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# INTEGRATION OF SCIENTIFIC AND BEHAVIORISTIC APPROACHES TO MANAGEMENT

Dr. Harold J. Leavitt



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Reviewed by: Col Ingmire Date: 11 Sept 63

INDUSTRIAL COLLEGE OF THE ARMED FORCES

WASHINGTON, D. C.

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30 August 1963

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Washington 25, D. C.

# INTEGRATION OF SCIENTIFIC AND BEHAVIORISTIC APPROACHES TO MANAGEMENT

30 August 1963

COLONEL NORMAN: Admiral Rose; Distinguished Guests; Fellow Students:

Thus far in our study of the field of management we have observed that there is a wide variance in the views of students of the subject, and even practitioners, as to the most effective or the proper approach to management. How do we want to be managed, and how do we manage to get the job done?

To help us to reconcile these varying views, or principles if we want to call them that, and hopefully to come up with a more utilitarian approach, we have with us this morning, Dr. Harold J. Leavitt of Carnegie Institute who will speak to us on the "Integration of Scientific and Behavioristic Approaches to Management."

Dr. Leavitt, I am pleased to welcome you back to the Industrial College.

DR. LEAVITT: Thank you. This talk this morning, I guess, is in some ways a little easier and in some ways a little more difficult than it would ordinarily be because of what happened to you this morning. It's easier because I don't have to go through some of the basic notions of the network experiment because you've just experienced them. It's tougher because I suspect, from watching you, there are a lot of balls being juggled, all at the same time in most of your minds at this point and that it's kind of difficult to make order out of some of the chaos this morning. But let me take on the job of trying to organize a little bit for you some of the ideas that I heard, at least, in the sort of review and discussion of the group that I sat in with, and add a few ideas to those.

I guess there are probably two general points that I'd like to make at a very general level. I guess they're both kind of obvious, but they're both worth

making. The first is readiness - the business of organizing and managing as in most other areas of the world. You don't get nothin for nothin. That is, if you want to try to maximize certain kinds of things you're going to have to pay for it in other areas that may be equally desirable. I'll try to expand on that one before I'm through. Essentially, the notion is that it's very difficult to achieve the best of all possible worlds at no cost in management, as it is anywhere else.

The second idea, which is, I guess, equally obvious but which I'd like to push is the notion that no matter how much we like to believe that our individual personalities and our personal skills and our reasonableness are critical in determining what happens in the organizations that we run, the fact remains that the structure within which we work - the organizational structure within which we work - serves as a very significant control over what we can or can't do. That is, to a great extent the structure determines how things come out, just as much and in some cases more than, the personalities, skills or abilities of the individuals.

Having said those two things let me try to pick up from there and go on. Let me go on, really, by doing this; by trying first to report to you in some detail, some of the findings that have come out of research on the communications networks, of the sort in which you had a little experience this morning. But let me tell you about some experiments which were, in some senses, cleaner and purer and less complicated than what you had this morning, and therefore, in some ways less realistic, but it helps to isolate some things out.

This morning you had two or three things going at once. You had leadership in these organizations (writing on the blackboard). Some of you had been appointed as leaders. You had the communications structure, which was a given, and you had a rather complicated task; to some extent a complicated task;- this squares puzzle is not nearly as complicated as some of the problems we run into. But in

this sense it's complicated. Even if we gave all the parts to any one of you, it isn't clear that you could get it just like that. You'd have to work on it for awhile trying to figure out how to make five squares out of those parts.

Let's do this for the moment; let's knock out the complications and let's knock out the formal leadership. Let's talk about a situation very much like the one you were in this morning, except that the thing we're interested in concentrating on is the effect of the communications structure without any assigned leadership and with a very simple task. Here's the way we did it. If you don't mind, I'll assign the report on research for a few minutes, and then I think we'll come out the other end and start talking about whether or not this has any real relevance in the world.

We'll use the same three nets, now, that you fellows were in this morning. The first one, let me just call it "Star." Let me label the people "A" -"B" - "C" - "D" - and "E". The second one we saw is the "Chain." This is the same as the chain that you used; I just bent it a little bit (writing on blackboard); and we'll call these "A" - "B" - "C" - "D" and "E". The third one is the chain closed, a "Circle;" which, again, is the third of the three that you used this morning, and I'll label these too.

Now, we've decided to play games with these and to experiment with them over a large number of groups for a large number of trials and a large number of studies. And I might just tell you that these experiments have now been done in several countries, with several classes of people ranging from Dutch railroad workers to French nurses; including American executives and college students, with essentially the same results. So that, in some way within this fairly wide range the results hold up. You can have a good deal of faith in most of them.

Those are the nets. But we selected for early work in this, as I say, a

much more simple problem, and the problem was this. Instead of having a bunch of squares in front of you, what you had in front of you was a tin cup and in the tin cup there were five marbles -kids' marbles; a red one, a green one, a yellow one, a blue one and a white one. And you were all tested to make sure you weren't color blind. This was important. And the problem was for the group to discover that one color which appeared in all five cups. You see, this is almost a trivial problem. If I put the five cups in front of any one of you and said, "Find the color which appears five times - one in each cup," you can do it in a matter of 20 or 25 seconds. Anybody can do it; anybody with a minimal IQ could do it. You'd say, "Yes, there is a red one five times," or, "There is a green one five times."

We also introduced into these booths in addition to your tin cup with the five marbles, a little board on which there was a series of toggle switches. Over each switch was a color, and we said, "Now, when you think you know what the right or common color is, you flip that switch - the switch under that color - and that will turn a light on on the board in the next room. As soon as five lights go on, indicating that all five of you know what the common color is, that will be considered the end of the trial." And we tried to motivate the subjects in these situations competitively. We said, "Think of yourselves as being in competition with other groups to see how fast you can do this, and how accurately. And we're going to run this many times, so that, as soon as you've gotten the answer we'll pull these cups out and give you new cups and let you try it again, and then pull those out and give you new cups and let you try again," etc.

Now, in the first few trials, of course, it's going to take you awhile to do this. But what you want to do is get yourselves organized so that by the last few trials you can really bang, bang, bang away at it. That was sort of the instructional setup.

And we set up one other rule, which was that no message could pass more than one link. That is, if E wanted to get a message to B he could send one to A on one of his cards. But then A would have to rewrite it on one of his and pass it on, so that we could control the message count. I think this is what you did this morning. Okay. There's the problem. We said nothing about leadership; nothing at all. We simply took people as they walked into the room and plugged them into seats in the arrangement that you had this morning. And then we went to work with a whole series of groups in each case.

