SPECIAL FEATURE: PHYSICS AND ART

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Einstein, Picasso*

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Abstract

How the 20th century's most important scientist—Albert Einstein—and its most important artist—Pablo Picasso—made their greatest discoveries at almost the same time is a remarkable story: Einstein's relativity theory in 1905 and Picasso's *Les Demoiselles d'Avignon* two years later. A scientist and an artist confronted the same problem—the nature of time and simultaneity—and resolved it after realizing a new aesthetic. At the nascent moment of creativity boundaries dissolve between disciplines. This article explores the similarities in the early work of two of the greatest icons of Art and Science of the last century.

> That Maxwell's electrodynamics—the way in which it is usually understood—leads to asymmetries that do not appear in the phenomena is well known.
>
> *Albert Einstein*

> The painter's studio should be a laboratory. There one does not make art in the manner of a monkey, one invents. Painting is a play of the mind.
>
> *Pablo Picasso*

> [The demoiselles] are naked problems, white numbers on the blackboard. It is the principle posed of painting = equation. . . . Painting, henceforth, became a science.
>
> *André Salmon*

> The scientist does not study nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful.
>
> *Henri Poincaré*

* This article is based on the author's book entitled: '*Einstein, Picasso: Space, Time and the Beauty that Causes Havoc*' (New York: Basic Books, 2001).

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The beginning of the twentieth century was an exciting moment in Western intellectual history, akin to the Renaissance some five hundred years earlier. Change was in the air. Rebels against academic convention and bourgeois convention considered themselves part of the 'avant-garde'. Traditional knowledge was being questioned in architecture, art, literature, music and physics—particularly space and time. Einstein and Picasso were swept along by this wave.

They were not the distinguished elderly figures that later became so familiar: Einstein the serene white-haired man looking as if he had glimpsed the creation itself; Picasso the prosperous artist posing amidst bourgeois splendour. They were in their twenties, unknown, feisty, dirt-poor and prone to getting into trouble. Their personal and creative beauty caused havoc. Their occasional disdain for human interactions aside, their stories inspire. Through incredible self-confidence and perseverance they achieved remarkable intellectual feats under conditions that would have left almost everyone else in despair.

In 1905, Einstein was an absolute cipher. A middle-class, middle-level underpaid civil servant, whiling away his time in an intellectual backwater, struggling at home to make ends meet. In retrospect the only thing extraordinary about him was his lack of any extraordinary qualities. He

 0031-9120/04/060484+06$30.00

had made such a poor impression as a university student that it took a friend's intervention to secure a position for him at the Swiss Federal Patent Office in Bern, where he toiled six days a week, eight hours per day. That was in 1902, following two dry years of intermittent employment after graduation. The following year he married Mileva Maric, his college girlfriend with whom he had had a passionate love affair and a child out of wedlock, whom they gave away for adoption.

They had been intellectual soulmates, living the life of German *fin-de-siècle* bohemians. By the time of their marriage, however, Einstein had grown tired of her. She became subdued and lived in the shadow of her husband. At the Patent Office I 'was set free from everyday worries to produce [my] best creative work', he recalled wistfully. The Patent Office was his 'secular cloister', the nearest he ever came to Heaven on Earth. Einstein's Bern period, 1902–1909, was the most creative of his life.

His intellectual stimulation came from a study group at whose core were his pals Conrad Habicht and Maurice Solovine, affable intellectual dilettantes. Unabashedly they took all knowledge as their province and referred to themselves as the 'Olympia Academy'. Einstein had colleagues at the Patent Office and in the Postal and Telegraph Administration that occupied the lower floors of the building. Yet there were no clues for the creative explosion that would happen in 1905.

For the artist, Picasso, talent had been recognized almost immediately. His earliest Parisian friends were not artists but the new-wave writers André Salmon, Max Jacob and the larger-than-life Guillaume Apollinaire, who invented left-bank literary café society. Struck by Picasso's persona and recognizing his creative force, they became the core of *his* think-tank, called *la bande à Picasso*. Like Einstein's 'Olympia Academy', they were dirt poor but full of youthful optimism. They had nothing to lose and shared literally everything.

Picasso's atelier was in a ramshackle building that occupied the peak of the hill, or Butte, in Montmartre. Jacob affectionately called it *le bateau lavoir*, after its resemblance to the laundry boats along the Seine. Picasso's *bateau lavoir* period, 1904–1909, was the most creative of his life.

Not atypically, Picasso got little more than four dingy walls. But he was undisturbed and worked the situation to his advantage, meeting amongst other tenants his first great love, Fernande Olivier. For the first year or so she was his muse. After that she might be charitably described as providing negative reinforcement. By that time Picasso's mind was elsewhere. He had become obsessed with searching for a radically new artistic style that was highly conceptual rather than figurative and so not anchored in appearances.

