Expressionism, Relativity, and the Einstein Tower

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The Einstein Tower, designed by Erich Mendelsohn between 1917 and 1920, and erected in Potsdam, near Berlin, between 1920 and 1921, is one of the best-known examples of German expressionist architecture [*Figure 1*].[1] From its initial publication in 1921, the tower has been understood as an example of expressionism's often antirational approach to industry and science. Supplementing the history of form with a consideration of the building's function as an observatory and laboratory for research into Albert Einstein's general theory of relativity, and of relativity's impact upon both the metaphorical and literal levels of its program, challenges these assumptions. Furthermore, an examination of the evolution of Mendelsohn's highly personal approach to expressionism reveals the degree to which relativity influenced his thinking about architecture and further clarifies the formal and intellectual distance between the tower and this aspect of the expressionist mainstream.

Although few contemporary critics understood the way in which relativity had shaped the Einstein Tower, the building was, throughout the 1920s, at the center of the German architectural debates about the appropriate balance between individual expression and function. The popularity, after the middle of the decade, of attempts to represent rationalism has obscured the functional aspects of Mendelsohn's apparently willful architecture. Indeed the Einstein Tower provides the first example of what became Mendelsohn's characteristic manipulation of dynamic form within functional bounds, as he attempted both to represent and serve Einstein's controversial new scientific theory. Seeking to generate architectural form through the expression of the energy that the theory of general relativity encouraged him to believe was latent within mass, particularly the tensile strength of steel and the compressive power of reinforced concrete, he nonetheless worked within the constraints of a program largely established by engineers and scientists.

This article traces the gestation and birth of this approach, which I have chosen to label *dynamic functionalism*, a term that balances recognition of the lively forms that have dominated earlier discussions of Mendelsohn's *oeuvre* with a new attention to the degree to which they complemented, and even served, pragmatic purposes.[2] In the case of the Einstein Tower, the choice to build a monument to relativity, rather than merely a site for investigation into it, was the architect's; dynamic functionalism later provided him with the flexibility to respond to the needs of businessmen who sought a new commercial architecture that was both practical and evocative. An account of the design process of the Einstein Tower demonstrates that the young architect at first had difficulty reconciling dynamic functionalism's almost contradictory components. Although he designed the tower to be built out of reinforced concrete, much of it was instead constructed out of stucco-covered brick, breaking the bond he had longed to create between form and material. He was more successful in giving compelling shape to a program that would appear to have left little room for creative expression, converting what could have been a mundane commission into a building that would keep him in the public eye for another three decades.

Expressionism, Jugendstil, *and reinforced concrete*

The second decade of the twentieth century was for Mendelsohn a period of intense intellectual exploration that included a lively engagement with the artistic and literary movement known as expressionism. His appreciation of the paintings of Wassily Kandinsky encouraged him to look for supplementary sources for an architectural equivalent to these paintings, a search which led him to the work of Hermann Obrist, Max Berg, and Henry van de Velde. The experimental drawings, which were the first product of this investigation and are the intitial impetus for the dynamic form of the Einstein Tower, maintain the predilection for curvilinear forms shared by all of the young architect's otherwise diverse sources.

Mendelsohn's education in Munich, where he was one of the many promising students of Theodor Fischer, was enlivened by his contacts with the city's expressionists. In 1912 he decorated the hall for the Presse carnival ball, which Max Reinhardt, the expressionist director of Munich's Künstlertheater from 1909 to 1911, returned to the city to stage.[3] Mendelsohn, who mentioned Kandinsky admiringly in two letters written in 1913,

FIG. 1: Erich Mendelsohn, Einstein Tower, Potsdam, Germany. Designed 1917–20, constructed 1920–21. Note the grass-covered platform of the underground laboratory.

had probably visited the Blue Rider exhibitions of 1911 and 1912 and read the *Blue Rider Almanach*, which appeared in 1912 [*Figure 2*].[4] In the spring of 1914 he and Hugo Ball, at that time the dramaturgist at the Kammerspiele and later a founder of dada in Zurich, led an attempt to produce Kandinsky's avant-garde compositions, *The Yellow Sound* and *Violet*, at the Künstlertheater.[5] Proof of the depth of his involvement with expressionists in 1914 comes from Ball's notes for a never-realized second edition of the *Almanach*, which show that Mendelsohn would have contributed an article on stage design.[6]

Inspired by the radicalism of the Munich expressionists, who by 1914 sought to replace representation with an abstraction they believed would be more comprehensible to a mass audience, Mendelsohn sought to create an architectural equivalent to new developments in painting and theater.[7] He wanted to overthrow tradition, but it was inconceivable that he could create appropriate architectural forms for his expressionist ideas without referring to already existing architectural imagery and rhetoric. He found such sources in the discredited example of *Jugendstil* designers and architects and in recent uses of reinforced concrete.[8]

Kandinsky himself provided an important precedent for Mendelsohn's turn towards *Jugendstil* sources, as the roots of his own curvilinear, almost abstract painting lay in lessons learned from two *Jugendstil* figures, Hermann Obrist, primarily a designer, and August Endell, an architect.[9] In November 1914 Mendelsohn befriended Obrist.[10] Although he was by then a somewhat peripheral figure in the artistic life of the city, Obrist's exhibit of his own embroideries had introduced the *Jugendstil* to Munich in 1896. In them he had substituted stylizations of botanical forms for historically derived ornament. Obrist was keenly aware of the architectural implications of the *Jugendstil*. He claimed that its transformation of the decorative arts could be extended to architecture through the use of new materials, methods of construction, spatial arrangements, and decorative vocabularies. Conceiving of the style as an attitude toward the creation of artistic form rather than as a recipe book of motifs, his study of natural forces prepared the way for their entrance into architectural theory.[11] Mendelsohn found in Obrist's work "a preparation for and an indication of the correctness of my own formal expression," which he had now shorn of overt historical references.[12] He may have been thinking of the Karl Oertal tomb in Munich of 1905, in which Obrist replaced conventional treatment of his material, cut stone, with a startling geological metaphor, sculpting the stone into a grotto, crowned with a mossy encrustation that recalled the natural setting of his material [*Figure 3*].

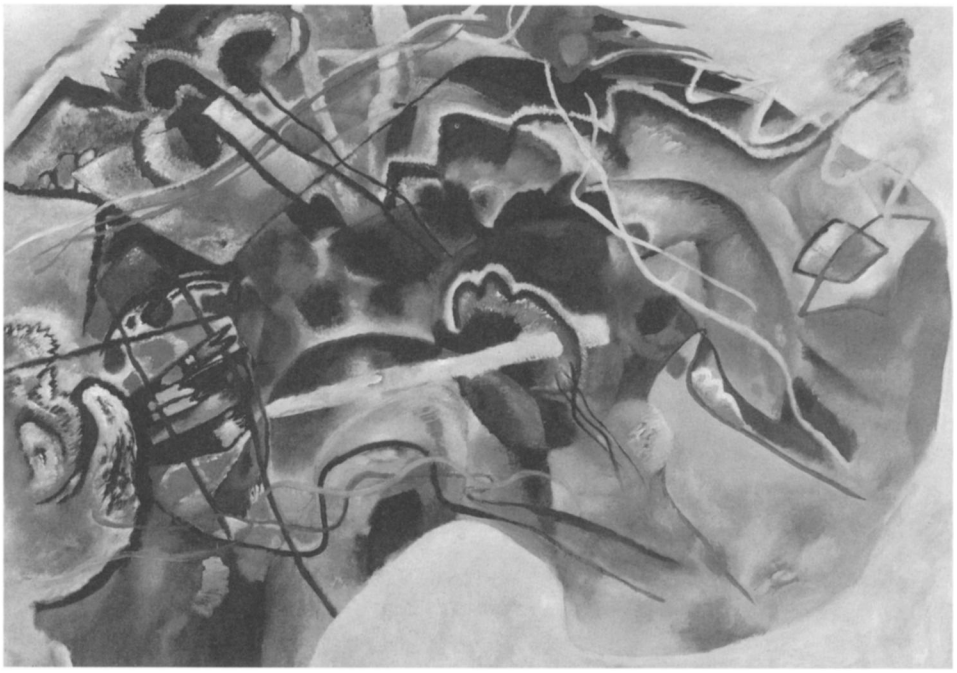


FIG. 2: Wassily Kandinsky, *Painting with White Border*, May 1913, Solomon R. Guggenheim Museum, New York, Gift, Solomon R. Guggenheim, 1937. Paintings like this one influenced Mendelsohn's graphic and his architectural styles.

At the same time that Obrist was moving towards abstraction, other German architects and designers were responding to the increasing mechanization of production. For Mendelsohn the activities of the German *Werkbund* (whose first president, Theodor Fischer, was his former professor) encouraged an appreciation of new construction technologies, in which engineering demands molded reinforced concrete into shapes reminiscent of the forms used by Kandinsky and Obrist.[13] It also enabled him to conceive of industrial architecture, rather than the emphasis on spectacle characteristic of expressionist theater, as the appropriate vehicle for the new architecture he hoped to create. By the spring of 1914, Mendelsohn realized that the new expressionist architecture he sought could be derived from a frank application of industrial materials, particularly steel and reinforced concrete. Describing the importance of adhering to the individual character of each material and the architecture which would follow from such honest use, he wrote:

> Every building material, like every substance, has certain conditions governing the demands that can be made on it . . . . Steel in combination with concrete, reinforced concrete, is the building material for the new formal expression, for the new style. . . . The relation between support and load, this apparently eternal law, will also have to alter its image, for things support themselves which formerly had to be supported. Walls are kept in place without the weight of the roof pressing on them and holding them together. Ceilings over our heads and vaults reach out without any intermediate supports being necessary. Towers mount and grow out of themselves with their own power and spirit and soul.[14]

Reinforced concrete offered, far more than did iron-and-steel skeletal framing, the greatest impetus to the overthrow of traditional architectural statics, in which Mendelsohn located the greatest opportunity for an expressionist architecture, while its massiveness furthered the monumentality that his generation originally believed to be essential to meaningful architectural reform.[15] Although the most important pioneers in the development of this material in the second half of the nineteenth century—Joseph Monnier, François Coignet, and François Hennebique—were Frenchmen, German architects, assisted by the expertise of the construction firms of Dyckerhoff and Widmann, and Wayss and Freytag, made consistently innovative use of concrete in the years just before World War I. Furthermore, in Germany, where architects and engineers were less apt to have had rigorous classical training, those who used concrete were less often compelled to adhere to the pier-and-lintel system of construction preferred by their French contemporary, Auguste Perret.[16]

Nowhere did the forcefulness of German engineering more closely approximate the forms found in Kandinsky's paintings than in the almost biomorphic character of many of the interior details of Max Berg's Centennial Hall in Breslau (now Wroclaw, Poland), which Mendelsohn visited in August 1913, shortly after its dedication [*Figure 4*]. Although basically a frame construction, the ribbed span was supported in part by four enormous arches whose splayed curves, along with the angled supports of the gallery behind them, provided Mendelsohn with a dramatic example of the way in which physical forces could find architectural expression through exposed construction. His only regret was that a restrained exterior screened the drama within.[17] Mendelsohn also singled out for praise Henry van de Velde's theater [*Figure 5*] for the *Werkbund* exhibit, held in Cologne in 1914, in a letter he wrote that summer. He credited van de Velde with "really searching for a form."[18]

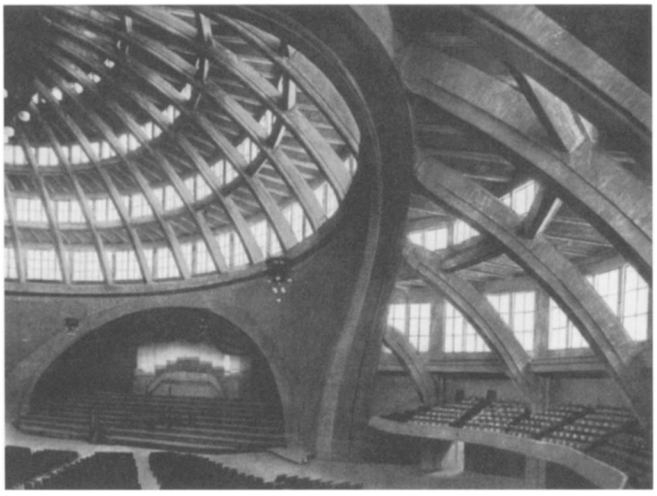


FIG. 3 (Top): Hermann Obrist, Karl Oertal Tomb, Munich, Germany, 1905.
FIG. 4 (Bottom): Max Berg, Centennial Hall, Breslau, Germany (now Wroclaw, Poland), 1913. Note especially the shape of the aisle buttresses.

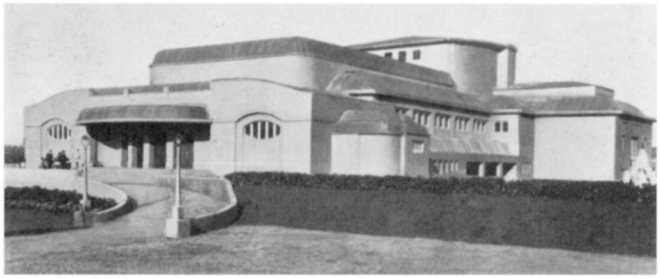
Characteristically, van de Velde subordinated applied ornament to highly sculptural massing, which appeared to grow directly out of the program-determined plan, rather than being determined purely by his own aesthetic preferences.[19]

In 1914 Mendelsohn began to draw perspective views of imaginary buildings, which illustrated his ambitions for an architecture in which curvilinear form would emerge organically from reinforced concrete construction [*Figure 6*]. Although his first sketches were for somewhat bombastic monuments, he quickly turned his attention instead to industrial subjects, a shift that further separated him from even the vaguest evocation of historical forms, and strengthened the apparent relationship between form and the efficiencies of engineering-based function; few were ever accompanied by plans. These drawings were the departure point, in terms of both style and material, for the design of the Einstein Tower.

The impact of relativity

In 1913 Mendelsohn made the acquaintance of the astrophysicist Erwin Finlay Freundlich, the eventual client for the Einstein Tower, and through him became aware of Einstein's developing theories of relativity. Relativity would encourage Mendelsohn to think about the relationship between mass and motion, but the shape that his expression of the problem took had little to do with Einstein. In the task of developing architectural forms intended to communicate what he saw as the dynamism inherent within the general theory of relativity, he drew heavily upon expressionist painting and theater, *Jugendstil* architecture and design, and reinforced concrete construction.

