation of the third dimension, that aids architects, urban designers, designers (industrial, graphic, interior) and also sculptors, painters and sketchers, in the mental processes of handling space, form or figure (mental spatial imaginings),"[2] which we name *graphuage* in order to clearly identify it from language; according to Umberto Eco we could also call it «iconic code», although such code might arouse the traditional controversy between paint and drawing and we are already inclined towards drawing –for the moment- without leaving aside or ignoring the plastic possibilities of paint with color.

So, we understand graphuage as a complementary form of thinking, evaluating and offering solution to very diverse problems that require logics and sensibility different to verbal traditions, and thus, very important in the process of conceiving and communicating the projected objects.

Drawing, then, participates in the comprehension, representation and transformation of the world. Its outstanding importance for architecture, initially led us to establish the difference among the two principal communication systems used by the human being, the linguistic and the iconic that seem to respond to both cognitive styles proposed by different thinkers, starting from Aristotle. We start from the difference between practical and speculative intellect with their consequent separation in mechanic and liberal arts. The practical turns to solving problems *de facto,* the theoretical to the search of truth. The first makes use of space – time operations using a pre verbal or pre conceptual logic; the second one uses formal or logic operations to reach its goals. The separation, through history, of both thinking styles, lead Piaget to his rupture between practical intelligence and cognitive intelligence.

We are based upon the substantial difference, and of complementary character, between those two ways of thinking, the practical intelligence and the speculative. That difference is clearly expressed by Rouault, from whom, thinking, to a painter is to have sensible a sensible creative vision of form and color and the faculty to express himself with better or worse pictorial assert,[3] but this way of thinking is manifest during the act of drawing or designing which agrees with the exposed by Cézanne: "[...] conception cannot proceed execution because configurations can never be translations of clear ideas."[4] The act is a process, but particularly at its beginning has to be taught in the painter's logic and by means of sequenced acts. This way of thinking according to Piaget, implies a pre conceptual or pre verbal logic, but it's a way of thinking that "[…] leaves aside all supposed logic and the composition recipes towards the development of a more intuitive, faster drawing in which the perspective the or the volume of the formal elements are not, at first, principal matters."[5] This schematic drawing, as a way of thinking, explains Ohiana Robador, derives from Rouault´s acceptance as to the need of evolution in the artist's drawings; this concern related to drawing was common to almost all painters in the transition of modern art, like Cézanne or Picasso. This «graphic thinking» that Seguí clearly defines "passes in time and implies a group if images of different kinds".[6]

As of authors like Nelson Goodman and Susane Lange the opposition between discursive languages like literature, poetry and music and the iconic languages like painting and drawing, has been proposed. The outstanding difference is in the development of the first in time and the second in space, at least in the bi dimensionality of a surface. Goodman himself classifies the systems of symbols according to a degree of «*notacionalidad*», this is, the grade of concretion and objectivity that a writing manifests considering semantic and syntactical criteria, this aspect is similar to the scale of iconicity of Abraham Moles towards the visual aspects and its similitude to reality, which would imply the same form attachment to pictorial conventions. These scales or degrees led us to propose another opposition in this case, in the sense of evolution of concretion or objectivity of the message, proposing in the vertical sense the binomial that implies a transformation from the artistic or metaphoric languages towards the scientific or concrete language.

At this point we must make clear that the resultant, a «frame», pretending categorization, schematically represented our ideas in a conventional way, but the visual orientation asked for some adjustments to the graphic.

At the end of our investigation about Piaget´s theories in the area of psychology and genetic – constructive epistemology, it is perceived from the four Piaget stages of the formal logical construction up to the latest studies published by Rolando Garcia showed that, the actions achieved in the first stages were notably richer than in the last stage of the formal logic, where the mathematical operations are reduced to only six and in the INRC group of the logical operations of Piaget –as we see– is limited to four, the latest compared with the infinite actions of movement in space with which begins the formation of logics.

These considerations led us to propose a trapeze in representation of a shell hole with only two binary groups, the first of opposition and the second of transformation, as axis of genetic or historical evolution, as can be seen in image 1.

The scheme proposed in the «Frame», was the same as the one made by Brigitte Chavallier focused on explaining the functioning of the brain, partly on the discoveries of Dr. Sperry about the sidedness of the brain's functions placing the linguistic on the left side and the spatial on the right. In the axis of transformations he registers the evolution of the brain from the reptiles, passing through the limbic brain (place of emotions) ending in the crust or superior brain, that is the last to be constituted and in which lays all reasoning; thus, passing from the primary processes of emotions, to the secondary processes of reason.

In his *Lógica del límite* Eugenio Trías presents a categorization of the arts in a «frame» in which we agree in general, mainly in the opposition between arts in state of rest or of space and arts in movement or of time. In the axis of transformations or of evolution, Trías starts with the environmental arts or non semantic, without language, and evolves towards the worldly arts, those of the sign. The same author places paint and literature, the graphic sign and the concept sign, in the lower extreme of his frame, agreeing with scientific languages.

In order to work specifically in the area of presentational arts, spatial, or of graphuage it was considered for the first opposition the difference proposed by Rafael Sanzio and Baldassare Castiglione between the drawing of the architect and that of the painter, to the last is granted the recently discovered perspective and to the architect the drawing in plant, façade and section or the *flat* representation of descriptive geometry. This separation between conic projections and orthogonal projections was forced with the differentiation G. H. Luquet makes between the "intellectual realism" that implies drawing as not only what you see in an object, but «what is known about it», and the "visual realism" represented by the submission of perspective.

In his posthumous book *La realidad del artista. Filosofías del arte*, painter Mark Rothko makes the same difference regarding paint, when he identifies «two schools», categories or «basic» differences since all the others are «corollary distances» "[….] the first belongs to *tactile* plasticity and the other the *visual* or *illusory"*,[7] about this last one he establishes that the frame creates an "identical illusion, as far as possible, as to what is seen through his sense of view",[8] the other demands "that a frame be a reality by itself, that its textures and movements satisfy directly a physical sensation of the