The Falcondale Collection

Stafford Beer

Initiates an Audience into the World of
Systems and Managerial Cybernetics

Session 2

The History & Nature of Cybernetics:
Part 2

So I tried to tell you that I was trying to get you excited and join in the feeling of all this, then you've hit another historic moment by complete accident because since I saw you, which is only half an hour or whatever. I have received by special messenger a copy of my new book.

I shall talk to you about the contents of this book later in the week when we get there I was just thumbing through it and I could not help thinking how apposite the start of the preface of this book is and I thought that I would just read you these couple of sentences if I can find the right place.

This book is new in every sense although it is issued under the generic heading of "My books" 'The Managerial Cybernetics of Organisation'.

'Why do I persist in using a word that has finally penetrated the wall of public unknowing in the grotesque shapes of cybermen and cyborgs, and whose original and inspirational meaning wonders like a lost shade through the groves of an uncomprehending academe. It is because a reductionist world badly needs it's holistic message as science and a regulation of large complex probabilistic systems actually exists that is interdisciplinary in approach and consequently inclusive in its world view.'

I thought that really did follow on I must say rather neatly so a historic moment when I say that I have not held that in my hands before.

I was reviewing what I said and apart from Ashby all the emphasis was on what happened in the United States and I thought I would just mention what was going on elsewhere.

A lot was happening in England, and it centred to some extent on the invention of the computer. Now, if we are going to talk about regulation obviously the computer is in there somewhere isn't it? and I think, in all the wrong places, I think this machine has been grossly misinterpreted mishandled and wrongly used and what is far worse, it hasn't been used for any of the things it could actually do, well, that is. We shall be poking away at that as we go on. I don't want to devote a special programme as it were to computers, but let's get it in on the act.

Who would like to suggest when computers first came up?

Where do you see it?

Babbage. It was the first mechanical wasn't it ?

Right Babbage.

War time ish?

War time ?

Earlier than that actually in a sense programmable machine in Lace Making.

Lace Making. The Jacquard loom.

You're a French scholar. It was a French ....The Jacquard Loom, when was that?

Oh dear I don't know the history ... Eighteenth Century

Yes, Eighteenth Century. I'm pretty sure.

You know what we're talking about?

You know what we are talking about? It's a loom which punched holes in.. It was exactly like the first computers with punched cards like the Hollerith machine as was and so on and it made very complicated fabrics, a marvellous invention. Way ahead of its time, and that was responsible of course for all the revolts under the name of Luddites. People opposed to this kind of development.

Let's try another.

Somebody else said and you said Babbage, and you said the War?

Pre-war,

That was fast. It was about 100 years ago.

Yes, Babbage was a very extraordinary man. He tried to build a steam computer, literally a huge steam engine there, and it was all mechanical. It turned these huge gear wheels. I've actually worked a Babbage machine, which is in the Science Museum.

I was lying on the floor trying to look up into this glass case, and the Curator fell over my legs. He was running, and came a hell of a cropper. He was very embarrassed and the result of that was that he very kindly took the glass case off, and I must be one of the very few people who have actually pulled the lever and seen what happens.

That was mechanical.

Now Leibnitz, I mentioned earlier, who was a German philosopher who very clearly saw that something like this could be done and a number of, .. He invented a calculating machine which had carrying capacity and so on. It could carry numbers and so forth. Obviously some of this was adaptable, but the modern computer was clearly an invention of a man, who most people have never heard of, whose name was Alan Turing.

Ever heard of him?

The Turing machine, you should have done. I think his paper on the Enshiedles problem. It was 1933 or 36 I can't remember. But he tried ...He was a mathematician, and he tried to solve the problem in theoretical logic call the Enshiedles problem. I won't go into that, for goodness sake. But in the appendix in this paper to The London Mathematical Society, he put forward the design of universal computing engine, as he called it. and it was exactly the specification that you need.

You need an input, and you need to inspect it, and you need to be able to change the last symbol under a certain set of rules. And he had the whole thing there in the 30's. This was followed up, and a lot of people think that the Americans ran the first computer, but they didn't. The first computer was run in Manchester.

Is it Lyons cakes?

Pardon

Is it Lyons cakes?

Yes, Lyons cakes were close behind. The so-called Leo machine which was the office machine. The first computer was run in Manchester University, and it beat the Americans to it because the American machine didn't have storage. It was very complicated means of computing, but it didn't have a stored program. It had a stored memory but not a stored program.

England was very prominent in this and at the time, you see I'm going back to the early 50's. We had got through the 40's by hook or by crook, this morning. I had the feeling you were all thinking, "When does he mention the Flintstones!"

The 50's is a little more respectable. I was in Sheffield, as I mentioned, and the centre of cybernetic activity in England was, for some God forsaken reason, in Bristol. Now, Ashby, was running the Burden Neurological Institute in Bristol and nearby was Grey Walter. Has anyone heard of him?

He was the man who invented the mechanical tortoise.

Very useful!

Yes, well. Most ...What I'm trying to give you the flavour of is the investigating a new area. How do you proceed? You've got a computer here, which is ungainly and does certain things in a rather predictable way. Then you start thinking about the biological world and you say well not really like a computer is it? You see. Then you start wondering why it is and why it

isn't. You start trying to evaluate this. Meanwhile the popular press is going mad, talking about thinking machines and hyping it up and making scientific advance rather difficult frankly. I had fourteen reporters camping on the lawn of my house at one point and I was panic stricken. It is pretty alarming to be assaulted by the media. This was in the 50's

So let me just give you the flavour of Grey Walters.

