PARIS notes

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Euro April 27: .767
Euro March 24: .743
Rain Days: 14
High Temp: 68°F/20°C
Low Temp: 49°F/9°C
Nat'l Holidays: May 1, 8, 21, 31

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Tower Power

By Mary McAuliffe

Eiffel's amazing tower still has the power to inspire awe and command respect—120 years on

It seems hard to believe that the beloved Eiffel Tower—now celebrating its 120th birthday—was ever controversial. But, surprisingly, that was exactly the case, especially at the outset, when this airy iron behemoth angered traditionalists by defining a new and more modern sense of beauty, leaving backward-looking rivals and critics in the dust.

And there were rivals and critics aplenty. One of the foremost was Jules Bourdais, a prominent architect, who, with Gabriel Davioud, designed the Trocadéro Palace for the 1878 Paris exposition. Those in charge of the 1889 exposition, timed to celebrate the centennial of the French Revolution, hoped to feature something far more dramatic—a huge tower that at 300 meters (or 1,000 feet) would be higher than anything ever before built. Despite the daunting challenge, more than 100 people submitted plans. Of these, the two most serious contenders were Gustave Eiffel and Jules Bourdais.

There could hardly have been two more distinct architectural visions. Bourdais was a staunch proponent of stone, and his proposed tower was to be entirely of granite. It would be built in five successively smaller tiers, like a huge wedding cake, each layer swathed with decorative sculptures and columns. At the top would be a huge electric-powered beacon, intended to sweep nighttime Paris with its powerful beam.

Eiffel, of course, had a different idea. By this time widely acknowledged as a successful engineer and builder of prominent iron structures, especially bridges, Eiffel was the proverbial "wizard of iron" who understood metal better than anyone else on the planet. More than this, he firmly believed that the age of stone was over. According to Eiffel, the medieval cathedral builders had pushed their medium about as far as it could go. To build higher and larger, it would be necessary to rely on iron and steel.

Two of Eiffel's subordinates, Emile Nouguier and Maurice Koechlin, were the first to have the idea of an iron tower, which they conceived as being made of four lattice-like girders "standing apart at the base and coming together at the top," with trusses joining the girders at regular intervals. Architect Stephen Sauvestre modified this design, adding the enormous arches at the base of the four uprights. A daring but workable plan, this tower bore a distinct resemblance to bridge piers, which the Eiffel team knew well. In fact, much to the consternation of traditionalists, aesthetics played little role in the tower's design. Every feature was the product of careful computations based upon in-depth knowledge of stresses, weight, gravity and wind forces. Even the tower's attractive splayed legs were designed for wind resistance.

Despite Eiffel's original lack of interest in the project, he soon signed on to his employees' idea, buying the exclusive patent rights from them and taking active leadership. When Bourdais called Eiffel's proposed tower "vulgar," Eiffel pointed out that a tower of this height could not be made of stone, and certainly could not be built within the required time. After all, the Washington Monument, at half the size, had taken several decades to build. Even more damaging, Eiffel pointed out that Bourdais had not properly calculated wind resistance, nor had he planned any foundations for his stone monolith, whose base was to rest directly on the ground.

Fortunately, the committee making the final decision was not swayed either by Bourdais' arguments or by his proposal, and Eiffel's tower handily won the competition. Gustave Eiffel, master builder of some of the world's most remarkable bridges as well as the all-important internal framework of the Statue of Liberty, was going to build the highest and the most spectacular structure in the world. It was quite a coup. But now a huge groundswell of opposition emerged from a different quarter. Eiffel's tower was about to go up on the Champ de Mars, where it would visually dominate Paris. A number of Paris' leading citizens were appalled at the idea of this "monstrosity" blighting their view.

A Committee of Three Hundred quickly formed (one member for each meter of the tower's height). Its roster included some of the most celebrated artists, musicians and writers in Paris. Led by Charles Garnier, the well-regarded architect of Paris' sumptuous (and unquestionably traditional) new Opera House, the Committee shot off a "Protestation des Artistes" to the exhibition's commissioner. As "enthusiastic lovers of the beauty of Paris," they wished to warn him in the strongest possible terms against erecting this "useless and monstrous Eiffel Tower." Such an eyesore, they predicted, would dishonor and devastate Paris, dominating it like a "gigantic black factory chimney."