The commission for the tower came directly from Freundlich's interest in proving Einstein's theories, which began in 1905 to be published in papers outlining new concepts of the relationship between light, space, and time. According to the special theory of relativity, the speed of light is constant, while



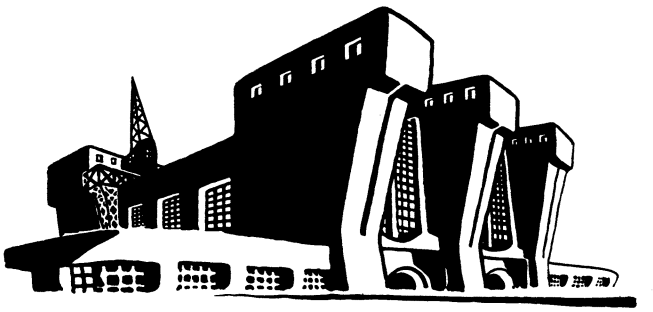


FIG. 5 (Top): Henry van de Velde, Werkbund Theater, Cologne, Germany, 1914.
FIG. 6 (Bottom): Erich Mendelsohn, project for an AEG factory, 1914, the final version of the architect's first industrial project. The AEG served as inspiration rather than as actual patron for the scheme.

measures of duration and distance depend on whether the observer is at rest or in motion. Einstein's work united seemingly contradictory observations from mechanics and electrodynamics, two different branches of physics. The famous formulation $e = mc^2$ (energy equals mass, squared), or that mass and energy are different manifestations of the same physical forces, was included in the first of these articles.[20] In 1907 and 1908 Einstein expanded his understanding of light, claiming in the first steps toward the general theory that it could be bent by gravity.[21] An article of 1911 suggested that this idea could be tested by measuring during an eclipse of the sun the degree to which the sun's gravity deflected the light of stars beyond it.[22]

This suggestion brought Einstein, by this time a professor at the German University in Prague, into contact with astronomers, including Freundlich, who had become in 1910 the youngest assistant at the observatory in Babelsberg just outside Berlin.[23] The two men quickly became friends, and Freundlich, excited by the prospects relativity offered for revolutionizing his own field, proposed to lead an expedition to the Crimea in August 1914 to observe a solar eclipse and make the measurements that might demonstrate the validity of the general theory. The outbreak of World War I resulted in his team's being deported from Russia without conducting the experiment. Disappointed, Freundlich returned to Berlin, where he kept in close touch with Einstein, who had moved to the German capital in 1913.[24]

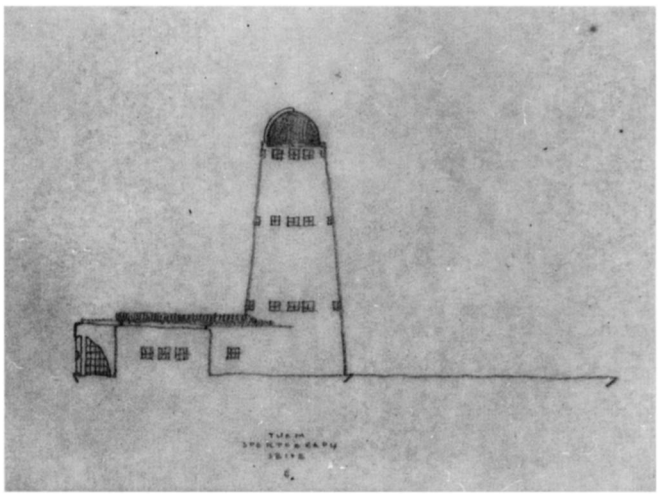
In 1913 Freundlich introduced Mendelsohn to the general theory even before Einstein had completed his formulation of it, and well before awareness of its implications spread beyond a small community of physicists and other scientists. By 1916 this theory encompassed a new understanding of gravity and of its relationship to space, and replaced Newton's original formulation of gravity.[25] The tone of Freundlich's explanation to the architect can be reconstructed from the book he published in 1916 explaining the theory. The first book devoted to the subject, *The Foundations of Einstein's Theory of Gravitation,* included a preface by Einstein, to whom the manuscript had been submitted for approval.[26] Freundlich's was a low-key and somewhat mathematical account of the way in which the general theory of relativity altered classical mechanics, specifically Newtonian concepts of gravity and inertia. He explained that the theory upset traditional understanding of time and space, but he did not illustrate this change with the apparently irrational examples that characterized many later popular accounts. Similarly, he mentioned time as the fourth dimension in mathematical equations, without making the common later error of trying to visualize such a system.

During the rest of the the war, after his expulsion from the Crimea, Freundlich was occupied with a search for facilities where he could mount a second attempt to prove relativity through astronomical observation. He hoped, through a comparison of the spectra of artificial light and sunlight, to find that sunlight was the redder of the two, evidence of a gravitationally caused shift in its mass. In 1915 he published an article outlining this potential experiment, and Einstein assisted him in an attempt to gain access to the equipment of the Babelsberg Observatory.[27] Its director, Hermann Struve, refused, however, in an argument quickly buttressed by an attack upon Freundlich's proposal by Hugo Ritter von Seeliger, the director of the Munich Observatory.[28] Freundlich decided to build his own observatory. Meanwhile, in 1915, Mendelsohn enlisted in the army's engineering corps to forestall being drafted into the infantry. At first he was in training in Berlin, where he and Freundlich spent many evenings together, discussing their plans for the observatory.[29] From May 1917 to at least May of 1918, however, he was stationed on the Russian front.[30] Despite guard duties, he was able to correspond regularly with his wife and Freundlich, and to sketch.

In response to his first letter from Freundlich, Mendelsohn sent his friend a carefully penciled elevation drawing for the observatory [*Figure* 7].[31] The drawing was far less radical than the highly plastic and heavily glazed industrial structures he had been sketching since 1914. This timidity was connected, no doubt, with its relationship to a potential commission.[32] Hints of the many imaginary, programless projects survived in the observatory drawing only in the semicircular window that he wrapped around the annex to the tower. Although no documentary evidence about a program survives, the combination of an observatory tower banded by rings of windows and an adjacent

low-lying wing probably reflects the conversations Mendelsohn had had with Freundlich before his departure for the front, as it is related to later written discussions of the subject.[33]

Mendelsohn also resumed at this time the series of sketches he had begun in 1914. This new group included ten studies for an astronomical observatory, several of which were made during a concert. In contrast to the elevation drawing, these were entirely experimental.[34] In quick notations drawn with a soft pencil which only paused to outline the main forms of the building, he played with rounded masses. These drawings illustrated the formal freedom that his use of the *Jugendstil* gave him and echoed the distinctive shape of the revolving observatory cupola, through which light was admitted to the telescope inside. Although no indications of the materials he intended to use exist for the observatory sketches, the letters that accompanied them suggest that he was already thinking in terms of reinforced concrete.[35]



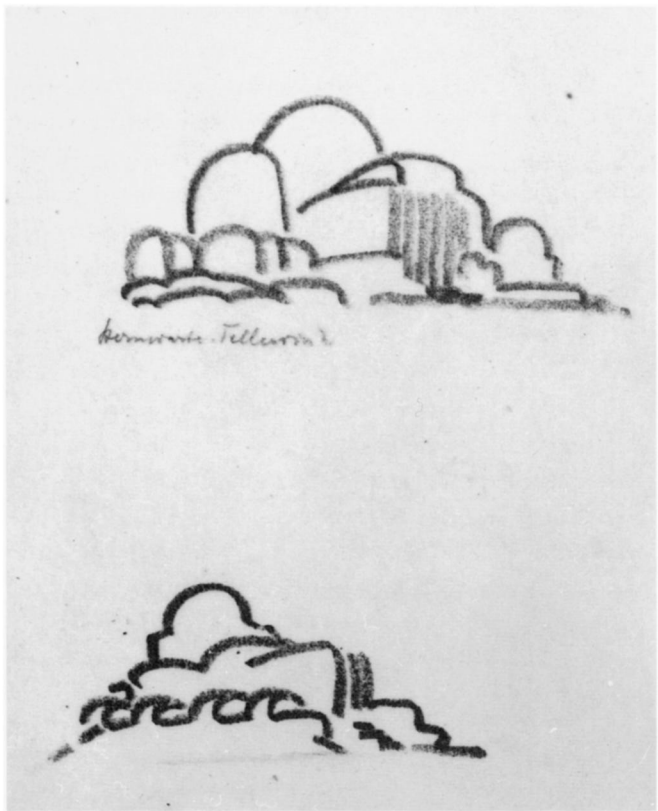


FIG. 7 (Top): Erich Mendelsohn, the earliest presentation drawing (detail) for what would become the Einstein Tower, 1917.

FIG. 8 (Bottom): Erich Mendelsohn, observatory sketches (detail), 1917.

Like the rest of Mendelsohn's architectural fantasies, the observatory sketches were drawn without the constraint of an actual program. The enormous variation in massing between the different sketches was a result of this freedom. Two approaches, joined in one instance on a single sheet, characterized his attitudes toward the problem he had identified for himself [*Figure 8*]. In the top sketch the hierarchical arrangement of the masses culminating in a centralized dome, stabilized the composition. In the bottom one, this stability vanished. Instead the crest of the dome appeared to be propelled forward on the wavelike profile of the platform.

A fragment of Mendelsohn's theory, published in 1924 but written between 1914 and 1917, set forth the reasoning behind the two approaches.[36] On the one hand, the scope of relativity's challenge to plane geometry and conventional conceptions of space initially disconcerted the young architect. His initial description of architecture as a bulwark against the implications of relativity parallels the stable composition of the pre-expressionist sketch at the top of the sheet. "Out of the three dimensional unlimitedness of cosmic space—which in itself is inconceivable—[architecture] brings spatial conception into the cosmos by virtue of its defined limits," he wrote, echoing the astronomer's vocabulary. He continued, with phrases that directly contradict the conclusions of relativity: "With the objectivity of its real distance, its absolute orientation, this [architectural] standard resolves enigmatic mysteries into predetermined legitimacies."[37] This defensive stance was rooted in the realization that relativity would not alter the role that gravity and inertia, as understood by Newton, played in architectural structure.

Mendelsohn was simultaneously tempted, however, to infuse his architecture with the excitement of Einstein's vision of movement at the speed of light. "Light must first set mass into motion," he wrote in an image inconceivable without exposure to Einstein's ideas, and "raise it to a transcendental expression of dynamic and rhythmic excitation." Capturing a sense of movement in built form particularly appealed to him. He outlined the means to such an architecture in characteristically choppy prose:

> The dynamic condition—movement of space—to be observed on the contour as space's linear element, the rhythmic condition—relation of the masses—to be observed in elevation as their surface projection, and

the static condition—balance of movement—to be observed in ground plan and sectional area as their construction elements.[38]

In contrast to the top sketch, only the plan and cross section of the scheme rendered beneath it could have had such an effect. Here the stability Mendelsohn established was a "balance of movement" rather than total calm. In this second sketch the rhythmic relation of the masses, with the off-center placement of the tower behind the cross axis and the repetition of the platform waves, compounded by the dynamic contours of the profiles of these masses, did indeed produce an architecture of motion.

In an extraordinary letter to his wife, which accompanied some of these drawings, Mendelsohn reiterated the lessons about light and mass he had learned from relativity, and connected them specifically with the aesthetics of expressionist painting. He began with the observation that traditional architectural representation, the method learned in architecture schools, was the equivalent of realistic painting, the style whose limits Kandinsky had condemned in *Concerning the Spiritual in Art*.[39] Instead Mendelsohn maintained:

> The representation has nothing to do with nature, for it takes its laws from architecture itself. Dynamic masses are to be shown so that their dynamism is clearly expressed, so that movement and countermovement show the balance. Between the two coefficients of direction—energies and sounds—stands the sudden transition, from light to shade, from black to white. These pauses are the pivots of the movement. They are the impulse, the living element, while the mass is stable. According to the way it is built up, this mass can be mighty, oppressive, or finely and sensitively outlined, without losing its stability. The pause stands at the point where the movement is to be given a new and unexpected direction. That is why it surprises, why it stimulates.[40]

The power of two-dimensional art to evoke emotion, to attract an audience, and to convey motion, to which Mendelsohn had first been exposed by Kandinsky's paintings, he now translated into architectural drawing. He was especially interested in Kandinsky's technique of depicting implied motion as a way in which he might capture some of the energy implicit in Einstein's theory. He went on to equate expressionist art with the goal of representing relativity:

> The balance of movement—in mass and light—mass needs light, light moves mass—is reciprocal, parallel, complementary. The mass is clearly constructed, if the light balances the mass. Returning in conclusion to the contour! The light is properly distributed, when it equalizes the moving mass. Returning in conclusion to the representation! This is the general law of the art of expression.[41]

This letter is the key to understanding the aims of Mendelsohn's drawings and his architecture. While it is not a coherent philosophical statement, relativity itself did not appear to be rational and certainly could not be transposed easily into architectural terms. A sleight of hand, or at least of words, was in order. Throughout his career Mendelsohn would attempt, through an expressive use of curves, to invoke the energy he saw as latent in architectural mass. He substituted this implied movement for the impossibility of converting the material fact of the building into actual energy.

By July 1918 Freundlich had decided to build his own institute. Encouraged by an offer from Gustav Müller, the director of the Astrophysical Observatory in Potsdam, of a site on its grounds, Freundlich sent a detailed description of the building's program, complete with sketches of a possible elevation and ground plan [*Figure 9*], to Mendelsohn, now stationed on the French front. He also included a description of the building's program in which he offered two possible solutions for its configuration. The first consisted of a double-walled concrete tower capped by a cupola and standing atop an extensive underground laboratory, entered through a small cabin next to the tower. In the second scheme, light from the tower was projected into an above-ground laboratory, a less expensive arrangement that had the disadvantage, however, of

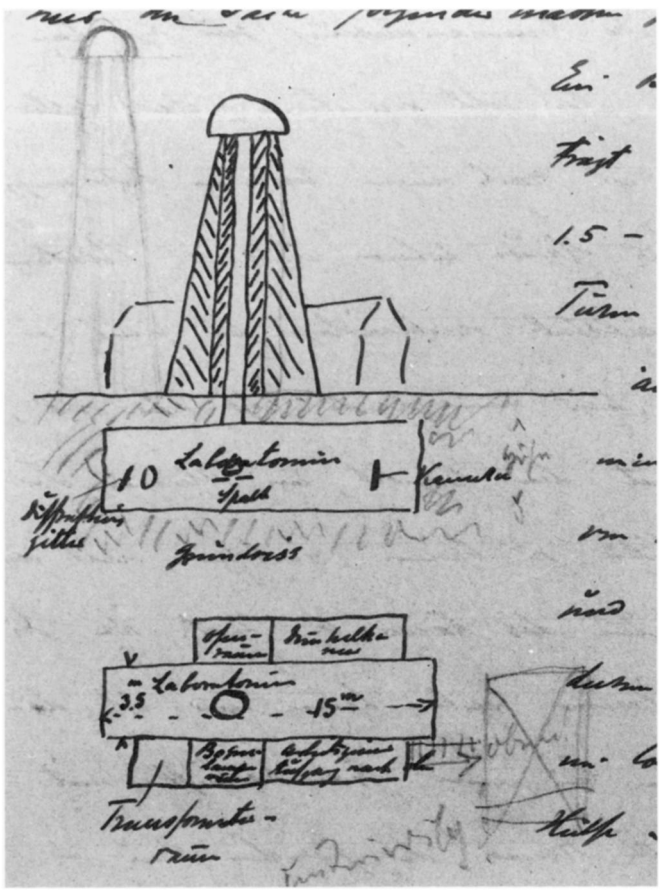


FIG. 9: Erwin Finlay Freundlich, detail of his letter to the architect in which he set forth two possible plans for the Einstein Tower, 1918. His sketches elaborate upon the scheme he describes first, which features an extensive underground laboratory flanked by accessory spaces for various equipment.