Now, you remember the question we were interested was, - the basic question we were interested in, and I guess the one you were interested in this morning, was, which of these three nets is the most effective for solving problems, other things being equal? You see, we've got people selected at random. Presumably intelligence and such are controlled by the fact that we've got lots of groups, people selected at random, so there shouldn't be any differences based on that. The differences, if any turn up, presumably should be based only on the fact that these things are constructed the way they are. They should be based only on the fact that you've got a particular communication system instead of some other one.

Well, now, that's kind of a simple question initially; "Which of these three nets is the most effective for solving problems?" But it turns out that it isn't such a simple question at all; it's a rather complicated question. In fact, if you want an analogy to worry about, consider three small manufacturing companies, for example, across the street. And suppose I tear up their profit and loss statement so you can't see those. And I say to you, "Now, I want you to go across the street; visit all three companies; they all make widgets; tell me which is the most effectively managed." You see, in some ways this is almost the question we are asking here; "What do you mean by effectiveness? What determines effectiveness? What are

the kinds of things you want to look for?"

In some ways we have begged that question here, because we have said to these men, "What you want to do is to work for speed; you want to see if you can do this as fast as possible." So, it was pretty obvious that one of the things that we wanted to measure here to determine effectiveness was speed. On the other hand it was also obvious that if one of these groups was faster than the other, but also made a lot more errors and also kept coming up with the wrong answers, this wasn't going to be a very effective group, and speed alone, obviously, was not enough.

So, one of the other things that hit us real quick was that one of the other things that we would have to do somehow would be to take account of the balance between speed and errors. And if a group was both accurate and fast, that was good. But you see, again, that probably isn't all there is to differences between organizations. If we went across the street to these three companies again; speed probably is equivalent to production per hour. You might find that one of these outfits is producing widgets at a great rate - a greater rate than the others. It might be that their quality is high. But you might also want to look at some internal policies; how do these outfits operate? And one of the things you might find, for example, you might be interested in the amount and kind of communication that flows through the organization.

In this case we could ask questions about the number of messages. When we ask questions about the number of messages or the amount of communication, what are the beliefs underlying it? The beliefs underlying it, I guess, for most of us, that if Outfit A, B or C can do this job as fast as the others, with as few errors as the others, but somehow with less talk, communication and writing, the less communication the better, to get the job done. This is one kind of standard. But this gets a little fuzzy too. Because, sometimes, if you remember some of the stuff that

you've been reading and listening, I'm sure in your course around here, the notion that sometimes pops up, at least, is the notion that it's not the less communication the better in an organization - not that proposition - but, the more communication the better.

And one of the things you have to worry about is, what do we want in these three plants across the street? Do we want just enough communication to do the job? Or do we want lots of communication because somehow we feel that's good? And if it's good, why is it?

Well, let me stop here and just tell you about these doubts on these three issues. We're not through, because there are some other kinds of questions you might want to ask. These things are not experimental; the results turn out to be quite clear, although the differences are small. This group turns out to be fastest, as most of you, I think, would guess. This one is second. And this one is slowest of the three, characteristically and regularly.

Now, in the job we're talking about it didn't take half an hour to do it, as it did with you this morning. Once these teams get warmed up and once they learn their own organization, as it were, they can do this whole job in something less than a minute - every group can. What we're talking about are very small differences between, perhaps, 40 seconds and 60 seconds between these two. They get good. Buzz, buzz, buzz, and five lights are on. It's a bang, bang, bang operation.

So, we've got these differences in speed. They favor the Star. If we look at errors - and we'll now ask the question, "Well, now, the Star may be good, but is it accurate?" - it turns out that there are no significant differences in errors. If anything, it looks like the Star makes a few less. So that, although we can't really say anything which is significant, we at least don't have any counter-evidence here. It looks like the Star is at least as accurate as the others. Okay,

so far we're riding fine. We've got an initial answer to our question; the Star looks like it's the most effective of these three for solving the problem.

Then you go to the message question. It turns out that if you do a little sort of abstract analysis of these nets, that under the rules that we had; the rule being that everybody had to come out with an answer, it takes a minimum of eight messages to get the job done in any five-man net. As the number of messages goes up the number of men does, but no five-man net of the 24 that you could name - and incidentally, these are only three of 24 possibilities that you can construct for five men; the number goes up very rapidly when you start talking about 10, 15 or 20 men; the number of possibilities is tremendous. But, any of these can be done in eight. And sure enough, what happens is, that the Star averages - and I'm talking now about the last few trials, after they've warmed up; in the first few trials there are messages in all of these nets, flowing all over the place, as were yours this morning; - this one ends up with an average of a little over eight, but darn close to the minimum possible. This one ends up with an average of a little over nine, and this one with an average a little over twelve. There's a lot of talk in that third one.

So, now we have a fairly clear picture still. That is, when it comes to speed the Star is best and the Circle is worst; when it comes to errors the Star is either at least as good as the Circle; when it comes to messages the Star is best and the Circle is worst, if you like as few messages as possible.

Now what do we do? We have the answers to the questions and we pack up our bags and go home? The answer, of course, is not quite. Because one of the things you begin to ask, if you're trying to assess the effectiveness of these structures, is probably, again, the kind of thing you might ask in the three plants across the street. What's going on here? It's not enough to know just the output sorts of

things like messages, speed and errors, but what are the processes? How are these things organized? Do people know their jobs? You know, if you knock on a consultant's door and ask him to come in and assess your organization, and he sends a bunch of interviewers and investigators out, one of the kinds of things the interviewers will do will be to sit down with the people in the organization and say, "Tell me what your job is. Tell me who you report to. Are the lines of responsibility and authority clear? Are the communication channels clear? Do the people know their jobs? And there is a whole series of questions of that sort.

So, we might talk about these as kind of work processes, and the degree to which they are organized and understood. And you can get that. You can get it by interviewing the people in these nets after the experiment is over, and you can also get it by reconstructing the messages. Because they'll tell you something about the order, since they're numbered and coded. So, you can figure out just about what happens in these nets.

