SPACE UNDERFOOT:  
TOWARDS EXPANDING THE ROLE OF THE FLOOR IN ARCHITECTURE  

by  

GERALD N. BERSTELL  
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Certified by:  
Thesis Advisor: Lawrence B. Anderson  

Accepted by:  
Department Head: Donlyn Lyndon  

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"The tennis court exemplifies a space which is mainly defined by the floor. The role of the floor in architecture has so far hardly been studied."

Christian Norberg--Schulz
Abstract:

Space Underfoot: Towards Expanding the Role of the Floor in Architecture

Author: Gerald N. Berstell

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This paper investigates the role of architecture's most basic element—the floor underfoot—an element isolated for study because its unique visual and contact relationship to man gives it an importance that has seldom been recognized by designers during the past fifty years.

How the floor's material, slope, patterning etc. affect and reflect from underneath behavior, moment, and activity above is examined through studies of: 1) outdoor spaces—especially those of the Renaissance—and landscape design, where the base plane is relied upon to a much greater extent than normal in defining space, 2) large interior spaces where other architectural elements become remote, 3) space characterized by specialized movement, as athletics, dance and theater, 4) living patterns of other cultures, especially the Japanese, 5) contemporary art and sculpture, which seem to have given the floor more consideration than has contemporary architecture, 6) footwear, 7) historical architectural works, 8) American and foreign vernacular building, and 9) personal observations of the writer.

Challenged are apparent taboos associated with the space just above the floor level that have resulted in great wastage and inflexibility in the use of the costly floor—area commodity, and the role of the floor solely as an architectural barrier to the space underfoot.

Thesis Supervisor: Lawrence B. Anderson
INTRODUCTION—A PERSONAL OBSERVATION

As an undergraduate at MIT, I lived in the five-story "East Campus" dormitory, built in the 1920's with approximately 45 single-occupancy rooms on each floor:

The floors of the students' rooms were of linoleum tiles, generally covered by the student with a rug, but those of the corridors and stairwells were of terrazzo. Now although the terrazzo surface of course did not encourage water fights, it was certainly indifferent to them, as any water falling on the material does no damage to it and dries off fairly quickly.

On the other hand, the material was a very good conductor of both heat and dirt; i.e. it was very cold to sit down on, and those who tried to do so found their trousers (no matter what the original color) a shade of gray not unknown at MIT; the surface definitely discouraged sitting. Furthermore, one would find little reason to sit or even stand in the hall to converse with another, for (assuming that no water bombs were flying) the conversation would be constantly interrupted by the clopping of shoe heels of passers-by and the slamming of fire doors.

At best East Campus corridors were thus places of walking only.

Those on the hall who used the same bathroom at the same hours gradually got to know one another; acquaintanceships between hall members using different bathrooms were considerably less frequent.

Any socializing took place solely within rooms (whose doors were usually closed because of corridor clapping. Because all such "hack
sessions" took place behind closed doors, less gregarious hall members scurried back and forth along the corridors without ever being noticed.

East Campus well deserved its reputation for housing most of MIT's most monastic "tools" and also her most juvenile hall behavior.

During Summer 1968 neutral gray carpets were installed on the hall floors, covering all of the terrazzo and even climbing several inches up the hall walls. Water fights ceased immediately, and even water pistols were frowned upon; everyone knew the new floor would find such behavior disagreeable.

The rug removed the clip clop and foot scraping noises, so people meeting in the halls were able to stop and converse without the former background noise. As a conversation would continue and the standing position become more tiring, the warmth and resilience of the carpet invited sitting thereon (and one's pants wouldn't even become significantly dirtier).

The 4'6" corridor width was ideal for this, allowing conversing parties to sit across from one another at good conversation distance, their backs supported by opposite walls. Somehow the topics discussed here were never very academic--such conversations would generally pick up and go to someone's desk. As other hall members, similarly eager to forget about their academics, came along, they too would join in and sit down. It was not unusual to find twelve people stringing themselves out along the corridor in this fashion, six on each side, in what was now an extremely successful conversation area. As the more reticent hall members crossed over these conversation pits in order to get to and from their rooms, the forming of acquaintanceships with them became inevitable. Likewise with people from the other end of the hall.
No longer did this space have its monastic look of 45 locked cells running along it, but rather the corridor had a fairly rich life of its own. People now kept their doors open much more than before, perhaps due to "friendlier radiation" coming from the corridor space. More important, the space was to a much greater extent a continuation of the individual's carpeted living space; a resident could now casually go out into the corridor without having to go through the conscious motions of finding and putting on his shoes in order to go from his private space to the more communal one.
The Floor as Shelter

Fish swim and birds fly, but in general, if man wants to get anywhere, he has to walk. The earth is enveloped by a continuous surface, Nature's floor, and by his successful interactions with this floor (the only part of the physical environment with which he is in constant contact) he is able to get from "here" to "there." Gravity and human physiology dictate that a walking surface should support one's weight and be fairly flat; the fewer the obstacles one has to step over or around, the easier the journey.

Unfortunately Nature's incredibly rich floorscape contains many hazards to possibly hamper one's success in walking, such as pits punctuating the surface, ground materials that do not support his weight (as deep water) and loose objects that can upset and throw him off balance. Yet as long as such obstacles can be perceived ahead of time, he will cope. Blind people do this by means of a probing cane; most do it through vision, having learned the correspondence between the visual characteristics of most floorscape elements and their tactile ones. Yet often Nature covers her stable ground by tall grass or dead leaves which disguise hazards; treading onto an unseen twig or stone will surprise, trip, and perhaps injure; a surprise pit or quicksand surface could consume one entirely. No wonder primitive man felt that fearful powers working towards his destruction dwelt underneath him!

That which is below has always been of greater mystery than that above; its dangers made it for Dante the appropriate place to put Hell and the Devil, and for Jules Verne to put another collection of grotesque
creatures. Volcanism and earthquake action bring death from below, and perhaps it is the spirits of the dead buried there that come up to trip people in the dark.

Shelter is thought of in basically umbrella-like terms, but one of its most important functions is protection from elements below as well as from above and around. If the natural ground itself cannot be cleaned and adapted to provide a usable floor, then considerable amounts of effort and material must be used in creating one less directly supported by the ground.

Man made environments thus are designed and built with floors their most solid and visible elements, carefully protected from Nature's whims so they can be approached with greater confidence than the natural floor. Maintenance and cleaning keeps the manmade floor clear of hazardous surprises, so that even in a strange building or city, one can be fairly confident that there will be few surprises underfoot (though in many cities canine contributions to the pavement do deserve significant attention!). Many therefore strongly feel that the position of the manmade floor should be totally unambiguous and have no suggestion of the kinds of toe-stubbing pitfalls man is so anxious to avoid. Floor patterning with a three dimensional effect—such as that on parts of the Doge's Palace in Venice, or that on some late Hellenistic Roman floors which use colors in a way producing the impression of transparent overlapping, a dreamlike and ghostly effect, or that flower garden illusion of some Victorian carpets—surface treatments negating the substantiality that must characterize the floor can be upsetting to those who use it.

The man made floorscape is designed and kept so walkable that it is difficult to imagine how much it is taken for granted until Nature re-
asserts herself. For instance, when one person has gone out onto the
brand new floorscape created by a heavy snowfall, the next person, seeing
the footprints of the first marked out across the entire scene (and seeing
that they do not cease half-way across at a place from which muffled
cries can be heard), will probably follow them footstep by footstep
with just a bit of the joy that Robinson Crusoe felt at seeing the foot-
print of Friday. Evidence of one man's having walked on a surface is
very assuring to the next, and people coming later will follow similarly,
perhaps in a looser fashion, eventually forming a beaten path. In the
same way, a deserted frozen pond is approached with more confidence if
skate marks are seen on its ice. Legend has it that Boston's complicated
street pattern follows paths originally created by meandering cows, but
what could be more assuring to a pilgrim on a strange continent than the
path he is taking being able to support a cow!

More commonly, on a rainy day when the familiar sidewalk pattern
turns into an unfamiliar sequence of puddles and dry spots, people devote
more of their attentions than usual to the ground below, choosing paths
different from those normally taken, and often retracing the steps taken
by the stranger in front.

Edward T. Hall feels that "in large outdoor spaces, the sense of
spaciousness actually experienced depends on whether or not you can walk
3 around." He points out the Piazza San Marco in Venice as a place felt
to be particularly "spacious" and exciting because "every inch of it can
4 be traversed on foot." It is by walking around and seeing the parallax
effect of the environment's sculptural elements moving against one an-
other that the four-dimensional space of the built environment is exper-
fenced. A building whose floor supports standing at only one place
could be experienced as well by looking at a photograph as by being there in person.

The Unwalkable Floor

Very powerful images of man's walking the unwalkable exist, such as Christ's walking on water, Indian fakirs walking on beds of nails, the tightrope walker, and more recently the space crew of Kubrick's film "2001" walking inside extremely concave surfaces.

Unless very shallow, a floor surface of water generally provides as good a barrier against human trespassing as a vertical wall, and visual and acoustical relationships between spaces are not affected. For centuries the unwalkable watery floor has been used to complement or replace the wall in providing defense (the castle moat) or creating privacy (the deserted island). Such horizontal barriers, keeping the goal in sight but making conveyance towards it more difficult, are often used to filter people's movements towards that goal along a preferred route, as is done in Venice to get most people into and through the Rialto Market area.

That water can be traversed by boats can resolve one of the floor's most basic problems—the conflict between movement thereon. Relative speeds of pedestrian and vehicular traffic make separation of the two desirable, yet because both can and do move on the same ground surfaces in most urban environments, conflicts result. However in Venice, one ground material is traversible only by gondola and boat and not pedestrians, the other only by pedestrians and not boats. Pedestrian crossings are confidently accomplished over canal bridges in the third dimension, instead of hoping that time separation might enable conflicting movements
to occupy the same two dimensional floor.

The danger potential of the floor has been exploited by Japanese designers to spectacular effect; the waters and mosses of Japanese gardens are often plotted with a series of small irregular steppingstones. Because each stone is too small to comfortably rest both feet on, the visitor must keep walking; because of the irregular stone shapes and spacings, his attention must be focused at all times on the ground until he reaches a stone or platform made large enough to permit resting. For the first time he is then free to look up, and he experiences the surprising and significant views of the garden or residence intended by the designer.

Periodically varying the substance of the floor, and therefore its ability to support, has major effects on what ensues in a given space, though to date only Nature has accomplished this to any extent. During the day her ocean tides invite and then repel those relaxing on some of her best beachland. The visitor to Mont St. Michel will want to be there at both extremes of the tidal cycle, viewing the moonlit spectacle reflected in the surrounding water at night, returning in the morning to walk entirely around it on what is now a plane of sand, and in the afternoon to again find water.

The seasons bring their changes: According to Lassels, "it were a fine sight to see in a hard frost the streets of Venice all frozen, and people walking up and down the diamant streets or a crystal pavement," yet within days the canals again became the domain of boats only.

And the millenia bring historic changes, such as the creation and destruction of the Asian-American land bridge enabling migration of the American Indians, the icing of the channel between Sweden and Denmark
enabling the armies of the former to march over and conquer the latter, and the temporary parting of the waters of the Red Sea for the crossing of Moses. The nearest man has ever come to such periodic changes of the floor's walkability is the raising and lowering of the moat's drawbridge.