FIG. 10: Vertical coelostat and horizontal laboratory, Snow Telescope, Mt. Wilson, Pasadena, California, 1907. The coelostat tower was the second built on the site.

creating a laboratory environment more subject to changes in temperature.[42]

Together the drawings and written description in Freundlich's letter reveal the influence of a series of solar telescopes built at the Mount Wilson Solar Observatory near Pasadena, California under the supervision of George Ellery Hale. For two decades, Hale, a pioneering astrophysicist, had experimented with new scientific equipment and the structures necessary to house it adequately. Before beginning work at Mt. Wilson he had commissioned and participated in the design of the Yerkes Observatory in Williams Bay, Wisconsin, for the University of Chicago. There he had been troubled by the way in which the mounting of the extremely powerful telescope precluded experimentation with rigidly mounted spectographic instruments. He attempted to rectify this situation in the Snow Telescope at Mt. Wilson, which was completed in 1905. Here a coelostat, a pair of rotating mirrors, reflected light directly through the fixed telescope into a horizontal spectographic chamber. Difficulties with regulating temperature and controlling wind led to further experiments with the form of increasingly tall towers and the adjacent laboratory spaces. In 1908 Hale completed a sixty-foot tower directly adjacent to the Snow telescope, where for the first time he raised the coelostat high above the spectographic chamber, which was now located underground.

Freundlich's drawing seems to be based on a photograph of the Snow telescope's long, shingled laboratory and this tower, which Hale published in 1907 [*Figure 10*]. He was also influenced by details of a second, taller tower, completed in 1912, but published already in 1910. Here, as in Freundlich's sketch, an open lattice-work of steel obviously supported the actual cupola, now completely enclosed so that the coelostat, too, could be kept at a constant temperature, while light from the coelostat reached the laboratory through a separate freestanding lightwell at the center. This 150-foot tower telescope sat above a slightly larger underground chamber, lined in concrete, and still oriented vertically. Freundlich's major contribution, as described in his initial scheme, was to place a *horizontally* oriented chamber under a tower, which would soon be fully enclosed. This combination would produce far more generous work and circulation spaces than those at Mt. Wilson.[43]

The drawing that Mendelsohn enclosed in a letter of 10 July 1918 to his wife is one of two similar sketches he may have made in response to this program [*Figure 11*].[44] In them, two tall masses flanked a prominent tower on a curved base. While the relationship between the 1917 presentation drawing and Freundlich's second scheme suggests that the two men had already been discussing this arrangement for some time, the drawings of 1918 seem to be related to the new scheme, in which the underground laboratories are located under the tower. Mendelsohn got little further before events that led to the end of the war intervened.

During the war years Mendelsohn had relied on periodical articles for most of his acquaintance with developments in contemporary architecture. But, although only a lay observer, he was in direct contact with the central figures in the discussion of Einstein's general theory of relativity, meeting Einstein and Planck, Germany's two foremost physicists, as well as counting Freundlich among his closest personal friends. It was thus physics, more than the meager architectural events of the war years, that provided the crucial inspiration for his increasingly original vision of a new architecture. Yet it cannot be said that physics determined the form that that vision took. The conver-

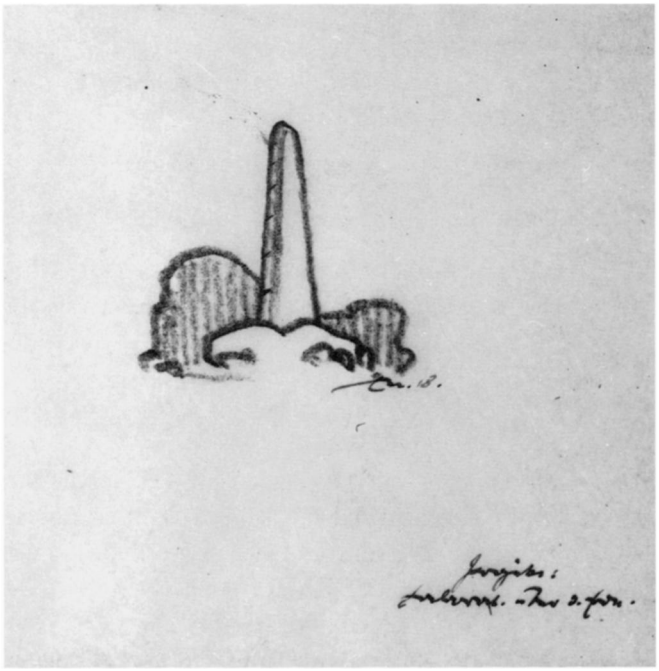


FIG. 11: Erich Mendelsohn, perspective for the Einstein Tower, 1918 (detail), probably drawn in response to Freundlich's suggestions as seen in Fig. 9.

sion of physics into a visual language depended on the influences of familiar visual precedents.

The architect in postwar Berlin

The German defeat in November 1918 put an end to any hope of construction and thrust Mendelsohn into revolutionary artistic activities in Berlin. The only architect among the founding members of the *Novembergruppe*, he maintained a personal and theoretical distance from his fellow expressionist architects, none of whom he had apparently known before the war. Thus he exhibited his drawings in a solo show at the Paul Cassirer Gallery rather than in the famous Arbeitsrat für Kunst's *Exhibit for Unknown Architects,* and disseminated his theoretical views through lectures rather than participation in the Crystal Chain letters.[45] Certainly the activity taking place around him stimulated him to refine his own positions and encouraged him to believe that changes he had previously only dreamed of could indeed be realized. Above all this meant that he could now hope to build the Einstein Tower in the style of his most experimental wartime sketches.

Although Freundlich had anticipated beginning construction in August 1918, Germany's defeat at the hands of the Allies and the collapse of the political system that accompanied it made a mockery of his optimism.[46] For over a year Mendelsohn and Freundlich made almost no progress on what would eventually become the Einstein Tower. Throughout 1919 Mendelsohn focused almost exclusively on other matters, returning to full-time work on Freundlich's observatory only after, at the end of 1919, the Royal Society and Royal Astronomical Society in London announced that they had proven Einstein's theories to be correct.

Mendelsohn referred to the implications of relativity only obliquely in the lecture he delivered at the opening of his exhibit at Cassirer's gallery late in 1919.[47] The discovery of relativity by his countrymen was, however, about to ensure the still largely unknown architect his own place in the public spotlight. On 6 November 1919, the Royal Society and the Royal Astronomical Society met in London to hear that the experiment Freundlich had hoped to perform in the Crimea in August 1914 had been completed by two British expeditions, producing proof of Einstein's general theory of relativity. The once-esoteric theory almost instantly became the stuff of popular science. Einstein became the first celebrity of Germany's recently founded Weimar Republic, effortlessly attaining a fame he had done nothing to court. The difficulty of the theory was no obstacle to its initial popularity, which depended more on the pride a defeated nation took in such a high level of intellectual achievement than on its little-understood scientific details. For instance, Einstein's trips abroad in the early twenties, especially to France, where other German scientists remained unwelcome, were widely reported in the national press.[48]

Relativity appeared to many among its lay audience, admirers and detractors alike, to be an irrational theory, and thus consistent with the growing appreciation of expressionism, whose literature, theater, cinema, and art were now enjoyed by a far greater audience than the Berlin and Munich cafè coteries engaged in their production before the war. Einstein, however, continued to insist that his ideas had been a product of careful deductive reasoning.[49] His example encouraged Mendelsohn to believe that there was no discrepancy between technological issues of construction, which he saw in expressionist rather than in the strictly rational terms of engineering, and expressionism's utopian goals.

Throughout 1919 the architect produced only one elevation and plan for the Einstein Tower. The initial enthusiasm for relativity that followed the British announcement spurred Freundlich, however, to organize a foundation in Einstein's name that would fund the construction of his observatory. He worked quickly. Only a month after Einstein and his theory became world-famous, he wrote a public appeal for half-a-million marks to be applied toward German research on the general theory of relativity. He secured the signature of eight of the country's leading scientists, including Max Planck and the directors of Potsdam's two observatories. The call, couched in nationalistic terms, pleaded for the money for just one site where German research could be given a chance to hold its own against the numerous experiments being conducted at the time in England, France, and America, the countries that had defeated Germany only a year earlier. Freundlich also lobbied

the Prussian state government for an appropriation of 150,000 marks to purchase a spectrograph, the proposed observatory's most important and expensive instrument. He raised additional money from industrialists, and persuaded them to donate materials and equipment for the building at cost.[50]

The design process

Freundlich's successful fundraising sparked a frantic burst of activity on the part of his architect. Between May and July of 1920 Mendelsohn completed his design.[51] Although the final product only superficially resembles the first drawing of 1917, a thread can be drawn through most of the many stages of the tower's design. Accompanying its evolution, in which increasingly specific technical requirements influenced its form, was Mendelsohn's ever more sophisticated understanding of the limitations of experimental architectural representation, as he sought to convert the dynamism of his drawings into built form.

A thumbnail sketch dated 1918, and possibly drawn while Mendelsohn was still in the army, was the basis of a larger drawing in pencil and yellow chalk that he certainly made after returning to Berlin in November 1918 [*Figure 12*].[52] Here the architect replaced the bland profile of the original presentation drawing with a sharply angled perspective view, and substituted vigorous draftsmanship for the carefully demarcated forms of the earlier drawing. The animation, which characterized each subsequent version of the design and had previously been seen only in the fantastical sketches, now appeared for the first time in a drawing related to Freundlich's program, where it added plastic vigor to the building's form. The three side windows of the office block, for instance, now projected forward of the side wall, while the windows terminating the block were deeply recessed. Mendelsohn also transformed the three circlets of windows on the tower shaft to big bites taken out of its forward face. The architect also added a low-slung section to anchor the forward motion of the design as a whole. This addition also hints, although no plans are available to confirm it, that he and Freundlich had continued to think in terms of the first scheme presented in Freundlich's letter of 1918. In that version of the program an underground laboratory lay directly below the tower's shaft.

In June of 1919 Mendelsohn reported in a letter to his wife that he was working on plans for the tower.[53] The one known result of this work is a plan which for the most part corresponds with the perspective discussed above [*Figure 13*].[54] Here he

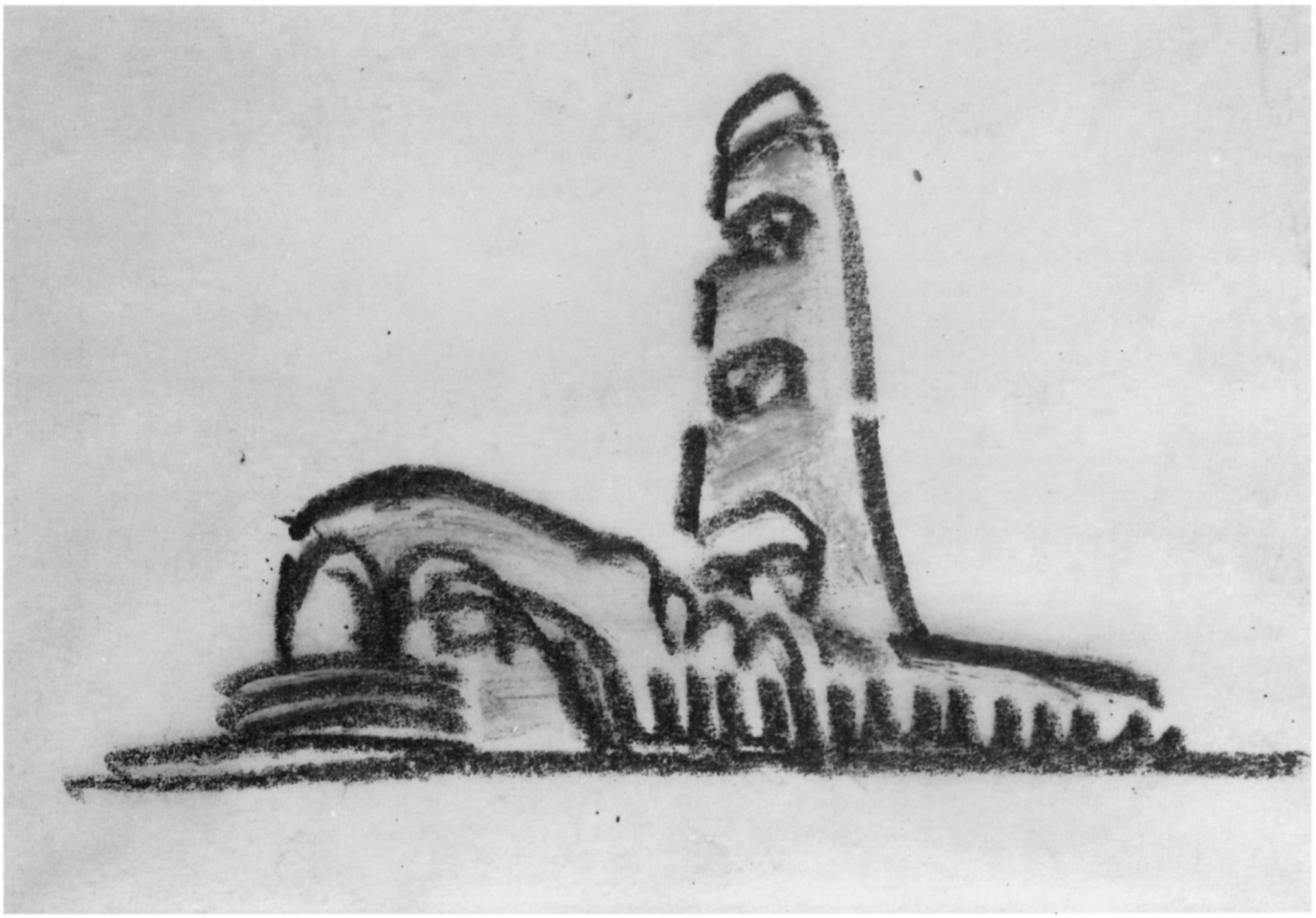


FIG. 12: Erich Mendelsohn, a perspective sketch for the Einstein Tower from either late-1918 or 1919.

