YOUR PRIVATE SKY: DISCOURSE
R. BUCKMINSTER FULLER

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DYMAXION HOUSE
MEETING ARCHITECTURAL LEAGUE, NEW YORK
TUESDAY, JULY 9, 1929[1]

The Meeting convened at the Architectural League, 115 East 40th Street, New York City, on Tuesday, July 9, 1929, at 2:05 p.m., Mr. Harvey W. Corbett presiding.

Chairman Corbett: I became interested in this at the meeting of the American Institute of Architects in Washington, where Mr. Fuller, who has devised this new type of house, had it on display, and it had a very great appeal.

I think that we all realize that the housing business, which is one of the largest industries in the country, is the most inefficiently managed, the most uneconomic; it has never been organized, never been put on any kind of a basis that corresponds adequately to every other industry.

Mr. Fuller, fortunately, is not an architect. Still more fortunately, he is not an engineer. He isn't any of those objectionable things that we all know about. But he began to philosophize on housing, on the proper kind of a machine to adequately serve for living purposes. He approached his problem without any preconceived notions either of architectural forms or habits or of customs or practices which have come down through the centuries.

As I say, he wasn't an engineer. Therefore, he didn't think of it in terms of building, as the engineer might have thought of it. You know, if an engineer tries to design a house, he immediately thinks that he ought to put some architecture in it, which he doesn't know much about; and if an architect tries to design a house, why, he knows he has to put some engineering in it—and he doesn't know much about that. Between the two, they always mess it up; and they have been messing it up for centuries.

Mr. Fuller's approach to the problem interested me tremendously because he approached it so abstractly, so free from any previous conception of what a house ought to be. I heard his exposition there, and I went up later during the convention and heard him again, and I have since seen him two or three times in New York. I feel that he has something that is worthy of the consideration of every thinking man in this field.

Now, I would ask you to listen to him, making your mind as far as possible a blank. That is easy for any architect to do. (Laughter) But just dissociate your previous conception of a building or of a house. Just cut it out—forget it. Make your mind like a sponge, if you can, just to take these ideas in. Accept them on their face, for the time being at least, without prejudice, and see how he has approached this living problem.

I am not proposing to tell his story at all. He will tell that much more effectively than I can. But I can see, as a future possibility of the development of this thing, that we will have houses to live in very much as we have automobiles to ride in. You know that if an architect had designed all the automobiles, instead of the practical considerations determining the design of automobiles, we would be riding around in a Roman chariot today instead of the comfortable cars that we have.

Now, he has thought of this simply as a machine for living purposes, with a replacement value, a machine which can be set down practically in any location; and when the dwellers in that location are tired of it, they can send for the moving man and take it up and set it down in some other location at comparatively little expense.

Do you realize that every time an ordinary house is built and set on the ground and fastened to it, there is not only no replacement value but that, if that thing is abandoned, it costs money to take it down? Every cent that is expended in the house is ended there. Nothing comes out of it.

There is no reason, as I see it, why houses shouldn't be manufactured in mass production on just as large a scale as other commodities are made and used in that way. After you have lived in one of these houses for a couple of years and you want to take a trip to Europe, why, you just send word to the laundry; they call for it, take it back, wash it and clean it up, iron it out, set it up again; and when you are back, you are in a new house.

I am glade to introduce Mr. Fuller, who will explain how he came at this thing and the philosophy behind it. Mr. Fuller.

(Applause)

Mr. Buckminster Fuller: I think the picture Mr. Corbett has already given of the inadequacy of inefficiency in housing would be enough for the group of architects here. But, in as much as this is to be a book, I think that I had better give a little of the picture of housing which I came to view after about five years in the building material business, after being in the Navy for some time (I have been a naval officer). After having been a mechanic, a full-fledged cotton machine fitter, and after having had considerable corporation experience.

I think that the picture of something a little extraneous to our immediate necessities will give us the picture of housing as I see it. Take the automobile, which is something that has motion and upon which we have a little perspective.

If, today, you wished to acquire an automobile, and had to get it on the same basis you have to get housing, this is approximately what would happen: I don't know how many architects there are in New York, but there are approximately two thousand that profess architecture in Chicago. If you went to one of two thousand automobile designers in Chicago and brought around with you some picture of a rickshaw or velocipede, there being no general design or standard conception of how to provide transportation, and you said this automobile had to run on one road, there is just one local condition that is going to apply to it, and your wife had a definite conception—she wanted an eight-cylinder motor, and she wanted that motor on the seat—that would be the problem that the designing architect would immediately be confronted with. He would have to have a compromise. Otherwise, he wouldn't have any freedom of design; he wouldn't be able to start over again, which is the best basis for all.

What would happen next in the automobile would be that, after some months of getting together parts from automobile accessory cataloges—concrete frames and mahogany frames and tin wheels, any number of peculiar necessities—you would get up some kind of design and let it out for bid. You would let it out for bid to about five local garages. They would go over this thing and, not having any really fixed schedule of production, there would be a variation of at least fifty per cent in their bidding. That is what happens in residence bidding today.

Finally, in some quandary over these varied bids, you would pick out good, old Murphy, because he built your father's velocipede: and Murphy would start in.

Now, this would be a nice design, all arranged. And the next thing, Murphy would say he does not like those wheels. He has never used those kind of wheels and he would really advise not putting them on. In fact, he will charge you about the same for putting on those wheels; but he would do it for a little less with some other wheels. So you abandon your wire spokes and go back to an old wooden wheel.

Then, Murphy says, "You can't use that reinforced concrete frame. They don't allow them in this town. You had better go around to the Town Council." So you spend three months making friends with the Board of Aldermen and, finally, get a permit to put in this reinforced concrete frame; or, possibly, have to go back and put in a bamboo.

Then the insurance companies will say that they don't approve of this form of wheel, or this motor, because their particular banking group wasn't interested in that syndicate. They would say, "Out with that!"

Then the bank itself would say, "That body that you have arranged there is absolutely no good. Our practical man says it is no good. He has looked it over. (There isn't any real test; he just says it is no good.) You will have to give up that body."

By the time you got through with all these compromises, you would have an entirely different thing. Then they would start to work and put in different trade units.

This is a perfectly terrible picture. But that is exactly what happens to housing. It takes six months to a year to build this automobile, it would cost about fifty thousand dollars to build it, and it would be worth nothing to anybody else. That is not at all a hard picture of the way housing is done.

Through a general philosophical study, trying to find out what was wrong in this world and what I individually could do about it (as every individual should consider), I have come upon the thought that housing was responsible for practically all of our ills—this preconceived idea of doing things on a vanity basis rather than having things done on the basis of the clearest, most intelligent research test of science.

There are two million people who die annually from floods and earthquakes and tornadoes in this world. Until we have some general conception of housing that can overcome those elements, we haven't progressed very far. There were approximately one hundred thousand children who were run over and killed in the cities of the United States last year, due to the congestion in the cities, to which people have come for a small diminution of drudgery and a meager amount of sanitation. The majority abode in the United States is still the five-room individual house; and the majority of the individual houses of this country still have no bathrooms. So we have not progressed very far.

Due to the high overhead of a tailoring business, architects cannot take on five-room house jobs. They do, to a small extent, for people who have made a lot of money and who, nevertheless, just want a small house—such as someone who has made a lot of money in monkey-wrenches and wants to have a coat of arms and has built a feudal castle. But they only do one per cent of five-room houses. The other ninety-nine per cent copy what this one per cent has made, because they want to relate something to vanity. They copy through magazines, through building material companies' designs, etc. But there is never a new conception of housing.

One of the main handicaps that I have found even in the consideration and talking about industrial housing has been this phrase that I continually encountered—this damage of standardization, mechanics spoiling everything, and the idea of having things look like peas in a pod. You keep hearing that expression: "They look like peas in a pod. That's terrible!"

Now, of course, we don't want things to look alike, like peas in a pod, when they have no meaning to us and just become more clawing. But we have no objection to a bunch of roses which are so similar that you can't tell the difference in one from the other. They are machines for the propagation of life. It seems to be the very secret of life itself that, if anything is perfect enough, it is reproducable after its own image.

