The external configuration is usually rather simple, but there is packed into the interior of an organism an amazing complexity of structures which have long been the delight of anatomists.

The specific form of a plant or animal is determined not only by the genes in the organism and the cytoplasmic activities that these direct but by the interaction between genetic constitution and environment. A given gene does not control a specific trait, but a specific reaction to a specific environment. *

Contrast between the inside and the outside can be a major manifestation of contradiction in architecture. However, one of the powerful twentieth century orthodoxes has been the necessity for continuity between them: the inside should be expressed on the outside. But this is not really new—only our means have been new. The Renaissance church interior, for instance (137), has a continuity with its exterior; the interior vocabulary of pilasters, cornices, and drip moldings is almost identical in scale and sometimes in material with its exterior vocabulary. The result is subtle modification but little contrast and no surprise.

Perhaps the boldest contribution of orthodox Modern architecture was its so-called flowing space, which was used to achieve the continuity of inside and outside. The idea has been emphasized by historians ranging from Vincent Scully's discovery of its early evolution in Shingle Style interiors to its flowering in the Prairie House and its culmination in De Stijl and the Barcelona Pavilion. Flowing space produced an architecture of related horizontal and vertical planes. The visual independence of these uninterrupted planes was scored by connecting areas of plate glass: windows as holes in the wall disappeared and became, instead, interruptions of wall to be discounted by the eye as a positive element of the building. Such cornerless architecture implied an ultimate continuity of space. Its emphasis on the oneness of interior and exterior space was permitted by new mechanical equipment which for the first time made the inside thermally independent of the outside.

But the old tradition of enclosed and contrasted inside space, which I want to analyze here, has been recognized by some Modern masters, even if it has not been much emphasized by the historians. Although Wright did in fact "destroy the box" in the Prairie House, the rounded corners and solid walls of the Johnson Wax Administration Building are analogous to the diagonal and rounded corners of Borromini's interiors and those of his eighteenth century followers—and for the same purpose: to exaggerate a sense of horizontal enclosure and to promote the separateness and unity of the interior space by the continuity of the four walls. But Wright, unlike Borromini, did not puncture his continuous walls with windows. That would have weakened the bold contrast of horizontal enclosure and vertical openness. And it also would have been too traditional and structurally ambiguous for him.

The essential purpose of the interiors of buildings is to enclose rather than direct space, and to separate the inside from the outside. Kahn has said: "A building is a harboring thing." The function of the house to protect and provide privacy, psychological as well as physical, is an ancient one. The Johnson Wax Building fosters a further tradition: the expressive differentiation of the inside and outside spaces. Besides enclosing the inside with walls, Wright differentiated the interior light, an idea with a rich evolution from Byzantine, Gothic, and Baroque architecture to that of Le Corbusier and Kahn today. The inside is different from the outside.

But there are other valid means of differentiating and relating inside and outside space which are foreign to our recent architecture. Eliel Saarinen said that just as a building is the "organization of space in space. So is the community. So is the city." I think this series could start with the idea of a room as a space in space. And I should like to apply Saarinen's definition of relationships not only to the spatial relationships of building and site, but to those of interior spaces within interior spaces. What I am talking about is the baldaquin above the altar and within the sanctuary. Another classic building of Modern architecture, again admittedly not typical, illustrates my point. The Villa Savoye (12) with its wall openings which are, significantly, holes rather than interruptions, restricts any flowing space rigidly to the vertical direction. But there is a spatial implication beyond that of enclosure which contrasts it with the Johnson Wax Building. Its severe, almost square exterior surrounds an intricate interior configuration glimpsed through openings and from protrusions above. In this context the tense image of the Villa Savoye from within and without displays a contrapuntal resolution of severe envelope partly broken and intricate interior partly revealed. Its inside order accommodates the multiple functions

of a house, domestic scale, and partial mystery inherent in a sense of privacy. Its outside order expresses the unity of the idea of house at an easy scale appropriate to the green field it dominates and possibly to the city it will one day be part of.