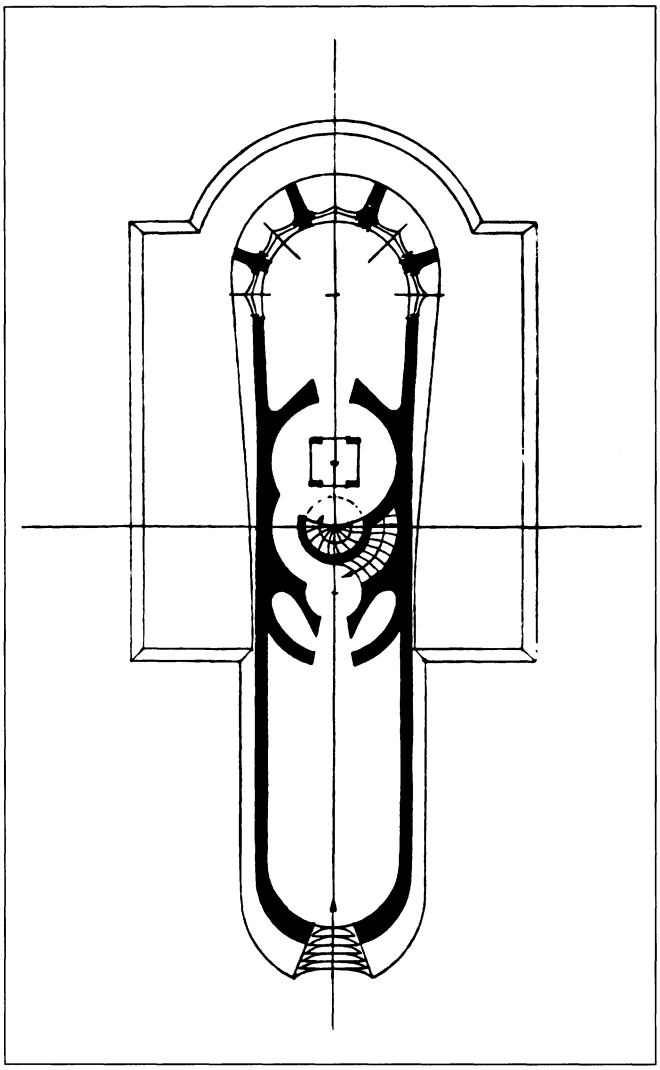


FIG. 13: Erich Mendelsohn, first-floor plan of Einstein Tower, 1919, showing a larger porch and shorter underground laboratory than were eventually built.

definitively established the location of the underground laboratory, which now began immediately below the porch and ended just beyond the workroom, and confirmed the function as an entrance porch of the low wing seen in the rear of the earlier perspective, while offering new details of the building's interior organization. He subordinated the curiously shaped vestibule entirely to his conception of the exterior form of the building. More elegant in plan than they would have been in practice were the stairs leading up to the astronomical observatory crowning the tower. The architect coiled them within the larger curve of those running down to the underground laboratories. The plan for the building's first floor level gave no indication of the crucial division of these underground spaces. In later designs Mendelsohn eliminated the incongruity found here between the successive semicircular forms tucked into the tower shaft and its monolithic façade, and instead used the demands of the building's plan and concrete buttresses to enliven its exterior appearance.

For nearly two months in 1920, beginning in early May, Mendelsohn—aided by the staff of his small office, especially an assistant named Kaprowski—produced a steady stream of sketches, models, and drawings, culminating in the construction documents for the building.[55] This intense burst of activity was initially sparked by a trip Mendelsohn and Freundlich made to meet with the staff of Carl Zeiss, the Jena optical instruments firm that manufactured most of the lenses and other scientific apparatus for the building. It may have been then that Mendelsohn learned that the tower shaft would have to be wider than Freundlich had indicated in his description of the building's program of 1918, for immediately afterwards he wrote his wife that he was thickening its diameter.[56]

Mendelsohn was responsible only for designing an appropriate shell for the Einstein Tower's technical equipment. Freundlich left to engineers, two of them from Zeiss, the task of determining the detailed requirements that this equipment imposed upon its architecture.[57] The engineers, not the architect, were responsible for such basic decisions as the height and width of the cupola housing the observatory, the interior tower, and the underground laboratory, as well as for details of the construction of this tower and the laboratory. The arrangement was typical of the agreements in which Germany's most talented prewar architects, men who often had little expertise in the details of industrial and scientific equipment, made factories and other industrial structures into elegant and influential new buildings.[58]

The new design initially resembled a tethered animal straining at the end of its leash.[59] Here Mendelsohn appended the entrance porch to the office wing, leaving the function of the rear section again unclear. As he moved beyond this version, he began to pay increasing attention to mass instead of the linear energy that had initially fascinated him. He turned to models to work out details of the building, commissioning at least three of them in the first three weeks of June alone.[60] Only now did he begin to consider seriously the choice of materials for the tower's construction. In May he first voiced the hope that he might be able build the entire structure out of concrete.[61] A month later he was still not sure that this would be possible, although he was enthusiastic about the energetic qualities concrete could bring to the building.[62] Growing out of the frustration he had voiced in his lecture of 1919 about the paper architecture of his contemporaries, his new concentration on mass and construction culminated in the statement that "line must die, [it] must become the contour of the mass.... Architecture is domination of the mass."[63] Two handsome colored chalk elevation drawings document this change. Figure 14 illustrates one of these.[64] In them he added three stabilizing tiers of projecting semicircular additions to the revised tower shaft.

These drawings were but two of the many Mendelsohn

sketched during the weekend of June 26.[65] In the final design he grafted a new tower onto the body of the 1919 scheme [*Figure 1*].[66] Besides being thicker, this tower differed from its predecessor in the unarticulated rise of its front and rear elevations. In front, a concave apron separated two parallel stacks of four small side windows. The architect admitted that he liked the play of the shaft's inset corner windows against what he termed the "membrane" of the building's skin.[67] By the end of June only the task of developing new ground plans, and from them working drawings, remained.[68]

In the rush to complete the design, Mendelsohn drew upon the most completely developed of his wartime projects, the 1917 optical instruments factory [*Figure 15*]. The Einstein Tower added backbone to this project. The factory had been composed of a low, flared base, a slightly higher rear section, and a towered center, the configuration he adopted in 1919 for the Einstein Tower. In the final elevation for the Einstein Tower, he connected the twin towers of the factory. The division of the porch into two curved arms, a solution carried over from the 1919 design, and the unification of the towers stabilized the factory's hurtling locomotion. These changes interrupted the sweep of the base and of their tower windows, balancing upright positions against horizontal motion.

Although the story of the tower's design process necessarily chronicles the translation of unbuildably energetic drawings into more sedate construction documents, the degree to which the completed building conveyed the animation of the 1919 drawings remains one of Mendelsohn's greatest accomplishments. None of the built work of the first years of the Weimar Republic came so close to the technological boundaries of construction, and converted into the three dimensions of architecture so much of the dynamism that had become commonplace in the flat surfaces of expressionist paintings.

Construction

Construction began in the summer of 1920, soon after Mendelsohn completed the necessary drawings.[69] The contractors were A. F. Bolle and Dyckerhoff-Widmann.[70] The latter firm was among Germany's leading experts in reinforced concrete construction, with Berg's Centennial Hall already to their credit.[71] The exterior structure of the building was completed by October of the following year. The process was not without incident. Years later, Luise Mendelsohn recalled her nightmares that the building would slide down the hill.[72] In his description of the building her husband stated, "The architectural form meets the inner needs and keeps to the formal conditions of reinforced concrete."[73] Shaped by an aesthetic sense of the possibilities of monolithic reinforced concrete construction, rather than a truly technological understanding of the material, the willfully sculpted profiles of the tower proved, however, almost impossible to build because of the difficulty of crafting the needed formwork.[74] The situation was perhaps complicated by the postwar shortage of concrete, which Freundlich had hoped would be obtained largely through donations.[75]

By the end of October 1920, economic considerations forced Mendelsohn to compromise.[76] Reluctantly, he substituted stucco-covered brick for reinforced concrete for all the above-ground portions of the building, except the entrance, which with the basement laboratory had already been successfully constructed out of concrete. He took care to achieve a uniform surface treatment between the two materials. By this stage it was too late to alter the design to conform to the more mundane choice of material. Instead, the most important change he made to the design at this point was the windows he added to the first floor workroom. The architect was enormously disappointed. At the end of his life he wrote that he had mistakenly emphasized form over structure.[77] The fact that he built nothing else that remotely resembled the Einstein Tower can be attributed above all to the disillusionment produced by his new intimate experience with concrete construction. Having already struggled with a variety of authorities while "giving birth" (his expression) to the building's design, he now found

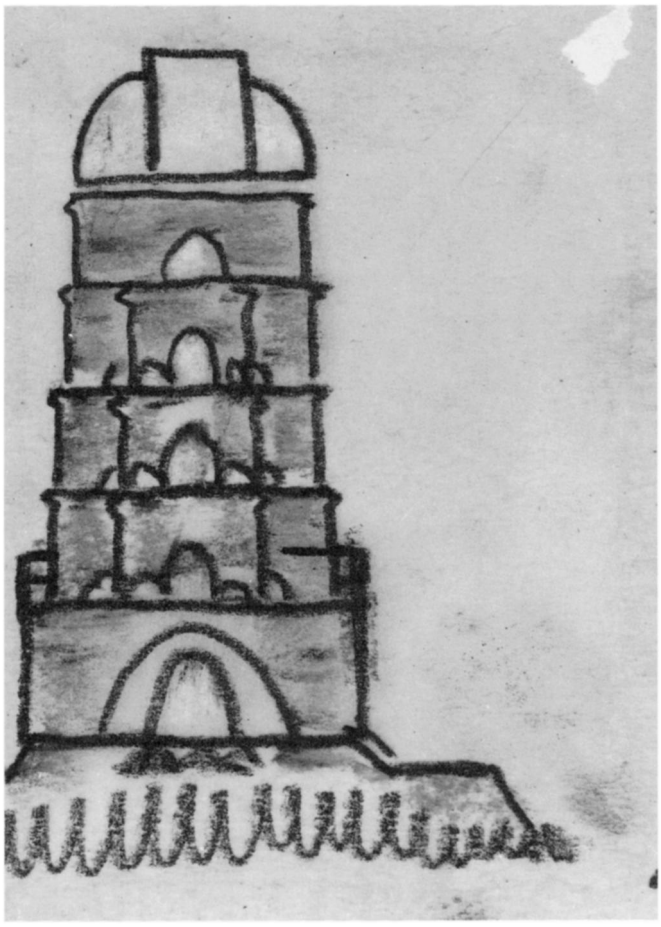


FIG. 14: Erich Mendelsohn, elevation of penultimate design for the Einstein Tower, June 1920.

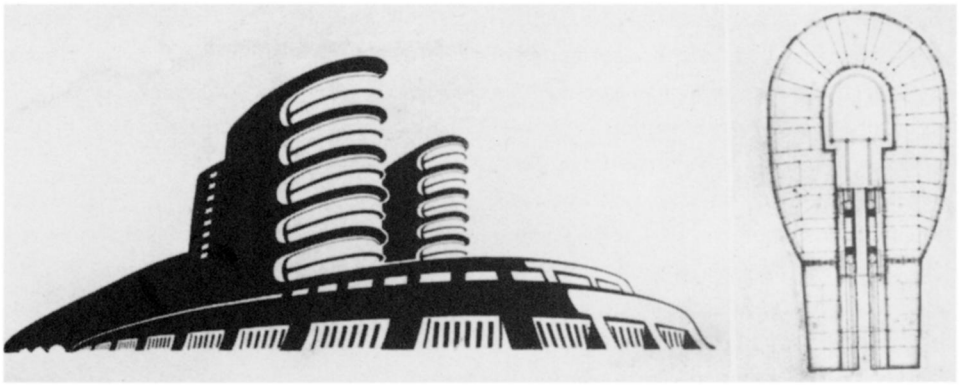


FIG. 15: Erich Mendelsohn, project for an optical instruments factory, 1917.

himself unable to redesign the tower shaft midway through construction to reflect the materials of which it was actually being built.[78]

The Einstein Tower as observatory and laboratory

It was the engineers, not Mendelsohn, who developed Freundlich's original building program of 1918 into a far more sophisticated set of requirements for the delicately calibrated instruments housed in the observatory and laboratory. These specifications exerted an important functional check on the plasticity of Mendelsohn's design. On the most obvious level they determined the general character of the building's elevation and most details of the basement plan. At the same time, Mendelsohn crafted the exterior of the building into what he believed was an expression of, and monument to, the experiments which were to take place within.

In his theory of relativity Einstein calculated that as light travels, it loses mass, a loss that can be measured through the increasing reddening of its rays when they are broken by a prism into a spectrum of colors. This was a key component of his declaration that mass and energy are equivalent. Proof of the redshift in the color of light would offer proof of this hypothetical equivalency that lay at the core of relativity.[79] In the tower, Freundlich would be able to measure and compare the spectra of starlight and sunlight with that of two earthly light sources, the light from an oven that he believed reproduced conditions on the coldest stars and the light of an arc lamp.[80]

The building's first programmatic requirement was thus for an astronomical observatory through which sun and starlight could be captured [*Figure 16*]. Here Freundlich followed Hale's example. The revolving cupola of the Einstein Tower contained an opening through which light entered. This opening could be positioned to face in any direction. Light fell through this opening onto the coelostat, from which it was reflected downwards through lenses set parallel to the observatory's floor.[81] The coelostat had to sit absolutely level on a stand impervious to any disorienting motion. A separate interior tower built of two independently constructed wooden lattices supported this heavy piece of sensitive equipment. The tower

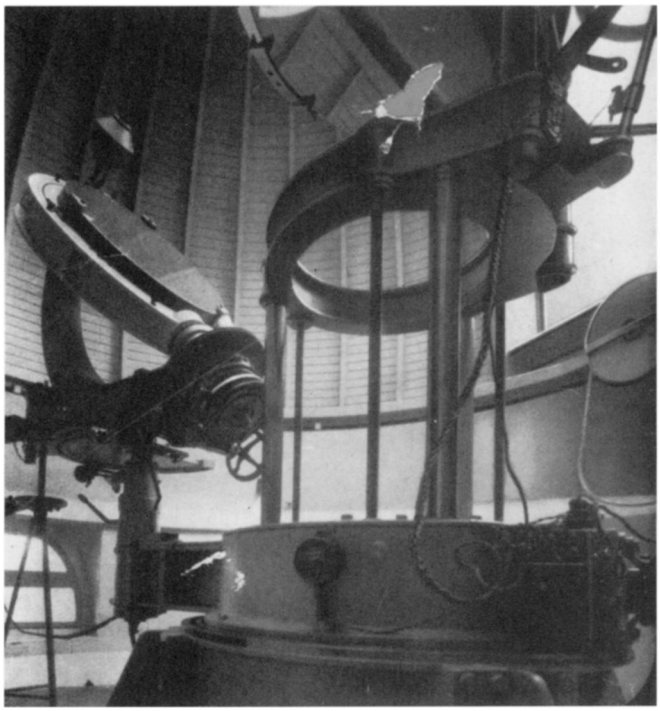


FIG. 16: Coelostat in the observatory of the Einstein Tower as installed in 1924. Light gathered here was projected vertically into the underground laboratory.

rested in turn upon four concrete corner pillars (A) that were located in the underground laboratory immediately below the perimeter of the exterior tower [*Figure 17*].