People who have had one idea in housing have felt that they were going to show their individualism; they were going to be different. Now, it is very clear that as long as any two of us have to share the same stomach, literally having a pipe between our stomachs tied up, so far as our being really individual, proceeding in the realization of truths as our intelligence presents them, we would be licked in putting them to effect. As long as people are in a group, our material systems are not going to be individual in housing. That is why all this terrible picture of breaking down the creative design of the individual buyer occurred, as I have related, with the automobile.

I am going to clear up, at the very beginning of my talk, this business about standardization. In the first place, you apparently cannot standardise. The word "standard" refers to the symbol, a standard bearer who typifies the group ideal. By "ideal" I mean the latest, sensational refinement towards truth along any one direction, along any one line. The standard then, being the group ideal, is an abstract. You cannot freeze up standards.

There has been a definite impression among people that, when you talk about producing housing industrially, you desire to inflict some terrible design upon the world, and that they would have to take it. Now I can't make ten million triangular green smoking pipes and say that the world will take them. Even if I try to give them away, people will not take them. You have to satisfy standards in quantity production. But when you begin to satisfy standards, you can produce in direct proportion to your satisfaction of those world standards; and, as you satisfy them, standards improve.

In starting the consideration of this house, I want you to think of it all the time as an industrial problem. Remember that an industrial problem is not so much the final crystalline object which you are producing to satisfy standards.

The final Ford car was a very minor part of the problem of Henry Ford in his last change. The big part of his design was the industrial cycle. He has hundreds of thousands of people working in unison over the whole surface of the globe. He has approximately forty million dollars of material in transit all the time—no dead storage at all. That was the large part of his problem; not the final crystalline car which would satisfy a standard up to a certain period of time.

So you must think of this design all the way through in relation to an industry. Remember that, inasmuch as we are here to live, the one thing we have to have most and the major expenditure we have in life is housing. If it were put on an industrial basis instead of tailoring basis, it would be in proportion to all other businesses as the battleship compared to a small boat—a gigantic industry. You have to think of a service station delivering housing, etc., replacing parts.

This design would be extremely expensive done as a tailoring job. The new Ford car, as opposed to our idea of standardized housing, cost forty-three million dollars for its original. But, after he had solved the design, it cost twenty-two cents a pound for the reproductions. Our idea of standardized housing, as opposed to that, would be a ten thousand dollar form of production of some meaningless, archaic form which we could cheapen down to nine thousand dollars by doing a hundred in a row.

The basis of design here is one of using forces or dynamics all the way through. I start from the inside and work out entirely, instead of starting on the outside until it looks like something, then cutting down and fitting inwards. I literally start centrally, with a central mast, and build out progressively—everything fitting: there must be no cutting. What I do is this: Our service station comes up to the site in the world I choose where, if I had a million dollars, I would have my house. There is no compromise. I would like to have it there when I can afford to have every single thing. We have complete transportation to and from any point in the world.

The service station comes to this point with a group of tools. It makes a circular motion. It makes a round hole in the ground four meters deep. Into this hole goes a tank made up in three parts—two septic tanks and a fuel tank. This tank is going to be the only compression contact with the earth.

Remember, as my problem, that I must overcome all the elements. I must be proof against earthquakes, floods, tornadoes, cyclones, marauders, electrical storms. The reason for the single contact is the same as the single contact in the mast of a ship. By having a single contact, I will have no heaving from an earthquake.

Now, on the tank head is planted this mast. This mast is somewhat similar to the radio mast, the dirigible mooring mast or the battleship mast. I immediately go to a maximum height on my building, centrally, with this in mind: that we can now hang everything and use graft to plumb everything instead of fighting it all the way up. It is going to mean, from now on, single contacts, as far as the assembly of the house goes. The single contact and everything falls and finds its other two contacts, giving you your triangulation of contact.

What I am trying to do in housing, very broadly speaking, is to compass space and control the space compassed and present the whole harmoniously. The reason for going up in a central area of compression and coming down in tension out here is that metal, speaking very generally, is about twelve times as strong in tension as it is in compression. That comparison is made on a very short billet of steel, if I am speaking of steel, for compression: because the minute I get above my thirty diameters, it begins to deflect. You are getting a tension motion and not getting a true compression test. By tension I am not limited to length, any more than is the tension in a suspension bridge. The principle in the suspension bridge is to have as much of a compression as possible and take care of your greater lengths in tension. This house completely abandons square or cubic triangulation as we have it in housing today. The best reason I can find for all the square walls and square windows that we have is our direct immediate heritage from the Mediterranean civilization, when they thought the earth was flat; and the cubical geometry was developed in the light of that fact. Now, in any engineering job, you don't set things up in triangulation, with plates fighting at every joint in the old feudal way of might makes right. Today, in all good engineering mechanics, you use forces that mean that mind and might makes right. That is perfectly simple. Every architect knows it.

You may say, "What is the matter with our present cubical building? We have been doing pretty well." Just this: that it is wasteful. We go into tremendous waste adjusting plates, etc., to provide a moment of repose. Then we have to have tremendously strong members for the torque to take care of the gusset-plates and the self-accumulated weight.

You have here this mast and triangulation.There are no gusset-plates. There is absolutely no rigid joints. There is nothing similar to our present building, fighting for a moment of repose. It is all a completely flexible proposition—all resolved in forced triangulars of compression and tension. You acquire the idea, as you contemplate this method and design, that this is beautiful because it is natural; things are where they belong; there is no fighting—just like a tree itself.

You will notice that all these compression members are in tubular forms. These tubular forms are duralumin tubes. They are somewhat similar to the tubular spars of a boat, which are strong enough to carry their working loads. But, once in position, sealed, they form a tank like the air tank in a garage. They are inflated with air. Air is put in up to three hundred pounds pressure, going above the lowest elastic limit of the metal—the pressure raising the metal above its lowest elastic limit. What happens is this: While these forms, if this air was not there, would be amply strong for their loads, the point is that the compression portion is carried by the air and all the metal is flexed and in tension. As I said before, metal is twelve times stronger in tension than it is in compression. Furthermore, as a safety factor for blow, if it received a shock, it would be immediately transferred by the air and transmitted to all your tensile surface.

This mast is the same. This mast itself is done in a tripod. I have used a form that we use in the Navy, with some modification. There are three compression members and three tension members here. You could run an aeroplane into any one side of it and bust that unit down—the fourth unit, the windowed unit, could be broken—and your mast would still stand up. You would always have two compression members and a tension member. You would have what we call the Navy shears, with the tension member behind it.

Now, to get some idea of what we are getting at here, this house that I am discussing is just a minimum house, forty feet high and fifty feet in diameter. These tubular spars, as you would see them in the regular house, would weigh just one hundred and seventy-eight pounds. So that a strong man could lift them without any trouble. You might ask, "What is the advantage of the weight?" But remember that the Ford car is sold on the basis of twenty-two cents a pound and that all industrial products get down to a weight basis; and weight is going to be the controlling factor of whether you have done well, after you have followed the dynamic problem.

The next thing that happens in this housing, having arranged this compression arch here, this hexagonal compression arch, to give me a support for the floor, we come to the problem of the floors themselves.

Flooring to date has been the heaviest single factor in building. In our present flooring we deal only with solids. In fact, all architecture deals with solids. It takes no consideration of the fact that molasses may be liquid or frozen.

In this floor we have concentric hexagons of piano steel wire every meter in here, the load emanating from the outside. You follow these lines around here.

This spider wire of piano steel wire cable is of tremendous strength. We have always known the strengh of the catenary net. You have seen people jump out of ten-story windows into the firemen's net. It is tremendously strong.

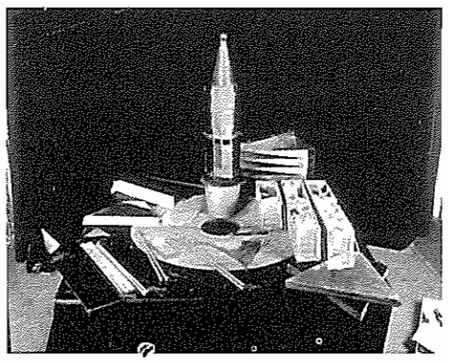
We haven't been able to use it in our solid floors of flooring because of the motion of the catenary net; because the minute this floor sets up real motion and it gives to my load, the floor is finished as far as the concrete members go. There is a theoretical flow. We all know how fast concrete flows. So that if it really gives, it is going down.