Now, if you look at the Star, how do you think it will work? That's a rhetorical question for the moment, but we'll talk about it later. However, you can guess, can't you? Within very short order, in just about every case, the Star resolved itself into a process like this; the bell rings to start the experiment. A sits there quietly and waits, except that he gets four blank cards ready to write answers on. E, D, B and C, meanwhile, have grabbed cards, are writing the names of their colors on them and are flipping them in to A. As soon as he gets them he adds his own information to them. He scans the whole process. You see, these fellows can't pass marbles; they can only pass messages about marbles. He scans the whole set, he works out the right answer, he scribbles the answer on the four cards, he flips it out with both hands to his four men, they then flip their switches and the job is done. It's regular, it's consistent, it's predictable; it's an in-out

organization. There's nothing ambiguous about it at all. Okay?

It's clear on the procedure, and you can understand why; and I suspect that if any of us sat down and tried to plan on how this ought to be operated, this is probably the kind of plan we'd generate. Let me just call it "in-out." And it's perfectly clear; clear in this sense; that if you grab D after this experiment is over and say, "Now, just what was your job?" he can tell you exactly what his job was. He says, "As soon as the bell rings this is what I do; I wait for an answer, and then I flip the switch." If you ask A he can tell you exactly what his job is, etc. It's clear; it's unambiguous as can be.

Further, if from the questions list you ask the leadership question - you see, we haven't appointed leaders here as you had this morning - we just asked afterward, "Did your group have a leader? If so, who was he?" And the answer is just about 100% A, with a few of the exceptions that I saw a little bit this morning, of the guy in A's position being modest and disclaiming leadership. But if you sort of pass by that stuff, this is the way it comes out. It's clear, unambiguous, sure of itself; everybody knows his job. If somebody died in this organization and you had to replace him with another man, you could train him in about two minutes by telling him exactly what he was supposed to do.

If you look at this one it turns out that it's a little less clear. But it is fairly clear. What usually happens in this after a very few trials is that it operates in a two-stage hierarchy. B and C send their messages to D and E, who add their information to it and send it up to A. A makes a decision and sends it down to his middle management, who then pass the information on down - bang, bang, bang, bang; usually.

Now let me call it in-out again - in-out; two-stage, with some variations; variations like this, for example. Occasionally C will be a very slow guy. And

B, by dint of the fact that C is very slow in writing messages, information gets all the way around to B before it comes up with C. Okay? In that case, B is apt to end up in the leadership spot, and he's apt to be recognized as the leader. That is, it will go off-center by one because of some peculiarity of one of the members. If you ask the leadership question it comes out about 85% A; and the reason for the other 15% is because sometimes it's B or E. And often, if you ask D and C this, they give you a kind of vague answer. They'll say, "Well, I know I got my answers from E, but I know that somebody upstairs was making the decisions and I'm not quite sure who." They aren't quite certain of what was going on.

On the other hand, it's a fairly clear setup; fairly reproducive. Now, what happens with the Circle - and this is a more interesting question in some ways. How the deuce does that one work? The answer is that in most cases it works in no clear way that anybody can specify. This one would drive an industrial engineer mad if he watched it in operation. You can see how it might work. One way that it might work, for example, is to have B and C simply close this, and then it would be just like this net and would operate the same way; or any other pair could do that and end up with the same hierarchy. But that's almost never done.

If you reconstruct the messages, or if you interview people afterward - the interview is sort of interesting here. If you grab D and say, "How did your organization work? What was your job in the group?" The response is apt to be - not hostile, exactly, but sort of, "What do you mean what did I do? I sent messages." And you say, "Well, to whom did you send them, and in what order?" And he says, "I did what was sensible; I sent messages to my left when I got information from my right, and I sent messages to my right when I had information from my left, to transmit." And I'd say, "Well, now, did you get the answer?" He says, "Sometimes I got the answer and sometimes I didn't. If I got it myself I passed it on, and if

somebody else sent it to me I passed it on in the other direction."

You try to reconstruct this from trial to trial, even within the same group, or compare group to group - and as I say, it's an industrial engineer's nightmare because there is no clear consistent method; there is nothing like this that you can finger and say "Good." What happens is that when the bell rings he sends this way and he sends that way and then in the next stage they switch. This almost never happens. Usually what happens is that there are several people who come to answers more or less simultaneously and not necessarily the same people in each trial. So, from one perspective at least - let me just write the word "mess" here to indicate that there is no clear, orderly system that you can isolate in most cases, except in those occasional cases when this group operates like a chain. And that's a very rare phenomena. And this goes on for 15 trials.

So, the work processes are not at all clear, and if you ask the leadership question in this one, the most common answer you get is a question mark on the question. People say, "What do you mean, leader; you didn't appoint anybody. We don't know what it means." Okay?

Now, suppose we were to stop there. If we were to stop there, I think the answer is perfectly unambiguous, isn't it? Our original question was, "Which of these three nets is the most effective?" We set up a list of the standards of effectiveness - speed, errors, messages, clarity of work processes, clarity of leadership - because, I think most of us have grown up in the belief that it is good for the groups to know what their leadership structure is; it's good for work processes to be clear and well-understood; it's good to have as little information as possible - as little communication as possible, consonant with getting the job done; it's good not to make errors; and it's good to be fast - at least in this setting. And by all of these standards the answer is quite clear that the Star is the best of

these three nets, and the circle is the worst. That is, if you stop there.

And, if you were raised in one school of management that is where you'd stop. I don't know whether this makes any of you unhappy, but it makes me unhappy. And it makes some of us who are doing these experiments equally unhappy. Since, here we were, sort of social-science human relations types, and what have we got? We've got a Star with a tight central leader, a real authoritarian-type structure, apparently, in which one guy does all the deciding and the rest just report in to him. And it comes out best; it's great; it really gets the job done. Well, this, of course, led us to worry about this, and not only to worry about it, but to think about questions like this; "If you took an old-fashioned industrial engineer into these three plants across the street, with you, it's probably true that these are the questions he would ask."

But suppose you didn't? Suppose, instead, you took one of the sort of social scientific types that have appeared on the horizon in the last 16 years or so? Suppose you took Ben MacGregor or Lickert, or Eigner (all phonetic), or some of the other fellows I suspect you've been reading, and you walked into the same plant with them, or the same set of plants? In fact, I might tell you I did this when I was a graduate student at MIT. There was a Department of Business Administration on the first floor and there was a Department of Social Science on the third floor. And I took questions to both. And it literally would happen; if you walked into one of the local plants in Cambridge with some of the boys from downstairs, these are the questions they'd ask. They were pretty doggone skillful at asking them and in assessing them.