Veneer

But even if a piece of natural ground can physically support a person's weight, it may still require modification. Consider an outing to the beach:

Most people going to the beach bring some kind of beach blanket, not because the sand won't otherwise support them, but primarily because its particles stick to their bodies, find their way into food and cameras, etc. The blanket also replaces a hot and scratchy surface texture with one less uncomfortable to the skin. As far as human usage is concerned, laying that blanket on a part of its sandy surface changes the entire environment of the beach. Although no vertical space defining elements have been erected, a bounded space has nevertheless been created. None of the people who brought the blanket will sit or lie "outside" of the space it defines if he can help it; these boundaries are real even though visual communication with the rest of the beach is of course unimpaired.

This particular part of the beach now has implications of ownership and territoriality, claiming the space above the blanket floor as the domain solely of the blanket's owner as long as his blanket is there (even if he temporarily leaves to go into the water); strangers will not walk into this space. And when the owner returns from his
swim, the strong demarcation of this part of the beach's floor (augmented by the exceptionally brightly-colored patterns chosen for beach blankets) summons him back to its space just as he will later be attracted back to his three-dimensional house. The picnic cloth, offering protection from grass stains and ants, has the same effect on the country meadow.

The structural support of such cloth-created spaces is born by the stable ground underneath, so the structureless blanket can be easily folded up and carried away. Lay it down and something with many of the identifiable characteristics of architectural space is created; pick it up later and the space disappears; what more potent example could exist demonstrating the floor as architecture's most basic element?

The blanket or cloth acts as a veneer laid upon a mass or structure which can physically support people, but which for some reason presents a surface they find undesirable to directly contact. Distinctly different floors are created when this blanket veneer is supported by beach sand, wooden planking, flagstone, or canvas stretched over a frame, even though in all cases the floors look alike and the feet of man and his furniture are in contact with the same veneer material.

A look at the contact properties which generate the great variety of floor veneers currently in use might best be done through the examination of one currently popular veneer material—carpeting.

Friction.

A material's friction (along with "evenness" which is friction at a larger scale) is the most important veneer property affecting movement
along it. Friction ranges from that of ice to that of sandpaper, with most carpets falling towards the sandpaper end of the scale (even more so for the bristly welcome mat). Because ordinary walking is characterized more by the lifting up and setting down of the foot rather than its gliding along the floor surface, even the carpet's great amount of friction does not impede it greatly. For gliding foot motion, such as dancing, the carpet, however, is considered unacceptable. Sliding objects along a carpet's surface is difficult—the dining room chair that glides easily in and out over linoleum will often seem cemented to the carpeted floor.

Because the carpet (and its natural analogue—grass) provides a great deal of friction, it mandates lower amounts of pedestrian and furniture traffic above than do materials such as linoleum and terrazzo. To move a sofa or other heavy furniture over a carpeted floor involves several people picking the piece up, transferring it, and setting it down again so that the spontaneous shifting of furniture arrangements that characterizes the flexible linoleum-floored playroom is impossible in a carpeted room.

Temperature Contact

Although both the bathroom tile floor and the wooly bathmat on it may be 60° in the morning, it is far preferable to step from one's shower onto the bathmat surface, which doesn't feel cold because it

* Because interaction with the floor plays such a great role in movement, the role of the floor is expanded greatly in spaces characterized by "movement for movement's sake" such as dancing and athletics. Enormous effort has been exerted in producing the correct waxed basketball court surface, the right clay texture for a tennis court, and especially an astro-turf suitable for baseball and football.
does not conduct body heat to the floor. Shoes, discussed below, usually resolve this problem as far as the foot is concerned, yet in MIT's East Campus dormitory it was apparent that people begin to relate other parts of their bodies to the floor if its temperature is not unpleasant. "Cold" materials like tile and terrazzo also have a tendency to transfer dirt to skin or clothing.

Resilience

Resilience—the instantaneous "give" of the floor under the pressure of one's foot—is that characteristic which makes a cushion different from a rock, and a certain amount is desirable to give a "spring" to the walk. The far greater amounts characterizing the thick carpet begin to impede the walk and make it more tiring. On the other hand, just as the cushiony materials of well-stuffed furniture invites one to sit or lie down on it, so do they also when applied to the floor. Such "give" is achieved only with a noticeable thickness of such material above the structural floor, and very resilient floors and carpets often become dented by heavy furniture atop.

Maintenance

The maintenance characteristics of a floor material are important because people entering one environment often carry on their feet or shoes things from another and, more important, most human activities—

* In the way that the carpeted floor meets with corridor walls to create a comfortable sitting space in the corridor, the west concrete exterior wall of MIT's Dreyfus building similarly supports the backs of as many as sixty relaxing people, sitting on the thick grass running up to it. Few other exterior walls at MIT are used this way.
eating, writing, reading, handicrafts, etc.—involve interaction with inanimate matter which can accidentally fall. Solid objects, especially if broken, are removed as possible hazards.

However, much of this matter is liquid—water, soft drinks, milk, ketchup, oil, grease etc. Getting rid of the results of an accident requires an amount of effort dependent on the liquid dropped and the floor surface material. Carpeting is fairly intolerant of liquids (although new fibers are being synthesized with greater tolerance). When a staining accident occurs, possible alternatives are cleaning, repairing or replacing. Less effort is involved in replacing the newspapers the dog is being house-trained on than in cleaning or repairing them. The cost of carpeting material and installation positively prohibits casual replacement, on the other hand. Chemicals, shampoos and a good deal of physical effort usually succeeds in removing coffee stains from a rug (depending on its color, pattern and fiber structure). Grease or oil stains might necessitate patching or weaving in of new fibers, obviously a difficult and costly process.

Whereas friction and resilience properties of veneer materials are easily perceived by someone in contact with the material for the first time, maintenance properties have to be taught by society, usually through one’s parents. Except to very small children and aborigines, the carpet mandates extremely careful moving with coffee and soft drinks; it all but rules out gluing model airplanes above, and entirely prohibits the fixing of the lawnmower engine. East Campus showed the restrictive effects of carpeting as compared to terrazzo, though even terrazzo has its maintenance limits. A material (especially in a dormitory) usually gets the worst it can tolerate, and as a former dormitory
resident, the writer is sure that if it were more feasible to start a fire on terrazzo (as it is on brick or sand), it surely would have been done in East Campus.

One of the joys of going to the beach or camping site is that almost all of these restrictions are eliminated, and people can amuse themselves with activity unfortunately too often impossible in or near their domestic environments, as making campfires, splashing water, etc. On the other hand, surfaces even more prohibitive than the rug exist. Even walking is prohibited by an extremely fine lawn, flower garden, or the finely raked sands of the Japanese contemplation garden. The grass on a French park will spell so much doubt to the visitor that a fence only one inch high is enough to complete the statement "Do not walk."

In summary, carpeting does allow certain activity that wood, tile or concrete beneath does not, as is best evidenced by an environmental psychology experiment done by MIT students in which a 9'x12' carpet was laid down on the brick surface of Boston's outdoor Government Center plaza. Generally only circulation characterized that space, but with the rug there, people began to take their shoes off there, sit down and relax for the first time. One even did a headstand.

On the other hand, the experiment showed that most people (admittedly somewhat puzzled), who were interested in proceeding directly to their destination, were discouraged from walking over the rug and walked around it.

The totally wall-to-wall carpeted residence seems a rather static and inflexible environment where little spontaneous self-movement as
dancing occurs, where one is very careful to hold his saucer under his four o'clock teacup, and where this year's furniture arrangement will probably be the same as last's. In the way that the absence of ashtrays implies that the host desires no smoking, perhaps the owner of such a carpeted environment may be using the carpet as a nonverbal statement to visitors that they should act in a restrained manner.

The writer has heard that lower ranking corporate executives often find their offices carpeted with the same materials as those ranked above them, but cut a few inches short from the walls instead of being wall-to-wall. The writer has developed the following hypotheses attempting to explain why this would express hierarchy.

1) Wall-to-wall carpeting costs more, reflecting that a greater amount of money has been lavished upon such an office. The increased cost of replacement is similarly implied.

2) The area rug is portable; it could have been brought in by the employee as a sign of protest, whereas the other was obviously installed by the corporation itself.

3) Sherrill Whiton says without explanation that a room so carpeted looks smaller. Conceivably this is because the exposed floor doesn't seem to contribute towards the room's floor area, just as the sand on all sides of the beach blanket is not felt to be part of the blanket's space.

4) The fact that wall-to-wall carpeting is tacked or cemented down implies that only carpet-type activities (board meetings, etc.) can ever occur in the room. The untacked area rug suggests that the possibility exists of rolling it up in order to perform manual labor in that space.

* * * * *
It is obvious that despite its comfort and warmth, people can not and generally do not try to accommodate themselves everywhere and at all times to the extremely limited range of activities that carpeting underfoot dictates. Bathroom carpets are having limited success, and the kitchen carpet seems doomed to failure. People and their furniture are not as static as wall-to-wall carpeting demands, and the carpet avenges heavy traffic with worn spots, which in turn further discourage furniture moving (as this would reveal the embarrassing contrast of worn and unworn). When the carpet is finally deemed too worn for one particular room, it is almost impossible to put it elsewhere, as the circulation and furniture arrangements of the first room are indelibly marked into it.

It is not the purpose of this paper to so evaluate all floor materials currently used in architecture and in the manmade and natural landscapes. Application of personal knowledge and experience to Sweet's Catalogue entries reveals the differences in physical comfort and maintenance properties that exist between materials. The brief and very generalized diagram below shows how the interaction between characteristics of common veneer materials spells out different ranges of allowed and discouraged activities for each.

**BODILY COMFORT**

<table>
<thead>
<tr>
<th>Tatami Rug</th>
<th>Wood</th>
<th>Terrazo, Asphalt, Sand, Earth, Mud, Water</th>
<th>Tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>little</td>
<td>some gliding water, grease</td>
<td>fire, pets pigs</td>
<td>sitting, discouraged</td>
</tr>
<tr>
<td>activity</td>
<td>some spills</td>
<td>allowed, allowed</td>
<td></td>
</tr>
</tbody>
</table>

**EASE OF MAINTENANCE**
Indoors and out, a large range of materials from this spectrum is necessary to accommodate the spectrum of activity that distinguishes human beings from corpses. The typical American dwelling recognizes this, and in differentiating activities according to rooms (i.e. "bedrooms," "dining rooms," etc.) it characterizes these different rooms by different floor materials. Even the converse is true; advertisements for "kitchen flooring," "playroom flooring" etc. appear in both professional and lay magazines.

Removing the vertical definitions from the writer's eighteen year old Connecticut home would produce the following floorscape:

It would be redundant to mark "kitchen," "bedroom," etc. on such a sketch—the different materials just about say it all.

That there exists no place in this dwelling except the bathtub in
which to put a wet umbrella or drip wet stockings indicates that its range of materials is still a bit too limited. That the circulation scheme of this house is worn into the carpeting, the entirety of which must therefore be replaced every six to eight years, and that these paths continue between rooms, suggests that the changing of floor materials merely according to "room" is not a satisfactory or efficient solution towards accommodating the range of human activity in the domestic environment, and perhaps hints that "room" itself is a concept not strictly in accordance with human behavior.

By means of its floor materials, traditional Japanese domestic architecture differentiates space according to movement and repose to a much greater extent. The entrance and kitchen spaces (sometimes connected) both have earthen floors, allowing all of the mishaps natural to cooking and housetending. Part of the kitchen's earthen floor is covered by a raised boarded floor; that this earth and board combination in the kitchen is uncomfortable underfoot mattered little, as only women, whose needs were considered secondary, used it.