A building can include things within things as well as spaces within spaces. And its interior configurations can contrast with its container in other ways besides those of the Villa Savoye's. The circular perimeters of bearing wall and colonnade in Hadrian's Maritime Theatre at Tivoli (138) produce another version of the same spatial idea. Even Wright, although only by suggestion, contains the interior intricacy of his Evans House (139) with a rectangular envelope implied by the sculptural corner posts. At the other extreme, the intricacies within the plan of the typical Tudor manor, Barrington Court (13), for example, are hidden, maybe excessively and expressed only incidentally, if at all, on its rigid, symmetrical façades. In another symmetrical Tudor plan the kitchen balances the chapel. The intricacies revealed in section in the château at Marly (140, 141) are a concession to light and convenience inside. Because they are not expressed on the outside, the interior light is surprising. Fuga's walls wrap around S. Maria Maggiore (142), and Soane's walls enclose the distorted intricacies of courtyards and wings of the Bank of England (143) in the same way and for similar reasons: they unify outside, in relation to the scale of the city, the contradictory spatial intricacies of chapels or banking rooms which evolved in time. Crowded intricacies can be excluded as well as contained. The colonnades at St. Peter's (144) and at the Piazza del Plebiscito in Naples (145), respectively, exclude the intricacies of the Vatican Palace complex and the city complex, in order to achieve unity for their piazzas.

Sometimes the contradiction is not between the inside and the outside but between the top and the bottom of the building. The curving dome and drum on pendentives in Baroque churches protrude beyond the parapets of their rectangular bases. I have already mentioned in the P.S.E.S. skyscraper the curved base, rectangular shaft, and angled top as manifestations of multiple functions contained within the building (41). In the Castel Sant' Angelo (146) the rectangular elements evolve from a circular base. The Romantic roofscapes of Richardson's Watts-Sherman House (147) and the multitomed trulli of Puglia (148) contrast with the severe exterior perimeters of their lower walls. From the outside, the space within a space can become the thing behind a thing. The enormous clerestory of Wollaton Hall (149) reads as a
big-scale thing behind a smaller-scale thing. In S. Maria della Pace (150) the superimposition of enclosing elements, which are successively convex, perpendicular, and then concave, become contrasting things behind things to work transitions between the outside and the inside.

Essentially, Le Corbusier's plan of the Villa Savoye exemplifies crowded intricacies within a rigid frame. Some of the plans of his other houses of the '20's suggest starting with the frame and then working inward. Similar things happen in elevation in his High Court Building at Chandigarh (151). Like the rear of McKim, Mead and White's Low House (72), but at another scale, it contains intricacies within a rigid façade. The severe roof and wall envelope of the house contain complex spaces and floor levels which are expressed by varying window positions. Similarly, the single, sheltering gable of the Emmental-type house in Switzerland (152), and the constant shed of Aalto's Maison Carrée (153), contradict the interior spaces below. And similar tensions in the rear façade of Mt. Vernon (71) result from the contrast of the severe pedimented envelope and the irregular window positions. In the side façade of Hawksmoor's Easton Neston (154), the windows are positioned by particular interior requirements in defiance of its horizontal order. Crowded intricacy within a rigid frame has been a pervasive idea. It exists in such diverse examples as a fantasy of Piranesi (155) and the composition of a Michelangelo niche (156). More purely expressive examples are the façades of the parish church in Lampa, Peru (157), and the chapel entrance in Fontainebleau (158), which contain enormous pressures within their borders like a Mannerist painting.

Containment and intricacy have been characteristic of the city as well. Fortified walls for military protection and the greenbelt for civic protection are examples of this phenomenon. Contained intricacy might be one of the viable methods for dealing with urban chaos and the endlessness of roadtown; through the creative use of zoning and positive architectural features it is possible to concentrate the intricacies of roadtowns and junkyards, actual and figurative. And like the sculpture which consists of compressed automobiles by John Chamberlain and the photographs through telescopic
lens in Blake’s *God’s Own Junkyard*, they achieve an ironically compelling kind of unity.