But if you walked in with the boys from upstairs they wouldn't look at these things at all. One of the very first things they'd look at would be - as you might guess - morale. How do people feel around here? As you walk into this plant, what

do the signs look like? Do the signs say "NO SMOKING ON PAIN OF DEATH?" Or do they say, "PLEASE DON'T SMOKE."? If they say "PLEASE DON'T SMOKE," this is better; it's more human relations, etc. Do the people seem to be happy about their work, or don't they? If I walk into this plant and I find four guys sitting in an office with their feet up on the desk, sort of arguing with one another - and I grew up in this tradition - what's my reaction? My reaction is that these guys ought to be working, and they're not. If I walk in with the boys from upstairs who have the sort of social-scientific view of the world, they'd say, "Ah, this is good; lots of communication."

Well, speaking in those terms, then, you can begin to ask some other kinds of questions that belong, I guess, along this line, and one of them is the morale question. Well, we haven't said anything so far, about whether or not people are happy in these doggone organizations, and so we now ask it.

At the end of this experiment we set up a little questionnaire that said, "How did you like your job in the group? Rate it from 1 to 9; 1, this is the greatest thing that ever happened to me, and 9, this is the worst thing that ever happened to me; that sort of thing which you've all done, I'm sure. We average the results and what do we get? What we get is; that this is by far the happiest organization - the Circle - and the Star has the lowest morale, and the Chain is in between. So, we get a reversal[9]. But then, depending on kind of what school you grew up in, and what you believe to be important, you either treat this seriously, or you can discount it. You can say, if you're a good, hard-headed industrial type - or organizational type - you can say, "Morale-schmorale, so they aren't happy; but they're working. And they're getting the production out and that's what counts." But if you're the more social-science or human relations type, you say two things.

You say (1) "This is a value; why shouldn't we have high morale in America in

1963?" And, "Why should anybody have to work in a situation in which he's miserable?" Well, that's sort of a value answer. But the other, which is a kind of hard-headed one, says, "Well, if morale is low, doesn't this mean that sooner or later this organization will blow up?" And, "Aren't we getting just a short-run reward from this thing because these people are miserable and sooner or later they're going to hit the brakes, or some such thing?"

Incidentally, this was an argument that we were able to use for a long time until a friend of mine out at Pace Institute ran these same experiments - running them for 60 trials instead of 15, and at the end of 60 trials the morale was still low over here, but productivity was still high. And, at least within four times the life span they hadn't hit the brakes yet. Maybe they would. And there are probably things you can do to compensate for it.

But the fact remain, in any case, that by this other criteria, the Circle is better. And if you push this a little further and do it not by total group averages but by positions - which we were doing in the group I was in this morning - then something else kind of interesting turns up. It turns out that not only that this has the highest morale in general, but if you compare the morale of this guy with the morale of this guy in a somewhat different position, with these two, those four and these two, etc., what do you think you get? Who is the happiest man in the whole organization? A, in the Star. Sure. The reason this group is low is because he's dragged down so much by the other four. But on the average, and consistently, A is having a hell of a good time. If you ask him why, he says, "Well, I'm busy; I'm powerful; I'm making decisions; and I'm telling people what to do and think."

And second highest comes about here. He's about tied with these five, all of whom are having a fine time. Then come these two middle managers. Well, that's all right; they've got a good job; they don't mind it. They're still telling people a

little bit about what to do even though they aren't making many decisions. Then come these four characters who are down pretty low. And then right down at the bottom of the heap come these two men. And, in general, they are pretty miserable about the whole thing. And this turns up in a lot of ways; it's almost visible. I thought I could see some of it this morning as I watched you. They do a little more than anybody else. They're hard to catch when the experiment is over. Characteristically, when you're doing an experiment like this, using college students, when the thing is over the boys hang around and say, "Why did you do this and why did you do that?" Characteristically these two guys say, "Give me my dollar." And they disappear; they don't want anything more to do with it.

In fact, there's a nine plus here. And, in fact, there's a plus in this one in Part Two. But one of the reasons that you get more than eight messages here very often, is because these guys tend to write irrelevant messages. They have nothing to do, so they'll write a dirty story or something. Well, if you talk to these fellows it turns out that they have something to say that's sort of interesting. You say, "Why are you so unhappy?" And they tend to say something like this; "Well, look; I'm a responsible guy. I'm perfectly willing to throw that switch that says, 'I, Joe Blow say that red is the right answer. I don't mind doing this; I'm a good team member. I'm willing to do my work. But in this lousy job that you have given me, what happens? What happens is that somebody sends the message down and eventually E sends it to me. And the message from E says 'Green is the right answer.' Well, I don't know E from a hole in the wall and I'm not quite ready to flip that switch yet that tells you that I, Joe Blow, think that this is so, until I know a little more. And so, in one of these early trials, perhaps, I send a message back to E, saying, 'Please verify.' I want to know this.'"

And E, characteristically, writes back and says, "Look, buddy, I don't know

any more about it than you do." And you can understand why this can cause all sorts of things. So, this makes E unhappy. He says, "I don't like this; it makes me itchy and uncomfortable to have to do this without knowing what I'm doing." But it's serious. The way he usually resolves this - at least in this setting, is - he doesn't quit; he doesn't refuse what he usually does is to do his job. That is, he does flip the switch, but he does it unhappily and with some conflict. And apparently, the way he resolves it is to withdraw from the whole damn thing. What he does is, he sends the messages in and then he doodles, or draws pictures, or writes dirty stories, and then when the answer comes down he flips the switch and goes about the more important business, which is drawing the cartoon he's working on.

Curiously enough, this sometimes shows up in a kind of interesting way, you see, because it is true that every once in awhile E will send down the wrong answer. Now, in most cases D has no way of telling whether it's the right answer or the wrong one. But in one case out of five, if D looks into his own cup he can see that it can't possibly be green - that is, the right answer can't possibly be 'green' because he doesn't have a green marble. And if he doesn't have a green marble, something is wrong. Well, what seems to happen here is that Ds just stop looking in their cups. Maybe he does and maybe he doesn't, but it's the stereotype of the apathetic worker; they do what they're told. If E says green is the right answer, D flips the switch under green and goes about his business, not bothering about whether it's in the right cup.