The main living area (subdividable by means of sliding or portable screens) is underlaid mostly by tatami mats. The 3'x6' mat, a slowly evolved design solution responding to and in turn influencing the pattern of Japanese domestic life through the centuries, is supported on a wooden framework. The standardized pad consists of approximately two inches of thick straw covered by green voers of tightly woven rushes,

* A Copenhagen apartment, designed in the late 30's, that the writer has visited, widened this range slightly by underlaying the bathroom with a concrete floor, enabling one to hang wet clothing to dry everywhere in the bathroom.
all tightly bound together with cords. While the surface has less friction than carpeting, it has more resilience. The yielding of the mat under foot pressure makes walking somewhat difficult and the placing of heavy furniture impossible. Liquid spilled onto its very porous surface is a fairly grim matter.

The tatami mat thus dictates (or complements) a life style even quieter than that of the executive carpet. Household activities such as eating must be executed with a deliberance almost unknown in Western cultures.

Most circulation is reserved for that floor area covered by finely polished wood boarding. Such use of special circulation materials defining the home’s circulation network recognizes the flow between quiet spaces and creates an efficient floor system whose materials do not quickly wear out.

Notice that the Japanese home is thus underlaid with floor mat-
Wright's treatment of floors bears resemblance to that of the Japanese in that he avoids changing materials at the doorway, as is so common in America. Instead he acknowledges the connecting functions of the approaches to the "doorway," underlaying space on both sides of it with the same material and then placing activity-defining materials (stone, rugs) away from the passageway in places where those activities can actually occur (certainly not in front of a door or passageway!). The floors of Mies's Tugendhat House similarly join its rug defined spaces. But both Wright and Mies sacrifice the comfort and sensuousness of the tatami in order to utilize Western furniture in further defining the spaces.

Such variations of material, made in response to actual variations in the pace of activity above, do take place in America's largest and most anonymous floor designs—those of her streets. As a person comes out of his residence, his approach to a six foot wide band of concrete extending indefinitely to either side of him makes him aware of the likelihood that people will be walking along its direction in that area. Further across, the strip of black asphalt coming into view will put him on the lookout for automobiles even though none are presently in seeing or hearing range. The more specific ground patterns of railroad or streetcar tracks give even more specific information on what to expect. Each floor material has a unique visual appearance, and the juxtaposition of different floor materials creates patterns atop this most continuous of surfaces.

The longitudinal or oblique way in which the horizontal floor plane
is seen five feet below eye level foreshortens distant surface changes to mere suggestive lines, gradually and subtly revealing undistorted textures and patterns to the pedestrian as he nears and passes over.

The perception of this pattern greatly influences the approacher’s decisions on how he will use the space. Lawrence Halprin:

"The textures of pavings can guide the activities and movements of pedestrians, can even channel their direction, or prevent their encroaching on specific areas, or slow them down. Smooth materials encourage walking, rough surfaces inhibit walking, and though the ladies’ high, spiked heel may not be with us forever, even flatter heels will slow down on rougher surfaces."  

Louisburg Square in Boston, presumably copied after old English street paving, subtly directs traffic by a considerable range of pavement materials. Such English paving may have different materials for those areas reserved solely for pedestrian walking (brick), pedestrian resting (grass), pedestrian crossing of the vehicular way (small flat cobbles), the vehicular way itself (large cobbles), and automobile parking (a fairly uneven stone texture that discourages the pedestrian from jaywalking and jolts the automobile traveling too quickly within a parking zone).

Such differentiation creates a pattern of great textural richness, efficiently guiding traffic and giving both the pedestrian and automobile information about where they may expect to encounter each other.
Unfortunately the fact that such a material change can create a large two-dimensional pattern often enflames the mind of the designer, who may begin to consider the pattern for its own sake, completely ignoring the reasons for the material change that are the basis for its creation.

Kresge Plaza at MIT is an example of an arbitrary surface pattern that has been powerless against an unpersuaded and vengeful public that has materialized its intention to go from point A to B a more direct way:

Having a floor that can be changed with time is like having one's cake and eating it too, but even though the non-structural veneer can be made flexible and portable, this is seldom done. When a party is held in a carpeted room, if it is not tacked down one can "roll up the rug" to expose the wooden floor. The new surface invites not only dancing but also "spinning the bottle," and it would now be only a mere
inconvenience to the party's hostess if one of her more lively guests dropped a drink or some cake. Removing the self-discipline a rug imposes allows spontaneity and revelry to increase. If the carpeting cannot be removed, foldable wooden dance floors can be placed atop, although with some effort. Judo mats and portable basketball floors are two such floor veneer alterations often made in the athletic world.

The ground surfaces of the natural environment change with day and season, complementing Nature's other daily and seasonal changes and encouraging totally different activities in a space over a period of time; summer's golf course becomes winter's snowmobile and sledding grounds; her summer hiking trails winter ski slopes. Two of the more dramatic man made examples of such veneer alteration are New York's Rockefeller Center, whose summer outdoor restaurant surface is changed in winter to an ice skating rink, and Rome's Piazza Navona, which used to be flooded with water for the purpose of cooling the air. Old prints suggest that the Piazza Navona became a lot more frolicsome space when this was done.

Footwear and Spatial Transition

People contact the floor with the soles of their feet, whose many bones, muscles and sweat glands would generally be happier if not bound into the leather, rubber and string corsets used as footwear. But shoes are nevertheless necessary at most times and in most places because of the coldness, dirt, slivers, germs, and sticky or rough spots that even the man created and maintained environment cannot always remove. Guaranteed security from these thousands of floor hazards when going to bed, man usually sleeps barefoot. Well vacuumed wall-to-wall
carpeting is almost this warm and safe, and it is the freedom to move around one's home without bound feet that is undoubtedly instrumental in its placement in bathrooms and even kitchens.

The touching contact between the foot and a completely safe floor material can be made into quite a sensuous experience. Kiyoyuhi Ni-shihara tries to communicate the sense of such contact with the Japanese tatami mat:

"The feeling one gets on a hot muggy day by coming home and walking barefoot across tatami that are new enough to still retain some of their soft green color, belies description." (10)

It is for their tactile appeal alone that the thicker pile carpets are installed in American homes; well polished slate and marble floors have also been described as having tactile appeal. As the built environment's chief contact surface, the floor's tactile potential should not be ignored.

People generally walk barefoot only in their homes, where the floorscape is most familiar and assured. Doing so in another person's house recognizes one's familiarity with that home and its owner, allowing one that extra comfort. Doing so in the hazardous street is almost a gesture of defiance or contempt for the sanitation ethic.

The stocking foot is almost as unconstrained as the bare one; the sock mitigates temperature and dirt contact much like a portable rug veneer. However glass, splinters and excessive roughness still remain dangers or discomforts.

* Enormous shoe-generated blisters forced the writer to remove his shoes while walking on streets of Stratford-upon-Avon, England, surprising him with the delightful feel of the English street's asphalt composition.
Just as clothing shelters people from the residual drafts and temperature variations in the manmade environment, so the shoe shelters them from residual floor hazards. That such floor discomforts are feared more than those shielded from by other clothing is evidenced by the use of sandals at nudist camps and shower clogs in public showers, and the shoe might be thought of as a micro-floor veneer tied onto the foot which accomplishes at the very small scale the same things as the "macro-veneers." The material composition of the shoe sole is generally more akin to that of furniture than it is to that of the other articles of clothing; note especially Dutch wooden shoes.

The leather soled shoe is generally worn in America because it can be used on just about all of the surfaces encountered there in daily life. But just as different activities demand different floor surface materials, so can these different surface materials require different footwear. The leather shoe no longer suffices on the outdoor floor covered by rain or snow; boots or rubbers must be worn. A vast range of foot coverings have been developed for different floor veneer conditions; the rich variety of natural or recreational floorscapes is approached with a correspondingly large variety of footwear--ice skates, hiking shoes, football and golf shoes, snowshoes, skis, track shoes, tennis and basketball sneakers. With many floor materials being dictated by the concept of "room," it should not be surprising that some forms of footwear have likewise been categorized in this way, as "bedroom slippers!"

Over the seasons Nature's veneer transformation of the golf course into a winter playground similarly changes the footwear of its users from golf cleats to snowshoes and skis. It should not be forgotten
that vehicles too are often classified by the terrain they travel—as tanks, dunebuggies, golf courts and snowmobiles; even automobiles deck winter footwear of snow tires and chains for the new wintry street.

Footwear is changed in response to the sequential transition from one space to another that is distinguished by a different floor surface. Because of the way our bodies and shoes are built, changing shoes takes time and effort, and this heightens one's awareness of the transition to take place. The time-consuming effort of finding and lacing one's shoes before passing from one's room to the corridor was a barrier which helped isolate the communal corridor from the private living units in East Campus. The writer feels the removal of this time barrier contributed towards making the corridor part of the individual's living space, and it was his usage of this space in common with the other members of the hall that made the corridor a uniter rather than a divider of a viable hall community.

This is diagrammed on the graph below. The materials scale on page 19 serves as the vertical axis, compared to a horizontal scale showing a sequence of spaces experienced in time and the materials underlying those spaces. A fairly horizontal line joining subsequent spaces indicate that they are floored by materials from the same part of the spectrum:

```
    terrazzo
      1   2
    concrete
```

A very steep gradient between materials underlying successive spaces:
indicates the likelihood of a time-consuming alteration of footwear before one proceeds to the next space.

The solid line on the graph below represents floor material transitions in East Campus before alterations, while the dashed line represents after.

Because the exterior environment is paved with concrete and asphalt, one must generally put on shoes to go outside. And because the stairwells were never carpeted, one must still put on shoes just to go to another of the building's five stories. The dormitory's main lounge is on the first floor and all must go by way of a stairwell to get to it.
Could this perhaps partially explain why it is always deserted and no one considers it the "living room" it was intended to be?

Gradients between materials within the typical American suburban dwelling are generally not great enough to require a change of shoes within the house. Leaving the house, however, takes one down a very steep gradient, bridged partially by the bristly welcome mat. In addition to the outside welcome mat, many homes have a rubber mat or inexpensive throw rug inside their doorway, the latter often collecting rubbers and shoes. But the outside is so different from the inside that even after all the footscraping rituals on these indoor and outdoor mats have been enacted, it is still likely that the shoes will be left at the door anyway, to be retrieved upon leaving.

In Mediterranean villages, on the other hand, the gradient between a home's interior floor materials and the street paving materials outside is almost horizontal, stone paving both. Although such interior floor-

\[\begin{align*}
\text{tatami rug} & \quad \text{tatami rug} \\
\text{wood} & \quad \text{wood} \\
\text{terrazzo concrete asphalt} & \quad \text{terrazzo concrete asphalt} \\
\text{sand earth} & \quad \text{sand earth} \\
\text{water} & \quad \text{water}
\end{align*}\]

\begin{align*}
\text{American Suburban Residence} & \quad \text{Mediterranean Village Residence}
\end{align*}
ing is not too appealing to the suburban American, the nonsloping
gradient between inside and out seems to have an effect similar to that
of the flat gradient between the carpeted East Campus rooms and halls:
the outside street is felt to be more of a continuation of personal
living space. Many pictures of such villages show women sweeping the
street "outside" their dwellings as carefully as they do the floor
inside.

Boston's now demolished West End neighborhood exhibited a scheme
of material transitions leaning a bit towards that of the Mediterranean
classic. Floor materials inside the dwellings were seldom as
high on the scale as carpet (probably linoleum and wood) but exterior
materials--brick and cobbles--were not as low as suburban asphalt,
thus producing a material gradient of relatively low slope. To the
writer's knowledge, people living in this neighborhood had a far richer
outdoor community life (people there often swept their sidewalks also) 
than those in the carpet and asphalt world of the projects replacing it.