Notions and conceptions

During 1905 Einstein had already begun to seek a new conceptual style, rather than striving toward a theory of physics abstracted from phenomena we have actually witnessed in the world about which we move, the figurative style of physics in vogue. At intervals of eight weeks, starting in March, he produced three papers that set the style and content of physics in the twentieth century and beyond. The first one concerned the structure of light, the second provided a basis to prove that atoms actually existed and the third was the relativity paper. Later that year he published yet another paper. It contained a result he had overlooked in the relativity paper, $E = mc^2$.

Central to Einstein's reasoning in the relativity paper was a new notion of *aesthetics*. He had already tried it out in the one on light, where he wrote of the 'profound formal distinction' that science makes between waves and particles. But this was not the way that nature worked. In certain cases why not have only the traditional representation of light as a wave and a bold new representation of light as particles, or 'light quanta'? For example, an electron can be the source of light waves, which we can imagine as spherical waves spreading out from a rock thrown into a pond of water. Sometimes, however, it is preferable to deal only with an electron and particles of light, or light quanta, instead of mixing particles and waves. Einstein used this 'minimalist' approach to resolving the seemingly intractable 'photoelectric effect'.[1]

[1] Under certain circumstances shining light on a copper plate can force electrons out of it. This was called the 'photoelectric effect'. The puzzle, in 1905, was that according to classical electromagnetic theory the photoelectric effect ought to depend only the intensity of the incident light. In other words, it ought to occur for light of any frequency if one waited long enough. But the liberation of electrons from the copper plate turned out to occur only if the incident light was above a certain threshold frequency. Using light quanta Einstein was able to explain why this occurred.

He also used this notion of aesthetics in his discovery of relativity theory. This came about from the unexpected direction of how electrical dynamos generate electrical current. Symbolic of the second industrial revolution, these behemoths were not entirely understood. But the great men of science declared that this issue was not terribly basic. At the Patent Office Einstein had had extensive experience with dynamo design. What others accepted as obvious, troubled him.

Two very different explanations were accepted for how an electrical dynamo produced electricity, depending on whether the wires of its electrical circuit (armature) or its magnet moved. To Einstein two different explanations for the same phenomenon—generation of electricity—was a redundancy that he regarded as an 'asymmetry' because in his view it was unaesthetic and so 'unbearable'. Everyone had overlooked that the key point in this process was the *relative motion* between the electrical circuit and magnet; this was the *cause* of the measurable *effect*, which was electricity. They were all 'theorising out of their depth', as Einstein recalled his audacious opinion of the science sages of the day. The Patent Clerk knew what to do. He asserted that the two cases did not differ at all; it was only a matter of an observer's viewpoint. How you look at it, that's what it is. The asymmetry, as Einstein recognized, masked a deep law of nature—the principle of relativity. Einstein's discovery of a new aesthetics in science—minimalism—called for a high degree of abstraction. It was a bold move toward conception over perception.

In that year Picasso was also beginning to explore the world in terms of conception over perception and to seek new notions of what is aesthetic. What drove him were recent paintings by his friend André Derain and Derain's teacher, the already famous artist Henri Matisse. They were trying to represent the world in a manner that went beyond what we perceive.

They had all been struck by the primitive Iberian sculpture exhibited at the Louvre in May 1906, in which the tribal sculptor attempts to depict what he *knows* rather than what he *sees*. Picasso felt that his own paintings paled in comparison. He was challenged and resolved to overthrow the great Matisse as leader of the avant-garde. What better way to do this than with the most ungenteel theme imaginable—a bordello scene, only with the violence ratcheted up to heights that even shocked his bohemian companions.

Picasso embarked on this project with no muse to inspire him. He worked fanatically and alone. The honeymoon with Fernande was over. To make matters worse, friends who saw the painting in its various stages had nothing favourable to say. Picasso worked alone and had to endure incredible loneliness, as he painfully recalled. By fall 1907 he had succeeded in producing what became known as *Les Demoiselles d'Avignon*. The painting can be viewed at the Museum of Modern Art in New York (see www.moma.org).