It is kind of reminiscent of the things you hear, especially from people in management - I don't know if you hear it from the people in the military or not - about how workers ain't what they used to be; they don't give a damn anymore or they don't take any pride in their work. Well, it's true, D and C in the chain ain't what they used to be. They don't take any pride in their work. But appar-

ently the reason is not that they were different people to begin with, or because their parents were bad, or because they had a progressive education, or anything else; it happens because this organization breeds this in them within ten trials. That is, the position they were in in this structure makes these kind of guys. I try to put some emphasis on that. We're talking now about MIT undergraduates and some other types who, perhaps, got more irritated by this sort of lack of responsibility and the like - or monotony or what-have-you - than some other people might get.

In any case, we turned these guys into apathetic workers within ten trials. But, so far as we know, they were no different from anybody else when they started. And if we had put them in the A position they would have been just as happy and responsible as A was. Well, that's one thing. So, we've got the morale issue and the morale issue gets some reversals and sort of complicates matters. And now you have to sort of say things like, "Well, now, if we want all these things maybe we're going to have to pay the price, to some extent, in morale." And that makes you a little less comfortable.

I want to give you two more things - and I'd better rush if I can, because it turns out that there were two other pieces of data that became interesting. One was this, and it happened accidentally. Let me call it "creativity."

Again we go back to the three plants across the street. Suppose Plant A were making more widgets per hour by far than Plant C. And suppose we could also show that if and when there were new technological developments, or, if and when widgets were redesigned it might be C that would redesign them before A, then we might get interested in this, mightn't we? And suppose we could see that even though the productivity of the first plant was higher than the third plant; that somehow the research efforts of the third plant, or the innovative effort or something of this

sort - more energy was going into that end so that it didn't show up in productivity, but it might show up in the long-run in the form of new ideas or modified widgets or changes in materials or some other kind of things that might turn out to be pretty darned important - well, it turned out that we ran into something like this quite by accident, and it operated in this way.

Let me just give it to you in narrative style. These were initially these bright young MIT undergraduates. And along about the sixth trial - imagine yourself again in D's position now - along about the sixth or seventh trial when you've been doing this and you've got yourself pretty well organized, you're sitting there between trials and you can't do anything, and so you're just twiddling your thumbs and thinking. As you sit there you kind of look into your cup and you say, "Gee, five colors in my cup." Then you look at this board of toggle switches and you see six toggle switches; six switches, five marbles; six switches, five marbles. And then a little light goes on in some of these guys' heads, and they say, "By golly, I've got an idea. I've got a creative idea." This is defined as creativity because we didn't think of it, and that's a good operational method.

The idea is this. He says, "Look, here I'm sitting, writing down the names of five colors on one of these cards and sending it in. But since these damn-fool experimenters are only using six colors in all, I don't have to do that; all I really ought to do is send in the one color I don't have." Now, if you think about this, it's true. That is, if I look into my cup and see the five colors I've got, and then I look at these six toggle switches, the one color that I don't have, if I send that in to A and if everybody else sends in the one color they don't have, then the color left over on A's board will be the right answer. This is true. Okay, the method changes the light.

He's sitting there thinking about this. If you want to work on it sometime,

go ahead, but it's true. He's sitting there concocting this rather complicated idea. It's a little vague in his head; he can't do anything about it yet between trials; but really what he's thinking is, "Gee, this is really going to save time - a tremendous amount of time because we're only going to spend 20% of our time writing. If each of us sends the one color we don't have, instead of five, it's going to be a real imprtant method of improvement and it will cut down our time pretty rapidly. True; okay. You're clear on the idea. Accept it from me that it's true.

The next trial starts now. You're now ready for trial eight. This group has done it the last time, let's say, in 65 seconds; the time before that in 70 seconds. They've got a real good bang, bang organization. Okay; trial eight starts. What does E do? What E does is, he grabs a card and he writes on it, "I do not have blue." But then, he knows that A isn't going to understand what the hell that means, so he writes an explanation. He says, "Now, get everybody else - this is so vague in his head, that he has got to be succinct; he has to write something like - "Get everybody else to send you the color they do not have and the left-over one on your board will be the right answer." Okay? Something like that. How long does it take to write this? How much longer than to scribble the names of five colors? Four times as long, maybe? Okay? In this tight little world, you see, in which every tick of the clock means something.

So, that's what he starts to do. He grabs the card and he starts writing. Now change hats. Now you're A. You've been running a real bang, bang organization. Within 15 seconds, now, because these guys have gotten sharp at this, E, C and B have gotten messages in on your desk; you've got your four blank cards ready - they are all ready to go, and nothing comes in. You start tapping your foot, and the clock is ticking, because it takes him 40 seconds to write this, and maybe you

send an extra message down. It might say, "What has happened to you? Are you dead?" And, depending on who B is - now, there are variations here. Here personality does play a part. If D is a stubborn guy he knows he has a good idea by the tail and he just doesn't care. He's going to keep on writing. But he finally gets it written out, he slips it in to A and A breaths a big sigh of relief when he sees this thing coming to him, until he looks at it. Well, okay; you can guess the rest of the story. This throws A into a tizzy because he now has to make several decisions.

First of all, he doesn't understand what D means when he says "Make the marble blue." So, the choice now is whether he should spend an extra 10 or 15 seconds trying to decipher the rest of this thing which was written in small print on both sides of the card. Okay. Characteristically, the upshot of this - the outcome - is that A tends to reject this idea and it's generally thrown out of the system and does not become an operating part of the standard operating procedure.

And then, A writes back and says, "Stop rocking the boat; we're doing all right. Stop sending me letters." And sometimes this will end up in a very peculiar form, because there is no authority in the structure, you see; A is not the boss; A does not have rank over D or anything like that. So, if D still thinks it's a good idea and he's an independent cuss, what will happen is that the organization will sort of limp along for the rest of the experiment with D still insisting on sending the color he doesn't have.

In any case, then, this is what we saw most often. The creative idea tends to be rejected in this net and it tends to be accepted in this net, and becomes standard operating procedure within a very few trials. Now, that means that I really shouldn't write this, because we have no reason to believe that any one of them has this idea occurring more frequently in one net than another. What we

really ought to write down is the acceptance of a creative idea; of this kind of creative idea. And it's on the acceptance that the Star turns out to be four and the Circle turns out to be pretty good. And this one, again, as I recall, turns out to be vaguely in between. Although, these differences are for real and these two are not.

So, now you've complicated life even further. Now, on this kind of bit you go to those three plants across the street and you've got the possibility that one of them - and not necessarily the one that is most productive in this sense can turn out to be more accepting of innovations and have higher morale.