The significance of the changing of footwear and the consequent
mental as well as physical preparation undergone by the changer for
the space to come, is best exemplified by the Japanese residence.

There is no material gradient between the outside of the residence
and the sheltered entranceway or earthen floored kitchen. The visitor
comes under the shelter of the home's roof and even into its work area
without the American footscraping ritual. Now under the shelter of
the house's roof, before he can enter the living spaces he mentally and
physically prepares himself by stepping out of his shoes and into slip-

* In all of the sited cases other major factors obviously come into
play; nevertheless the writer feels the material gradient factor he is
isolating is an important complement to them.
pers which are used exclusively for walking upon the polished wood circulation areas. Coming to the tatami, he must again temporarily cease all motion in order to step out of these slippers, and then slowly and softly he makes a few steps barefoot on the delightfully sensuous mat to get to his book, table, or sleeping spot. Still different slippers are found at the entrance to the bathroom.

It is consideration for the floor materials alone and not affected customs that dictates these changes, which separate the bustle of the street and kitchen from the delicate pattern of family life by two conscious preparatory changes.
Visiting the Christianbourg Palace in Copenhagen would probably be no more exciting than visiting a bad copy of Versailles should be, except that when the visitor enters, he is given special cloth slippers to put over his shoes. Before entering the otherwise boring palace suites, the visitor therefore anticipates the fun he will have literally gliding across the palace floors with the same kind of physical movement that makes dancing and tennis enjoyable; therein lies the whole enjoyment of a visit to the palace.
The Response of the Floor

With the possible exception of some new electric eye or heat sensitive devices, the only way the inanimate physical environment recognizes and responds to the presence of a person is through his application of some kind of physical pressure, such as that which opens doors and windows and twists faucets. Without conscious effort people subject the floor to such a physical force, producing a series of impulses on it while walking. Different floor materials respond differently to these impulses, possibly transforming them into sound, deformation, or deflection.

Internally one's contact with the floor is experienced through the bones and muscles whose exertions make for walking. The spring that a resilient floor gives the walk results from an instantaneous deformation and recovery of the floor material due to applied and released foot pressure; to a degree such a response by the floor will be sensed by these internal body mechanisms as a desirable complement to their own functionings. The floor may also respond in a way detectable by the other senses; heel contacting hard floor surface generates a clicking sound, and wooden floor structures often squeak under walking pressure (despite carpet veneers). Audible responses range from the eerie silence of lightly mossed or fern-covered earth to the rustling and cracking of autumn's underbrush. Permanently visible floor responses result from walking on sand or wet concrete, and Gyorgy Kepes has used polarized light coming through a plastic floor to produce brightly colored visible stress patterns replying to the placement and shifting of a person's weight. Such "externally perceived" responses can affect people on the floor other than the person walking.
The writer has heard psychologists say that it is enjoyable (perhaps even necessary) for an individual to receive feedback about his existence and actions from the outside. One hopes for such feedback from other people; sometimes the source is a pet cat from whom scratching and stroking elicit a reassuring purr.

To a great extent, inanimate objects are also sources for such feedback. The baby enjoys shaking the rattle which converts her movements into a sound that comes back to her ears. Many adults take similar pleasure knowing that three hundred horsepower under the hood is responding completely to them, and the confirmation of one's muscular and mental coordination by a well-controlled golf or tennis ball is gratifying. The pleasure at being able to project oneself to himself and others by means of perceptible manipulations of the physical environment is best embodied in the small child who can stand fascinated for hours at a bank of light switches, eying whole rooms turning on and off at the beckoning of his fingertips. Conceivably children engage in vandalism for such reasons. Museum directors have caught on to the success of exhibits where the public is able to press buttons in order to turn things on and make them move.

As one's heels click against a hard pavement, the environment is audibly changed in a way that gives the pedestrian feedback about his part in it. The importance of such feedback is strongly indicated by Dober's comment that in the 1890's a noiseless stone block, although inexpensive, was disliked as a paving material, as were other silent pavings of Indian rubber, slag blocks, coal tar and leather. On hard pavings, each person's footsteps produce an almost unique sound; before renovations in East Campus a person behind the closed door of
his room generally became able after a few months of residence to identify the owners of footsteps passing in the corridor outside. Perhaps deprivation of self-feedback is most strongly felt in public spaces, where one's individuality tends to become lost.

A section drawing through a floor and its occupant shows the two to be almost a single structural entity; certainly if the floor shakes, the person on it will be shaken. Likewise, if the mass of a floor is small or flexible, then the man atop will be able to set it in a motion responding to the rhythms of his own movements. This is exemplified by a rocking chair, a trampoline, and a small row-boat, but best by the waterbed. By its position the waterbed is more floor than furniture (a distinction whose validity will be discussed later) and it might very well be put well above tatami on the materials scale, as it is almost totally unwalkable while being highly compatible to the reclining body. Each movement on the waterbed is magnified and returned to the sender by the flowing of the bed's watery mass. Obviously it also makes one more aware of the existence and movements of another on its surface.

When there are several people on the same floor, it begins to act as a communicator of one person's movements to the other. But as talking about oneself is enjoyable to the ego but seldom so to others, the same is true of the responses one is able to elicit from the environment and floor especially. For instance, there is a certain pleasure in picking up a rock, throwing it
into a placid water surface and watching the water surface ripple in response. But somehow there is little enjoyment in merely standing by and watching someone else throw stones into the pond. The same is true in listening to one's own rocking-chair creak versus listening to the creak of another's, or in discovering someone else's vandalism. While one person might amuse himself by jiggling his leg and watching the whole room (especially lamp shades and loose windows!) respond, anyone else in the room is sure to ask him to stop it. When such motion is completely out of a person's control, as on an ocean liner or in a tall building during a heavy wind, physical sickness can result, making one appreciate the stability of terra firma normally built into man made floors.

The tremor created by a walking impulse is effective at announcing someone's entrance onto the wooden floor characteristic of Northeast U.S.A. homes. Those who do not wish to be so announced must resort to careful and slow tiptoeing, and children of this region are quickly taught to "lighten" their walking on such floors. The Japanese tatami demands an even more delicate mode of walking in order not to convey an impulse to others sitting directly on the mats. On the other hand, Italians who have walked on nothing but the stone floors of that country have never become aware of the movement response of wood floors on wood framing, and it is the experience of the writer that Italians visiting the U.S.A. have walks intolerable in a New England home.

Particularly noisy floors have had their place: the purposeful excessive squeakiness of the "nightingale floors" of Kyoto's Nijo Castle effectively warned guards against intruders. The American tap dancer augments the sounds his feet make against the floor in order to
communicate to the audience's ears as well as their eyes the intricacies of his motions. Floors are capable of transmitting some vibrations and rhythms, and machinery is often isolated from it in order to avoid this. But the musical lyric "I feel the room swaying/ For the band's playing..." points out that the transmittal of musical rhythms from the band through the floor and into one's body can be a valuable supplement to that which comes to one's ear. Transmitted ground or floor vibration makes pedestrians on steel bridges more aware of approaching automobiles, and enabled American Indians to perceive oncoming railroad trains still out of seeing or hearing ranges.

The light switch mentioned before is an example of a mechanical device activated by contact pressure; devices intended to perform only upon the arrival of a person are often activated through pressure-sensitive devices laid onto or built into the floor. Most burglar alarms are activated in this way (as are land mines); gasoline filling stations often have a tube laid along their entranceways which ring a bell as an auto drives over it, informing the sleeping attendant that someone outside wishes his services. Similar devices buried in the pavement at road intersections give the automobile traffic light system information about traffic flow which direct the sequence of light changes to be more responsive to actual traffic conditions. And finally, when man's hands are too full to push open the door, the pressure sensitive floor pad signals the electrically-operated door to open for him (Such doors are especially popular with those children who orchestrate light switches). These examples give hints on how to create an environment "truly responsive" to a person's presence and every movement.
Movement and Slope

The trace of a person's movement on a two-dimensional floor surface is linear. In interior spaces it is generally the relationships between vertical elements that directs that line of movement; the floor itself is generally mute concerning which of the infinite number of directions on its surface to pursue. In general this neutrality is consistent with the way people wish to use the space, not subjecting their movements to only one path.

The pavement of Louisburg Square showed how material differentiation along the two-dimensional surface begins to direct movement; small variations of floor motion or slope can also be used to impart directionality from below.

Even if situated in the same plane and not separated from the stationary floor surface by railings, a break exists between a moving sidewalk and the rest of the floor; moving randomly across this break is difficult and unbalancing, and railings or low walls normally isolate the two. The floor's movement strongly suggests movement in the same direction, accomplished either by standing still on the floor and moving with it, or by supplementing its motion with one's own in the same direction. Walking in the opposite direction is an exercise in futility and moving transverse to the "grain" of the floor's movement sets one off balance and makes doubtful the point across the walkway where one will finally emerge. The 1964 New York World's Fair Vatican City Pavilion had four sidewalks moving at different speeds past Michelangelo's Pieta in order to quickly direct people past the exhibit. Most people resented such orders coming from below and many walked "backwards" on the moving floor in order to have some way as to the pace of their visit.
Furniture and objects are more amenable to such dictates from the floor below, and slowly moving floors are often used to convey objects. Floor movement need not always be linear; rotary motion (such as that of the carousel) has been used in many theater stage turntables in order to help choreograph the movements of furniture without stage assistants, altering the interrelationships between furniture in a space.

A floor surface moving very rapidly, such as a moving carousel, is difficult to approach and may perhaps be useful as a barrier.

Slope has an analogous effect on movement. Gravity facilitates walking down a slight slope and inhibits walking up it with an effect on motion comparable to that of the moving sidewalk. Because both human legs are the same length, walking transversely on a slope is more difficult. The level manmade floor surface covers Nature's undulating one in order to avoid this imposition of direction to movement above, and also to allow the use of furniture that can be oriented in any direction.

Wright's Guggenheim Museum ramp, though not so demanding as the moving sidewalks of the Vatican exhibit, badgers the visitor to continue moving downwards, past a sequence of exhibit art. Seldom does one break the sequence by partially returning back up the ramp. Higher degrees of slope make walking in any direction difficult, but may serve to attract non-moving usage. The sloped contours of MIT's Great Court
invite the body to rest and sun, while flatter areas of the court host more active frisbee and softball games. The only sloped floors generally found inside buildings are those of auditoria and theaters, where such slope is used to improve the sightlines of these very highly directed spaces. Theater seating must be quite specialized in order to resolve the effect of the sloped floor, and is commonly built in or bolted to the floor.

Just as it affects human movement, floor slope can also influence movements of objects and materials (such as along chutes), especially water. Well-drained streets are characterized by two directions of slope: first there is a slope from the crown of the street leading water to side gutters; then the slope of the gutters themselves lead it to drainage systems. Sienna's Piazza del Campo consists of nine fan-like sloping sections, all directed to an immense drain at the apex. Thus the attention of the entire sloped plaza is focused towards the Palazzo Publico behind it. Siegfried Giedion describes this in the reverse way:

*The floor of the bathroom of the Copenhagen apartment mentioned above was slightly sloped to a drainage opening to permit efficient drainage of water dropping from wet clothing, as well as water used for cleaning the room itself.
"The white marble stripes of the pavement shoot out like rays from a lighthouse at the focal point of the community." (14)

Although a steep slope can be made walkable by means of hand-railings and increased friction, without these it may be used as a barrier, and is so used at a "hilltown" housing project in Zug, Switzerland to resolve a problem common to such projects—giving each balcony visual privacy from occupants of upper balconies:

In the Zug scheme, those balcony positions from which one might peer down into the balcony below have highly sloped unwalkable floors acting as a barrier with this effect on sight lines:

Each resident's privacy is guaranteed without sacrificing the open qualities of the terraces.
Applied Visual Patterns

This paper's section on veneer concluded with a description of how a visual pattern generated by the use of different surface materials can encourage movement and channel people along certain paths (the snowpath) or attract them to rest in certain non-walking places (the beach blanket). The possibilities of floorscape surprises makes the eye wary of not only those patterns brought into being by material or level changes, but also those created by using different colors of the same materials (as tiles or stones), lines cut into the material (as concrete) or paint applied to the ground. This is especially true for surfaces characterized by a great amount or specialized kinds of movement.