Interestingly, Garnier and Eiffel had worked together previously and in apparent harmony on a huge observatory in Nice. Garnier had designed the overall structure, but Eiffel was left to carry out the observatory's most critical element, its enormous rotating dome. Eiffel proceeded to impress Garnier (and many others) with his solution to the problem. Instead of relying on a more traditional system of rollers to rotate his dome (which, of course, was made of sheet iron), Eiffel came up with an innovative circular float that essentially carried the dome's weight on a reservoir of antifreeze-laced water. Much to Garnier's amazement, the device worked, making it possible to rotate the 110-ton dome in a matter (continued on page 7)

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of minutes.

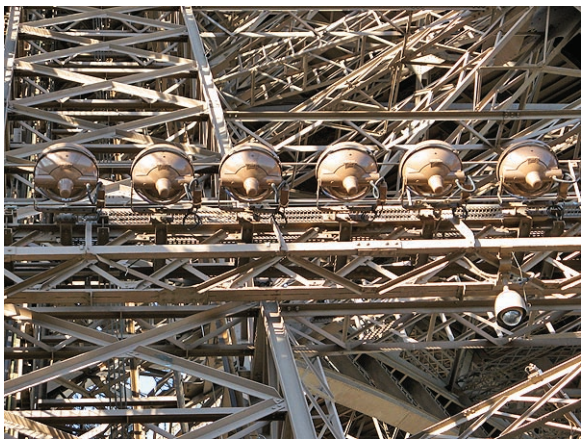
Yet, while Garnier was perfectly willing to accept iron in its place, it was only as a structural element—certainly not as an artistic component in its own right. Like Bourdais, Garnier favored stone as the perfect building material. In addition, both he and Bourdais were architects, regarding an engineer like Eiffel as a "mere" technician, incapable of creating works of beauty. But, ultimately, it may have been Garnier's realization that Eiffel's tower would become the highlight of the exposition that most fueled his resentment. What seems to have especially galled Garnier was the probability that this tower would eclipse his own contribution—an interesting but comparatively unspectacular row of more than 30 buildings, from cave dwellings to a Persian mansion, that illustrated the History of Habitation. (Garnier was right. His History of Habitation was razed at the exposition's end, and virtually no one today remembers it, even though it is listed among his major accomplishments on the large memorial to him located just outside the Palais Garnier.)

Eiffel's response to Garnier and the Committee was dignified but firm. Of course engineers have taste, he replied. Of course engineers appreciate beauty. Conversely, the aesthetic predilections of writers and artists are not infallible. Indeed, Eiffel firmly believed in the beauty of the laws of nature with which engineers worked, and the harmony of design that resulted from abiding by and respecting these laws. Did these writers and artists think that only richly decorated stone structures could embody beauty? He—and his much-maligned tower—would show them otherwise. And then he set about proving it.

In January 1887, Eiffel's tower began to rise. Although, in point of fact, it started out by going downward—an essential step that Bourdais, with all his refined asceticism, had overlooked. Since two of the tower's four feet stood on unstable land near the Seine, Eiffel probed 50 feet downward until he reached solid clay. He then sent huge sealed and electrically lit caissons 70 feet downward, well below water level, with workers breathing compressed air as they excavated (a system he had already tested successfully while building bridges). When all the enormous foundation blocks were in place and the equally huge anchoring bolts inserted, Eiffel was ready to go up. This first essential step had taken him a little over five months.

By July 1887, Eiffel's tower actually began to rise—a step for which he and his nearby Levallois-Perret firm were well prepared. As with his previous projects, Eiffel first had drawings of each of the tower's component parts made and the impact of gravity and wind on these parts precisely calculated. Then he had every one of these parts individually produced under his workshop's controlled conditions, including carefully drilled rivet holes (drilled to a tenth of a millimeter). These in turn were pre-assembled in manageable sections. At Eiffel's insistence, no drilling or adaptation was allowed on site; if a part was defective, it was sent back to the workshop. In all, some 18,000 prefabricated sections were eventually delivered to the tower site, forming a sort of gigantic and quite perfect erector set—a classic children's toy, which in fact would eventually be created based on Eiffel's famed methods.