To make up for this catenary net, which is naturally strong and gives me natural strength, we have six triangular duralumin pieces, of equilateral triangles. That fits in on this catenary net. This triangular duralumin unit is a bladder. It is blown up something similar to the pneumatic mattress that you see in the surf.

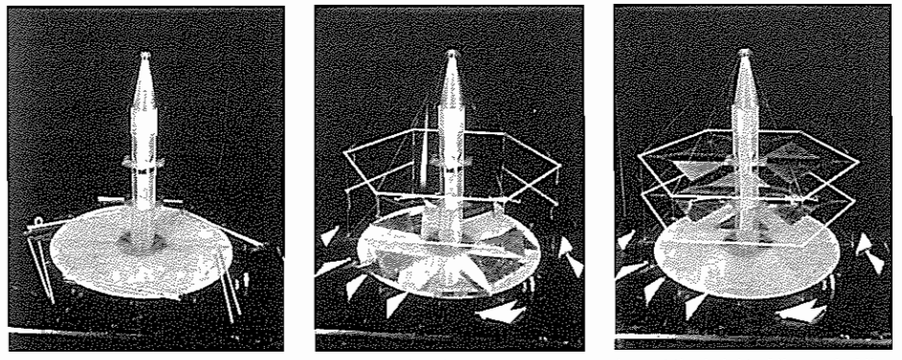
This duralumin, which is an alloy of aluminium, has very much higher tensile strength than the equivalent gauge of steel and very much more elasticity. It has such high elasticity that, when they put it in the same presses as they have for mudguards on automobiles, it springs back much into its original shape.

These bladders are inflated. As you inflate the metal bladder, it is thrown into tension and it tends to knit together. You know how it is when you punch an automobile tire of perishable rubber, in view of the fact that the fibers tend to knit together. This is relatively puncture-proof.

What happens is that my load is immediately distributed, due to the elasticity of the air, to all of the tensile surface of the metal and to all of the tensile surface of the catenary net. Further,



88 Dymaxion House, third model, probably late summer 1929. The components of the model reflect the parts and units of the real house. The photo series on pages 90–93 shows studio photographs by F. S. Lincoln. BFA



89 Dymaxion House, third model. Phases of constructing the model to illustrate the process of assembling the real house: (1) raising the supporting mast; (2) unclamping the hexagonal pressure rings at the height of the roof of the story; (3) stretching the wires for the floor; (continued)

like the automobile tire, it goes "plop, plop" when it goes soft; and when you kick it and it makes no more sound, it is getting hard.

A child can fall on these floors and not hurt itself. The shock is immediately absorbed by the elasticity of the air. You have very fine fabric covers on the floors, such as modifications of this oilcloth, etc., because they no longer pound in like an anvil.

The next thing to consider here is the extraneous covering of the building. You see these triangular forms, the windows here. These triangular forms are made out of casein. They are made as triangular flasks, vacuumized from one corner, like an electric light, so as to kill all heat transfer.

These triangular window plates are not set as are the usual rigid window plates we have here. You are using nothing rigid in this building. They are set down tension cables, like the cables of suspension bridge, pulling straight instead of trying to push straight. These are, again, piano steel wire cables. These flasks fit loosely into that cable. The edges of the flask are beveled to allow their fitting loosely in the bevel of the caging. A pneumatic tire, blown up, is put around that, giving air-tight and water-tight joint and flexibility.

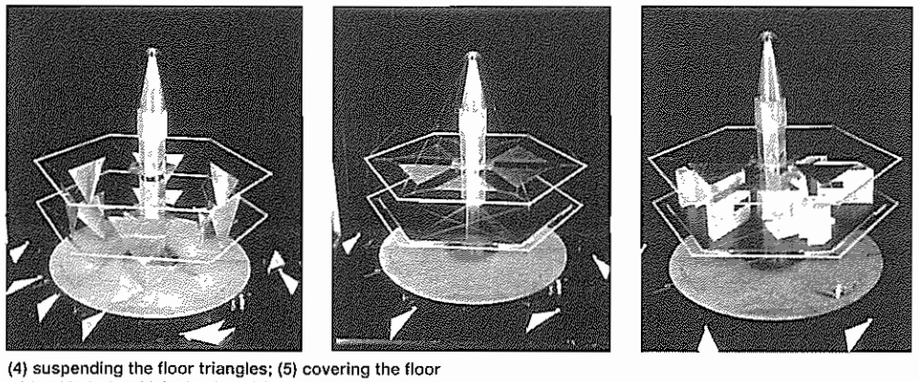
Everything in that whole window assembly is flexed in tension, and you can virtually run an aeroplane into it without busting it. The whole window assembly, these six units, is made up at the service station. They are brought to the job. They are hung up. They fall down into position. They are batted down, and a pneumatic tire goes around those. We find that that pneumatic tire, where you are not pounding it long like an automobile tire, can be blown up every two years, and it will last about ten years before you have to replace it.

The next thing you will notice is that that same triangular proceeds inward in my design. In fact, this whole design is done in terms of triangles, distances from the center out; but this triangular proceeds inward. So over the whole top of the house and the bottom go these triangular vacuum plates. We will have very little heat loss in that covering.

By the way, that casein is the natural solid residue. You take cheese and remove the butterfat, and you will have casein left. And, being such, it lets all the valuable light rays through it. The reason for this thermos bottle cover is so that I can arrive at some economy of operation inside of the house in heating, ventilating, lighting, etc. We combine in this house the lighting and the heating.

In the central mast, these three little triangles here are for the heat and light passage. I will later show you how we add bathrooms and grills, etc., to this mast with manifold coupling like the coupling on railroad cars. But what I am discussing at the moment is the lighting and the heating.

In our best industrial ovens we can go up to 150 degrees with the illuminating bulb, which is the only proper element where you have no heat loss. So there is no need to use anything else but heating bulbs for proper ventilation.



90 (4) suspending the floor triangles; (5) covering the floor with a kind of artificial leather; (6) assembly of the house utility units to divide the room; (continued)

Next: These spotty lights that we have in our housing are a direct heritage, of course, of the candle or cage, whatever it may be. They are not what we want. We want illumination without looking at the source of light; for looking at the source of light blinds us.

The air is drawn in at the mast here through these little breathing parts. As it is drawn in it is fused with the dust, and the right amount of moisture is put in or taken out. We have very nice clean air, and the right humidity goes with the right temperature.

This air is blown down the mast to the ceiling height. In the ceiling height of each floor, as I have already pointed out, there are these light clusters in right triangles. The ceiling is divided into sextants, pieces of pie like the floor—but, in this case, one meter high; rather, the elevation of a one-meter triangle with parabolic reflectors on three sides. So that the light enters here and carries around and gives you a complete light over your whole translucent ceiling. In the same way the air goes over the lighting elements, takes the heat out of those and blows out into the ceilings.

Now, blowing into a triangle, you have in the equilateral triangle an exact allowance for friction; so that air can go into the complete area. There, again, we find the whole fallacy of cubic air.

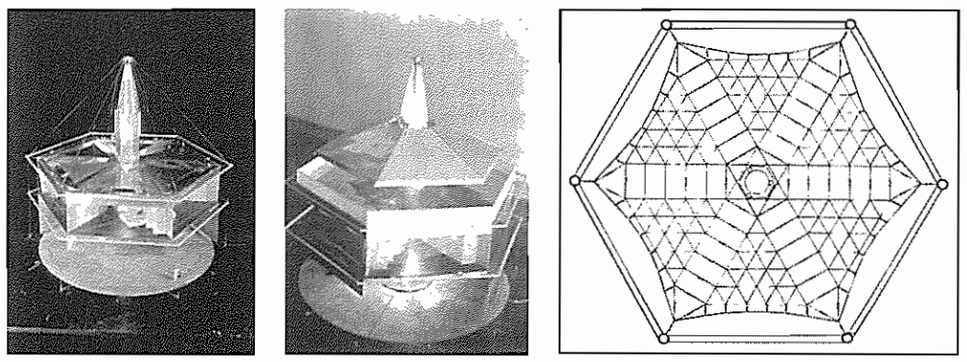
Here it has to go to the whole area of the ceiling. The whole ceiling is full of little perforations, the area of which is equivalent to the area of spline here. So the whole ceiling must be cozing air, freshly clean, with the right amount of humidity and no dust.