The power of a line on the floor to direct movement in a public space was well demonstrated by an MIT environmental psychology experiment. A highly visible cloth tape line was placed on the floor of a heavily used lobby (77 Massachusetts Avenue in Cambridge, Mass.)
Normally people tend to keep to the right while walking through the corridor that leads to this lobby, and there does exist a tendency to continue doing so, though somewhat more loosely, across the lobby to the automatic exit and entrance doors. In the experiment application of the simple cloth line was observed to sharpen this segregation of traffic directions.

The line was then bowed out slightly in one direction:

![Diagram of bowed line]

and the pedestrian traffic complied, its stream similarly bowing. Further increases of the line's deflection produced parallel deflections of the route of the pedestrian traffic; only a very great deflection of the tape path made it lose its power to direct traffic in that space.

Dance students often are taught new steps by following with their feet a sequence of footsteps dropped onto the floor by the instructor, guiding the student's movements one by one in a manner reminiscent of Japanese steppingstone placement.
Such a sequence of vinyl footprints affixed to the ground (occasionally replaced by a painted or bricked line) effectively leads tourists around a recommended sequence of Boston's sights on her Freedom Trail with minimum use of sign posts and other eye-level markers. This line and these footprints are red, a strongly advancing color that attracts attention, and it is not difficult to see why the long carpet which hosts a sequence of arriving dignitaries is of this color. On the other hand, blue, a recessive color (with some suggestion of water) is seldom used on the ground at all.

Arrows are similarly used for orientation. As a sign of humility Moslems kneel on the floor during a great part of their worshipping. While praying elsewhere than in their mosques (which are usually carpeted), they may use portable "prayer rugs" with a pattern such as this:

![Prayer Rug Pattern](image)

The rug is set down with its apex pointed towards Mecca, the direction of Moslem worship. The worshiper uses the material texture of this carpet to make his kneeling position more comfortable, and its pattern to properly orient his body for prayer.

Most streets channel automobile and pedestrian movement with less cost and more flexibility over time than does Louisburg Square (though also with less effectiveness) by means of painted crosswalk bars and parking lines. Lanes of fast-moving traffic are similarly separated from each other (especially those going in opposite directions) by solid or dashed lines. The asphalt streets of Treviso, Italy are often
too narrow to allow separation of pedestrian and automobile traffic by means of a raised concrete sidewalk (as is generally done in the U.S.A.), so instead a mere painted line on the asphalt ten inches from the side of the street suffices to indicate pedestrian territory, and the pedestrian can walk on his side of this demarcation line with a good deal of assurance.

Ivor de Wolfe describes another common Italian method of street patterning:

```
  ← ← ← ← ←
   |   |   |   |
   ← ← ← ← ←
   ↓   ↓   ↓   ↓
```

"On a main artery, could any symbols hold more menace than these flighting arrows whose speed is doubled by opposition!" (15)

bringing to mind opposing moving sidewalks. Such painted ground lines also direct automobiles into efficient rest, or parking, patterns, and are used to a very great extent to direct and bound the highly programmed motion of people participating in athletics.

The floor markings of tennis and basketball courts, baseball and football fields, and even less brisk games such as shuffleboard, hopscotch and marbles, are two dimensional underlying statements of the rules of those games that bound the motions of their players. Incorrect usage of such patterns is penalized by an umpire or referee, just as neglect of roadway patterns is punished by the traffic officer. Floor articulation patterns are such inalienable parts of most games that the games cannot be played without them, even by children playing on city streets, who must first reproduce them on the street with chalk before they can play. Game surfaces reduced to portable tabletop size,
as chess and Monopoly, represent the player by a "piece" whose movements are similarly bounded by rules and underlying pattern. Blowing up such well-defined tabletop game patterns to human scale has long been a source of amusement and curiosity; part of the pavement of a Berne, Switzerland park is patterned as a life-size chessboard on which life-size queens, kings etc. are moved. In "Through the Looking Glass," Lewis Carroll depicts an entire country paved in this manner, in which the story's adventurers must move on the ground in accordance with the pattern and rules of chess.

Perhaps the most interesting use of floor patterning to define human movement was the labyrinth maze on the floor of Gothic cathedrals. In an unpublished paper K.C. Woodward indicates that such patterns (the forty foot diameter one at Chartres described a pathway over 450 feet long) were actively used in conjunction with rituals. It is speculated that the twisting route of the maze's path represented the torturous path of Jesus from Pilate's house to Calvary, and the pene-tential act of following this maze on one's knees would take the religious pilgrim the same two hours it took Christ to make his journey. It is also speculated that such labyrinths were used as focal points for mystical choral dances. Inscriptions found on labyrinth patterns such as:

"Look upon this mirror and behold in it thine own mortality! Thy body shall become dust and food for the worms" (17)

indicate a superstitious feeling associated with this floor pattern of far greater potency, but basically not unlike that associated with concrete sidewalk expansion joints:

"Step on a crack; Break your grandmother's back!"
The beach blanket repose floor prototype is exemplified by the pattern of the plaza in front of the Milan Cathedral, the rectangular stones of whose pavement create eye-catching decorated rectangular shapes of a size and scale perhaps not coincidentally like that of beach blankets spread over a beach. This pattern contains no strong direction or orientation towards the cathedral's façade, indicating that entrance into the cathedral is not necessarily the expected terminus of one's motion in the square. The plaza seems instead to have been created as a continuous surface divided up by its pattern into human scale sections meant to underlie the daily business and gossip of small groups, the cathedral façade serving as a backdrop only. This can be contrasted to the almost scaleless brick surface underlying Boston's Government Center Plaza, seldom used for anything but through pedestrian movement.

Strong patterning calling attention to itself characterizes the black and white mosaic work of some Portuguese and Brazilian shoreside walks. The striking pattern draws promenading pedestrians from the beach on one side and from the street on the other. The meandering rhythms of this pattern strongly suggest that this is not a place for the automobile's insistent speed and direction, indicated on the adjacent street by long straight lines, but rather a place for lazy meandering. The narrowing and thickening of the white and black areas correspond to the stops and starts that characterize the promenade walk more than a merely wavering pattern could do, and it is easy to see why the ambience
provided by this pattern lends itself to the characteristic habit of promenading on sidewalks of those countries.

In order to convert a street characterized by heavy automobile traffic into a promenade-like pedestrian way, the creators of Brattlewalk in Cambridge, Massachusetts, having blocked the street off to automobiles, consciously or unconsciously applied the lessons of Milan and Portugal by taking care to destroy the directed lines of the street's automobile oriented patterning, replacing them with non-directional brightly colored "polka-dots." By destroying former associations of the space with automobile traffic, these circles invite the visitor into the area, suggesting to him the meandering pedestrian pace that its creators hoped would now characterize that section of Brattle Street.

Complementing of directed and non-directed movement by an outdoor pavement pattern is epitomized in Venice's Piazza San Marco, whose pattern of white travertine in black basalt was designed by Andrea Tirale (1722-35). Entering the Piazza from the west (position #1 on the drawing on p. 51), the view of the West front of the Basilica of San Marco lures most into moving towards it. This movement is in the direction of the two underlying enormous parallel meanders oriented in a basically east-west direction. At the outset of his walk, the foreshortening of this giant-sized pattern renders only the directions heading towards the basilica perceptible to the visitor, and the temptation exists to walk the length of the piazza atop the pattern just for the sake of finding out what it actually consists of. (Perhaps the unintelligibility of the pattern from ground level is also an inducement to climb the campanile, from whose top the total design is easily understood.)
It is the writer's observation that movement in the center of the Piazza (position #2) is more directed than that near arcades along the enclosing arcades where frequent stops to look at shop windows or to hear cafe music characterize one's more leisurely walk. There is no patterning near the walls and arcades.

The interlocking sequence of rectangular shapes that form each of the two meanders suggests a rhythm of walking with even less haste and more interruption than that of the Portuguese sidewalk, yet more directed and "goal-oriented" than that of the square in Milan. These major pattern lines therefore do not parallel the forms enclosing the piazza but rather diagram the movement of the visitor amidst these forms, heading towards the inviting façade of the basilica and steering clear of the formidable mass of the campanile.

But when the visitor arrives at that part of the Piazza from which he can see the full extent of the Piazzetta leading to the canal (with the view of Palladio's San Giorgio in the distance) (#3), the directed pattern underneath him ends. At this point he feels a pull towards many different directions—not only that continuing into the basilica, but also those leading to the small square to the north of the basilica, leading to the canal, and even leading back along the direction from which he has just come—but the pavement under him is silent and directionless, indicating the multidirectional ambience of this spot. When he leaves the front of the basilica and heads towards the canal, the visitor finds the pattern resumed as the basilica is left behind, (#4) running between the Doge's Palace and the library towards the two freestanding columns holding the emblems of the city and towards the sea.
As he passes the Doge's Palace, the whole sea front and canal promenade open up on all sides to him, again revealing a surprising diversity of further directions to follow, and again at this point (#5) the directed path underneath is abruptly cut off.

* * * * * * *

While the increase in pattern scale (such as the twenty-foot-long "dashes" used to indicate passing on highways, and the even larger directing patterns on airport runways) suggest higher levels of speed above, conversely the creation of a self-assertive smaller scale pattern on the ground tends to retard the pedestrian or even cause him to stop.

The bright addition to the normally speechless pavement that a pavement artist makes attracts the attentions of passers-by who stop to look at his pastel portrait or landscape—a picture small enough so that there is no foreshortening to make the observer wish to move around or over it. The pedestrian at a standstill, it is now easy for the "artist"—really a glorified panhandler—to successfully beg money from him. The pedestrian-stopping performance of the old-time organ grinder has the same effect, showing that unless the panhandler can devise a sophisticated means of stopping the passerby, his search for "spare change" will be met with little but quickly mumbled "Don't have any"s.

The slow ambulatory motion inside the Basilica of San Marco is underlain by extremely fine scale geometric mosaic patterns, each centering within a bay or under a dome to signify the pause in walking rhythm taken by the visitor under each dome and within each bay. The cathedral of Sienna underlays each of its bays with a biblical picture, causing the visitor to stop in each bay and look down at the picture below before slowly proceeding to the next bay, whose greatly fore-
shortened floor painting has already beckoned him to continue his ambulation. The eye-catching colors (and also the fragrances) coming from below one walking through a French garden have a similar effect, while the extremely intricate and subtle patterning of the flat combed sand Japanese meditation garden invite the contemplator to sit before it or walk around it for hours.

* * * * * * *

Because the person unfamiliar with a physical environment new to him is likely to give its floor more attention than usual (due to the potential hazards described above), the floor has been found a particularly good place to give visitors needed information. Most journeys in strange territory do not start with helpful Munchkins singing "Follow the Yellow Brick Road!" or an information center where one is told the meaning of the Freedom Trail paths and footprints, so such floorscape information is often expressed verbally or by means of conventional symbols in order to indicate landmarks presently unseen that will be encountered by continuing one's route atop the pavement.