Contradiction between the inside and the outside may manifest itself in an unattached lining which produces an additional space between the lining and the exterior wall. Plan diagrams (159) illustrate that such layers between the inside space and the outside space can be more or less contrasting in shape, position, pattern, and size. Diagram 159a illustrates the simplest kind which is analogous and attached. A different material inside, wainscoting in this case, provides the contrast. The Byzantine mosaics inside the chapel of Galla Placidia represent a lining attached but contrasting in richness of texture, pattern, and color with the drab brickwork of the exterior. The pilasters, architraves, and arches of Renaissance walls, such as Bramante’s façade in the Belvedere Court in the Vatican, can imply layers while the colonnade of the loggia of the south façade of the Louvre makes spatial layers. The colonnettes in the interior of the cathedral at Rouen (160) or the disengaged pilasters in the anteroom of Syon House (161) represent more detached kinds of layers also, but their subtle contrast to the outside depends more on scale than on form and texture. The lining becomes semidetached in Percier and Fontaine’s curtained bedroom at Malmaison, which is derived from a Roman military tent. The graduated series of symbolic doors at Karnak (162) are multiple linings in relief similar in two dimensions to the generic idea of nests of toy eggs or wooden dolls. These doors within doors, like the multi-framed doors in Gothic porches, differ from multi-pedimented Baroque openings, which juxtapose triangular and segmental shapes.

The graduated series of things or enclosures within enclosures which characterize the Egyptian temple carry out in space the motif of the multi-framed doors at Karnak. The series of walls at Edfu (163, 164) are detached linings. The outer linings enhance the enclosed inner spaces by making them seem protected and mysterious. They resemble the layers of fortifications in medieval castles, or the spatial nest in which Bernini contained his little Pantheon, S. Maria dell’ Assunzione at Arricia (165). The same tensions occur between the hovering layers of the enclosing sanctuary screens and the outer walls of the cathedral at Albi (166) and other cathedrals in Catalonia and the Languedoc. The multiple domes of the Baroque represent, in section, layers which are analogous but detached. Through their central oculi one can see spaces beyond spaces. In the project by the Asam Brothers (167),
for instance, the inner dome with its oculus masks high windows, thus producing surprising effects of light and a more complex space. On the exterior the upper dome increases the effect of scale and height. In their Abbey church at Weltenburg (168) the clouds of the frescoed upper dome, which are viewed through the oculus of the lower dome, increase the sense of space. In S. Maria in Canepanova in Pavia (169) the effect of the layered dome is seen on the outside rather than the inside.

The multiple domes of the S. Cecilia Chapel in S. Carlo ai Catinari in Rome (170) are detached and contrasting in shape. Beyond the oval oculus of the lower dome is seen a rectangular space flooded with light, containing a sculptural quartet of musical angels. Beyond this zone, in turn, floats an even more brilliant oval lantern. Soane uses interior domes in square spaces even in small areas like the breakfast room of Lincoln’s Inn Fields (171). His fantastic juxtapositions of domes and lanterns, squinches and pendentives, and a variety of other ornamental and structural shapes elsewhere (35) work to enrich the sense of enclosure and light. These layered structural-ornamental elements are sometimes vestigial (almost in a two dimensional pattern), but they give the complex effect of actually detached spatial layers. Armando Brazini’s neo-Baroque church of the Cuore Immaculata di Maria Santissima in Rome (172, 173) has a quasi-circular plan containing a Greek cross plan. The Greek cross plan is reflected on the outside in four pedimented porches marking the ends of the cross. These porches, in turn, are made convex to accommodate to the circular plan. In Modern architecture Johnson has been almost unique in emphasizing multiple enclosure in plan and section. The canopy inside his guest house in New Canaan (174) and the Soanian canopy within the synagogue in Port Chester (175) are both inner layers. Kahn employs detached layers on the outside; he “wraps ruins around buildings.” In the project for the Meeting House for the Salk Institute for Biological Studies (107) he juxtaposes in plan circles within squares, and squares within circles. According to Kahn, inside glaze will be counteracted by the juxtaposition of apertures, contrasting in size and shape, in the double-layered walls. Kahn has talked of the modification of light more than the spatial expression of enclosure as his reason for the contrasting layers. Lutyens’ motif of the circle in the square appears in his stairs with round wells within square rooms.
In the vestibule of S. Croce in Gerusalemme (176) and in
the interiors of SS. Sergius and Bacchus (177) and of St.
Stephen Walbrook (34) it is the series of columns which define
the inner, detached and contrasting layer of enclosure. These
supports, along with the domes above them, make the
intraspatial relationships of the interior. St. Stephen Walbrook
is a square space containing an octagonal space at the lower
level (178). Its squinch-like arches, at the intermediate level
between the columns and the dome, make a transition to the
dome above. Similarly, in Vierzehnheiligen (31) the piers
along with the domes define curving spaces within the rect-
tangular and hexagonal walls of the perimeter. But the inner
layers are less independent than those in St. Stephen. In plan
as well as section, the curve sometimes touches the outer wall
and becomes common with it (179). Both the plan and section
of Neresheim in Southern Germany (180) show that the com-
plex curves of the inner circle sinuously inflect as they near
the outer oval. These intraspatial relationships are at once
more complex and more ambiguous than those of St. Stephen
Walbrook's.