Then the whole atmosphere is exhausted or drawn out around the floor edge. Just like we boosted the steam radiator for years, always letting the steam out of dead air pockets, until somebody thought of putting a vacuum return line on it—so now the whole atmosphere moves down, away from you. It moves down very slowly, so that you can practically keep your heat units poised in the room, and the smoke and smell goes away from you. You can never be offended by cooking fumes, or some odor that you don't like.

With the atmosphere moving around and away from you, there is no draft along the floor. As far as comfort goes, you can sleep on the floor. You need no bed-coverings in this house because, whether you are at the Equator or at the north pole, the air is always at the right temperature and the right humidity, year in and year out.

With this central lighting, we are able to have complete control of light. We never shut the light off; we just shutter it. We shutter it centrally, so that you can have any amount of light, or any color of light, you want.

Now, you probably will say, "How about this goldfish bowl idea? Everybody can look in." Several people, in looking at this house, immediately asked me about that. Don't forget that this house is primarily planted in a place in the world where you have chosen to put it if you had a million dollars. We assume that you want to look at the view. But, if the sun is shining in or, perhaps, someone is landing an aeroplane, and you want to shutter it off, here we have a mechanical shutter. This house, of course, is being treated as a machine.



91 (7) finishing the upper ceiling; (8) after completion; (9) supporting system for the roof with hexagonal pressure ring and tensile floor structure.

Here we have these triangular metal curtains that come up and down all the way along like teeth. They are pulled from the corner, so they won't warp. They come around rollers, directly out from the floor, and up. Another one comes here. The two come together, giving knife-edge evenness and opaque shutter. If you want to sleep in the daytime, you can. In this house you can do anything you want. If the sun is bothering you, you can have it just where you want. You can pull down the whole top of your window.

Notice up here I have got a little convection fan that is indicating the blower. That actually is indicating the heat loss from that light.

The next thing I call your attention to are the partitions themselves. One of the main problems about this housing is not alone proofing you against the elements enough to live and keep from dying. That isn't so much. Any man would rather die than go back to the days of Roman galleys, where he would have to row and be whipped for the rest of his life. I always give that same simile and always say that the Roman galley slaves did not know that men would be sitting here, some day, completely in charge of their own time, as you are now. They just felt. "This is life," that is all.

In housing today I feel that women are very much more enslaved than were the men in the Roman galleys. We haven't had time or perspective enough to realize it, but it is so. Particularly are women penalized for loving and living and having children, etc. In having children they have a terrific course to go through.

I always cite the fact that my wife, in one of the most modern-style apartments in Chicago (though not expensive), has to spend ten hours a day to keep the baby from falling out the window or down the elevator shaft; and she has three hours of laundry to do daily for the baby. There are thirteen hours of the day already accounted for. Let alone the eating and sleeping, she has very little time to dispose of her own. That is what her slavery is. It is very much worse than the old Roman slavery, because she is having mental slavery; she must be mentally aware of every motion she makes—which is harder than physical exertion anytime.

So in housing we are going to do away with drudgery. To accomplish drudge-proofing, I have tackled, as a problem in housing, only the things that you have to do. I don't deal at all with what you choose to do. I must be very careful not, in any way, to interfere with what you choose to do.

Never interfering with what you choose to do, but dealing only with what you have to do, I find the best logical way of handling anything you have to do. The minute you resolve things to mechanics, you can produce your drudge-proofing units in factories. So we have segregated the space which you are going to compass here, which is your space and controlled for you, and provide various mechanical units in direct relation to that space where you want to be served with some utility unit.

You will notice up here in this plan that there are no partitions anywhere that say, "You shall not pass." Every partition here has a mast of some kind. It is a machine.

All these partitions or machines, irrespective of what they may be, were brought to the house before the windows were put on. They were hoisted up from the truck. Each one of them has been solved—after the solution of the problem; not before—into truck units. They go readily into freight cars and trucks. They are hoisted up and run in on a radial tension member here. They are hung up centrally to one point, hung up off center, so that they fall down and inwards.

Each partition, you will notice, is wedge-ended. As they fall down and inwards, they fall together. They form a horizontal arch, self-absorbing in compression. There are two dummy wedges in the floor of this particular house, so that they literally hang together like fruit under a tree. Being hung up, off center, it gives them great firmness. That is a standard hook. I don't care where I put a bathroom, it will always find its contact in one of the triangular areas here.

Mind you, those partitions were hung up; not fitting them on the floors and having the floors brought up to the partitions. Everything fits in this house. We are really going back to the philosophy of my design. We are getting progress by creation instead of progress by destruction. That is the absolute primary in my design.

At the present time we know that it is not an oddity, in building a skyscraper, to cart away over one million bricks in the form of dust. You build until you start to look like something on the outside, then cut down and bust all the way in. That is only one item. It isn't so much the waste in dirt as the waste in time.

I will show you what I have in this particular house to make clear these partitions. I was asked to make a minimum design last winter within my designing principle, with the central mast, etc. Anyone of you might make a minimum design of a cruiser or small house. This particular house is eight meters in the center to the exterior of the window plates, and then another meter to the compression members on the outside.

This room here is what I call my living room and the day living room—approximately forty by twenty feet. Here are the two bedrooms and the night living room, each with their bath. This is what I call the utility room. This is the material part of the house, where you grill and you launder, etc. This is what I call the going ahead side. This is the library here.

We come up to the mast in the central elevator. There are two vestibules on either side of the mast. You can pass through from this room into this vestibule and into any room. These little red dots here are the doors. You find that you go completely around any partition.

You certainly realize, looking at this house from the outside, that the extraneous corners are 120-degree obtuse angels. All acute angles in the house are passed as you go around. So I can go around any partition. Instead of having the sensation of being allocated to a certain amount of space in building, I own all this space, and all this space serves me.

The doors themselves—you will notice these vertical silver flutings here—are pneumatic. They are silver balloon-silk inflated. They are all full of air in position. You press a button, and the air goes out. Two springs draw these back. You press another button, and the air goes in. They pop into air position, just filling their rim like a tire. You will probably use a photo-electric system. Instead of pressing a button, perhaps, all you will have to do is clap your hands. Mind you, these are full of air, just like the floors, so as to kill sound. That controls light, sound, heat, etc.

The next thing is to tell you something of the partitions themselves. These bathrooms are all made in one piece. They are made of the same casein that my watch crystal is made of. But, in this case, the casein is translucent rather than transparent. You might like to pass it around.

You may have it translucent, transparent or opaque. This light comes through. You can have a beautiful green one, or pink, or whatever color you want. That is all made without any cracks. This is really break-proof. The whole channeling in the bathroom for conduit is within the walls themselves. The tub here is six feet on the inside.

As you come into the bathroom, I have just one fixture on the wall—something that has been used in hospitals, submarines, and other places extraneous to housing. That is a single dial control. You know just what temperature you want. You turn it until it says "Tub," and you fill it. That is the right height, and children can't monkey with it until they get to the right age. In getting away from drudge-proofing, I want to have a house that is don't-proof for children.

In this bedroom here you notice this form. These are semi-circular hanging coat closets. You press a button, and that swings around in the room. It has a capacity of thirty-two overcoats, or fifty dresses. They are never jammed. The air coming down airiates those perfectly in the closet. You don't go into any closet in this house. There is no such thing as a dirty closet to go into.

Next to the hanging coat closets are the shelves, these forms here. You see them all through the house. These shelves are like the double dumbwaiter, hung on cables, or like a ferris' wheel. There are two top wheels and two bottom wheels, with the cables coming over. The shelves are hung from these. They are not kept balanced, like the ferris' wheel, by the gravity alone. They go around with great rapidity, like the telephone reference pad.

They come to the right height. Here are the two bedrooms. The horizontal openings all the way through the house are the shelves. They are right where you want them. You never have to stoop down to get anything out of the shelves, or stand on a chair because they are too high.

Again, those are the right height, where children can't monkey with them until they are at the right age. The point is that if they do keep on monkeying with them when they are at the right age, you are better off than to have their mother act as a service station.

Those shelves are in the library for your books. They are in the utility room here for the refrigerator and for the dish closets. There are shelves everywhere.