Italy (where the outdoor pavement is seldom obscured by snow) often indicates highway directions at road intersections without forcing the motorist to take his eyes off the road to look for information mid-air.

Barcelona give information about subway station locations on a
surface certain to be noticed by the visitor because of the possibility of accidents—the sidewalk curb.

London's streets use this same place to indicate to the baffled foreigner the direction from which he might expect to see automobile traffic coming. Stones are laid in the gutter by the curb marked "Look Right" or "Look Left". Italians often place two inch high advertisements on the rise of the curb above the gutter. Some San Francisco streets have even used the sidewalk curb to display the names of the streets themselves without customary vandalizable street sign paraphernalia.

The rough doormat that one looks down to when scraping the dirt off his shoes before entering a home is similarly an appropriate place to put the family name or bid "WELCOME." Thresholds at Pompeii were often found bearing messages to the stranger such as "Beware of the Dog," and Roman
interior floor mosaics of the second and third century AD used pictorial devices having a "clear bearing on the activity carried on in the place where they were situated;" a humorous example being the "unswept floor mosaic" underlying dining rooms, which gave the strong illusion of "all kinds of scraps left over from a meal, as lobster claws, fishbones, nutshells and fruit peelings." Tatami mat bindings in the Japanese emperor's audience rooms were often color-coded to indicate to arriving guests of different ranks where each rank was permitted to sit.

It therefore seems that the lobby floor of a large building would be an appropriate place to put directory information, perhaps with floor
arrows guiding the newcomer to the various offices. Perhaps the eye-catching plan of the building located here, where the visitor can most easily relate it to the building's layout, would end the confusion the layman experiences when confronted by such a plan stood up on a vertical placard.

If painted or chalked onto the floor, patterns can be thought of as a decal which can be changed over time in order to articulate different movements in a given space. Seasonal changes of stadia ground patterns from the markings of baseball to those of football bear a resemblance to those changes in furniture which convert an unused "bedroom" into a "den." On MIT's athletic field, white chalk powder is dropped on the grass and then whisked away and replaced by another such pattern in order to accommodate over time a wide range of sports on a field of limited area. In converting the Christian church of Hagia Sophia into a mosque, the Turks found the building's orientation incompatible with the already described Moslem tradition of orientation to Mecca, so they laid a rug boldly patterned with parallel lines directed towards Mecca, creating visual and usage patterns completely contradictory to the enclosing architectural forms.

Herbert Bayer led visitors around his temporary exhibit on the Bauhaus in 1938 by means of a trail of footprints, arrows, and abstract patterns weaving on the floor through the displays. When the furnishings of the exhibit were removed from the exhibition room, so was its patterned floor, to be replaced by one complementing the furnishings of the new exhibit to take place.

The response of floor pattern to objects standing above, as in Bayer's
exhibit, occurs often in both natural and man made environments. For instance, the need for rainwater of the roots of a tree placed in a sidewalk necessitate the removal of the paving material in an area several feet in all directions from the tree, and its replacement by gravel, uncovered earth, or perhaps a steel grating like those in Paris. The visual quality of the pavement in the vicinity of the tree will also be changed in daylight by the shadow projected by the tree onto it; both the trunk that meets the ground and the foliage that hovers above it project shadows onto the flat non-distorting surface, making the pedestrian that much more conscious of the tree. The long shallow trenches for catching rainwater in the grounds around some Japanese homes make one similarly cognizant of the edges of the overhanging eaves above, even though the home's wall and support elements meet the ground at a considerable distance back.

Giorgio de Chirico's painting "Mystery and Melancholy of a Street" shows how shadows on the ground can make one aware of yet unseen elements standing above it; generally the environment is more articulate on a sunny day when the pavement acknowledges every picket fence, tree and building, than on a shadowless day.

Two-dimensional floor patterns have long been used to make formal responses to three-dimensional forms
above in order to reinforce the definition of such forms, show the geometric relationships between vertical elements, or, like de Chirico's painting, prepare one for something not yet in view.

The "border" pattern running parallel to a wall is perhaps the simplest means of emphasizing the wall, and Roman floors often had several concentric "borders" inlaid on their floors parallel to the enclosing walls. Oriental rugs generally have at least three such concentric bands defining their edges, and the Japanese combed sand garden mentioned before is often surrounded by six or seven pavement bands of different gravels. In the garden itself, the sand's linear pattern breaks a distance from each of the half buried rocks, around which the sand swirls like water around a stone dropped into it.

The floor pattern of the Pantheon in Paris is a verbatim restatement of the arches and domes above, each arch marking the ground below with a pavement band of the same width that joins the plinths of the pilasters supporting the arch; each dome projects a circular device onto it. Each bay of the building is separated from the next—from above by an arch, from the sides by columns or pilasters, and from below by paving bands—the floor pattern heightening the sense of division of space that characterized the neoclassical. This contrasts to German Rococo works such as Vierzehnheiligen Abbey, where the diagonally checkered floor pattern
weaves freely in and out between columns without such pauses that break the continuity of the space above.

Often the floor material itself has a texture or scale that is used to clarify the relation of the formal elements atop. The dimensions of the tatami mat are the basis for a three-dimensional module lining up posts, wall screens, and ceiling members with the joints between adjacent mats. The hexagonal tesselation of floors in Wright's Hanna House similarly express the situation of this house's walls according to a hexagonal geometry.

The pavement pattern of St. Peter's Square in Rome articulates the geometric planar relationships between colonnade, obelisk and fountains. It reemphasizes the obelisk as the center of the plaza and shows that the terminations of the colonnade were determined by superimposing a 45°
grid over the axes of the oval. Paving lines continue to complete the oval where the colonnade leaves off.

Norberg-Schulz observes that Michelangelo's "project for the Capitoline Hill employs the floor as a leading formal element; as a convex oval it contrasts with the surrounding buildings, and a star shaped ornament gradually converges on the equestrian Marcus Aurelius in the center." A closer look at the pattern and its history reveals that it also serves as a highly effective means of tying together the enclosing volumetric elements of the plaza. Centering on the statue of Marcus Aurelius, the original piazza was characterized by six main directions leading from (or to) it. Two of these directions are along the oval's major axis, one leading to the staircase ramp going down the hill, the opposite one to the fountain in front of the Palace of the Senators. The oval's minor axis defines two others leading into the entrances of the two palaces on the side. Finally, two oblique directions towards the rear lead to the bases of the symmetrically placed staircases of the Senators' Palace and also out of the piazza towards the Roman forum area. The writer believes that it was the intent of incorporating these six directions into a pattern centering on the statue, that generated a twelve sided figure, and a wish to emphasize that there are no "corners" enclosing this space, that determined the use of the oval.

Starting at any of the twelve peripheral points of the pattern and looking along the pavement line, one finds that his eye is first drawn towards the central star and then is bounced off towards the opposite
side of the oval. Following
the pattern like this, the
eye does not come back to
the point of origination
until it has revealed the
complex pattern to consist
of only one line dynamically
tying together the
twelve external points
with each other and with
the center. Along the
peripheral oval, this
starlike pattern forms
twelve roughly isosceles
triangles, and it is the
bases of these triangle
(rather than the points of
the star) that meet with
the six paths described
above (as well as the two other oblique paths towards the front, not
shown in any of Michelangelo's drawings and so assumed to have been
added later), suggesting arrows all over the periphery pointing to the
central statue.

The white twelve pointed star under the statue's pedestal is the
only element of the design not elongated towards the oval form. Draw-
ings of Hegemann and Peets indicate there are locations in the plaza
where in the standing observer's visual field, the tops of the statue and building behind it will coincide, and do so at a visual angle of 27° from the horizontal. Hegemann and Peets feel that "in order to see at its best a building as a whole, the observer should...see it at an angle of 27°. In this...case a building will fill the entire field of vision." Comparison of Hegemann and Peets drawings with the pavement pattern seems to indicate that Hegemann and Peets' ideal observation points coincide with points of the white star under the statue, although careful measurement would be needed to confirm this.
More often than not, the urban building on a street is approached by walking along side and parallel to the building's face rather than moving perpendicular to it. To the pedestrian, the building is a total unknown almost until he is directly in front of it. Even then, if his movement and vision are still directed straight ahead, the building passing him on the side affect him little. Shadows cast on the pavement by each building of course prepare the pedestrian to a small extent for what he will be encountering as he continues ahead, but schemes of pavement patterning have been devised to take this even further.

Referring to the square in front of the monastery--palace of El Escorial near Madrid, Paul Zucker says "there a few squares in the world, even considering St. Mark's in Venice and the Campidoglio in
Rome, where the pavement is so strongly felt as a counterpoint to the vertical 26 facades and vice versa."

The situation of the entrance to this square dictates that the visitor walk alongside the building and then turn to his left to enter the building's central doorway—a "grazing" scheme of entrance opposed to that of Versailles, for instance, where the doorway terminates the axis of one's movement rather than lying to its side.

Versailles  Escorial

Each of the pilasters of the building's almost totally flat facade is counterpointed with a corresponding "beat" in the rhythm of the paving pattern, and this rhythm quickens explosively to mark that part of the facade allowing entry. Since the facade pilasters correspond to the situation of courtyards and building wings behind the facade, this forecourt paving pattern also serves to those who can read it as an indication of how space is formed behind the long, almost expres-
Michelangelo analogously projects the rhythms of his Farnese Palace onto the pavement of the square in front of it, as does Palladio (though with more complexity) on the walks in front of his church facades, such as Il Rendetore in Venice.

The concrete paving around the Yale Art and Architecture building helps designates that building's rather obscurely placed entrances by "funneling" its expansion joints towards them. The passerby is similarly prepared for the corner and building's change of direction.

The circular Pantheon in Rome is paved with a pattern of squares, apparently contradicting the cylindrical geometry of the space. On an omni-directional circular room plan, such a pattern tends to demark very strong directions parallel to the sides of the squares and weaker ones along their diagonals. In the Pantheon these diagonals are strengthened by inserting circular devices into every other square.

At peripheral points where diameters parallel to the sides of the square strike the interior wall, the wall responds strongly, opening up to form semicircular niches. Rectangular niches open up in response to the oblique diameters. In placing an orthogonal pattern on the floor,
the Pantheon's designer made one of his boldest steps to shift attention from the center of the cylindrical space (where no permanent altar could ever have been placed because of rain falling through the oculus) to its circumference, where the altars actually are placed.

The floor grid is oriented with the axis joining the centers of the rotunda and the juxtaposed rectangular plan porch. It is along this north-south axis that the visitor moves from the square in front of the building, through the rectangular porch, and finally into the rotunda. On the floor of the rectangular porch the pattern underlying this axis consists primarily of circular devices, while in the Rotunda the devices are generally square, perhaps suggesting to the visitor on each side of the threshold the diametrically different formal experience to be encountered upon crossing it.

Frank Lloyd Wright made a comparable gesture in rectangular Manhattan, patterning the sidewalk in front of his spiral Guggenheim Museum with circles.

In the way that floor patterning can orient the movement of people, so does it also tend to orient the placing of furniture. Christian altars added to the Pantheon centuries after its floor pattern was laid were neatly aligned with the insistant floor pattern. In Lincoln, as well as other cathedrals, floor patterns have been similarly used to "fix the position" of recently installed pews, and even in Corbusier's Carpenter Center, visual arts students have lined the fronts and sides of their desks to the expansion joint pattern in the concrete floor.