One more item. There were some bright young men at MIT at the groups' networks laboratory who eventually got placed in the laboratory for electronics, who ran these experiments again, with some theoretical questions in mind, and they did the following. They ran the Star and the Circle, and they threw away the toggle switches. Forget about those; they had some sort of hand signals. The ran the two nets in precisely the same way. They ran them for 15 trials just as we did. At the end of the 15th trial, this was slow and this was fast (writing on blackboard). As you might guess, the Star net had come down to a pretty good level. The Circle net had come down to a little less good level. But they didn't stop there - this was the 15th trial. They ran 15 more trials. But they made the following change and they didn't tell anybody about it until they did it.

On your 16th trial, now, if you're sitting in this net you look into your cup when the man hands it to you, and instead of having five nice, clean, bright, practical colors - red, white, green and the others - you look into your cup and what you've got is five shades of khaki; and not only the five shades ranging in brightness, but five sort of mottled marbles, with a little yellow, or white, or gray, and they're not difficult to distinguish. These are what are called "noisy

marbles." You look at these, and if I gave you the five cups, again any one of you, you could say, "Yes; this one is identical with this one, and this one is identical with this one, and this one is identical with this one. But you see, what you're lacking now are names for the damn things. We can say to a guy, "I've got a red one and a blue one." But now what do we say? "I've got khaki one that is sort of a little darker. It's a little smokier with a few more mottles of white in it than the next one." And so, you begin to get some strange messages. And as you get them the time goes way up. And you keep on writing messages, "I've got one that's sort of smoky-looking; it looks a little bit like a military uniform, but not quite, and something or other. I've got another one that looks this; another one looks like that;" and you get a message back real quick, "What are you talking about?" So, in general, you see, messages begin to flow; time is consumed, and people have a terrible time naming these things.

What was really done was to introduce a new problem. As soon as these guys can agree on what the color of these damn things is; call this one an X; this one a Y and this one a Z, then they're all right; they're back to the old problem. But the question is, "Can they develop a mutual understanding to settle upon some kind of a code which they'll all agree on?" The answer, apparently, is, that in the Circle they can't. At least,within 15 trials or so in the Circle they've got this thing back down almost to where it was before. In the Star they're having a hell of a lot of trouble, and at the end of 15 trials they're almost taking as long as they were over here.

Well, what do you call this? Let me call it just for shorthand and not because it's a very significant word, "adaptability," down here at the bottom; flexibility, dealing with a new environment, new problems, a novel situation - I don't care what you call it; there it is. It's the problem of dealing with this sort of vaguely

unstructured, uncoded situation. When you look at that one - this was done only with these two men - this one turns out to be not so hot; this one turns out to be a good deal better. And there you are, gentlemen. We started out to ask which of these nets was the most effective in solving problems. And what we come out with is a typically academic answer; the answer is, "It depends." But, you can say what it depends on. What it depends on is what kind of criteria you're carrying around and what you're willing to pay. What's the currency you're willing to spend and what's the currency you want to put in the bank?

If you look at these - and this is an opinion now; it has nothing to do with the data - if you look at that first package; things like speed, errors, messages, work processes, leadership, it's quite clear to me, at least, that these hang together. These are kind of emphases on order, on system, on clarity, on organization, in the industrial engineering sense. And in all those respects there is no doubt that if those are the standards that are important, this Star central decision-maker, single decision-maker kind of net, at least for these classes of problems, seems to work beautifully. But if, somehow, the kinds of things you're trying to maximize are not known, but things like acceptance of new ideas, morale, adaptability and changing problems, then this sloppy, high communication organization in which leadership is not so clear and in which people can't exactly tell you what they do every day, except that they talk to one another, then that one turns out to look pretty good.

But if you want these things, at least within these experiments, it looks like you have to pay for them with these. That is, that you have to give up some order, system, neatness, clarity and tightness. On the other hand, if you don't really care about whether or not these guys are creative, or whether the organization changes; what you're interested in is whether it will do a bang, bang, bang job on

a problem which you can specify in considerable detail and in which you know just what outcomes you want. Then there isn't any doubt about which is better. No - these are games. We're talking about experiments and we're playing games with the students in laboratory situations. And when you start trying to generalize this to the real world, even when you start generalizing it to the extent that you generalized it this morning, by introducing factors like leadership and by complicating the problems in the way you did, some new kinds of things enter. But at least at the moment, it seems to me what we can say is that if you play games just with communication structure, and just vary it, one of the things that hits you is that the structure effects what happens in a very clear way.

It doesn't matter who the hell you put in the A spot, he ends up as leader. It doesn't matter, within the limits that we know, anyway, who you put in these spots; they end up being pretty miserable because the structure dictates it. So that, if you play games with structure you can show that certain kinds of structural form will tend to produce more operational effectiveness against these kinds of standards than other organizational forms. If you play games with this organizational form you can maximize these standards. And if you play games with that one you can maximize these. But at least at the moment, nobody has a very good solution to the problem of how you maximize both simultaneously.

I think it is time for us to take a break.

QUESTION: If you took D in the Chain after he was thoroughly disgusted and put him somewhere else, how would he react?

DR. LEAVITT: I can only partially answer that, but I can give you some data because there are now some hard data on it. I could guess about that one, but rather than do that, let me tell you about something that's related to it. If you

train a group in the Star, for 15 trials, and then break the whole thing and change it into a Circle net, two important things seem to happen. One is, their morale goes up; everybody's does. The other thing, however, is that whereas ordinarily if a group is raised in this net they organize in what I call a messy way. If they've been trained in this one and shifted to this one, they run it like this one. Are you with me? With one significant change. That is, the guy who was in the A spot here is never the guy who is in the A spot after that. They throw the rascal out.

If you do it conversely; that is, if you train people in the Circle and then put them into the Star - I can't answer the one about the Chain; I just don't know the data - whether it's comparable or not - what you find is that this is a way of driving morale down below zero. In a sense, your saying, "People raised in something like a democracy put into a tight and restricted situation just get miserable as can be." But I think you'd have trouble bringing this side out of it. It would take a little while.

QUESTION: Doctor, what happens if you increase the number of players?

DR. LEAVITT: I wish I knew more about that. We don't really know very much. But you can see where the complexity of some of these problems would get very great if you started adding folks to this. You'd soon get into an overload situation.

QUESTION: Do you have a limitation on that?