I guess I can tell you a little more about the utility room by describing the model itself. You see the opening through here. This is what I call my grill. The idea of this grill is that it should be just as nice as a piano, something that you would play yourself. You wouldn't have the waitress come in and play the piano for you. There is no drudgery to it.

Here in the passage through is a six-burner electric stove, with the oven directly under it. The height is right. You just pull it open. You do not have to stoop.

Here are your refrigerator shelves. Here are the dish closets for dish and dry grocery storage, so you can take things out without stooping. Anything can be taken off from that stove and placed upon the dining table in this room.

This is a dish-washing machine, a drain board and a sink. Directly under the sink is the sewerage disposal. You call it incinerator here. You just pull it open and close it. That goes off in a traveler down to your tankage.

On the other side of the utility room is the laundry unit. This laundry unit is a package machine. It is something that you have never seen in the way of laundry units until the present time, because it is much too large to produce. It wouldn't fit in, standardly, into any house. It is perfectly all right as a partition. It needs space to spread on it.

What happens is that you put one thing at a time into this laundry unit. There is a little door here on the side of this left-hand wall, like a coal chute door. You put one piece at a time into this pocket, like a mail chute pocket. That is the only requirement—one piece at a time. Each time you open and close the door it makes this machine go once. When you close the door it is fitted through an opening, so it controls the size, and it goes into a larger cage. It is integrally contained in this cage, so it can't be hurt or grappled from without. It goes through a terrific sluicing. The water bellows into it, as it does into the sails of a boat, and throws it up to one side of the unit, completely washing it out. The centrifugal of this water in the house goes through the sterilizing, through the air-drier, throwing it up and dumping it into the rough dry pocket in three minutes. The point is that you don't wait for your laundry to come through, but there it is stored, waiting for you when you are ready, instead of storing dirty clothes that rot and breed disease.

This is the other side of the house. Going through this living room, first, which is forty by twenty, I have this table. This dining table is hanging, because I want to have it shock-proof from the jars on the floor that emanate from above. So the people can dance away without shocking this table. Furthermore, it follows out the general philosophy of design, using triangulation in tension.

There is only one piece of furniture in this room. All the rest of the furniture in this house is built in like in an automobile or boat. It is the best logical place for all your major furniture. That is the logical place for a seat-place, etc. When you walk onto the best restaurants today you pick the seat along the wall, which is more comfortable, rather than a little spotty chair.

This diagram along the side here is fifteen feet long. On that wall you see all the controlled dials. You go on the bridge of a ship, and there is nothing more attractive than the controlled dials. They are the very essence of progression. The only way we can run a great liner, with fourteen thousand souls, like the *Leviathan* did during the War, is because of the fact that you have the essence of progression right at your finger-tips and you control things. In the present housing, we don't have anything like that.

Children will be able to observe the temperature, the wind direction, and note how much oil you have on hand. They will have the complete essence of progression. All they will need is experience in progression to form laws of their own. That will develop very rapidly. They will be able to tell the storms just like a sea captain. Any child will be able to do that.

This side here is the library, or the go ahead side of the house—what I consider the most important room of the whole house, because here it is going to be necessary that children be enabled to get their education by selection instead of having formulas shoved at them.

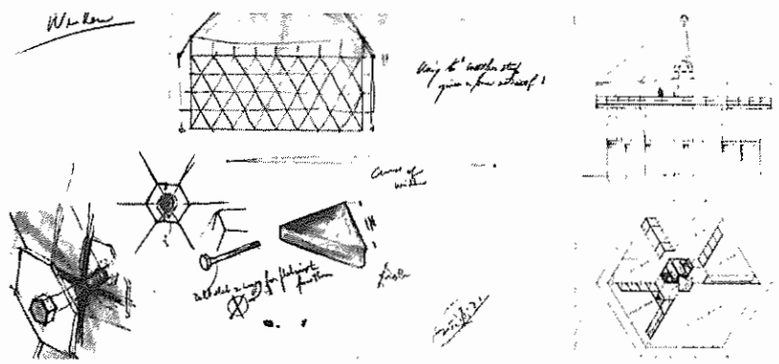
If we are designing decentralized housing as an industry, planned three hundred miles away from the city—one hour's flying distance—there is not going to be a pooling of schools, as you have them now, in closely concentrated areas. Most children are sent to school because their mothers really are drudge-tired, not because they think it would be nice to let the children get an education. It does let down on some of the thirteen to twenty hours of drudgery. But, in this housing here, mothers are not going to be worn by drudgery; and they are going to be able to provide this education by selection, which is going to be of great importance.

That means that children will be able to get their education up to the time when they have acquired their own individualism. Then they can go out and meet the world as individuals because they choose to, and not because they are shoved together at improper ages, as they now are.

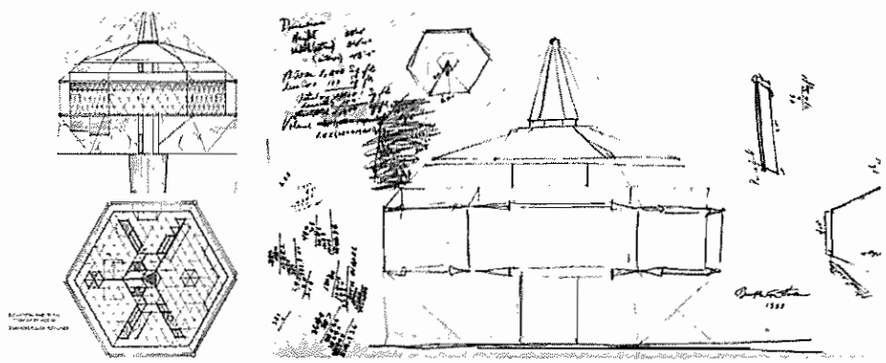
Here, when a child draws his first picture and begins to paint something, somebody will say, "Who do you think you are? Michelangelo?" and the child will stop at five years.

In this room we have a couch built in, which I have left out in the model. You see it here. It is a seven-foot couch, backed up against this window. I have left out a hanging triangular table, so you can see in there better.

On this side you see these maps revolve. You press a button and you can have any map, or a moving picture reflector from the inside of this first column plays up against that.



94 Sketch, detail of the outer skin; triangular windows in the system. Right: Elevation and floor plan of the middle phase of the project (corresponding approximately to the second model). From: Ward 1985



95 Left: Floor plan and elevation, advanced phase of the project (cf. third model). Right: Study for the later phase of the project. From: Ward 1985

On the outside of that column there is a loud speaker and a microphone. These rooms being sound-proof, you have very good radio transmission. Instead of having an individual telephone to which you whisper into, you are going to be able to talk directly to the children. The children, not having been "don'ted," are going to be full of secrets. Secrets are only compromises, and they are resorted to because people don't expect an understanding. You don't need that in this house.

Over there, on the left, you see your revolving bookshelves, of course. In the inner right-hand side you see recesses for a globe and an atlas, which are too big to go into the bookshelves. On the inside is a television unit.

On the second column is a pipe column, like the pipe column in the bedroom of a hospital. Swinging out from the outer edge is a drawing board, where you get your maximum light. On the inside of it there is, first, a little seat, then a shelf with a typewriting machine, and even a mimeograph. So you are immediately able to crystallize when you think of something.

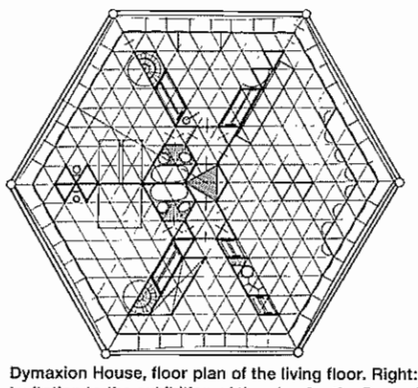
The principle involved on this education by selection is that, with the development of this housing, you are going to have a high development of it in radio. Radio is, of course, paid for by the advertisers. But they are still pretending it isn't. As long as any industry pretends something or has any hokum in it, it doesn't progress very rapidly. When radio first came along, I remember I was very much interested in radio and I saw a lot of it. The first test that Dr. De Forest made, in talking from a battleship to an aeroplane, was made on our boat. So I had a lot to do with radio at that time.