It is an in-your-face confrontation with five whores, with the viewer as client. As we look across the expansive canvas—244 centimetres in height by 234 centimetres in width—we see a partially clothed demoiselle on the far left with an Egyptian–Gauguinesque face whose seemingly disembodied arm is pulling open a curtain. Then there are two more attractive demoiselles of Iberian–Oceanic likeness. The standing demoiselle on the far right is parting a curtain, while the squatting whore is in a grotesquely impossible situation, with her back facing the picture plane and her head turned 180 degrees as if on a swivel, eyes distinctly different and off line, nose like a wedge of brie, profile and frontal views simultaneously represented, and a shockingly hideous face. The head of the squatter, the most advanced in geometrization and experimental representation, underwent the most extensive metamorphosis in Picasso's working drawings. It is the key to Picasso's discovery of geometrization that would become the hallmark of cubism and its new aesthetic—reduction of forms to geometry.

Simultaneity and representation

In March 1905 Einstein worked in isolation in his cramped apartment in the centre of Bern. Besides Mileva there was now a baby son. Visitors recalled being ushered into a room filled with cigar smoke. There sat Einstein rocking his baby son to sleep with one hand, writing equations with the other, while his mind roamed the universe of space-time. Einstein's most serious impasse concerned the proper way to represent events that occurred at the same time—that is, were simultaneous—but located far apart. He found a clue in two

papers written by the only other scientist to have looked into this problem and who, to my surprise, turned out to have been important to Picasso as well, the French polymath Henri Poincaré. Poincaré explored methods for measuring time and simultaneity using light signals.

The measurement of time was a hot topic in the navigation and geography sections of the French Academy of Sciences in Paris, to which Poincaré belonged, as well as in the Patent Office and the Federal Postal and Telegraph Administration in Bern. Besides mapping problems, which the French always fancied, there was the issue of reporting weather phenomena by far-flung observers who required synchronized clocks, as well as railroad scheduling which was chaotic over long distances, not to mention time onboard ship and strategic military planning. Although time zones had been set up in 1884, the issue remained of how best to synchronize clocks. While wireless telegraphy was agreed on, procedures had to be worked out for dealing with the time delays between sending and receiving electromagnetic signals as they coursed through space.

Poincaré became bogged down in a panoply of assumptions regarding how light travels and how we *perceive* its effects. Scientists agreed that light waves required a medium to move through. After all, how can there be water waves without water? Just as the speed of swimmers was affected by the currents in the water through which they swam, so could the speed of light as it moved through its medium, which scientists called the 'ether'. Something as basic as the ether had to manifest itself. Incredibly accurate and ingenious experiments were set up to detect it. They were all magnificent failures in that no effect on the speed of light due to the Earth's motion through the ether was ever measured. Fantastic hypotheses were made to interpret these null results in order to rescue the ether.

Einstein took a bold strategy. He offered a new law of nature according to which there were no problems about how light travelled—it did so always at the same speed regardless of any motion between the laboratory and the source of light. The venerable ether was rendered 'superfluous'. This had enormous ramifications, such as the dependence of time on a clock's motion and the relative nature of simultaneity: two events that occur at the same time—that is, simultaneously—for an observer at rest relative to them need not be simultaneous for another observer in relative motion. How you observe it, that's the way it is. There is no one true view of simultaneity. This was a triumph of conception over perception. It seemed to contradict what everyone had come to expect through reasoning on the basis of experience in the world in which we live—clocks initially synchronized will always read the same time no matter if they are in motion relative to each other.

Like scientists, artists are problem-oriented, too. And artists like Picasso were willing to take chances. He lived at the epicentre of the debate about representation versus abstraction. New developments in technology, science and mathematics ultimately would make the difference. For example, aeroplanes, wireless telegraphy and automobiles were altering everyone's conception of space and time. In science the discovery of x-rays seemed to render inside and outside ambiguous, the opaque became transparent and the distinction between two and three dimensions was blurred. What you saw was not what you got, in contrast to emphasis on figuration. Even more abstractly, mathematicians mused over exotic new geometries that could be represented in dimensions greater than three.

Newspapers kept Parisians up to date on these developments, which were further discussed in cafés. Picasso's think-tank kept him informed. Even cutting-edge literary journals carried discussions of x-rays and the fourth dimension. Although written by literary fantasists who tried to connect them with supernatural phenomena, the scientific exposition was quite good. Ideas were everywhere in Paris.

Picasso's sketch pads contain hundreds of preparatory drawings for *Les Demoiselles d'Avignon*. They resemble a scientist's notebooks with false starts and dead ends. The squatter is the most challenging to interpret. Sometime during April or May 1907, Picasso embarked on his most extreme geometrical experiments. A remarkable female figure appears who is faceted into interlocking diamonds with kneecaps. She differs from the standard geometrical constructions that Picasso saw in art school from Albrecht Dürer and Leonardo. Very likely he adopted this technique from the mathematician Ésprit

Jouffret's book, *Elementary Treatise on Geometry in Four Dimensions*.