When a strongly patterned floor abruptly meets and is cut off by a wall whose articulation bears little relation to that of the pattern
below, there is a suggestion of the floor's passing underneath and continuing in a space behind the wall. This is perhaps best illustrated by partitioning often used to divide school gymnasiums in two in order to segregate physical education classes of the opposite sexes. The way in which the partition abruptly cuts off the floor's basketball lines and circles makes one very strongly sense the existence of a space on the other side of the blank partition, and in effect unifies spaces separated by walls.

Gordon Cullen points out the effect of contemporary placement of buildings on featureless exterior floors:

"Instead of walls and floor being in harmony, the floor lining or separating architectural elements and expressing the kind of space which exists between buildings, it is as though the buildings were models plonked down on a blackboard." (27) referring to scaleless black asphalt. Robert Zion expresses the wish for "appropriate pavement design [that] can relate a building to its surroundings or set it apart—invite or discourage entry, encourage or discourage speed, direct or divert the eye."
Furniture

In Western Cultures the floor surface is reserved almost exclusively for the soles of the feet; other parts of the body relate to horizontal surfaces elevated from it, generally provided by furniture, such as chairs, beds, tables, etc. There actually seems to be a taboo against the use of the floor for other than walking or standing. Joseph Rykwert captures the essence of the forbidden quality of the two or three feet of space above the floor surface:

"The seat puts a distance between the bulk of the body and the ground and it seems that in that vital space gather the mysterious creatures which inhabit our more frightening dreams. It is under the bed we always look for the burglar; women frequently raise the skirts of a chair to see if there are any of those imaginary mice which nibble on their ankles. These anxious gestures betray fears which often direct and may distort our ways of thinking." (29)

An even macabre feeling for this space is given by Edgar Allen Poe in "The Raven":

"And the lamp light o'er him streaming
Throws his shadow on the floor.
And my soul from out that shadow that
Lies floating on the floor
Shall be lifted -- nevermore!"

In describing his investigations of this almost foreign nether-world, George Nelson reports his descent into it as like penetrating the Iron Curtain or passing through the mirror on the way into Looking Glass World. It could be speculated that it is because these several feet are the domain of animals—dogs, squirrels, crawling insects—or because they are nearer to the infernal regions, or perhaps because the cool air drafts that flow here make the climate of the space somewhat unpredictable and thus that much more like the uncontrollable outdoors—that Western man loses much of his formality when stooping to this level. "Up there" he plays chess and poker at worse; "down here"
it's crap games and spin-the-bottle, games that somehow belong to this netherworld and cannot be translated to the one just three feet above. There is said to be extra spice and animalism in sexual activity on the floor, and certainly the current use of waterbeds and mattresses directly on the floor has something to do with a liberated generation breaking taboos.

Until recently the home was a formal environment which one had to leave in order to free himself from the floor taboo. A picnicker eating while sitting on the ground does not arouse thoughts of un-sanitation; playing cards or conversing while down on a blanket at the beach is acceptable; and really getting away from the home on a camping trip even justifies the use of sleeping bags directly on the ground (There are those, of course, who insist on bringing chairs even to these places).

Architect Bruce Goff sensed that the greater spontaneity and informality of the outdoors could be brought into the home merely by using the interior floor in the same way:

"To enable guests to relax, to prevent any feeling of formality, I wanted everyone to sit on the floor. This was, and still is, almost unheard of in America, but because of this even strangers would appear as friends, and freedom from conformity would automatically commence. But there are serious problems with Americans sitting on the floor, for one, it gets hard—so soften it with four inches of carpet and foam pad. Without support, the back gets tired, therefore the walls are sloped, running the soft carpet up them...By insisting that people leave their shoes at the door (another shock for Americans), no dirt will be carried in, and now the rug can be snow white and envelope each person as a cloud. As is here apparent, one simple thought can and did evolve into many different aspects some directly connected, others indirectly, but all because of the simple directive that people should sit relaxed upon the floor." (31)
This floor taboo extended even to objects (only the lowly street merchant would display his wares on the ground), and especially to art objects and sculpture. Until not too long ago all sculpted pieces were set off from the ground on bases much like people on chairs. Vertical architectural elements (columns and walls) were similarly placed above bases and plinths. Alexander Calder liberated his sculpture from the base, first by completely disassociating it from the ground (the mobile) and later by setting his iron work sculptures directly on the ground without a base. Works such as the Great Sail at MIT suggest that the piece actually penetrates into the ground.

Maurice Tuchman interprets the full impact of this break with previous sculpture work:

"By violating the tradition of having an object sit on a base, all these works unsettle our common perceptions of things in relation to the ground and consequently of all things outside of us in relation to us." (32)

In general Western societies have filled their living and working spaces with furniture, each piece sending three, four, or even eight legs (for a large sofa) down as envoys to the floor surface supporting it. Furniture such as the table merely reproduce the qualities of a wooden floor several feet above it, but chair surfaces established above the floor's level are often given qualities denied the floor, such as
cushionlike resilience or a small degree of slope that responds to the body's contours. But while the floor surface of a room might appear to be cluttered with furniture, a rolling nickel will verify that except for these spindly envoys with their metal and plastic tips, the whole floor surface is entirely clear. One does not hesitate to justify the four inch high and deep toe space provided under those articles of furniture to which people often come near, or the two foot high leg space under tables and desks: over a period of time this volume of space obviously does become occupied by toes or legs, but what could possibly go on in such dead spaces as these except the collection of dust begging to be cleaned out?

George Nelson notes how the best furniture builders have hidden these legs whenever possible, and photographers always take their 33 photos above this region; nevertheless the mouse and electric wire run through a world of bedspring, drawer bottom and upholstery canopies from which threatening banners hang: "Do not remove this tag under penalty of law". Those in need of storage space quickly discover the great space resource here, especially under the bed. During the daytime colonial Americans kept a low child's trundle bed under a larger adult bed, pulling the former out for use at night. Until indoor plumbing
became common, the chamber pot also resided here, and drawers under the beds of Aalto's Baker House dormitory enable the residents to pull this space out from under their beds in order to use it for storing bedclothes.

Each of the levels established by furniture is seldom allowed to serve more than one part of the body: standing is for floors and perhaps a six inch footstool; standing on a chair or bed is rare, on a desk even rarer, and on a dresser inconceivable. Sitting is for chairs, sometimes occurring sometimes on the bed and less often on the desk, but seldom above (the dresser) or below (the floor) these ranges. Bleachers or grandstands are a notable exception, where the shoe sole level of one observer serves as the seat for another in front. Such suitably scaled floor level changes are potentially very functional in enlarging the range of human postures a given horizontal surface can serve:

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In contrast, almost all of the functions assumed by the various levels of Western furniture are assumed in the traditional Japanese home by the single level of the tatami matted floor. During the day a single matted area of a home might be used in all of the following

* Of late the bed's level has been expanding its role, serving not only lying but also sitting, temporary storage, and even as work space.
activities: at mealtimes, cushions are placed around a light table (rising perhaps one foot above the floor), the family members squatting down onto the cushions which are in turn supported by the resilient mats. This short table is not always necessary for the serving of food—oftentimes a person will place his plates and cups directly on the mat to his front or side, and oftentimes he will sit (or even nap) on the tatami without the use of cushions. After the meal the table is put away as easily as the dishes, and the cushions are moved about to allow such things as card games played directly on the mat and conversation between parties seated on the floor. A person might kneel or sit cross-legged on the mat to paint, play a musical instrument, or read, sometimes placing the book upon a low illuminated window ledge. At night stored mattresses and pillows are brought out, unrolled and laid onto the floor, creating ultra-queen size beds which children never fall out of.

Heinrich Engel discusses the visual implications of the floor's assumption of all of the roles assumed in the West by the varying levels of furniture:

"In the western residence it is impossible to establish one eye-level height for human activity, or to even fix three separate eye-level heights for the postures of standing, sitting and lying. While standing may imply an absolute average eye-level, sitting and lying, being determined in each house by a variety of different base levels, are both impossible to identify with a particular eye-level because of the infinite number of resulting heights. Hence, an important medium for distinct architectural expression in interior design, orientation to eye-level, is excluded. In contrast, postures of standing, sitting and lying in the Japanese residence are determined by a single base level, the floor, and have therefore produced three distinct eye levels. However, since in the Japanese house itself, standing is viewed as improper except when moving from one place to another, and since lying is a position used only when sleeping—and eyes are supposed to be closed then anyhow—the eye-level of the sitting person is the only architecturally important orientation, and this orientation is so pre-cisely made that in the Japanese house a standing person is alien
to his environment....Accordingly, interior designs, such as ceiling, sliding panels, windows, objects of art...furniture, and even the garden, are strictly oriented for the sitting posture, and such is the combined effect that standing within a room will cause a feeling of uneasiness and unrest in either the person standing..." (34)

One major consequence of the establishment of levels several feet above the floor supported by legs is the relatively heavy structural system needed by each article of furniture in order to maintain itself. The horizontal and vertical moments that must be resisted by the bed's structure in holding up its twenty square foot surface two feet off the ground require it to be heavy and bulky to the point that the bed is seldom moved. The same is true for a 30" high table at which several people can dine. On the other hand the Japanese bedroll is an easily moved and stored structureless bundle of cloth which becomes a bed only when laid out on the floor, thereby appropriating the firmness and strength of the floor below. Although the Japanese table is raised off the ground on legs, the distance is only one-third that of most Western tables, the resulting mass therefore being so small that even this table on legs can be fairly portable.

Thus the use of each square foot of floor area can be easily changed several times a day through the use of such light furnishings; there are no solid, massive three-dimensional functional furniture statements permanently covering a room's floor area and thereby permanently defining and limiting the use of the space above it.

It has been a convenient and common convention to define the "quantity of space" of a building by its floor area, measured in square footage, yet in the West so much of this costly commodity is usurped by inflexible furnishings that it lies fallow much of the time. Consequently the Western home and room must be larger than those of a
comparable Japanese dwelling. Moreover, because the "bed" is so im-
mobile, the "bed-room" has evolved around it, and perhaps this is a
partial explanation of the evolution of "titled rooms" in cultures that
set their furniture off the ground.

On a "duration-of-time" scale ranging from "spontaneous change"
to "eternally still," people fall towards the "spontaneous change"
side, moving around at will and seldom staying in the same place and
posture for an hour, while most buildings tend to the "eternally still"
side, it being difficult to alter most construction. Furniture helps
to bridge the gap between the two, as a physical intermediary between
the person and his all but inflexible environment that can be changed
more easily and frequently than the steel or brick of the architectural
environment. But the spectrum of furniture's changeability ranges
from the spontaneity of the cushion, which can be thrown to wherever
someone wants to sit, to the phlegm of the Western dining room cabinet
or bedroom wardrobe. Clearly all Japanese furnishings lie on the
spontaneous end of this scale, while Western furnishings have a sto-
lidity approaching that of their concrete or brick enclosures.

Attempts have been made in America to alter the role of the floor
in supporting furniture in order to free floor space for other uses
(or various uses over time) and also to enable lighter (and less ex-
pensive) systems for furniture support. The structural capabilities
of the wall are often used to support bookshelves, establishing hor-
izontal surfaces several feet above the floor without the structure
required to support those surfaces on legs set on the floor.