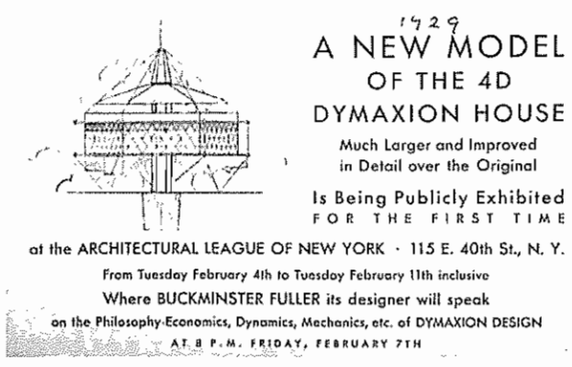
Just as the War ceased, the popular value of radio became evident. It was perfectly easy for the big merchant to see that merchandising areas could be reached by a radio advertiser which would take away his static clientele very rapidly. So lobbies took place and legislation was enacted about advertising on the radio. And now they sing and do a lot of fine things, and then announce the name of the sponsor—all kinds of evasions. But as soon as the bunk gets out about that, why, radio will begin to get somewhere.

You don't just go out and buy any kind of a magazine any more. You have a music magazine. You have a magazine on economics. Why? Because the advertiser pays for the magazine, just as he does for the radio; and it is worthwhile enough for him to pay the music magazine an amount which enables them to secure the very best writers they can on music.

The same thing will happen with radio. We will soon have radio on a selective basis. Instead of having a conglomeration of programs, there will be music stations and economic stations and general stations; and we will be able to turn the dials very quickly to selective subjects. When that happens, children will no longer have to have compromise teachers. They will have Lowell on "government", or some other authority on another subject, whatever it may be; and they will quickly tell you whether he is good or not. That is what I mean by radio by selection.

With television, children will be able to see other children paint and draw in Tokyo; they will be able to see what grown-up people do, and they will have a very definite balance of their own. There won't be any of this ridiculous crowd psychology.





96 Dymaxion House, floor plan of the living floor. Right: Invitation to the exhibition of the plan for the Dymaxion House at the Architectural League, New York, February 1929

Take the two bedrooms here. I have already explained the bathroom centrally and the revolving shelves and the revolving coat hangers. Here are two beds that are pneumatic and blown up to the firmness that you like. I have a double bed in one room and a single bed in the other.

There are triangular columns. The inner column is for cosmetics. The outer one is for furnishings, etc. There is a dressing table with a stool. There are two mirrors, and a third mirror swinging around, so you can sit there and see around you, with the light coming from above, of course.

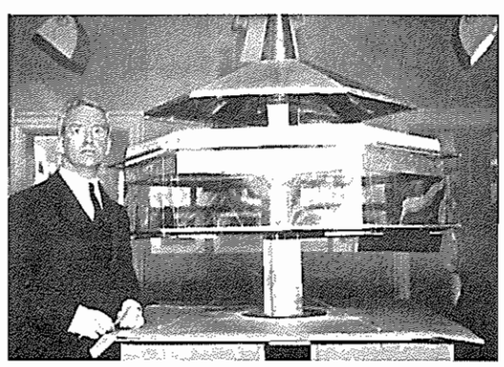
That pretty well finishes the interior furnishing. Up here I have a fifty-foot platter. This awning is set back much farther than it is over here.[1] These compression members are actually extraneous to the house, whereas here the bed is right in the surface. This is an older model.[2] The principle about this fifty-foot platter is that this hood is recessed back on this model, so that the wind breaks in streamlines over the top rather than through it; and so, even in a seventy-mile gale, you don't get blown off.[3] This being of duralumin, it reflects the light rather than absorbs it; so it is always a cool spot. The height of the railing bridge is the same as used in the bridge of a ship—a height that children cannot get over until they are four years of age. In these newer models here, we even have a netting over here. So if children playing here did fall off the top, they would just fall into the net.

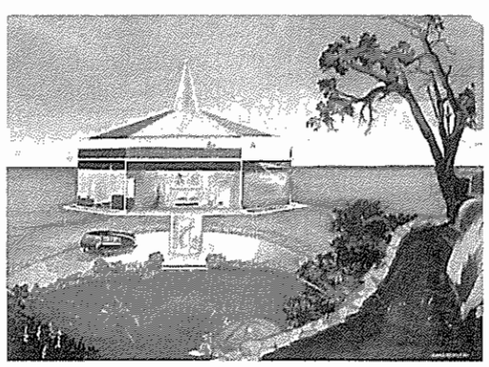
The next thing to consider here is these couplers that you notice at the top, with these panels. This house is four meters high, so as to be above flood area. It is a single contact, which is proof against windstorm, inasmuch as the tensile strength of this metal is designed to be equivalent to a strain or a gale of one thousand miles an hour; and the maximum gale we know is one hundred and eighty miles an hour. We are using piano steel wire, six hundred pounds tensile strength.

This coupler here is to relieve the pressure, when necessary. This coupler up here is of considerable importance. As the air is drawn back from the floor into the mast, it is drawn up through piping to the top of the coupler in copper tubes, where the tubes turn and go down and out here.[4] The new air goes up over the tubes; the heat tending to rise takes the heat off of those pipes; and this becomes a heat conservation pool.

Also, these are lenses; so that I synchronize the daylight with the central lighting. Even during the day your ceilings are illuminated. You can't tell whether it is artificial light or daylight. They are like these mirror lights you have seen in front of automobiles. You use the heat of the sun synchronized with the heating elements. In summer, in hot weather, such as we have now, the air comes in and is washed and cooled as it goes down the mast. Instead of going over the lighting unit, it by-passes it and goes into the ceiling. As it comes back, it takes the heat off the lighting element. It is like a thermostatic control all the way through.

To enter this building, we have this central elevator here. This central elevator is new in design. In decentralized housing we would be afraid of an overhead hanging weight counterbalanced elevator. So they would not dare to have that type of elevator in that type of house.





97 RBF with the third model of the Dymaxion House, circa 1930. Scale presumably 1:12. BFA. Right: Anne Fuller, The Dymaxion House at the Sea Shore, gouache, circa 33 × 43,5 cm, undated (circa 1934). BFA

What we have here is triangular areas with thrust bearing three ways. It can't rock within this area. There are no moving parts outside of the elevator itself. There is a little worm gear, a gear up on one side, just like a monkey-wrench. That is run by an air turbine. It can be run up to thirty thousand revolutions a minute. So that this elevator can be run rapidly, even though it is a worm gear. If the motor isn't working fast, you can work it with a hand-crank. With a larger house, of course, you can have stairs. This is just a minimum house.

This lower area is closed optionally, if you want it, with these duralumin screen curtains. That comes down to the same attachment points as the cables. That becomes, then, your hangar and garage.

In this hangar and garage I show this transport unit. I won't go into this in this discussion, except to say that this is a theoretical design, like the house itself. We don't know that it works, but it is dynamically correct. This is a wingless aeroplane, an amphibian transport unit. It was reduced down to three hundred pounds in this design. The present motor plane weighs nine hundred pounds. The Ford car weighs twenty-three hundred pounds. Whether you are using this transport unit by the time this house becomes an industrial unit, or whether you are using a motor plane reduced in weight, as it will be in that five years, the weight of your transport unit will be in the neighborhood of six hundred pounds. So we will allow for six hundred pounds in your transport unit.

The total weight of this building figures up to six thousand pounds. The price of the materials used figures at present quotations about fifty cents a pound. On quantity production, the cost would be about three thousand dollars. So, as an industrial indicator, you can see whether it is very much theory or definitely as to what can be done.

I have confined all the design in this particular house to proven mechanical units in some field other than housing today, in order that this particular model be realized. There are further refinements in design that we can't say are proven under service and stress conditions; but, in order to make this one here, I have used them.

The next thing this makes clear is the indication of the financing of housing. Housing today is sold on the mortgage basis, or the pound of flesh basis primarily; because the housing itself, as Mr. Corbett said to begin with, was worth nothing.

Down in Maine my family have a boat that is about twenty years old. They have had it for thirteen years. It is worth twice as much today as it was when they bought it. They didn't buy it because of vanity, but because they live thirteen miles from the mainland; they bought it so that they could go to shore and buy provisions. It is a fine-functioning boat. It is worth twice as much today because there is more demand for transportation. There has been no depreciation for vanity.