Layers are implied in Michelangelo's Sforza Chapel in
S. Maria Maggiore (181, 182) in the violent penetrations of
rectangular space and curved space in plan and of barrel vaults,
domes and niche-vaulting in section. The ambiguous juxta-
positions of these two kinds of shapes as well as the implied
intense compression and enormous scale of the flatly curved
spaces (which by implication extend beyond the actual enclo-
sure) give this interior its peculiar power and tension (183).

Detached linings leave spaces in between. But the archi-
teectural recognition of the in-between varies. Edfu is almost
all layers. The residual spaces are closed and dominate
the small space at the center. St. Basel's (184) is like a series of
churches within a church. The intricate maze of residual
spaces inside results from the proximity of the chapels to
each other toward the center, and the closeness of the wrap-
ning wall toward the outside. In Charles V's palace at Granada
(185), the Villa Farnese at Caprarola (186), and the Villa Giu-
lia (187), the courtyards dominate because they are large and
their shapes contrast with the shape of the perimeters. They
make the primary space; the rooms of the palaces are left-
over space. As in the preliminary scheme of Kahn's Unitari-
ian Church in Rochester (188), the residual spaces are closed.
In contrast, the linings of columns and piers in SS. Sergius
and Bacchus, St. Stephen Walbrook, Vierzehnheiligen, and
Neresheim define residual spaces which open on the dominant
spaces, although they are separate from them in varying degrees. In the Stupinigi Palace (189) because the dominant space is so open, the distinction between dominant and residual spaces in the main hall is ambiguous. In fact, the inner lining is so open that there remains only a vestige of a central inner space, indicated by four piers and the very complex vaulting patterns of the ceiling. The complex oculus and other openings of the inner dome in S. Chiara, Brà (190, 191), define residual space, which is open in order to elaborate space and manipulate light. The detachment of the inner and outer window openings in Aalto's Imatra Church (192) similarly modifies light and space. The use of this method is unique in recent architecture.

The wooden vaulting of seventeenth century Polish synagogues (193), which imitates masonry, makes closed linings in the upper section. In contrast to the previous examples their residual space is closed. Closed poché determined primarily by exterior spatial forces rather than the inherent structure of the form is almost unknown in Modern architecture except for Aalto's unique Concert Podium (194) composed of a wood skin-frame structure, which directs sound as well as space. Residual space in between dominant spaces with varying degrees of openness can occur at the scale of the city and is a characteristic of the fora and other complexes of late Roman urban planning. Residual spaces are not unknown in our cities. I am thinking of the open spaces under our highways and the buffer spaces around them. Instead of acknowledging and exploiting these characteristic kinds of space we make them into parking lots or feeble patches of grass—no-man's lands between the scale of the region and the locality.