DR. LEAVITT: I have no magic number; for the following reason: Because the problem is important. The task that you're doing is important. If we're playing the marbles game, I think for most of us you could add five more men or so without very much trouble. But if you're playing the square game in which the decision isn't trivial and you bring in more partners it makes it very rapidly more messy. Then my suspicion is that you couldn't handle very much more people.

You're kind of getting at the old issue of a standard control about which we

were talking. My only concern with the standard control notion is that the people have set it up as a kind of magic number. My guess is that it shouldn't be treated as a magic number; that the question of how many people can report in ought to be a function of two other things; one is the task, and two is the people. And if you play games with tasks, so that you're dealing with more complex or less complex ones, and if you change the IQs or abstract levels of the people, you can change this manner of control very radically.

QUESTION: Is there any advantage to initially designating a leader? That's a good question, and I don't know the answer. My guess is - well, advantage in what respect? Suppose we designated a leader in the Circle. Then, in all probability if A had been designated the leader, the Circle would often, at least, migrate toward this. So that, it would run this way. Okay? Is that an advantage. It kind of depends on which of these things you want to try to get.

If the leadership thing weighs heavily there's a tendency to push the circle into the more single decision-maker form. And if you push it into the more single decision-maker form you'll probably get better productivity in these kind of things but you'll lose some of this stuff. Presumably, for example, the DuPont Corporation is set up, the top of it, with an executive committee in which the president has just one vote. Now, he's still the president, and it's not clear that his vote is bigger than anybody else's.

Nevertheless, apparently they have worried about it, trying to keep this as open as possible; I gather because they are probably concerned at the executive committee level with these kinds of issues. You see, what we keep getting into; we get into the question of the tasks that people are going to do. If it's *a task* in which it's quite clear that these are the things you want - you want people to turn out 100 widgets an hour, then that's what you want. Then you can answer the sort of

question you're asking, one way. That gave the leader.

If you're trying to get these kinds of things, my guess is that you'd want to keep authority differences minimal = as low as you could get them.

QUESTION: Would you comment on the effect of where the players are assigned different specialties and these specialties are required to arrive at a common solution?

DR. LEAVITT: It complicates life. I think that the principle would still hold. That is, if information from several sources is required to arrive at a common solution, and what we're really talking about is a novel solution in a novel setting, then my suspicion is that it won't make any difference. That is, it won't change the general effect if you specialize in knowledge in here or in here. I think I'll have to make a kind of little speech for just a minute.

We've been talking about structure - communications structure. You've raised a question already about two other things. One is task; you're talking about the relationship between structure and task. Another one is, the quality of the people. Another is the sort of state of technology; the kind of tools that are available. Now, I know I'm wandering from what you raised, but I think I can clarify some things if you look at it this way.

In the experiments we've been talking about we've been talking about the relationship between structure and task. If you manipulate the communications structure what effect will it have on you? Usually, when we talk about organizational problems we tend to think of organization structure as though it were the organization. What I'd like to suggest to you is that it makes some sense to think of another kind of model. Structure effects the way a job gets done. What I've suggested here is that this kind of a structure looks like it's pretty darn good for what you might call "novel, unprogrammed paths." Whereas, that kind of a structure

looks pretty good for relatively rote and routine program paths.

Now, one of the things that would be reasonable for you to raise, and I suppose somebody will, suppose you change people? Wouldn't that have some effect? The answer is, "Yes." If we purposely sought to select people for these positions in the Chain, who can tolerate monotony and were't particularly ambitious, then that would make it possible for some of this to change. On the other hand, suppose we could come along and take this noisy marbles task, and suppose we could develop some kind of a new tool that would make it possible for people to code noisy marbles easier, then if you started playing this game it would turn out that the technology would effect the structure and would effect the task.

It's a kind of key point and I'm making it very badly. But, the key point I'd like to make is that you can never talk, to my mind, about organizations without worrying about the interrelationships that all four of these contain. If you start playing games with an organizational structure like shifting from this to this in order to get a job done more effectively, before you know it you've got problems with your people that you didn't have before. If you take a tight structure like this and you open it up into a more "democratic" structure and some people get unhappy or there are some people who can't handle this very effectively, you've got to change it.

If you start playing games with people, like running training sensitivity programs and encouraging them to talk more openly with one another, and then you put them back into a Star structure, it won't work. Because, start doing things to people here in order to get the job done differently, and the structure changes on you, or there's pressure on the structure. Somebody comes along with a computer in his pocket that didn't exist yesterday. And some problems can be solved differently from the way they were yesterday. Before you know it you start out by saying, "Well,

let's just bring in a computer to help our EDP because what we're interested in is the relationship to get our job done more effectively. But before you know it, the structure is changing on you. Because, when you've got this EDP there are some decisions you can make and locations that you couldn't make before. And maybe you're going to move away from the Circle and toward the Star.

Maybe, now, one guy can sit in a position in the organization and make decisions that he couldn't possibly have made before; that he has data and information that he didn't have before. Suddenly you need different kinds of people than you did before. Because, when you've got these kinds of tools you need people who are skilled in using them. Maybe you need fewer people; maybe you need more; maybe you need different ones. So, any time you start manipulating any one of these in order to get this job changed, you're likely to have negative or positive, but unforeseen effects on the others. And when you start worrying about managerial jobs one of the things I think you always have to worry about is, "If I change one of these in order to improve the way the job gets done, what's going to happen to the others?"

Now, having said that, and really, it's not relevant to anything, I'll stop and let someone else ask a question.

QUESTION: Have you studied any variations of the Star, in which you permit cross-communication?

DR. LEAVITT: There have been some. It's awfully easy to think that one of the things we can do here is to do something like this and get the best of both possible worlds. One of the problems is that there is a tendency when this happens, for the thing to migrate toward a centralized system. That is, you'll get informal communication across, but generally, what will tend to happen is that movement - in these experiments at least - toward the use of this as though it were a Star. It's just doggone hard to get the best of both worlds, to shift from one to the other.

QUESTION: Doctor, what is your theory as to why the Star network didn't quickly come up with a code system which you've done with this obvious lead?

DR. LEAVITT: Well, I think it's the same sort of reason, perhaps, that some of you saw this morning, where all the parts were shipped to A. When the decision is relatively trivial here - I shouldn't say trivial - when it's clearly within A's capacity, then A becomes a switchboard, a decision-maker, or what-have-you? When you start shipping him lots of pieces and he doesn't know exactly how they go together he becomes a bottleneck. And I think one of the reasons that the noisy marbles thing works the way it does is because now he becomes a bottleneck; not because of his own wish, but because he is trying now to resolve differences and to arbitrate, to get everybody to agree on what these doggone things are, and everything has to flow through him.