Automobiles today depreciate, we will say, an average of fifty per cent when they come out of the store—which is indirect proportion to their vanity; because the Ford car, for instance, is about three hundred pounds of transportation and about who thousand pounds of vanity.

Housing, as we do it here, is confined to its functionalism. The operation cost of this house is miraculously low. It apparently will operate for about five dollars a month. That being so, whether people like the looks of it or not, is not the point. There is this demand for housing. It means that you are going to have a demand for housing that will possibly give you accrued value instead of depreciation in housing.

Furthermore, it means that you are going to be able to sell housing on the time-payment or acceptance basis of all other industrial products. Industrial products that are being produced on satisfactory standards finance their operations by having the buying-public provide the capital. There is no bank or group of banks that could underwrite the manufacture of any of the large industrial products. The buying-public, being given time-payment or capital control units, purchases the product and returns the capital to the manufacturer; and so the cycle continues.

It is of great importance that housing be brought to this abstract basis of trade instead of the material basis. It is the last lingering feudal unit. Its essence as a land trading unit is the gold standard, which is being relatively eliminated. Gold wears out a s material unit. All our other trading units are abstract. We don't buy shirts any more for gold in London or New York. We buy and we exchange paper. You may call up your broker and even do business without ever exchanging anything, except your word back and forth.

When we get the housing industry on this same abstract basis, we are going, forever, to lick materialism as the basis of progress in the universe. That comes down to the very essence of philosophy as far as an industrial conception of housing goes.

Furthermore, As Mr. Corbett said, you will be able to say to the service station, "Take this house up and give me another one in April." You are going to break up crowd psychology. If we can all have mobility in housing, and if we only spend five dollars a month on our rent, we will be able to do that.

Economic indicators will show you that. If you go along Fifth Avenue, or Michigan Boulevard in Chicago, or the highest rental areas in every city, you will find that the stores occupying those high rental areas are the ones who can afford to pay for them.

There is more demand for motion than anything else. Only one half of one per cent of the human family owns any land. All the rest are mobile and want to be mobile. That is an industrial truth.

I think that completes my story this afternoon.

(Applause)

Chairman Corbett: Are there any questions? I have to leave here in fifteen minutes.

Mr. Raymond M. Hood: How do you get out of the elevator on the second floor?

Mr. Fuller: Well, in this, I am using this back half here for conduit in this house. In a larger house I would be able to allow for more area for that. I have a step across to the vestibules.

Chairman Corbett: You see, that conduit here feeds that, and this is open.

I would like to say, before questions start, that Mr. Fuller has presented this without consideration of the aesthetics, as we architects normally judge it. But I feel, if you could see in a field or in an area buildings of that type, designed exactly as this is shown here, and placed with some order in relation to each other, that you have just as pleasing a prospect as anything that we have today in any of our housing developments.

There has to be an adjustment of ideas, a new association of ideas, a new conception of housing from the aesthetic point of view. But I think the possibilities of pure architecture along these lines are just as great, in my opinion greater, than they are along the old lines. I think that, when someone looks at a thing of this kind and says, "Oh, I wouldn't live in a thing like that, because it is ugly," it is only because they have a misconception of what beauty looks like. It is not real beauty but a matter of association of ideas.

You see, from Mr. Fuller's discussion of this thing, that he has not only developed a house which is mechanically possible, which uses materials to their maximum efficiency; but he has back of it all a philosophy of life—which, of course, should be the basis of evolving any kind of living machine. I, personally, hope very much that, in the course of the next few years, he will at least be able to create one of these houses, full size, which people can see. I think that, in itself, would be an education in the whole housing situation. I, personally, am willing to do anything that I possibly can to help him realize that goal.

I would be glad to answer any questions—I won't answer the questions, but Mr. Fuller will answer them.

Mr. Hood: I just want to ask this question: Will the partitions interfere with the development that you describe? You describe the partitions dropping from the corner. What about the partitions having a series of weights?

Mr. Fuller: I am using aeroplane weights.

Mr. Hood: There is one other question: How about a house that is mechanically ventilated? Would not the opening of every door affect this ventilation? Then, also, I think that the heat from the sun, the radiation out of the glass surface, even if you pull the blinds down, would unbalance the system.

Mr. Fuller: No, that by-passage itself will take off the heat units. That will affect your air passing out, up the mast here, and affect your thermostatic control. So you won't bring as much heat in. It will synchronize with that.

Mr. Hood: You mean that it has been constantly balanced?

Mr. Fuller: Yes. You can just cut off the amount of sun that would be taken off from the lighting. In fact, the lighting itself would be conserved by that.

Mr. Ralph T. Walker: What happens when you get the lighting in the daytime?

Mr. Fuller: You keep the lighting going all day. Your ceilings are always lighted. Sometimes that lighting is diminished to synchronize with the daylight.

Mr. Walker: In the summertime you are producing heat all the time. Is that sent through your building by your lighting system even when it is reduced?

Mr. Fuller: Yes.

Chairman Corbett: Mr. Fuller forgot to mention one point which, in a previous discussion I heard, I thought was extraordinarily interesting. As we build today, you take a four-story building of normal size, built of steel frame; and you take a cross-section through the steel that you use in just that four-story building. Take that total area. That area of steel cross-section is equal to the area of the cables which carry the new suspension bridge at 186th Street. In other words, we use up, in a little four-story building, an amount of material which has strength possibilities equal to the new bridge, which is supposed to carry sixty thousand automobiles, or something of that kind, per hour. It is just another indication of the wasteful methods that we follow in building.

This scheme, as it is devised, uses every bit of material to its maximum efficiency. There isn't a loss of a pound. A man can order a house from a catalog, have it brought up, put into shape, and in a couple of days' time be ready to move in—just as we buy automobiles.

In the old days we used to buy an automobile, and then the salesman would say to us, "Well, now, don't you want a speedometer?"—"Yes." So we would put that on. Then he would sell us a lamp out in front of the car, and we would put that on. We would begin to collect all kinds of gadgets; and by the time we had bought all the gadgets necessary to run the machine we had paid again the price of the automobile. Today you buy an automobile and drive it out; and it has everything ready for operation.

The theory of this house would be the same thing. When the house is delivered, the family would move in; and there wouldn't be a thing for them to get.

Mr. Walker: I didn't gather from what you said, Mr. Fuller, whether you made your own juice in this house or not.

Mr. Fuller: That was apparently left out. I have one utility unit which has air cross-sections, a water-softener and air generator all in one unit, which is hung up in that bevel. It is hung-sprung from the mast so that the vibration won't go through the house.

Mr. Walker: Is it fully accessible?

Mr. Fuller: Yes. You do generate your own juice.

There is much that I have left out as far as the philosophy of the design is concerned, because it is so terribly hot today and it is pretty hard for people to stay here.[5] I could keep on talking for hours on this thing.

Mr. Walker: There is one question I have about cost, and that is that I don't think that mass production will properly determine this sort of a house; because I don't think that it necessarily is the final answer to a house.

Mr. Fuller: Not at all.

Mr. Walker: So I think the problem had better be called a quantity production house, rather than mass production. My understanding of mass production is that you have really got to get to the point where you spend forty-two millions so you can start spending another one million.

Mr. Fuller: I will make something clear about that. If this was a particular house, all the laundry units and the bathrooms would apply to any type of structure that you had to use those in. I have had people say to me, "Why can't I use those shelves? I am doing a hundred houses for some industrial group." My point is that one hundred of anything is not enough to warrant any quantity production. Quantity production prices wouldn't govern at all. No producer would dare to go into quantity production set-up on these shelves today because of this tailoring business.

Mr. Walker: I am wondering whether they would dare to go into the production of that house.

Mr. Fuller: Here is where we come to a nicety in the unifications. Instead of talking about standardization, this is *unification*—the adjustment of one partition to others in relation to angles. I imagine it is always going to have angular adjustment, one to the other, dealing in a sixty-degree angle, in an equilateral triangle. You probably get an infinity of progress through this angular division. That is exactly the way a tree keeps building up its fruit.

Chairman Corbett: I don't want to break up this party, but I have to go. I was very glad to be here. I hope you will stay and ask as many questions as you possibly can. I have had some experience with this before. I have never asked him a question yet that he couldn't answer.

