The Fourth Dimension and Cubism

Richard Hammack

http://www.people.vcu.edu/~rhammack/Math123/
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Pioneers of 4-D Geometry
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Georg F.B. Riemann
1826–1866
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Hermann Grassman
1809–1877
Pioneers of 4-D Geometry

Georg F.B. Riemann
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Arthur Cayley
1821–1895

Alicia Boole Stott
1860–1940
Pioneers of 4-D Geometry

Georg F.B. Riemann
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Alicia Boole Stott
1860–1940
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Models of 3-D cross section of 4-D dodecahedron,
Alicia Boole Stott, c. 1900
Collection of University of Groningen
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Collection of University of Groningen
4-D Polytope Slicer

See: dogfeathers.com

http://dogfeathers.com/java/hyperstar.html
TRAITÉ ÉLÉMENTAIRE

DE

GÉOMÉTRIE À QUATRE DIMENSIONS

ET INTRODUCTION

À LA GÉOMÉTRIE À n DIMENSIONS,

PAR

E. JOUFFRET,

Lieutenant-Colonel d'Artillerie en retraite,
Ancien Règle de l'École Polytechnique,
Officier de la Légion d'Honneur,
Officier de l'Instruction publique,
Membre de la Société mathématique de France.

PARIS,

GAUTHIER-VILLARS, IMPRIMEUR-LIBRAIRE
DE BERGUE DES LONDRES, DE L'ÉCOLE POLYTECHNIQUE,
Quai des Grands-Augustins, 41,
1903

130

CHAPITRE VII.

doncien immédiatement, comme projection sur le plan des a, b, c,
c'est-à-dire dans le compartiment à la figure 83, le carré qui
est dessiné avec des traits pleins et des points noirs, et dont les
côtés sont parallèles aux axes. Les quatrième et cinquième
carreaux donnent un carré partout dans le compartiment 0. Les

Fig. 91. — Les huit cases hexagonales qui limitent l'octaèdre.
Maurice Princet (1875–1973) introduced Picasso to this book.
Effect on Picasso *
Effect on Picasso *
Effect on Picasso *
Effect on Picasso *
Effect on Picasso *
Effect on Picasso *
Effect on Picasso

* According to some art historians.
numéro des sommets correspondants de l'hypercorps, se rapportent également aux deux ou aux quatre points dont ils sont voisins; nous ne les avons écrits qu'une fois, et il appartient au lecteur de faire le cas échéant, le triage des numéros se rapportant à l'un ou à l'autre de ces points. Chaque carré de A ou C,
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Pablo Picasso

*Portrait of Ambroise Vollard, 1910*
Fig. 31. — Diverses projections de l’octaèdreide, ou $O'$. 

La première et la deuxième colonnes du tableau ci-dessus nous
Les polyédres.

I. — Méthode géométrique.

La première et la deuxième colonnes du tableau ci-dessus nous

Pablo Picasso

Portrait of Henry Kahnweiler, 1910
Maurice de Vlaminck

Restaurant de la Machine at Bougival, 1905

Still Life, 1910
Maurice de Vlaminck

“I witnessed the birth of cubism, its growth, its decline. Picasso was obstetrician, Apollinaire was the midwife, Princet was the godfather.”

Restaurant de la Machine at Bougival, 1905

Still Life, 1910
Jean Metzinger, *Cubist Landscape*, 1918

Picasso lays out a free, mobile perspective, from which that ingenious mathematician Princet has derived a whole geometry.

Maurice Princet joined us quite often. Although quite young, thanks to his knowledge of mathematics he had an important job with an insurance company. But, beyond his profession, it was as an artist that he conceptualized mathematics, as an aesthetician that he invoked n-dimensional continuums. He loved to get artists interested in the new views on space that had been opened up by Schlegel and some others. He succeeded at that.
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Jean Metzinger

“Picasso lays out a free, mobile perspective, from which that ingenious mathematician Princet has deduced a whole geometry”
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“Maurice Princet joined us quite often. Although quite young, thanks to his knowledge of mathematics he had an important job with an insurance company. But, beyond his profession, it was as an artist that he conceptualized mathematics, as an aesthetician that he invoked $n$-dimensional continuums. He loved to get artists interested in the new views on space that had been opened up by Schlegel and some others. He succeeded at that.”
Max Weber,
*Interior of the Fourth Dimension*, 1913
Max Weber,
*Interior of the Fourth Dimension*, 1913

“The interior of the fourth dimension is the space around an art form which is stirred by the essence with which that form was vested by the artist.”
In plastic art, I believe, there is a fourth dimension which may be described as the consciousness of a great and overwhelming sense of a space-magnitude in all directions at one time, and is brought into existence through the three known measurements. It is not a physical entity or a mathematical hypothesis, nor an optical illusion. It is real and can be perceived and felt. It exists outside and in the presence of objects, and is in the space that envelops a tree, a tower, a mountain or any solid; or in the intervals between objects or volumes of matter if receptively beheld. It is somewhat similar to color and depth in musical sounds. It arouses imagination and stirs emotion. It is the immensity of all things. It is the ideal measurement, and is therefore as great as the ideal, perceptive or imaginative faculties of the creator, architect, sculptor or painter.
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Albert Gleizes
*Landscape with a Figure*, 1911
Albert Gleizes
*Landscape with a Figure*, 1911

Albert Gleizes
*Women in a Kitchen*, 1911
But beyond the three dimensions of Euclid, we have added another, the fourth dimension which is to say the figuration of space, the measure of the infinite.
Albert Gleizes,
*Brooklyn Bridge*, 1915

“But beyond the three dimensions of Euclid, we have added another, the *fourth dimension* which is to say the figuration of space, the measure of the infinite.”
Marcel Duchamp,
The Bride Stripped Bare by Her Bachelors, Even (The Large Glass),
1915–1923

The ideas in the Large Glass are more important than the actual realization. The "Large Glass" constitutes a rehabilitation of perspective, which had then been completely ignored and disparaged. For me, perspective became absolutely scientific.

What we were interested in at the time was the fourth dimension. Simply, I thought of the idea of a projection, of an invisible fourth dimension, something you couldn't see with your eyes.

Since I found that one could cast a shadow from a three-dimensional thing, any object whatsoever – just as the projecting of the sun on the Earth makes two dimensions – I thought that, by simple intellectual analogy, ...any three-dimensional object...is a projection of something four-dimensional, something we're not familiar with. "The Bride" in the "Large Glass" was based on this, as if it were the projection of a four-dimensional object.

See http://www.understandingduchamp.com/
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Marcel Duchamp,
*To Be Looked At (from the Other Side of the Glass, with One Eye Close to, for Almost an Hour...)*, 1918
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*To Be Looked At (from the Other Side of the Glass, with One Eye Close to, for Almost an Hour...)*, 1918

“We weren’t mathematicians at all, but we really did believe in Princet.”
Marcel Duchamp,
*Nude Descending a Staircase No. 2*,
1912
The Fourth Dimension as Time
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Giacomo Balla

*Dynamism of a Dog on a Leash*

oil on canvas, 1912
Giacomo Balla

*Dynamism of a Dog on a Leash*
oil on canvas, 1912

*Young Girl Running on a Balcony*
oil on canvas, 1912
Next Time:

Non-Euclidean Geometry and the Visual Arts

http://www.people.vcu.edu/~rhammack/Math123/