Jouffret analysed from different perspectives in succession the projections onto two dimensions of complicated four-dimensional polyhedra, along with their rotations. How could Picasso have known of such literature? He learnt them from a member *en marge* of *la bande à Picasso*, Maurice Princet. Princet was an insurance actuary with a keen interest in advanced mathematics. He was introduced into *la bande à Picasso* by his notoriously unfaithful mistress Alice Géry, who had been one of Picasso's girlfriends at the time he met Fernande. Although not a bohemian, his earnestness and academic bearing impressed everyone. Princet was seen with Picasso's group in cafés, took part in their hashish sessions, and visited Picasso's atelier at critical times when Picasso had problems with *Les Demoiselles d'Avignon*. *La bande à Picasso* were enthralled by Princet's informal lectures in cafés and bistros on Poincaré's famous book *La Science et l'hypothèse*, all the rage in Paris. It had also held Einstein's Olympia Academy spellbound.

We can imagine that of particular interest to Picasso was Poincaré's suggestion of how to view the fourth dimension. Images from the fourth dimension can be projected onto a three- or two-dimensional surface from different points of view, or perspectives. 'Imagine that the different perspectives of one and the same object succeed one another', Poincaré continued, with Jouffret's diagrams in mind. With his visual genius Picasso realized that he could go beyond Poincaré and exhibit them all at once in spatial simultaneity. This emerged in the squatter. But not immediately.

By April Picasso began to transfer sketches onto a large canvas. But he really had not advanced from what he had accomplished the year before. Picasso was stuck and unhappy. Besides his personal life being a mess, Matisse had been proclaimed leader of the avant-garde. In June he stopped work. What to do? Derain suggested a visit to the exhibition of African masks at the Ethnological Museum at Trocadéro. Picasso was 'shocked' at what he saw and immediately had two far-reaching ideas. He realized that African art offered a way out of the impasse because it supported his conceptual approach, a line he had taken since his visit to the Louvre the previous year to see primitive Iberian sculpture.

Secondly Princet's lectures on multi-dimensional geometries fell into place. He realized that geometry was the language in which he could express the conceptual message of primitivism. In this way he could formulate a new mode of artistic representation that could take its place with the great achievements of avant-garde science and technology. The formerly informal language of art became formalized in Picasso's hands. Sketchbooks from June onward focused almost exclusively on geometric studies by which he ultimately resolved the problem of representing different perspectives or views of an object all at once, in a spatial simultaneity.

We can find other clues as to how Picasso discovered *Les Demoiselles d'Avignon* in the vibrant visual culture of Paris, with its technological developments, in particular the cinema. The disembodied left arm of the curtain raiser at the left, and the floating demoiselle next to her, reflect Picasso's attempt to create a space permitting unexpected and surprising series of movements. We are reminded here of the Parisian filmmaker Georges Méliès, a pioneer of special effects. His most famous one was the fragmentation and reassembling of human bodies in sometimes weird and hilarious ways. Picasso and his gang regularly saw his movies at the local cinema. To some degree cubism would become disembodiment.

Moving forward

On another experimental–technological track, there were the classic explorations into motion by the French physiologist Étienne-Jules Marey and the English-born American photographer and inventor Eadward Muybridge. Both men were pioneers of motion pictures. Muybridge created closely spaced sequences of photographs, while Marey studied a sequence of events on a single frame.

Marey's multiple exposures must have recalled for Picasso the effect of x-rays in their interpenetration of forms, and went beyond them in their breathtaking views of continuity of motion. Such Marey photographs influenced Picasso's solution of the problem of how to represent on a single canvas several views of an object simultaneously.

Muybridge offered Picasso something else: the idea of a 'motion picture sequence' of

five women with the 'plot' of increased geometrization. The end is a four-dimensional view of the squatting whore, the embodiment of Picasso's realization that spatial simultaneity was of the essence here.

As we would have expected of those who defined the avant-garde, Einstein and Picasso were intellectual opportunists. They drew on apparently disparate fields, while working on the same problem—the nature of simultaneity. Einstein solved it for temporal simultaneity with the special theory of relativity and Picasso for spatial simultaneity in *Les Demoiselles d'Avignon*, which was the springboard to cubism. Both concluded that how you look at something, that's the way it is. There is no one true perspective.

Einstein and Picasso were never again able to duplicate their intensely focused days when they produced their first great works. Einstein left his 'secular cloister', the Patent Office, in 1909. In that year Picasso left the *bateau lavoir*. They never forgot those days in which they had nothing to do but create masterpieces. They went on to become icons of their age and their attention was drawn elsewhere. They achieved fame beyond fame.

Received 16 January 2004
PII: S0031-9120(04)74654-7
doi:10.1088/0031-9120/39/6/003

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