From here a mirror, standing on an independently grounded pillar (B), deflected the light perpendicularly into the spectographic chamber (C), where it was analyzed. This chamber was designed to maintain a constant temperature; a one-meter gap (D) isolated its walls (save the one connecting it to the laboratory) from the building's exterior. The chamber itself was wrapped in Torfoleum, an insulating substance used in cold-storage rooms. The aperture through which light passed into the chamber (E) was arranged with the aid of prisms so that up to three light sources could pass through it simultaneously. Below it were additional apertures holding photographic emulsions onto which fell light that had been reflected back from the camera lenses of two pieces of equipment located within the

chamber: the prism spectograph (F), and a gridded spectograph (G). The prism broke the light into spectra, allowing Freundlich to analyze the proportions of different colors within the light from different sources. The gridded spectrograph enabled these fine distinctions to be measured.[82]

The two earthly light sources, the arc lamp (H) and the spectral oven (I), were located in the laboratory just outside the spectrographic chamber, one on each side of the mirror used to direct cosmic light sources into the chamber. This laboratory lay under and to the left and right of the tower shaft; the spectographic chamber began under the workroom and stretched back beyond the building's above-ground structure. Freundlich believed that the spectral oven, with temperatures of three thousand degrees Celsius, produced light in conditions that reproduced those of the coldest stars. Despite these high temperatures, a layer of cold, flowing water kept the exterior of the oven cool enough to touch. Consequently the building itself did not have to be insulated against extreme heat.[83] Eight lidded windows allowed light to enter the basement. The rear six were cut into the building's turf-covered platform; the front two emerged directly from the concrete sides of the open porch.[84]

An organic monument to relativity

The Einstein Tower is a pivotal point between the prewar fascination many German architects had with monumental architecture and the postwar *neue Sachlichkeit* substitution of technology for pomp, between images of permanence and the ephemeral, between stability and dynamism. In his design for one of the first monuments erected during the Weimar Republic, Mendelsohn borrowed from sources as diverse as the nationalistic Battle of the Nations Monument in Leipzig [*Figure 18*], designed by Bruno Schmitz and dedicated in 1913, and futurist explorations of form in motion, to create a double

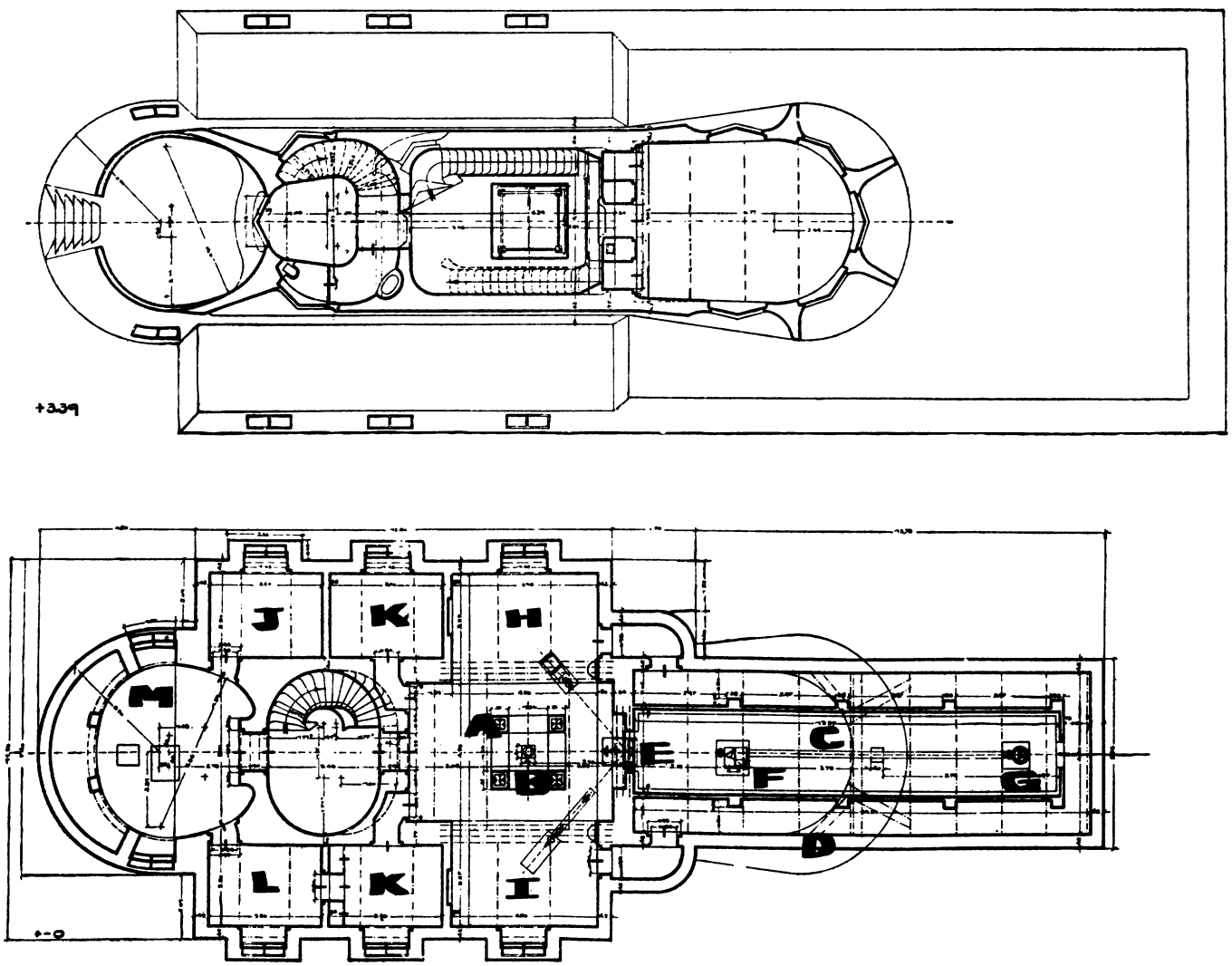


FIG. 17: First-floor and basement plan of the Einstein Tower. Note the extension of the laboratory beyond the back of the above-ground portions of the building. (A) footings for the interior tower, (B) mirror, (C) spectographic chamber, (D) one-meter gap between exterior walls, (E) aperture, (F) prism spectograph, (G) gridded spectograph, (H) arc lamp, (I) spectral oven, (J) high voltage battery, (K) equipment, (L) battery, (M) microphotometer.

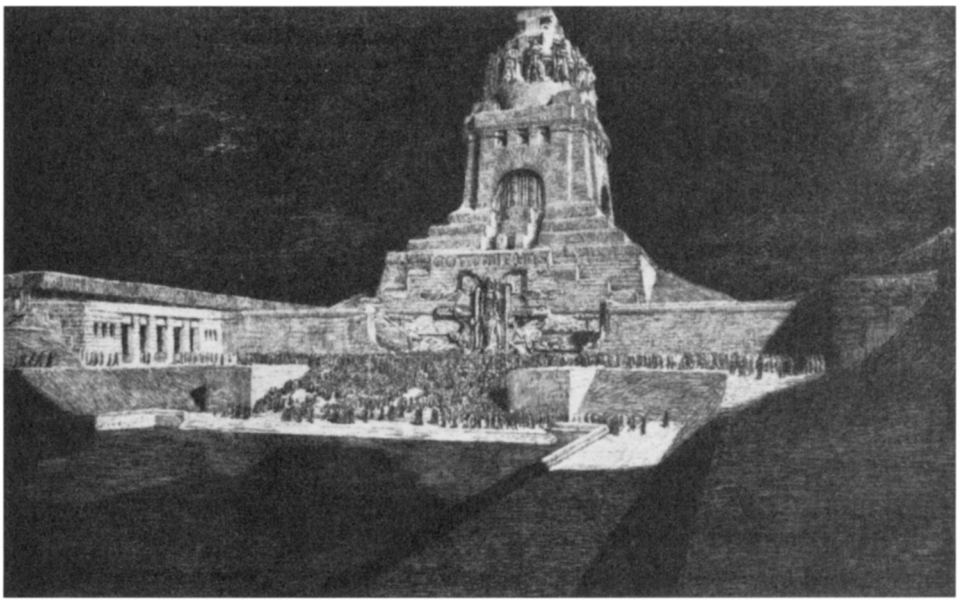


FIG. 18: Bruno Schmitz, Battle of the Nations Monument, Leipzig, Germany, 1913.

metaphor for the relationship between mass and energy posited by relativity and for the material properties of reinforced concrete.

Monumental themes had been central to the concerns of prewar German architects. Reformers such as Olbrich and Behrens shared this interest with far more conservative patrons, like those who commissioned the Battle of the Nations Monument.[85] Mendelsohn must have seen Schmitz's building when in 1913 he traveled to see two more modern treatments of this popular theme, Bruno Taut's Monument to Iron in the same city and Berg's Centennial Hall in Breslau.[86] A liberal who would welcome the replacement of the monarchy with a democratic government, he deplored all that the Battle of the Nations monument stood for, but recognized the effectiveness of many of Schmitz's formal decisions.

Schmitz's siting was masterful. The building was deeply rooted in, yet rose triumphantly out of, the surrounding landscape. The architect carved its forecourt deep into the earth, and prominently defined the resulting space by flanking it with tall grass-covered mounds, which extended beyond the rear of the building to form a meadow raised far above grade, from which in turn sprung the side and rear façades of the tower itself. Mendelsohn adopted some of the same strategies. Although not actually sunken, the strong sense of enclosure conveyed by his entrance captured the flavor of Schmitz's forecourt, while the concrete-framed windows of the underground laboratory peeked out of a raised, grass-covered platform whose existence, as in Leipzig, almost literally anchored the building in the surrounding landscape. Since this platform sheltered the laboratory, it too stretched beyond the rear of the above-ground workroom to the limits of the extruded underground space.

On a far smaller scale (the Einstein Tower is only twenty meters tall) Mendelsohn was able to refer to prewar monumentality, yet his tower's celebration of a scientific discovery rather than a military victory spoke of his hope that Germany's postwar democracy would champion intellectual and artistic inquiry rather than military prowess.[87] And his recasting of Schmitz's rugged masonry into smooth concrete in this context demonstrated material as well as political progress. Furthermore, his tightly unified composition, enhanced by the tower's continuous surface, made Schmitz's rusticated blocks appear chunky and awkward. In his rejection of ornament as well as rich textures, Mendelsohn flexed the suppleness of variant interpretations against the obviousness of Schmitz's neo-Assyrian relief sculpture.

At the same time, Mendelsohn's desire to represent as well as celebrate relativity led him to futurism and to organic metaphors for reinforced concrete construction. Throughout the design process Mendelsohn attempted to animate the tower, giving it the appearance of a body moving through space. This was easier, of course, to achieve in perspective sketches than in an actual building, but the completed tower nonetheless succeeded in conveying the appearance of movement. Most importantly, its wind-swept forms gave the sense of a body in motion shedding mass. This effect was strongest in the profiles of the four pairs of side window's cut into the tower shaft, which sloped down and back as if carved by wind or water.

In order to achieve the illusion of motion, Mendelsohn turned to Boccioni's *Unique Forms of Continuity in Space*, an exploration of the human figure moving through time and space sculpted in 1913 [*Figure 19*].[88] Boccioni's sculpture had been exhibited in Paris in 1913 and published by the artist himself the following year. It was well known in Berlin's expressionist circles where the artist had been championed by Herwath Walden, the influential editor of *Der Sturm*.[89] Al-

though the sculpture is usually discussed in relation to cubism, which Boccioni had recently studied in Paris and regarded as the main stylistic rival of his own futurist movement, for Mendelsohn the "dynamic" (the word is one Boccioni himself frequently used) quality of Boccioni's curved, and even at times apparently wind-swept figure, would have recalled Obrist and Kandinsky. And, although Boccioni based the work on a study of time and space rather than nuclear physics, its form could also be used to communicate Mendelsohn's message that the energy needed to propel motion comes from the loss of mass. Already committed to a new architecture, one based on the architectural representation of the energy inherent within mass, Mendelsohn could have discovered in Boccioni's art and in his writings confirmation that the dynamic pace of modern life demanded artistic expression.[90]

For Mendelsohn this dynamism was indivisible from an organic interpretation of technology, influenced by his understanding of relativity. In a lecture in 1923 in which he described the Einstein Tower as "a clear architectural organism," he also stated:

> Ever since science has come to realize that the two concepts matter and energy, formerly kept rigidly apart, are merely different states of the same primary element, that in the order of the world nothing takes place without relativity to the cosmos, without relationship to the whole, the engineer has abandoned the mechanical theory of dead matter and has reaffirmed his allegiance to nature. . . . The machine, till now the pliable tool of lifeless exploitation, has become the constructive element of a new, living organism.[91]

These views led Mendelsohn to design the tower in part as an analogy between an industrial material—reinforced concrete—and the human body.[92] The form of the tower shaft resembled human vertabrae. The imagery worked on several levels. First it represented the truth of reinforced concrete construction in which a steel frame or skeleton supported and stiffened concrete flesh. Secondly, the architect was able to depict the stresses shaping the form he chose (in this case, the compression and tension of reinforced concrete and of the human body). For him this procedure was not an arbitrary decorative strategy, but was instead indivisible from the actual demands of construction upon the building. Thirdly, the human spine is composed of intricately curved pieces that corresponded to his aesthetic taste and to *Jugendstil* precedent. Finally, the metaphor gave the building a human presence that would arouse the empathy of viewers.

The tower's reception

In 1921 the tower was not only the most startling new building in Germany, but also the one which most obviously advanced the idea of the radical new architecture so often propounded by fellow expressionist Bruno Taut. From the first, this apparent similarity has obscured Mendelsohn and Freundlich's intentions for their building, emphasizing its mysticism, and diminishing the specificity of the sources brought together in its creation. Like Taut, Mendelsohn sought to create powerful architectural symbols to revitalize postwar society. The two men differed, however, about whether science could help them fulfill this ambition. In December 1919, the same month that Mendelsohn offered construction in steel and concrete as the proper source for a new architecture, Taut stated that "the danger of scientific methods . . . will be overcome when astronomy becomes astrology."[93]

Because of its association with relativity and its unusual appearence, the Einstein Tower quickly became one of the best-known buildings in postwar Germany.[94] Familiar to the German public at large and in architectural circles abroad, the tower served throughout the 1920s as a lightning rod for discussions about what contemporary architecture should look like, and in particular about the balance to be struck between individual expression and functional form. While many had faith in the tower's modernity, others, including to some degree its architect, came to believe it embodied only the hopes of the immediate postwar years, and turned instead toward more obviously rational and industrial forms.

FIG. 19: Umberto Boccioni, *Unique Forms of Continuity in Space*, 1913. Bronze, (cast 1931), 43 7/8 x 34 7/8 x 15 3/4". The Museum of Modern Art, New York. Acquired through the Lillie P. Bliss Bequest.

When the tower's dedication finally took place in 1924, the building was already famous. Like everything connected with Einstein in the early twenties, it attracted enormous publicity. In an account of the recent Astronomy Day in Potsdam, which had included a tour of the tower conducted by Freundlich, the *Berliner Tageblatt* of 26 August 1921 noted that the building was attracting lively interest from specialists. That attention would spread to the general public when, on September 4, it was published in both that paper's illustrated Sunday supplement and on the cover of the illustrated tabloid, *Die Berliner Illustrierte Zeitung,* which had the highest circulation of any periodical in Europe.[95] Pictures of the tower could also be found in many of Berlin's cigar stores.[96] The publicity, which may have been sought by Freundlich, but in which Mendelsohn apparently played no part, provided many with their first glimpse of a new style of building as astonishingly antitraditional as any political, scientific, or artistic development of which they were aware.