Yet as Eiffel's tower went up, the criticism continued. Fear-mongers predicted that the structure would inevitably collapse. After all, no one had ever attempted anything quite like this before, even if some of Eiffel's bridges had been equally daring. But if many people were uncomfortable with Eiffel's design, and especially with his chosen material, iron, Eiffel certainly was not. In fact he had, after much consideration, deliberately chosen iron rather than



lighter-weight steel for his tower. His decision was based in part on steel's costliness but also, and more importantly, on its greater elasticity, or "give," under high winds—an elasticity that Eiffel believed would be excessive for weather conditions on the Champ de Mars. As for the structure's weight, Eiffel's tower would prove to be surprisingly light. Its latticework design and attention to distributed weight-load (per square centimeter, it amounts to something like the weight of a man sitting in a chair) make its 7,300 tons, if not exactly feather light, certainly an amazing achievement. Well-grounded, light on its feet and perfectly calibrated for wind tolerance and all other forms of stress and strain, this tower was not about to collapse or tip over, as its detractors warned.

Not only that, Eiffel delivered his mammoth undertaking on time. With the exception of the elevators, which posed their own unique challenges, the tower was completed by the exposition's opening in May 1889 (the elevators followed several weeks later). It was a complete success from the outset, with visitors pouring up the steep staircases even before the elevators were working. This vindication was especially welcome to Eiffel, given the hostility he had faced and surmounted. It was also welcome from a financial standpoint, because Eiffel had borne much of the cost of the tower himself.

The City of Paris and the French government had anted up only 1,500,000 francs, which barely covered a quarter of the projected construction costs. In response, Eiffel had set up a company to distribute shares, half of which he retained in his own name and paid for out of his own personal funds. It was an enormous risk, and the City of Paris and the French government figured that Eiffel was headed for a major loss. But as it happened, the tower was every bit the success that Eiffel expected it to be. He covered his costs during the first year of operation, and subsequent profits—including entrance fees, revenues from the tower's restaurants and other commercial enterprises, and the sale of those little Eiffel Tower models—made him a very wealthy man.

In the end, what made Eiffel's deal especially lucrative was the 20-year operating concession that the City of Paris and the French government gave him and his company as part of the original deal. (This arrangement was renewed in 1910 and continued until 1980, when it expired.) Success must have been especially sweet for Eiffel, given the opposition his tower had received as well as the lackluster financial support the city and state had given him. But unfortunately for Eiffel, public acclaim for him was short-lived. Soon he would be swept into the Panama Canal scandal, a painful episode that led him to retire from his engineering career and devote the rest of his life to scientific pursuits.

Not surprisingly, many of these pursuits involved Eiffel's magnificent tower, which he had always seen as an ideal spot for scientific observation and experiments. To reinforce his vision, he ringed the first platform of his tower with the names of 72 prominent French scientists, such as Lavoisier and Foucault. In particular, he wanted the tower's scientific usefulness to win it a reprieve from destruction once his 20-year concession was up. And so, besides being a top draw for public amusement, Eiffel's tower became the site of meteorological observation, aerodynamic experiments and telegraphic transmission. It was the latter that ensured the tower's survival, for after a permanent radio station was installed there, Eiffel's concession was renewed for 70 years. During World War I, this station became a center of communications as well as an interceptor of enemy signals, such as the famous one leading to the arrest of Mata Hari. A public radio station began transmitting here in 1921, and television broadcasts began in the 1930s.

But it was the overwhelming embrace that the public threw around the tower that was particularly noteworthy, especially given the vituperative opposition that it had elicited at the outset. This enthusiastic reception included the artistic community, in which, by the 1920s, Eiffel's tower had become a widely accepted symbol of the avant-garde. Painters, poets, photographers and cinema directors adored it, thus bringing to a close this particular episode in the never-ending debate between old versus new. The new, embodied by metal and representing the 20th century's plunge into science and technology, had proved to be a spectacular popular success. More than this, it had turned out to be an aesthetic triumph as well.