So, he has messages backed up. He has a message down to E saying, "Have you got one that looks like such and such?" And E comes back and says, "What the hell is such and such?" And meanwhile he has sent the same message to B. This is what you see. And you see A almost going into panic after awhile, because there's so much for him to handle, of a different sort. You see, as long as the thing is tightly organized and programmed, and it's within the capacity of all these people, then this kind of net is chronic. And that is why I think in the history of management this sort of thing is associated with industrial engineering and scientific management.

If you really carefully plan and program everything you want to do, and you can specify just what you want to do, and you're pretty sure that it's within his capacity to do it, you specify what each of these guys wants, then this sort of system will work out beautifully. But the minute you kind of blow the thing up by introducing uncertainties, new information from what's there before, complexities that

didn't exist before, then this whole thing is likely to go out of whack.

QUESTION: What happens to the Circle when you introduce cross-communication? I assume that would be like introducing a committee in bilateral terms.

DR. LEAVITT: When you fully connect this thing so that you have ten channels, for example, what happens is this; that it operates kind of like the Circle except that there is one problem. That is, that they have an awful time getting organized; they're very slow getting started, which is perhaps what you might expect. Because, you see, included in this one as we've now drawn it, are all 24 possibilities. There are 24 different organizational forms existing here and it's as though these guys had a terrible time deciding which one to use. So that, for a long time it kind of moves along at a very slow pace and then it begins to pick up as they accept one or another of these organizational forms.

Usually, as I recall, they will - no, I guess this one stays disorderly too; they don't usually get themselves organized.

QUESTION: Dr. Leavitt, do your network theories also apply to, say, national organizations and branch offices around the country, and a national headquarters located at one point? Can they substitute for the symbols A, B, C, D, etc?

DR. LEAVITT: I think, although that's a pretty big jump - now you're asking me to stick my neck out on some opinions on things, and I'm perfectly willing to - I don't care whether A, B, C and D are individual units. I think when you start getting units you get new complexities of what happens within units. But essentially, I guess I'd argue that relationships between units are about equivalent to relationships between individuals on this kind of thing, and the same kind of general notion prevails.

Now, let me just say again what I think the general notion is. The answer to the question, "Which organizational form is most appropriate?" has to be predicated

very heavily on what the mission of the organization is. And I can say something about that. When the mission or the task is structured and well-programmed, then there is some sense to the centralized - how shall we describe the whole class of things in there? - I don't want to call it autocratic because that then implies that this guy is an autocrat; it's a centralized single decision-making kind of organization - top-level decision-making. Let me just say "centralized decision-making.

When the task, however, is ill-structured and novel, then there are clear advantages to what you might call a decentralized open communication system. And if you now ask, "What does it all mean? Does it mean that your organization ought to be like this and mine ought to be like this?" I think the next question you have to watch out for is the possibility that in a complex organization like a system of systems - that you're talking about - that you might want Circle-like structures in one part of the organization, because there are several tasks or several missions in a complicated organization; you might want Circle-like structures in some places where the tasks are novel in structure, and you might want Stars somewhere else.

So, I can conceive, for example an organization of organizations that went something like this. That is, that within each unit where the task may be highly programmed you may have a Star-like structure, but between units where you're trying to agree on policy, or changes, or modifications, or whatever you've got, you should change your product quality. The relationships among those units might well work in the Circle.

And I see nothing wrong with the notion - and I think it's an important one - that there is no single best organizational form. I don't think there is one. I think what you have to do is talk about management according to task, or organization according to task, and this may lead you to several organizational forms within

the same firm, or the same group, or the same organization. You see, in this, if you think about it, it's kind of contradictory to some of the things that have been taught. It seems to me that some of my friends in this business have argued rather strongly that there is a best organizational form, and that the inside of an organization is something like the inside of a caterpillar if you step on it; it's a bunch of green stuff, and that it's all alike. And if you grew up in one of these traditions - if you grew up in the traditional secientific management tradition, then the right answer is the Star; the president ought to be programmed and the vice president ought to be programmed, and the first line foreman ought to be programmed. And organizations should be set up like Stars; one shouldn't worry about span of control, and everyone should know specifically what his job is, and a whole series of other principles are associated with this. And that would be the ideal organizational form, period, not matter what the hell you're trying to do.

That strikes me as kind of nonsensical, although it was a pretty bright idea when it started. It had an awful lot of important positive uses. Then comes the 1930s or so and you get kind of a big about face on this. Then Lickert in Michigan comes out with the notion that organizations shouldn't look like that at all; they should look like a bunch of overlapping circles. And he, in fact, promulgates this theory with a lot of convincing, I think, argument; that really the appropriate organizational form - also everywhere in the organization, now - that he's really saying the green stuff is not a bunch of Stars, the green stuff is really a bunch of circles; all organizations ought to be set up like this, in which some units are circularized and open, and there are connecting links between them.

I don't see that either of these makes sense. Maybe it's because I'm too damned task-oriented or something. It seems to me that if you don't step on the caterpillar, but you dissect him rather carefully what you're likely to find is

that there are a whole series of sub-systems in him that are very different from one another; some of them are Star-like and some are Circle-like, depending on the function they're intended to perform. We have a circulatory system that is different from our digestive system. The nervous system is different from both, and they operate by different rules.

Well, when you start talking this way about a real organization you get into some real problems about whether or not people should all be treated alike or treated differently. The problem that arises from my notion of differentiation, if you like, is having Stars somewhere in an organization and Circles elsewhere, and how you relate these to one another. If the Research Department people can come in at 10:00 o'clock in the morning and quit at midnight, or any time they want to, whereas the Production guys working in the next room have to come in at 8:20 and punch the time-clock - and punch out again - how are we going to keep this organization together? It would not be fair. And I grant you that this is a real problem.

One way it has been solved in research - "solved" - is to take the research lab and move it 20 miles down the road, out into the country, with a nice grassy plot, and keep it away from the production people so they don't see one another. But that costs you something too.

COLONEL NORMAN: Dr. Leavitt, I think this is a very fine note to wind up on. I want to thank you very, very much for giving us a fine discussion this morning, and it will help us tie together our studies in the management theory course.

DR. LEAVITT: Thank you.