Mr. Walker: There is another question I would like to ask. With most mass production articles, the cost is not the big thing. In other words, distribution adds one hundred per cent, and sometimes two hundred per cent, to the cost. So in your statement of the cost of thirty-five hundred dollars, did you include distribution?

Mr. Fuller: I was including that, exactly. The Ford car I was talking about costs twenty-two cents to deliver in Chicago. It costs about twelve cents for distribution. This really figures to about fifteen hundred dollars.

Mr. Walker: The question of building this anywhere in the country would, in itself, be a great task. One of the fine things about mass production is the replacement of parts. I understand the Soviet Government at the present time is having a hard time to adjust that. In other words, when a harvesting machine breaks down in Russia, it is very difficult to get replacement parts.

Mr. Fuller: You will remember that I said, in the beginning, that industrial competition was of very great importance. None of this is any good without a complete service station set-up. It probably means aerial delivery of parts, etc. I have made a long study of that, and it works out very nicely.

With regard to what you are talking about, arriving at quantity prices, I find, for example, that the Crane Company, or some other plumbing company, would much prefer to make bathrooms complete than a million types of pipe which they must retail all the way through. When there will be a segregation of functions, when they will just produce bathrooms, and the other industries will produce grills, etc., when they know you have an angular set-up, things will be able to fit, and it will be possible for them to go into production.

Mr. Walker: You said that you never went into closets. It seems to me, however, that your closets are susceptible to dirt. It seems to me that the cleanest possible house would be the house without any interior space at all, that was open to an exterior space. [And] I don't see why it would be more expensive to buy individual pieces of furniture than built-in furniture on the same production basis. I believe that the thing would be, perhaps, easier to put up if all your things were not built in.

Mr. Fuller: Of course, I am just discussing a minimum house. I found that this was easier to clean.

Mr. Walker: Well, I mean those shelves, for instance. How do you clean the bottom of the space that those shelves revolve in?

Mr. Fuller: We use an air-brush. Remember that the air emanates from the top, going down (and that happens in the partitions as well as in the rooms), and goes out through the vacuum line. But, if I want to do any specific cleaning, I use the air-brush. With the air going down the vacuum line, it is just a matter of putting it into circulation, and down it goes.

Mr. F. Scarlett: Could all the cleaning in the house be done by the air-brush?

Mr. Fuller: I don't know whether you could say that. I think you should probably want to do some washing. I think the air-brush is pretty satisfactory.

Mr. Scarlett: Would there be any possibility of turning the hose on?

Mr. Fuller: I see no reason why there shouldn't be. I have a trap here. If rains went into those air ducts, they would fall down the trap; and you could go down to the bottom of the mast and get those things out. There is no reason why the water couldn't be carried out.

Mr. Scarlett: And the drying accelerated.

Mr. Fuller: Yes.

I should have brought this up (I don't know why I didn't) in discussing those bathrooms; I usually do. As you know, the building business is today the second most dangerous in the world. Next to coal mining, it is the second most dangerous industry. It is perfectly ridiculous that this domestic art should be. But a more surprising fact, I think, than almost anything that I have studied (and this has to be rough, but I have made quite a study of it, and I have gotten a lot of figures from my brother, who is an engineer) is that the men, in most jobs, average only fifty steps a day of useful contact. Now, men can't be paid either for their danger or their waste steps.

Mr. Walker: That danger doesn't apply to domestic work necessarily. So I don't think that the building industry is as dangerous as coal mining.

Mr. Fuller: The point is, though, that with bathrooms, instead of a plumber standing on his head and putting formula pipes together, he can stand still and make bathrooms in line. He readily figures that he can be paid fifty dollars a day instead of twelve dollars a day, and work only three days a week and five hours a day, and turn out more and cheaper bathrooms for people who can consume them. That is the final argument, which is going to be the most necessary one to convince the labor unions. You will convince the individuals very rapidly, although not the labor unions, as unions.

Have you any questions?

Miss Moore: Well, I have been thinking about what I believe Mr. Walker and Mr. Hood said about the heat. I don't understand about the heat.

Mr. Fuller: Your air, instead of taking the heat off the heating element, enters into the rooms here. If there is additional heat coming through the walls, it would only be radiated; it wouldn't come through the thermostatic bottle wall. That is compensated by the regulation in the heat coupler. It is readily adjustable.

I have made a very definite study of the *harmony* of this. Mr. Corbett said I made no mention of the aesthetic. But the harmonic presentation here I adduce in this way: Taking a mathematical abstraction, you say a straight line is the shortest distance between two points. I could not make a straight line, but I can see that, in accordance with my intelligence, that would be the shortest line if I could obtain it. Now, if I make a straighter and straighter line, it becomes finer and finer, until finally, as I attain perfection in it, it is no longer there; it is an abstraction, or eternity.

But, without digressing from the truth, without diverting from the straight line, I can harmonically divide that; or else I can digress in relation, knowing that that was the truth, and this would be the minor scale. I can apply relatives as far as harmony is concerned without diverting from the truth, and make it harmonically feasible. Because it seems to me that, as I study it, all

around us are truths. Edison doesn't invent anything; he just discovers them. That is all that happens. They are just prosaic truths. And unless you are abstract enough to recognize prosaic truths, they are not there. So there is a very definite artistic conception of it.

Mr. Scarlett: Would it be possible to flood it?

Mr. Fuller: Well, in larger units, as far as the swimming pool goes, I have a larger residence where we have the swimming pool at the bottom. This is a ten-story residence with a small swimming pool and a gymnasium and running track around here.

Mr. Scarlett: Did you ever consider a tower dwelling of that plan?

Mr. Fuller: I considered the handling of my problem by controlling my area, going up and out. When we have a greater area to control, we join the two together, and you get the same effect as trees in a forest.

Mr. Scarlett: You could go on indefinitely up vertically, couldn't you?

Mr. Fuller: Yes. You can go to a tremendous height, as long as you adhere to the forty-five degree angle.

Mr. Walker: I would like to ask one more question: How much of a mechanic does a man have to be who lives in that house?

Mr. Fuller: It doesn't seem to me that he has to be any out of the ordinary mechanic—any more than my baby is; because she is a year and three-quarters and runs the Victrola.

Mr. Walker: I have a fairly well mechanised house of my own. When I first left the apartment to go to the country, I thought I was going to simple life. Actually, I have had to become more of a mechanic than I appreciated. I have gone into a great deal of thought as to the simplest sort of things, such as having three oiling points instead of six, and all that sort of thing. Even, at that, the amount of breakdowns during the year (that is, minor breakdowns which a man with some mechanical sense—which I didn't have when I went to the country, but which I have somewhat acquired—can fix) was quite remarkable.

I know of people who never would become even that much mechanically minded, even in this age. So that one of the things that I have found, looking at the thing from the standpoint of economy, in trying to build this mechanized house, is that I didn't allow enough space for people to work around. An expert mechanic can work in a small amount of space, but a dub has to have about five times as much space as the expert.

That is one of the things I was concerned about when I asked you if there was accessibility; because there is no accessibility to automobile parts for a man who is not an automobile mechanic. There are so many things that he has to take apart before he can get at the root of the trouble.

Mr. Fuller: Certainly, we will go through, as industrial housing develops, an era of trial—just as people did in the automobile business. But many lessons learned in the automobile business are going to be applied all the way in housing, and the period of trial should be very small in proportion. There is generally progress in everything. But, certainly, that is the order of the time that our minds must learn to compass the machines; and as fast as people's minds do compass the machines, the machines can then be saddled with the work.

The meeting came to a close at 4:00 p.m.

1 Meeting, Tuesday, July 9, 1929. Architectural League, New York (typescript by National Stenotype Service, N.Y.C.; carbon copy, 57 p.). BFA, *Dymaxion Chronofile*, 1929, Vol. 36.
2 RBF mentions certain differences between the updated drawings and the displayed model.
3 The text reads "in extreme lines," which makes no sense. Most likely RBF used the term "streamlines," a word to become most popular only after 1930.
4 The text reads "copper cubes"–analogously to (3) replaced by "copper tubes."
5 Original reading: "... as far as the velocity of the design is concerned..."–"velocity" replaced with "philosophy."