Einstein himself flattered Mendelsohn when, in a one-word review of the tower, he labeled it "organic."[97] A magazine article of 1926 described the modernity of Mendelsohn's design to a lay public as a new form made out of new materials.[98] The reception of the building among architects and architectural critics was to be much more varied than this easy acceptance of Mendelsohn's own aims for the building. The tower, still under construction, was first published in the Dutch architecture magazine *Wendingen* in October 1920.[99] During the next decade it was featured in many of Europe's leading architecture magazines and was included in surveys of modern architecture published on both sides of the Atlantic.[100] Discussion centered on the issues of whether it was indeed new and, if it was, if this was indeed what the new architecture should look like. Despite Mendelsohn's failure to construct much of the tower out of concrete, it was also included in surveys devoted to the material. In this context the architect won high praise for his convincingly monolithic approach to the material.[101]

Mendelsohn's *Jugendstil* sources were recognized by a number of commentators.[102] Others associated its unusual form with the popular occultlike view of science characteristic of many projects by members of the Crystal Chain correspondents, rather than the spirit of scientific inquiry in which it actually operated. Hermann Scheffauer, for example, wrote:

> The building, mysterious even in its outward aspects, attains to something of an esoteric scientific uncanniness within. We are in the brilliant crypt of the modern alchemists and sorcerers, in an arcanum of subtle discovery, one of the radiant poles where the ultimate mysteries of the cosmos, of time, of space, and of the eternal forces are being weighed, analyzed, and interpreted.[103]

Although in his lecture of 1919 Mendelsohn had attempted to distance himself from this mystical attitude towards science through frequent references to modern machinery and technology, the champions and detractors of the Einstein Tower throughout the rest of the twenties saw the observatory as characteristic of this immediate postwar preference for individual expression at the expense of function. This view was first stated by the Dutch architect J. F. Staal, who wrote in *Wendingen* that the tower was more like an old-fashioned monument than a futuristic workplace. Thus, he contended, it was typical of the best German architecture.[104] Behrens, who was at that time experimenting with neo-Gothic forms, commented along the same lines in a lecture in 1924 in which he labeled the tower "romantic" and "fantastical."[105] In 1930 Paul Friedrich Schmidt, citing this element of architectural fantasy, labeled the tower "a final tribute to the emotional and chaotic time of the revolution, a direct transfer of the dynamic principle to crystalline structure, without the intermediary architectural methods."[106]

The building was lauded by some who were uncomfortable with the more sober direction many former expressionists were taking by the mid-twenties as striking the proper balance between individuality and function, and they praised it as the embodiment of modernity. Arthur Segal praised it in a 1924 letter to Mendelsohn, in which he attacked more extreme forms of functionalism.[107] Walter Müller-Wulckow's photographic surveys of German architecture, published in the twenties, were comprehensive and included many distinguished, but not especially adventurous, buildings. He noted the tower's "organic simplicity" and its combination of a new functionalism and a powerfully felt sensuality.[108] In commentary written from the same aesthetic position, Fritz Hellwag in 1926 equated the modernity of the Einstein Tower with relativity itself. This comment is especially interesting, as Hellwag's article is based on his visit to the tower, through which he was probably guided by Freundlich. His article gave by far the most complete description of the building's program written for an art or architecture journal.[109]

As the decade progressed, the building was, however, increasingly criticized by proponents of the more sober, or *sachlich,* architecture which by the middle of the decade had replaced the most visionary aspects of expressionism. These critics knew much less than Hellwag about the building's purpose and its success in fulfilling it, and based their attacks upon photographs which offered little insight into its use. They were concerned instead exclusively with its apparently irrational image. The first, and most bitter, of these attacks was penned in 1923 by Paul Westheim, the editor of *Das Kunstblatt* and one of the country's most radical and perceptive art critics. Westheim, an opponent of expressionism, championed Le Corbusier and Mies in the pages of his magazine. While Staal, whom he cited, had claimed that German architecture was best known for its

individualism, Westheim condemned the tower for its monumentality, and argued that the problem with German architecture was precisely this tendency towards individualism. Westheim grouped the tower not with the postwar architecture of Taut and other *Arbeitsrat* members, to which Staal was probably referring, but with the reactionary imperial-era architecture of the Battle of the Nations Monument. He dismissed Mendelsohn's attempts at symbolism as pure advertising—advertising, he wrote, not for the observatory, but for Mendelsohn himself.[110] The tone of Westheim's comments was echoed in a denunciation of the tower's form written in 1928 by the Swiss Peter Meyer.[111]

The criticism of the building as an extreme image detached from considerations of program and construction must have wounded its architect, who considered himself, at the time he designed it, to be more interested in exactly these issues than were most of his colleagues. Just two years after the building was completed, and a year before it was dedicated, Mendelsohn himself admitted, however, that it was not a purely functional design, while at the same time defending its formal unity. He must have been disappointed that while critics recognized the tower's monumentality and were willing to equate its form with Einstein's equally unsettling idea, no one noticed the degree to which he had attempted to represent that theory. Moreover, the tower's style, which also proved not to respond to the capabilities of reinforced concrete construction as well as Mendelsohn had hoped, quickly appeared dated. The tower, with which its architect had intended to express modern science and technology, became identified instead merely with expressionism. The liberation from traditional architectural form that Taut and his circle had provided Mendelsohn, in the end constrained his message and encouraged him to unleash a form whose novelty, as expressionist architecture failed to realize its visions of a reformed society, came to triumph over its meaning. The Einstein Tower has thus endured as an exemplar of an innovative and often irrational style rather than the embodiment of the theory it was intended to serve and symbolize.

Beyond the Einstein Tower: The reformulation of dynamic functionalism

Mendelsohn's innovative responses to motion, light, and space, the architectural issues that he believed were affected by relativity, were to keep him, however, in the forefront of modern architecture until his death in 1953. Never again would his forms appear as fantastic; indeed he would be one of the first to employ industrial imagery as a sign of the functionalist approach few recognized in the tower. While many of his fellow modernists would focus on the rational delivery of housing to members of the working class, for the next decade Mendelsohn led the transformation of German downtowns. Here he fused rationalism and theatricality, efficiency and exuberance in office buildings, department stores, and a single, influential cinema that all looked very different from the Einstein Tower but were entirely congruent with the sensibility that had produced it [*Figure 20*].

Dynamic functionalism ultimately proved to be uniquely suited to the expression of the capitalist marketplace's mix of efficient production and glamorous consumption. Just as the tower's inventive silhouette tied specifications established by the engineers, who controlled the width and height of its tower and mapped out the plan of the basement laboratory, to Mendelsohn's own understanding of monumentality and relativity, here, too, lively forms were inseparable from mundane

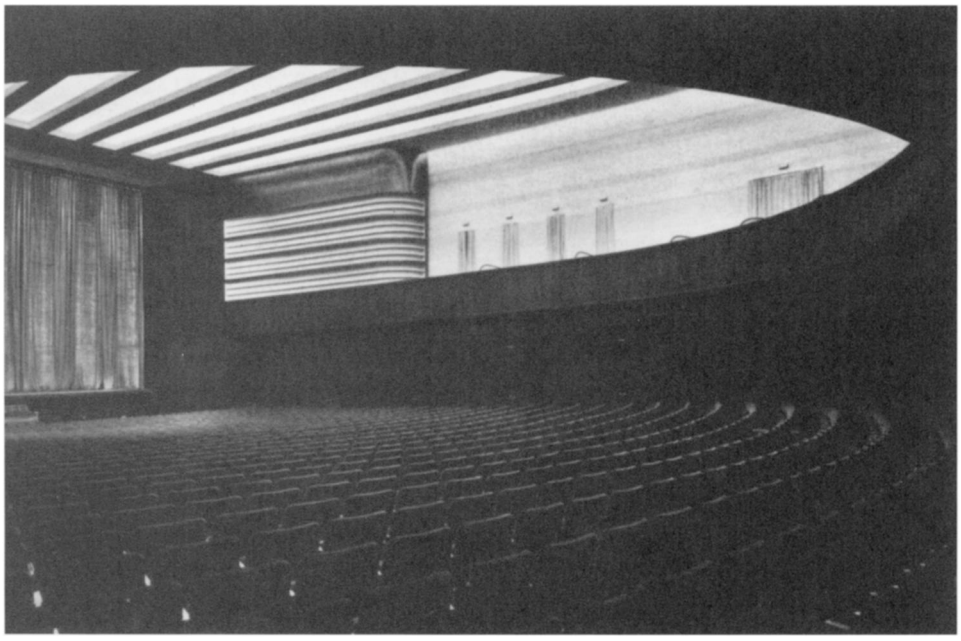


FIG. 20: Erich Mendelsohn, auditorium of Universum Cinema, Berlin, Germany, 1928.

details of what were now commercial functions: shop windows, night lighting, and staircases. Indeed these commissions were often a direct result of the tower's fame. Jewish businessmen turned to Mendelsohn in part because he and Einstein were fellow Jews. They also recognized in the tower the power of architectural form to catch the public's attention. Their architect neatly poised the advertising component of the resulting buildings between earlier illusions of social mobility achieved through consumption, and the newer emphasis upon psychological manipulation as a way to generate previously unrecognized needs when he declared of the Universum Cinema, upon its opening in 1928:

> Thus no rococo palace for Buster Keaton.
>
> No stucco pastries for Potemkin . . .
>
> But, also no fear!
>
> No sober reality, no claustrophobia of life-weary brain acrobatics—
>
> Fantasy!
>
> Fantasy—but no lunatic asylum—dominated by space, color, and light.[112]

Mendelsohn's success in this arena arose from his ability not only to fulfill a patron's program, but also to represent it metaphorically as well, a synthesis he first achieved in the Einstein Tower. In particular, his understanding of relativity encouraged him to believe that the same unstable, plastic forms that proved so commercially popular arose directly from scientific principles. At a time when many of his colleagues moved toward austerity as a metaphor for rationalism, dynamic functionalism enabled Mendelsohn to celebrate modernity instead through the very complex individuality of the programs he had been given to construct. Recollecting the details of the function of the Einstein Tower, and thus the limits of its architect's formal choices, reestablishes the tight bounds of what has too often been seen as merely eccentric architecture.

Notes

This paper draws upon two earlier papers that I presented at the annual meeting of the SAH held in Boston in March 1990 and the ACSA Technology Conference held in Cambridge, Massachusetts, the following February. I would like to thank the anonymous readers for the *JSAH*, as well as David Brownlee, Barbara Miller Lane, and Alex Pang for their many helpful comments. My research was partially funded by a Jacob Javits Fellowship and by a Faculty Summer Research Fellowship from the University of Minnesota. Unless otherwise noted, all translations from the German are my own.

[1] After their emigration to Great Britain, Mendelsohn and his wife adopted English spellings of their names, Eric and Louise. Because this work deals only with the years in which they lived in Germany, I will use the German spellings, Erich and Luise.

[2] Mendelsohn himself never used the term, although he did subtitle a 1923 lecture, "Dynamics and Function," reprinted as "The International Consensus of the New Architectural Concept, or Dyanmics and Function," in *Erich Mendelsohn: The Complete Works* (New York, 1992), 22–34, an English translation of *Erich Mendelsohn: Das Gesamtschaffen des Architekten* (Berlin, 1930). Norbert Huse, *"Neues Bauen": 1918 bis 1933* (Munich, 1975), 33, uses the similar term "functional dynamism" to describe Mendelsohn's work.

[3] Hans Rudolf Morganthaler, "The Early Drawings of Erich Mendelsohn (1887–1953)" (Ph.D diss., Stanford University, 1988), 49.

[4] Erich Mendelsohn, letter to Luise Maas, 11 Nov. 1913, in Oskar Beyer, ed., *Erich Mendelsohn: Letters of an Architect*, trans. George Strachan (London, 1967), 27; and Mendelsohn, letter to Maas, 20 Dec. 1913, in Erich Mendelsohn, *Briefe eines Architeken*, ed. Oskar Beyer (Munich, 1961), 23. These two collections of Mendelsohn's published letters are not identical. The German edition will be cited only in cases where the letter is not included in the English edition. See also Hans Rudolf Morganthaler, *The Early Sketches of German Architect Erich Mendelsohn (1887–1953): No Compromise with Reality* (Lewiston, Maine, 1992), 11–12, 17, 36, 79–80, 84, for Kandinsky's impact upon Mendelsohn.

[5] Hugo Ball, "Das Münchener Künstlertheater (Eine prinzipielle Beleuchtung)," *Phoebus* (May 1914): 68–74; Luise Mendelsohn, "Biographical Note on Eric," *L'architettura, Cronache e storia* 9 (1963): 34; Morganthaler, *Sketches* (see n. 4), 9; Peter Jelavich, *Munich and Theatrical Modernism, Politics, Playwriting, and Performance, 1890–1914* (Cambridge, Mass., 1985), 217; and Peg Weiss, *Kandinsky in Munich, The Formative Jugendstil Years* (Princeton, 1979), 102–3, 202–3.

[6] John Elderfield, ed., *Hugo Ball, Flight Out of Time: A Dada Diary* (New York, 1974), 10.

[7] Rose-Carol Washburn Long, *Kandinsky: The Development of an Abstract Style* (Oxford, 1980); and L. Mendelsohn, "Biographical Note" (see n. 5), 304.

[8] Morganthaler, *Sketches* (see n. 4), provides a ground-breaking discussion of Mendelsohn's early drawings and their sources in *Jugendstil*, expressionism, and industrial design. See also Bruno Zevi, *Erich Mendelsohn, Opera Completa Architetture e immagini architettonische* (Milan, 1970), xiii-lxxvii; Julius Posener, *Aufsätze und Vorträge, 1931–1980* (Braunschweig and Wiesbaden, 1981), 175–77; and idem, "Eröffnungsrede der Mendelsohn-Ausstellung in der Akademie der Künste," in *Der Mendelsohn-Bau am Lehniner Platz: Erich Mendelsohn und Berlin* (Berlin, 1981), 10.

[9] Weiss, *Kandinsky* (see n. 5), 22–40.

[10] Erich Mendelsohn, letter to Luise Maas, 10 Nov. 1914, in Beyer, *Letters* (see n. 4), 34.

[11] Kathryn B. Hiesinger, *Art Nouveau in Munich, Masters of Jugendstil* (Philadelphia, 1988), 79; and Siegfried Wuhmann, *Hermann Obrist: Wegbereiter der Moderne* (Munich, 1968).

[12] Erich Mendelsohn, letter to Luise Maas, 10 Nov. 1914, in Beyer, *Letters*, 34.

[13] Joan Campbell, *The German Werkbund: The Politics of Reform in the Applied Arts* (Princeton, 1978).

[14] Erich Mendelsohn, letter to Luise Maas, 14 Mar. 1914, in Beyer, *Letters*, 29–32.

[15] Reyner Banham, *A Concrete Atlantis* (Cambridge, Mass., 1986), 106.

[16] Peter Collins, *Concrete, the Vision of a New Architecture* (New York, 1959), 26–94; Julius Posener, *Berlin auf dem Wege zu einer neuen Architektur, Das Zeitalter Wilhelms II* (Munich, 1979), 482–507; and Spangenburg, "Zwei monumentale Hallenbauten in Eisenbeton," *Deutsche Bauzeitung, Mitteilungen über Zemet-, Beton, Eisen- und Eisenbeton* 44 (1910): 161–62, 219–24, 226–28, 242–45, and 250–55. Mendelsohn had plenty of opportunities to keep abreast of developments in the material. A number of reinforced concrete buildings in Munich garnered national attention in the final years before the war. See "A. H.," "Neuere Münchener Monumentalbauten," *Baumeister* 9 (1909–10): 25–36; "Konstruktion der Ausstellungs-Hallen der Stadt München im Ausstellungspark an der Theresenwiese," *Deutsche Bauzeitung* 42 (1908): 671–76, 688–92; and "Der Neubau der kgl. Anatomie in München," *Deutsche Bauzeitung, Mitteilungen über Zement, Beton- und Eisenbeton* 42 (1908): 1–4, 9–11, 17. In order to achieve generous spatial effects at little cost, Fischer had built the Garrison Church in Ulm (1906–11) out of it. Spangenberg (162) described its twenty-seven-meter clear span as the widest yet realized in a reinforced concrete building in Germany, and for that matter perhaps the world. See also Winfried Nerdinger, *Theodor Fischer, Architekt und Städtebauer 1862–1938* (Berlin, 1988), 103–12, 233–38. Fischer's colleague at the Technische Hochschule in Munich (also one of Mendelsohn's professors there), Edler von Mecenseftig, in 1910 published a treatise on concrete, *Die künstlerische Gestaltung des Eisenbetons*, cited in Morganthaler, *Sketches* (see n. 4), 59.