Residual space that is open might be called "open poché." Kahn's "servant space," which sometimes harbors mechanical equipment, and the poché in the walls of Roman and Baroque architecture are alternative means of accommodating an inside different from the outside. Aldo van Eyck has said: "Architecture should be conceived of as a configuration of intermediary places clearly defined. This does not imply continual transition or endless postponement with respect to place and occasion. On the contrary, it implies a break away from the contemporary concept (call it sickness) of spatial continuity and the tendency to erase every articulation between spaces, i.e., between outside and inside, between one space and another (between one reality and another). Instead the transition must be articulated by means of defined in-between
places which induce simultaneous awareness of what is significant on either side. An in-between space in this sense provides the common ground where conflicting polarities can again become twin phenomena. 36

Residual space is sometimes awkward. Like structural poché it is seldom economic. It is always leftover, inflected toward something more important beyond itself. The qualifications, contrasts, and tensions inherent in these spaces are perhaps cogent to Kahn's statement that "a building should have bad spaces as well as good spaces."

Redundant enclosure, like crowded intricacies, is rare in our architecture. With some significant exceptions in the work of Le Corbusier and Kahn, Modern architecture has tended to ignore such complex spatial ideas. The "utility core" of Mies or early Johnson is not relevant because it becomes a passive accent in a dominant open space, rather than an active parallel to another perimeter. Contradictory interior space does not admit Modern architecture's requirement of a unity and continuity of all spaces. Nor do layers in depth, especially with contrapuntal juxtapositions, satisfy its requirements of economic and unequivocal relationships of forms and materials. And crowded intricacy within a rigid boundary (which is not a transparent framework) contradicts the modern tenet which says that a building grows from the inside out.

What are the justifications for multiple enclosure and for the inside's being different from the outside? When Wright expressed his dictum: "an organic form grows its structure out of conditions as a plant grows out of the soil, both unfold similarly from within," 37 he had a long precedent behind him. Other Americans had advocated what was at the moment a healthy thing—a needed battle cry:

Greenough: Instead of forcing the functions of every sort of building into one general form, adopting an outward shape for the sake of the eyes or association, without references to the inner distribution, let us begin from the heart as a nucleus and work outward. 38

Thoreau: What of architectural beauty I now see, I know has grown gradually from within outward, out of the necessities and character of the indweller. 39

Sullivan: (The architect) must cause a building to grow naturally, logically, and poetically out of its condition. 40 . . . . Outward appearances resemble inner purposes. 41

Even Le Corbusier has written: "The plan proceeds from within to without; the exterior is the result of an interior." 42

But Wright's biological analogy is self-limiting, because the development of a plant is influenced into particular distortions by the particular character of its environment as well as by its genetic order of growth. D'Arcy Wentworth Thompson saw form as a record of development in environment. The inherently rectangular order of structure and space of Aalto's apartment house in Bremen (76, 193) yields to the inner needs for light and space toward the south, like the growth of a flower toward the sun. But generally speaking, for Wright the exterior and interior space of his invariably isolated buildings was continuous, and as he was an urbanophobe, the suburban environment of his buildings, when specifically regional, was not so particularly limiting spatially as an urban context. (The flowing plan of the Robie House, however, adapts to the constriction of the back sides of its corner lot.) Wright however, I believe, refused to recognize the setting that was not sympathetic to the direct expression of the interior. The Guggenheim Museum is an anomaly on Fifth Avenue. But the Johnson Wax Building perhaps makes a negative gesture toward its indifferent urban environment by dominating and excluding it.