Floor and ceiling are used together in order to support the com-
monplace pole lamp, which takes up only one square-inch of floor area.
Hammocks in the old frigate "Constitution" go one step further than the sleeping bag: each end of a piece of cloth that could be stuffed into a large pocket hooks onto one of the vertical posts of the lower deck of this ship at night to create a bed. During the day the hammocks are unhooked and rolled up, making the nighttime sleeping quarters into daytime work space. Other furnishings that attempt to allow varying uses of floor area over time include the convertible sofa and the drawbridge-like Murphy bed and ironing boards that fold down from the wall. Even if not removable from the floor entirely, furniture pieces that replace the metal tips of their legs with wheels can at least be moved from place to place on it.

As an article of furniture evolves into something immobile, reaching almost to the floor, it is often eventually incorporated into the architecture. In America the bathtub was originally a portable basin brought into the kitchen; then finding a more permanent place in the bathroom, it was set on stubby legs, creating what was probably the early twentieth century's most frustrating cleaning problem. Finally it was let down to the floor and has since become, along with the other fixtures, more and more synthesized with the bathroom floor and wall structures. "Wardrobes" of the past, whose floors were set six inches off the ground, similarly evolved into built-in closets, and it did
not take long for the long-legged free-standing wringer washing machine, refrigerator, oven, dishwasher, etc. to settle into permanent places in the home and lose their legs.

Theater and auditorium furniture is never moved and consequently is bolted to the floor, making the floor bear horizontal loads applied to the seats and thus allowing the floor to be clear of supporting members which would obstruct people moving to their seats. Perhaps the most promising trend towards spontaneous furniture that can be easily moved or removed at the whims of the user is inflatable furniture. Although still beset with problems, this furniture has no legs, is light enough to be easily picked up and moved, and can be deflated and stored away when not needed. Very significantly, such legless items of furniture have the potential for relating to the floor in more than one way, thereby establishing surfaces at different use heights in a manner reminiscent of Robert Morris's sculpture groups in which a single object is given many relationships to the floor and hence to the perceiver.

Robert Morris sculpture group

inflatable furniture
Floor Penetration

The Japanese reduce the height of their furniture in order to make it less bulky and more portable. Anchoring objects into the ground can produce the same results, creating a cantilever system in which horizontal loads are born by the mass of the floor, greatly simplifying the support structures such objects must have.

Nature seldom places her furnishings atop her floors—trees, grass, plants etc. all penetrate into the ground. When a six foot tree is uprooted and set onto the imperforate interior floor at Christmas time, an elaborate tripod structure is needed to stabilize its new relation with the ground below. Street and outdoor furnishings—telephone and flag poles, signs, parking meters, gasoline pumps, picket fences—generally penetrate the pavement floor in order to simplify their supporting structures and keep the pedestrian area as clear of obstacles as possible. Portable outdoor furnishings also penetrate the ground for support: large beach umbrellas are stabbed into the sandy floor of the beach, enabling their light aluminum structures to support them against sea breezes without impairing portability. Were such devices to be supported entirely atop the ground, the necessary structural system would make them impossible to get into and out of one's car. Complex sub-
structures sitting atop the ground have not replaced the simple golf tea
or croquet wicket, and even people on the golf course get lateral bracing
by pressing the cleats of their shoes into the ground.

The floor has appropriated a greatly expanded role in the portable
dwellings of nomadic societies. Little or no furniture exists—the
ground (possibly covered with a rug or some reeds) forms the base for
all activity. More important, the collapsible light-weight tent draws
all of its support from driving its poles and stakes into the ground.
In the windy midwest, the somewhat movable American mobile home is often
similarly buttressed by ties into the ground.

Penetrating the floor for structural support does not necessarily
imply the permanence and inflexibility of auditorium seats, bar stools, or
turn-of-the-century classroom furniture. Bicycles are continually
dropped into and retrieved from grooves approximately two inches wide,
ten inches long and four inches deep in Copenhagen sidewalks, tempora-
arily supporting parked bicycles without the use of complicated American
steel bike racks. Blegen and Rawson found many small holes in the floors
of the ancient palace of Nestor, which they conjecture supported
shelves, looms, portable walls, sunshade devices and for "many other
imagined uses," suggesting an exciting potential for lightweight one-
legged portable furnishings that could be used in conjunction with such a
system of floor penetrations, especially in a concrete pad floor. At
Nestor's palace such holes were generally not large enough to interfere
with walking when unused; those that were were probably plugged like
a drain until needed.

Japanese walls and partitions are so light because their tops and
bottoms are supported in grooved ceiling and floor tracks, along which
these partitions can then smoothly slide.

Floors are penetrated to communicate or filter something to the space below. Drainage openings become elements of the floor pattern, and the Milan Galleria's floor pattern incorporates their iron covered insets much as it does pilasters, suggesting that the Galleria's designer felt a drainage hole to be a "negative column" meeting the floor plane from the opposite direction.

Warmth and air are often conducted through floor registers or through the floor surface itself (especially in Korean floors, which were copied by Wright). In large office spaces electrical and telephone wiring comes up from the floor rather than from the walls in order to get rid of wire clutter on the floor. In SOM's headquarters for the Connecticut General Insurance Company, these devices coming up through the carpet every six feet re-enforce from below the building's modular grid system much like the Japanese tatami mat joints.

The columns of Corbusier's Maison Domino do not sit on a base upon the floor, but instead penetrate through it, thereby becoming inseparable from the floor. The pattern of lines incised into the concrete floor of the studios at his Carpenter Center in Cambridge articulates this relationship. Each column is placed in the center of its respective concrete pavement square, and it is clear that the
floor grid is in complete harmony with the column support system. Even floor electrical outlets are placed in the centers of their respective paving blocks (indicated by light dots on drawing). The enclosing walls of glass or concrete, however, are placed in very obvious disharmony with the floor pattern, cutting the squares into rectangles, trapezoids and even L-shaped sections. The floor pattern here seems to be making a syllogistic statement about the relationship of the two types of elements meeting it—enclosing wall and structural system—such as:

"Supporting system (columns) is related to the floor. Wall and enclosure are not related to the floor. Therefore enclosure is not related to the structural supporting system."

That the Maison Domino drawing lacks enclosing elements entirely, and that the facade treatment of Carpenter Center clearly separates floor slabs from walls above and below by grooves, complete this statement.

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Most floors are totally silent about what is underneath, it being such an effective barrier that the resident of an apartment building usually knows more about what ensues fifty feet down the hall than nine
feet above or below him. Yet as the floor begins to open up with such penetrations, it begins to whisper about the space underneath. Objects penetrating into the floor suggest continuation thereunder. Calder's sculpture on page 73 does so to a slight degree; Corbusier's columns penetrating floor and ceiling without base or capital suggest their continuation through to spaces unseen. The floor's habitual silence frequently gives things below it a mystery, and the creators of the enormous head sculptures projecting from the ground on Easter Island took advantage of this, inserting the stones only deep enough into the ground to prevent their overturning, yet very emphatically suggesting that their entire bodies exist below and will emerge imminently from it. At Versailles Le Notre produces a comparable effect by half submerging sculpted figures in the waters of the Basin of the Dragon. Somehow the moosehead or tiki mask placed on the wall lack this latent power.

The writer has often heard steam coming from underground pipes given infernal associations, and the "trap" door in the floor is associated with treachery and the inevitable alligator pits below. One of the excitements of fishing is the luring of one of the creatures from this mysterious territory out into the human domain.

The Japanese do not consider the space underneath their feet and floors to be part of another world, and opening up the floor does not imply intrusion into space belonging to the "people below." Instead, it is recognized as a potential continuation of the space above. The flooring of their bathrooms is a series of slightly spaced bamboo poles

* People amuse themselves at Fontainebleau by throwing bread crumbs over its lake and watching fish suddenly appear from below the water's surface to catch them, even before they hit the water, and then disappear back into it.
which allows a person to stand atop while water passes down through, but also allows breezes and a view of the ground below to come up from under one's feet. The boarded part of the Japanese kitchen has removable floor sections revealing storage spaces; tearoom floors have removable sections exposing a recess containing a brazier for heating the kettle. and the living room floor opens up in winter to uncover a sunken fireplace. In each of these cases, two superimposed floors of different materials both underlie the same space, and the user of that space has a choice of which one to use at a given moment, either choosing to use the wooden floor for resting his book or removing it to build a fire on the rock or metal floor underneath.

The floor of the acoustical anechoic chamber is a floor where space does not stop at the soles of the feet. A wire mesh supports the person while sound (and also light) pass below his feet in order to be absorbed by an underlying floor of sound absorptive material.

In an auto repair shop, cars are placed on bases which are hydraulically lifted above the garage floor in order to provide space under cars in which to work. The floor under the orchestra at Radio City Music Hall is moved in the same way, bringing the orchestra above the audience's horizon in a manner reminiscent of sunrise.

A multiplicity of floors of differing quality (e.g. different materials, slopes etc.) superpositioned under one space seems a possible way of expanding the range of uses of that space over time. In rehabilitating an old apartment building with ten foot ceilings, perhaps the floor should be raised, rather than the ceiling lowered, making sections of the new floor removable to uncover storage space or a fireplace; perhaps even a mattress or bathtub.
There is evidence that people do not always like the abrupt stoppage of space at the soles of their feet, in the particularity of vistas underlaid by calm bodies of water—lakes, rivers, and reflecting pools. Perfectly smooth water surfaces disavow their masses and replicate the space above. Rippling water creates below a kind of impressionistic space by gently tearing apart the colors and shapes of the space above. The writer feels this to be the main reason photographers find the Piazza San Marco so captivating in the rain, when its black basalt pavement becomes mirrorlike, reproducing below one's feet the masses and spaces above, which all move below him as he walks. The white pattern lines do not reflect and seem suspended between the spaces above and below. Indoors the great sheen of highly polished wooden floors of palace ballrooms similarly reproduce below the swirling colors of the dance and pageantry above, and one wonders if it is not a desire for such space underfoot that makes the American housewife so obsessed with the shiny waxed finishes of her wooden and linoleum floors.

A culture's attitude towards this spatial quality underfoot might best be expressed in its art. Egyptian paintings underlaid each profiled figure with a heavy base line, and Renaissance Italian paintings also had strongly delineated base planes. However, Gothic jamb statues hover with feet hanging freely above the ground, and in the late nineteenth century Manet's fifer stands on an almost non-committal film where only his shadow fixes a position for him on it. The base plane finally dissolves entirely in many cubist works.

The glass bottom boat destroys the mystery of the sea below, but reveals a spectacular world underneath one's feet. Thousands annual-
ly visit Capri's Blue Grotto to sit for a few moments above its luminous watery floor, reflecting blue-green rippling light onto the rocky ceiling. Sigfried Giedion attempts to describe the effect of the totally perforated gridiron floors of Henri Labouste's Bibliotheque Nationale in Paris:

"Light pouring through the gridiron floor plates...penetrates to all parts of the stacks. Here they [gridiron plates] serve a purely utilitarian function, but at the same time they contain the germ of new artistic possibilities." (36)

But so far the possibilities of space underfoot have still scarcely been realized, except for fire escapes and the steel frames of buildings still under construction.
Text References

2. Sherrill Whiton, Elements of Interior Design and Decoration, p. 65.
   and Rudolf Arnheim (personal interview).
4. Ibid.
7. Sherrill Whiton, op. cit., p. 539.
13. "Hello, Dolly!"
15. Ivor de Wolfe, The Italian Townscape, p. 194.
17. Ibid., p. 35.
24. Werner Hegemann and Elbert Peets, Civic Art, p. 43 fig. 219.
25. Ibid., p. 44.
27. Gordon Cullen, Townscape, p. 121.
32. Maurice Tuchman, American Sculpture of the Sixties, p. 10-11.