[17] Max Berg, "Die Jahrhunderthalle und das neue Ausstellungsgelände der Stadt Breslau," *Deutsche Bauzeitung* 47 (1913): 462–66; Erich Mendelsohn, letter to Luise Maas, 20 Aug. 1913, in Beyer, *Letters* (see n. 4), 26; and Erich Mendelsohn, "International Consensus," in *Complete Works* (see n. 2), 28–29.

[18] Erich Mendelsohn, letter to Luise Maas, 14 Sept. 1914, in Beyer, *Letters*,

33; Erich Mendelsohn, "International Consensus," 29; and Erich Mendelsohn, "The Problem of a New Architecture," in *Complete Works*, 22.

[19] Klaus-Jürgen Sembach, *Henry van de Velde* (New York, 1989), 194–95. Mendelsohn almost certainly based his comments upon frontal views of the building's sweeping tiers, remaining unaware of the more conventional columnar details of the side or embankment façade. The outbreak of World War I prevented him from visiting the exhibit for himself.

[20] Ronald W. Clark, *Einstein, The Life and Times* (New York, 1971), 86–89; and Albert Einstein, "Zur Elektrodynamik bewegter Körper," *Annalen der Physik* 4th ser., 17 (1905): 891–921.

[21] Clark, *Einstein*, 115–16; and Albert Einstein, "Über das Relativitätsprinzip und die aus demselben gezogenen Folgerungen," *Jahrbuch der Radioactivität und Elektronik* 4 (1907): 411–62, and 5 (1908): 98–99.

[22] Clark, *Einstein*, 141–42; and Albert Einstein, "Über den Einfluß der Schwerkraft auf die Ausbreitung des Lichtes," *Annalen der Physik*, 4th ser., 5 (1911): 898–908.

[23] Käthe Freundlich, letter to Lewis Pynes, 29 Apr. 1973, File 11, no. 241, Albert Einstein Archives, Hebrew University, Jerusalem, copy, Princeton University. For more about Freundlich and a complete list of his writings, see Klaus Hentschel, *Der Einstein-Turm* (Berlin, 1992) 15–35, 175–80.

[24] Clark, *Einstein* (see n. 20), 161–62 and 174–76.

[25] Albert Einstein, "Erklärung der Perihelbewegung des Merkur aus der allgemeinen Relativitätstheorie," *Preußische Akademie der Wissenschaften, Sitzungsberichte*, 2nd pt. (1915): 831–39; and Albert Einstein, "Die Grundlage der allgemeinen Relitivitätstheorie," *Annalen der Physik*, 4th ser., 49 (1916): 769–822.

[26] Erwin Finlay Freundlich, *The Foundations of Einstein's Theory of Gravitation*, trans. H. L. Brose (New York, 1920). The Einstein archive contains letters to and from Freundlich about the manuscript for this book. Additional letters from Einstein to Freundlich are in the collection of the Pierpont Morgan Library, New York.

[27] Ibid., 66–67; also Erwin Finlay Freundlich, "Über die Gravitationswirkung auf die Spektrallinien," *Astronomische Nachrichten* 202 (1915): 17–32; and Erwin Finlay Freundlich, "Wie es dazu kam, daß ich den Einsteinturm errichtete," *Physikalische Blätter* 25 (1969): 538–41.

[28] Christen Kirsten and Hans Treder, eds., *Albert Einstein in Berlin, 1913–1933*, 2 vols. (Berlin, 1979) 1:22–23. This account is based upon material in a variety of formerly East German archives, partially published in the first volume and catalogued in the second. For the academic politics behind Struve and von Seeliger's actions, see also Hentschel, *Der Einstein-Turm* (see n. 23), 51–58.

[29] Erich Mendelsohn, letter to Luise Maas, 20 June 1915, in Mendelsohn, *Briefe* (see n. 4), 36–67.

[30] Ibid., 38–43; Beyer, *Letters* (see n. 4), 37–42; and Morganthaler, "Early Drawings" (see n. 3), 90.

[31] Freundlich's letters to Mendelsohn and the originals of two of Mendelsohn's letters to Freundlich are preserved in the Mendelsohn Archive, Kunstbibliothek, Staatliche Museen Preußischer Kulturbesitz. Sigrid Achenbach, *Erich Mendelsohn, 1887–1953, Ideen, Bauten, Projekte* (Berlin, 1987), 60, dates this sketch to 1918, but the inscription's number *6* appears to identify it, as Morganthaler, *Sketches* (see n. 4), 70, has pointed out, with the drawing mentioned in Erich Mendelsohn, letter to Luise Mendelsohn, 27 May 1917, in Beyer, *Letters* (see n. 4), 37.

[32] Similarly his 1915 competition entry for renovations of the Becker villa in Chemnitz were also relatively restrained. See Achenbach, *Mendelsohn*, 48–50; Morganthaler, *Sketches*, 61–62; and Zevi, *Opera Completa* (see n. 8), 22–23, for this project.

[33] Erwin Finlay Freundlich, letter to Erich Mendelsohn, 2 July 1918, in Achenbach, *Mendelsohn*, 61–64.

[34] Morgenthaler, "Early Drawings" (see n. 3), 183–88; and Zevi, *Opera Completa*, 32–33. These drawings accompanied Erich Mendelsohn, letters to Luise Mendelsohn, 27 May, 17 June, and 24 June 1917, in Beyer, *Letters*, 37–40.

[35] E. Mendelsohn, letters to Luise Mendelsohn, 28 May 1917 and July 1 1918, in Beyer, *Letters*, 37, 44.

[36] E. Mendelsohn, "Gedanken zur neuen Architektur," excerpted in "Erich Mendelsohn, Bauten und Skizzen," *Wasmuth's Monatshefte für Baukunst* 8 (1924): 3, and republished in part in the original German and an English translation as "New Architecture," *Daidalos* 5 (1982): 15; and in English as "Reflections on New Architecture," in Dennis Sharp, ed., *Modern Architecture and Expressionism* (New York, 1966), 181–82.

[37] Mendelsohn, "New Architecture," 15.

[38] Ibid., 15.

[39] Wassily Kandinsky, *Concerning the Spiritual in Art*, trans. M. T. H. Sadler (New York, 1977).

[40] Erich Mendelsohn, letter to Luise Mendelsohn, 17 June 1917, in Beyer, *Letters*, 40.

[41] Beyer did not publish this portion of the 17 July 1917 letter cited above. The following text is taken from the copy of a typewritten transcript of the original letter (I used the copies in the collection of Ita Heinze-Greenberg, Haifa, Israel; an additional set of copies is now in the collection of the Getty Center for the History of Art and the Humanities, Santa Monica, California.): "Der Bewegungsausgleich—in Masse und Licht—Masse braucht Licht, Licht bewegt die Masse—ist gegenseitig, parallel, sich ergänzend. Die Masse ist klar aufgebaut, wenn das Licht sie ausgleichend bewegt. Rückschluß auf die Kontur! Das Licht ist richtig verteilt, wenn es die bewegte Masse ausgleicht. Rückschluß auf die Darstellung! Das ist allgemeines Gesetz der Ausdruckskunst."

[42] Erwin Finlay Freundlich, letter to Erich Mendelsohn, 2 July 1918, in Achenbach, *Mendelsohn* (see n. 31), 61–62.

[43] Erwin Finlay Freundlich, *Das Turmteleskop der Einstein Stiftung* (Berlin, 1927), 4. For the telescopes themselves, see *Mount Wilson Solar Observatory of the Carnegie Institution of Washington, Annual Report of the Director* (1907): 139, 149, and pl. 8; (1909): 178–79; (1910): 175–76 and pl. 2; (1912): 177–78; Helen Wilson, Joan Warnow, and Charles Weiner, eds., *The Legacy of George Ellery Hale* (Cambridge, Mass., 1972), 21, 42–45, 75, 239; and Rolf Riekher, *Fernrohe und ihre Meister* (Berlin, 1990), 256–59; and for Hale's contribution to the development of the type of spectograph later used in the Einstein Tower, see Donald E. Osterbrook, "Failure and Success: Two Early Experiments with Concave Gratings in Stellar Observatories," *Journal of Astronomical History* 17 (1986): 119–29. Wilson, Warnow, and Weiner (67–69) print the full text of an exchange of letters in 1913 between Einstein and Hale about Freundlich's experiments. See also Hentschel, *Der Einstein-Turm* (see n. 23), 63–66 and 89; and Joachim Krausse, "Gebaute Weltbilder von Boullée bis Buckminster Fuller," *Arch + 116* (1993): 32–33, for the general importance of Mt. Wilson, although they err in several of the details of its history, and in Hentschel's case confuse the Snow Telescope with the Yerkes Observatory.

[44] Zevi, *Opera Completa* (see n. 8), 62, fig. 4; and Achenbach, *Mendelsohn* (see n. 31), 60, which includes the inscription linking it to a specific letter. Morganthaler, *Sketches* (see n. 4), 62, dates one of these sketches, mistakenly I believe, to 1916.

[45] Morganthaler, "Early Drawings" (see n. 3), 269–89; Helga Kliemann, *Die Novembergruppe* (Berlin, 1967); Joan Weinstein, *The End of Expressionism* (Chicago, 1990); and Iain Boyd Whyte, *Bruno Taut and the Architecture of Activism* (Cambridge, Mass., 1982).

[46] Erwin Finlay Freundlich, letter to Erich Mendelsohn, 2 July 1918, in Achenbach, *Mendelsohn* (see n. 31), 64.

[47] Entitled "The Problem of a New Architecture," it is reprinted in Mendelsohn, *Complete Works* (see n. 2), 7–21. Morganthaler, "Early Drawings" (see n. 3), 269; and "Das Problem einer neuen Baukunst," *Berliner Tageblatt*, 29 Jan. 1920, document that this was the lecture which Mendelsohn repeated for the *Arbeitsrat* only in January of the following year.

[48] Clark, *Einstein* (see n. 20), 237–305. From 24 March to 12 April 1922 the *Berliner Tageblatt* carried frequent notices about Einstein's visit to Paris. His photograph was on the cover of the 23 April 1922 *Berliner Illustrierte Zeitung*.

[49] Paul Forman, "Weimar Culture, Causality, and Quantum Theory, 1918–1927: Adaptation by German Physicists and Mathematicians to a Hostile Intellectual Environment," *Historical Studies in the Physical Sciences* 3 (1971): 1–115, describes how other scientists turned away from logical thought during this time. For the political controversy surrounding relativity, in which the theory was attacked as un-German, see Fritz Stern, *Dreams and Delusions, The Drama of German History* (New York, 1987), 25–50.

[50] Freundlich's fundraising activity is documented in the Einstein Stiftung archive, in the archives of the former Akademie der Wissenschaft der Deutschen Demokratischen Republik, Berlin. A selection of the these papers have been published by Kirsten and Treder, eds., *Einstein* (see n. 28), 1:177–79, and are catalogued in 2:91–93.

[51] Erich Mendelsohn, letters to Luise Mendelsohn, May and June 1920; partially published in Beyer, *Letters* (see n. 4), 51–54; Mendelsohn, *Briefe*, 53–54; and the copies of the entire correspondence in the Heinze-Greenburg

collection (see n. 41).

[52] Zevi, *Opera Completa* (see n. 8), 62, fig. 2, for the first version. The date "1918" is written on the sheet. The drawing's small scale suggests that is was made when Mendelsohn was still at the front and anxious to conserve paper. Similarly the chalk drawing, through its generous scale and use of a material not found in the wartime drawings, can be identified as the fruit of the postwar period.

[53] Erich Mendelsohn, letter to Luise Mendelsohn, 18 June 1919, copy, Heinze-Greenberg collection (see n. 41).

[54] Mendelsohn, *Complete Works* (see n. 2), 55, dates it to 1919.

[55] Erich Mendelsohn, letters to Luise Mendelsohn, 7, 21, 24, 26, and 28 June 1920, copies, Heinze-Greenberg collection, document Kaprowski's contribution, mostly as the executor of working drawings. See also Posener, *Aufsätze und Vorträge* (see n. 8), 96.

[56] Erich Mendelsohn, letter to Luise Mendelsohn, 12 May 1920, in Mendelsohn, *Briefe* (see n. 4), 53–54; and Erich Mendelsohn, letter to Luise Mendelsohn, 13 May 1920, copy, Heinze-Greenberg collection.

[57] Erich Mendelsohn, letters to Luise Mendelsohn, 27 May 1917, 8 and 31 July 1918, and 9 August 1918, copies, Heinze-Greenberg collection (see n. 41), document his consultations about the building with his friend, the engineer Salomonsen, who worked for the the firm of construction contractors, Rothbert and Company. Freundlich, *Turmteleskop* (see n. 43), 6, writes that two engineers from Carl Zeiss named Meyer and Villiger, and a third from the Siemens and Halske company named Böttcher, collaborated with Mendelsohn in the tower's design.

[58] The case of the Einstein Tower repeats that of the celebrated AEG Turbine Hall in Berlin, where Peter Behrens had designed a building casing whose construction referred metaphorically to the activities housed within. See Stanford Anderson, "Modern Architecture and Industry: Peter Behrens and the AEG Factories," *Oppositions* 23 (1984): 60–61; and Tilmann Buddensieg, *Industriekultur, Peter Behrens and the AEG, 1907–1914*, trans. Iain Boyd Whyte (Cambridge, 1984), 59–66. See Banham, *Concrete Atlantis* (see n. 15), 186; and Karin Wilhelm, *Walter Gropius: Industriearchitek* (Braunschweig and Wiesbaden, 1983), 41–49, for the extent to which Gropius's and Meyer's Fagus factory represented a collaboration with Eduard Werner, the architect originally awarded the commission.

[59] Achenbach, *Mendelsohn* (see n. 31), 63, notes that three preliminary drawings for this design, dating from mid-June, accompanied Erich Mendelsohn, letter to Luise Mendelsohn, 18 June 1920, copy, Heinze-Greenberg collection (see n. 41).

[60] Erich Mendelsohn, letters to Luise Mendelsohn, 2, 18, and 20 June, copies, Heinze-Greenberg collection. Zevi, *Opera Completa* (see n. 8), 62, fig. 15, for a photograph of one of the models, perhaps the one documented in the 2 and 18 June letters, as Mendelsohn planned to send a photograph of this one to his wife. Oskar Beyer, "Architectuur in Ijzer en Beton," *Wendingen* 3.10 (1920): 10; and Heinrich Klotz, *Twentieth Century Architecture: Drawings, Models, Furniture from the Exhibition of the Deutschen Architektur Museums, Frankfurt am Main* (New York, 1989), 42–43, for the final model.

[61] Erich Mendelsohn, letter to Luise Mendelsohn, 14 May 1920, copy, Heinze-Greenberg collection (see n. 41).

[62] Erich Mendelsohn, letters to Luise Mendelsohn, 9 and 18 June 1920, copies, Heinze-Greenberg collection.