Contrast and even conflict between exterior and interior forces exist outside architecture as well. Kepes has said: "Every phenomenon—a physical object, an organic form, a feeling, a thought, our group life—owes its shape and character to the duel between opposing tendencies; a physical configuration is a product of the duel between native constitution and outside environment." 43 This interplay has always been vivid in the concentrations of the urban environment. Wright's Morris Store (196, 197) is another one of the exceptions he was confident enough to make. Its strong contractions between the inside and the outside—between the particular, private and the general, public functions, make it a traditional urban building rare in Modern architecture. As Aldo van Eyck says: "Planning on whatever scale level should provide a framework—to set the stage as it were—for the twin-phenomenon of the individual and the collective without resorting to arbitrary accentuation of either one at the expense of the other." 44

Contradiction, or at least a contrast, between the inside and the outside is an essential characteristic of urban architecture, but it is not only an urban phenomenon. Besides the Villa Savoye and obvious examples like the domestic Greek temples of the Greek Revival which were crammed expeditiously with
series of cells, the Renaissance villa such as Hawksmoor's Easton Neston or Westover in Virginia (198) juxtaposed symmetrical façades on asymmetrical plans.

Contradictory interplays between inside and outside spatial needs can be seen in the following examples in which the front and the back contrast. The diagram (199) illustrates six general cases. The concave façade in the Baroque church accommodates spatial needs that are specifically different on the inside and the outside. The concave exterior, at odds with the church's essential concave spatial function inside, acknowledges a contrasting exterior need for a spatial pause in the street. At the front of the building outside space is more important. Behind the façade the church was designed from the inside out, but in front it was designed from the outside in. The space left over by this contradiction was taken care of with poché. The plans of the two pavilions by Fischer von Erlach (200) illustrate through the concave curves in one the inside-dominant space and through the convex curves in the second the outside-dominant space. The concave façade of Lutyens' Grey Walls (56) accommodates an entrance court whose curve is determined by the turning radius of a car, and which concludes the vista of the approach. Grey Walls is a rural Piazza S. Ignazio (201). The concave exterior of Aalto's studio at Munkkindemi (202) shapes an outdoor amphitheater. These examples produce residual spaces inside.

Fischer von Erlach's Karlskirche (42), mentioned earlier, combines a small oval church with a large rectangular façade that accommodates to its particular urban setting by means of a false façade rather than by poché. The concave façade of the garden pavilion of the Arcadian Academy in Rome (203) is in even more contradictory contrast to the villa behind it. The façade has been given its particular size and shape in order to terminate the terraced garden. In the Sanctuary of Saronno (204) there is contradiction in style as well as in scale between the façade and the rest of the building.

In the Baroque church the inside is different from the outside, but the back is also different from the front. American architecture, and especially Modern architecture with its antipathy to the "false front," has emphasized the freestanding, independent building even in the city—the building which is an isolated pavilion rather than one which reinforces the street line has become the norm. Johnson has called this the American tradition of "plop architecture." Aalto's dormitory at M.I.T. (205) is exceptional. The curving front along the river and its fenestration and materials contrast
with the rectangularity and other characteristics of the rear: exterior as well as interior forces of use and space and structure vary back and front. And the P.S.F.S. building, which is a tower, has four different sides because it recognizes its specific urban setting: party walls, street façades—backs, fronts and corner. Here the freestanding building becomes a fragment of a greater exterior spatial whole, but the typical freestanding building of Modern Architecture, except for some surface treatment and screens, which act to de-emphasize the spatial enclosure or to recognize orientation differences, seldom changes front and back for exterior spatial reasons. To the eighteenth century, also, this was a conventional idea. The ingenious double axis hotel in Paris (206), even in its originally more open setting, accommodated outside spaces differently at the front and back. With similar justification, Hawksmoor’s Easton Neston (154) yields a tense disunity between front and side. The discontinuous elevation on the intimate garden side away from the long axis, accommodates varieties of spaces and levels inside and necessities of scale outside. The side elevation of the Strozzi Palace (207) anticipates its hidden position on a side alley.

Designing from the outside in, as well as the inside out, creates necessary tensions, which help make architecture. Since the inside is different from the outside, the wall—the point of change—becomes an architectural event. Architecture occurs at the meeting of interior and exterior forces of use and space. These interior and environmental forces are both general and particular, generic and circumstantial. Architecture as the wall between the inside and the outside becomes the spatial record of this resolution and its drama. And by recognizing the difference between the inside and the outside, architecture opens the door once again to an urbanistic point of view.