[63] Erich Mendelsohn, letter to Luise Mendelsohn, 28 June 1920, copy, Heinze-Greenburg collection: "Linie muß sterben, muß Massenumriß werden. . . . Architectur ist Massenherrschaft."

[64] The second drawing is published by Zevi, *Opera Completa* (see n. 8), 62, fig. 3.

[65] Erich Mendelsohn, letters to Luise Mendelsohn, 26 and 28 June 1920, copies, Heinze-Greenberg collection (see n. 41).

[66] Mendelsohn, *Complete Works* (see n. 2), 45; and Zevi, *Opera Completa* (see n. 8), 62, figs. 6, 7, and 10, and 65, fig. 2, for studies for this elevation.

[67] Erich Mendelsohn, letters to Luise Mendelsohn, 29 June and 2 July 1920, copies, Heinze-Greenberg collection.

[68] Erich Mendelsohn, letter to Luise Mendelsohn, 30 June 1920, copy, Heinze-Greenberg collection.

[69] The granting of the building permit was reported on 15 July in "Bautennachweise," *Bauwelt* 11 (1920): 392.

[70] Freundlich, *Turmteleskop* (see n. 43), 6.

[71] Gustav Adolf Platz, *Die Baukunst der neuesten Zeit* (Berlin, 1927), pls. 204 and 254. See also Gehler, "Städtische Beton- und Eisenbetonbauten," *Bauwelt* 2.18 (1911): 25–30, for the firm's recent work in Berlin and Dresden. The extent of their experience and of prewar concrete construction in Germany generally strongly suggests that they could have built the tower out of concrete, had the materials been available, and that Mendelsohn's desire to do so was less unusual than it has often seemed to later observers.

[72] L. Mendelsohn, "Biographical Note" (see n. 5), 306.

[73] Mendelsohn, "Beschreibung des Baues für den Turmspektographen auf dem Gelände des astrophysikalischen Observatoriums," Geheimes Staatsarchiv Preußischer Kulturbesitz Merseburg, Ministerium für Wissenschaft, Kunst und Volksbindung, Rep. 76 V c Sekt. 1 Tit. 11 Teil II Nr. 6 i Bd. 1, Bl. 7: Die architektonische Gestaltung entspricht dem inneren Bedürfnis und hält sich an die formalen Bedingungen der Eisenbetonkonstruktionen.

[74] Mendelsohn, "The Work of Erich Mendelsohn," 8, typescript of a lecture delivered in Pittsburgh in 1924, Mendelsohn Archive; and Julius Posener, "Eröffnungsrede" (see n. 8), 11, reinforce an interpretation which stresses problems with exactly this element of the construction.

[75] Samson, "German-American Dialogues," 120, cites Karl Bernhard, "Hochhäuser oder Skelett," *Zentralblatt der Bauverwaltung* 41 (1921): 44, who declared that the price of steel was twenty-five times higher and that of concrete fifteen times higher than their prewar costs. See also *Bauwelt* 11 (1920) for reports on the cost and availability of materials.

[76] Hochbauamt Potsdam, Report to the Prussian Kultusministerium, 28 Oct. 1920, Geheimes Staatsarchiv Preußischer Kulturbesitz Merseburg, Ministerium für Wissenschaft, Kunst und Volksbildung, Rep. 76 V c Sekt. 1 Tit. 11 Teil II Nr. 6 i Bd. 1, Bl. 28: "Die Anbauten des Turmes um Erdgeschoß sollen nach Angabe des Architekten in Eisenbeton ausgeführt werden. . . . Nach Angabe des Architekten erklären sich die für Ziegelmauerwerk wenig geeigneten Formen daraus, daß die Ausführung ursprünglich in Eisenbeton gedacht war, dann aber aus Ersparnis-rücksichten in Backstein erfolgte. Um entsprechende Änderungen vorzunehmen, ist die Bauausführung schon zu weit vorgeschritten." See also L. Mendelsohn, "Biographical Note" (see n. 5), 306; Erich Mendelsohn, letter to Arnold Whittick, 20 Mar. 1950, Mendelsohn Archives, in which he denied that he had had trouble with the building's shuttering, and blamed the compromise completely on the unavailability of concrete; and, for the construction photographs, Zevi, *Opera Completa* (see n. 8), 65, fig. 20; and Hentschel, *Der Einstein-Turm* (see n. 23), 105, fig. 27. Kenji Sugimoto, *Albert Einstein: A Photographic Biography*, trans. Barbara Harshav (New York, 1989), 95, illustrates a photograph taken after the tower was damaged in World War II, which again shows the brick structure exposed by damage to the stucco cladding.

[77] Erich Mendelsohn, "Background to Design," *Architectural Forum* 98, 2 (1953): 106.

[78] Erich Mendelsohn, letter to Luise Mendelsohn, 15 June 1920, in Beyer, *Letters*, 53. The letter to Whittick cited above mentions redesign work, but the resemblance of the finished structure to the drawings published in Beyer, "Architectuur in izer en beton" (see n. 60), 12–13, calls the extent of Mendelsohn's later claim into question.

[79] Nigel Calder, *Einstein's Universe* (Harmondsworth, 1979), 21–31.

[80] Freundlich, *Foundations* (see n. 26), 66–67, for a complete description of this experiment. For a full history of the experiments and observations conducted in the tower, see J. Staude, "Das Sonnenobservatorium Einsteinturm in Potsdam: Erforschung solarer Magnetfelder und der Physik von Sonnenflecken," *Sterne und Weltraum* 30 (1991): 505–9.

[81] Freundlich, *Turmteleskop* (see n. 43), 12–17, who offers many more details.

[82] Ibid., 11–12, 17–27.

[83] Ibid., 27–33. The arc lamp was an especially complicated piece of equipment because it ran on a second type of electrical current. This current and the huge wattage required by the spectral oven were both supplied by generators located elsewhere on the grounds of the observatory, although a side room in the front of the tower (J) did hold a high-voltage battery. Other underground spaces included two equipment rooms flanking the staircase (K), a dark room opposite the battery room (L), and, under the tower's entrance, the microphotometer room (M), where the images of the spectra were enlarged.

[84] Richard Neutra, letter to Dione Niedermann, Dec. 1921. Dione Neutra, ed., *Richard Neutra: Promise and Fulfillment, 1919–32, Selections from the Letters and Diaries of Richard and Dione Neutra* (Carbondale, 1986), 54.

[85] Dieter Bartetzko, *Illusionen in Stein, Stimmungsarchitektur im deutschen*

Fachismus, Ihre Vorgeschichte in Theater- und Filmbauten (Reinbeck, 1985), 75–77, 82; Peter Hüter, *Der feinste Barberei: Das Völkerschlachtdenkmal bei Leipzig* (Mainz am Rhein, 1990), esp. 74; Mark Jarzombek, "The *Kunstgewerbe,* the *Werkbund,* and the Aesthetics of Culture in the Wilhelmine Period," *JSAH* 53 (1994): 7–19; and Posener, *Berlin auf dem Wege* (see n. 16), 91–104.

[86] Erich Mendelsohn, letter to Luise Maas, 23 Aug. 1913, copy, Heinze-Greenberg collection (see n. 41). Luise Mendelsohn, *My Life in a Changing World* (n.p., n.d.), 7–8, describes Schmitz's work admiringly, but does not mention the Leipzig monument. Copies of this undated, unpublished memoir are in the collection of the Mendelsohn Archive, Heinze-Greenberg, and the Department of Architecture and Design, the Museum of Modern Art, New York.

[87] Hentschel, *Der Einstein-Turm* (see n. 23), 81 and 89, discusses this aspect of the buildings but does not cite Mendelsohn, "The Work of Erich Mendelsohn" (see n. 74), 7, in which the architect himself describes it as a monument to relativity. While Hüter describes Clement Thieme, the leading figure in the erection of the Völkerschlachtdenkmal, as an ultra-right-wing nationalist, Mendelsohn's letters to his wife show him to have been a very liberal democrat both during and after the war, who, like Einstein, was completely uninterested in any form of German patriotism (both men, however, were ardent Zionists).

[88] Susan King, *The Drawings of Eric Mendelsohn* (Berkeley, 1969), 14; and Reyner Banham, "Mendelsohn," *Architectural Review* 16 (1954): 89; M. Calvesi and E. Coen, *Boccioni: L'Opera Completa* (Milan, 1983), 466.

[89] The futurists exhibited in Berlin in 1912, 1913, and 1917 under Walden's auspices, and their work was reviewed both in the pages of *Der Sturm*, and featured prominently in three books Walden authored between 1917 and 1924 on contemporary art. Erich Mendelsohn, letter to Luise Mendelsohn, 31 Oct. 1912, copy, Heinze-Greenberg collection (see n. 41), refers to futurist art.

[90] Umberto Boccioni, *Pittura, scultura futuriste: Dinamismo plastico* (Milan, 1914); and Esther Coen, *Umberto Boccioni* (New York, 1988), 227–61. *Pittura, scultura futuriste: Dinamismo plastico* was known in the Walden circle.

[91] Mendelsohn, "International Consensus" (see n. 2), 24.

[92] Huse, *"Neues Bauen" 1918 bis 1933* (see n. 2), 132 n. 58, cites F. Schumacher, "Mechanisierungen," *Kulturpolitik, Neue Streifzüge eines Architekten* (Jena, 1920), 145–72, as a source for this analogy. Erich Mendelsohn, letter to Luise Mendelsohn, 14 July 1917, copy, Heinze-Greenberg collection (see n. 41), refers to Olbrist as its source. See also Erich Mendelsohn, "The Three Dimensions of Architecture—Their Symbolic Significance," a 1952 lecture cited in L. Mendelsohn, "Biographical Notes" (see n. 5), 302. I am also grateful to Daniel Friedman, who first pointed out to me the building's resemblance to the spine.

[93] Iain Boyd Whyte, *The Crystal Chain Letters: Architectural Fantasies by Bruno Taut and his Circle* (Cambridge, Mass., 1985), 25.

[94] The most famous was undoubtedly Hans Poelzig's Grosses Schauspielhaus in Berlin, which opened to the public in 1919.

[95] "Der Potsdamer Astronomentag," *Berliner Tageblatt*, 26 Aug. 1921; "Der neue Einstein-Turm auf dem Telegraphenberg in Potsdam," *Berliner Tageblatt, Der Welt-Spiegel*, 4 Sept. 1921, 3; *Die Berliner Illustrierte Zeitung*, 4 Sept. 1921, cover; and Martin Eksteins, *The Limits of Reason: The German Democratic Press and the Collapse of Weimar Democracy* (Oxford, 1975), viii and 112.

[96] Richard Neutra, letter to Dione Niedermann, Oct. 1921, Neutra, *Promise and Fulfillment* (see n. 84), 49.

[97] Erich Mendelsohn, "My own Contribution to the Development of Contemporary Architecture," University of California, Los Angeles, School of Architecture, 17 Mar. 1948, in Beyer, *Letters* (166) provides one of the first documented instances of this famous story, which both Erich and Luise Mendelsohn often recounted. Unfortunately, I was unable to locate in the Einstein archive any comment by him about the tower's appearance.

[98] G. Peters, "Die Neue Baukunst in Deutschland," *Deutsche Monatshefte* 3 (1926): 168.

[99] J. F. Staal, "Naar Anleidung van Erich Mendelsohn's Ontwerpen," *Wendingen* 3.10 (1920): 3.

[100] Jean Badovici, "Entretiens sur l'architecture vivante: Erich Mendelsohn," *L'architecture Vivante* 3 (1925): 16; Mendelsohn, "Bauten und Skizzen" (see n. 36), 5–11; Adolf Behne, *Der moderne Zweckbau* (Munich, 1926), 38–39; Sheldon Cheney, *The New World Architecture* (London, 1930), 319; Walter Müller-Wulckow, *Architektur der Zwanziger Jahre in Deutschland*, 3 vols. (Königstein, 1975) 1:1 and pl. 58; Platz, *Baukunst* (see n. 71), 70; Hermann George Scheffauer, "Erich Mendelsohn," *Architectural Review* 53 (1923): 156–59; and J. G. Wattjes, *Moderne Architectuur* (Amsterdam, 1927), pl. 124.

[101] T. P. Bennett, *Architectural Design in Concrete* (London, 1927), 11, lxii, lxiii; F. S. Onderdonk, *The Ferro-Concrete Style* (New York, 1928), 239–41; and Julius Vischer and Ludwig Hilbesheimer, *Beton als Gestalter* (Stuttgart, 1928), 17.

[102] Behne, *Zweckbau* (see n. 100), 38; Platz, *Baukunst* (see n. 71), 70; and E. M. Hajos, "Berliner Architektur und Architektur von Heute," *Die Kunstwanderer* (July 1929): 493–97.

[103] Scheffauer, "Mendelsohn" (see n. 100), 158. Badovici, "Entretiens" (see n. 100), 16, also refers to the occult.

[104] Staal, "Mendelsohn" (see n. 99), 3.

[105] "Peter Behrens," *Berliner Tageblatt*, 5 Nov. 1924.

[106] Paul Friedrich Schmidt, "Erich Mendelsohn," *Der Cicerone* 12 (1930): 220: "Ein letzter Tribut an die erregte und chaotische Zeit der Revolution, künstlerisch gesprochen, des Expressionismus; eine direkte Übertragung des dynamischen Prinzips in kristallhaften Aufbau ohne Vermittlung architektonischen Methoden." See also Kurt Weidle, *Goethehaus und Einsteinturm. Zwei Pole heutiger Baukunst* (Stuttgart, 1929), which discusses the tower as the epitome of architectural individuality.

[107] Arthur Segal, letter to Erich Mendelsohn, 24–25 April 1924, Mendelsohn Archive.

[108] Müller-Wulckow, *Architektur* (see n. 100), i, 8.

[109] Fritz Hellwag, "Der Einsteinturm," *Dekorative Kunst* 29 (1926): 157–60.

[110] Paul Westheim, "Mendelsohn," *Das Kunstblatt* 4 (1923): 307. Einstein was also accused of seeking publicity rather than scientific truths. See Max Born, letter to Albert Einstein, 13 Oct. 1920, in Max Born, ed., *The Born-Einstein Letters,* trans. Irene Born (New York, 1971), 39.

[111] Peter Meyer, *Moderne Architektur und Tradition* (Zurich, 1928), 8; and Behne, *Zweckbau* (see n. 100), 45, who finds it overly monumental and massive.

[112] Erich Mendelsohn, "Zur Eröffnung des 'Universum,'" *Der Montag*, 17 Sept. 1928, republished in translation in Sharp, ed., *Modern Architecture* (see n. 36), 126.

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Fig. 2. Carmelo Guadagno, © The Solomon R. Guggenheim Foundation, New York

Fig. 3. Karl Scheffler, *Großstadt Architektur*

Figs. 6, 13, 15, 16, 17. *Erich Mendelsohn: Das Gesamtschaffen des Architekten*

Figs. 7, 8, 9, 11, 12, 14. Staatliche Museen zu Berlin—Preußischer Kulturbesitz Kunstbibliothek

Fig. 10. *Carnegie Institution, Solar Observatory Mt. Wilson,* 1907

Fig. 18. *Deutsche Bauzeitung*, 1913

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Fig. 20. *Gesamtschaffen*