He was the President of the Electro-encephalography Institute of the World. He was the most famous of the people who invented this EEG. You put this thing on your head and you get the brain waves out.

A very extraordinary man. He wrote a science fiction novel, he did a lot of funny things. He particularly invented what was popularly called the Tortoise but he called, being a scholar Mechinaspeculartrix and I can't resist telling you what this was like.

I played with this thing. You imagine a little thing like this, looking like a ouiji board, with three wheels. You have two wheels on the back which drive the thing, with a little electric motor and one wheel on the front which swivels round and round so the thing could go mad if you just let it loose. On top of the front wheel is a photo cell again. This thing now has an eye with one input, either this photo cell is firing or it isn't. So it's like a periscope. This means that if you shine a light at this thing it will follow you. The issue that was facing people who were interested in brains and complex systems was how they were built up. Now this isn't the same as reductionism, because you were saying, how could you possibly get this kind of behaviour? So here we have this tortoise, with the eye and it's following the light and that's kind of weird you know when you first saw this people thought this was very odd. Then people cashed in and made toys like that and they made ....

I remember getting the whole of the board of United Steel, on their hands and knees, in the boardroom, trying to chase a bug that I was working with an ultrasonic whistle, in my pocket, and they didn't know how I was doing it.

People are children at heart, thank God!

Now the problem now is, you see I want to try and show you how the methodology of science works in practice if you abandon the reductionist model.

We are following ... getting this tortoise to follow us, are you with me and now it hits the table, what is it going to do? It can't do anything, it's stopped.

Now how do you deal with that?

Now I mentioned oscillators to you before.

What you do about that is, you turn the photo cell into an oscillator.

Now easily done.

You put a shell over this machine, that's why it was called a tortoise because the damn thing looked like a tortoise, on a single screw, pivot. Now it is following the light with its periscope and it hits something and it short circuits the shell against the chassis. Turns the photo cell into an oscillator, the result is that, the engine starts reversing and going forward and it feels its way round the obstruction. You lead it into the furniture, deliberately and then it works its way round it and comes after you again.

Now, with only have two cells. We've got a very biological looking machine on our hands; It's just extraordinary, really.

Now, Grey Walter put this thing into the South Bank Exhibition in 1952. After the war there was a thing called the South Bank Exhibition which was modelled on the Crystal Palace Exhibition of the 1800's, to hype things up for Britain a bit, after the war. This was a star attraction. It's interesting, such a simple little thing, is so out of keeping with what we think of as machines. This is what I'm trying to stir up in your minds.

Here is Grey Walter and he has several of these things running about his living room, so he is lying on the floor, with a note book, observing their behaviour, can you believe it, with a stop watch. Trying to find out what the result of interacting these quite small components is going to be.

One of these things stopped. Noted stopped. So here is Grey wondering if it is going to do something in the context of what the others are doing.

Nothing happens - It's broken.

Doesn't our friend Grey feel a complete bloody idiot?

You see he's lying there for twenty minutes with nothing happening. So he says we can't have this so he put an ordinary torch bulb a low circuit thing on a battery inside the shell which tested the circuits so that if the machine was still active when it stopped, then the light came on.

So no more lying on the floor looking at a dead machine. What happens? Take this one through my friends.

Here are two machines, wandering about, they hit each other, so they retreat at the moment they're still, both their lights come therefore, the two photo cells....see

They are following each other.

Exactly this is a courting dance. Any decent biologist would tell you that these things were about to mate. They just go round in circles just like this isn't it lovely. And then to conclude that story the... ..

They bred.

No. Greys house was painted white, he had a fascination for this. All his wives were Finnish.

This weird kind of blond, and, the skirting boards they were that deep, they were like that one, deep with white gloss paint.

Now you see one of these guys comes along, hits that, withdraws a bit. It's light comes on. It sees the light wurrurr aren't I a lovely boy? Then you see you've got narcissism, coming out of this simple little machine.

Now all of us were building these.

I've given you the most traumatic. My machines were a bit more complex. I built computers out of ponds by dipping stuff into a soup of primeval slime and so on.

Gordon Pask was also messing about with this. He and I are very close friends. We are the same age, same generation.

I used to go down from Sheffield to see Grey Walter, Ross Ashby and another man who was called Frank George who has written a number of books on cybernetics, who is a lecturer in Psychology in the University of Bristol? That was a pretty good visit you know to do all that, to come down from Sheffield to Bristol to see all these people and then I come back through Cambridge and look at EDSAC, which was the computer they were building there. Through Teddington, which was the National Physical Laboratory which was forgotten what it was called now, ACE and then DEUCE, were the machines there. Mark One Star, was Manchester, which became the first one that actually worked, and these were all digital machines. In Farnborough, within the Royal Aircraft establishment they had an analogue machine which filled three semi-detached houses and was so complicated the last time that I went there I remember it very distinctly, they admitted that there wasn't anybody who knew how it all worked, people knew about bits of it and nobody understood the whole thing any longer.

There is an awful lot of lessons in all this and its immensely fun, and that's really the key to my opening with you is to try and get across the idea of fun. Few of you have a background in

science and the popular image of a scientist in a white coat and a row of biros and no sense of humour is really a bore. Real scientists are not like that at all I assure you,

The other place, where quite a lot was happening at the time, most peculiarly, I think, was France.
Why do I say peculiar? Because Descartes.

Have you heard of Descartes?

Cartesian philosophy dominated the French culture. Was the ultimately reductionist thing. The French have been hugely conditioned by this reduction approach.

So it was quite odd that there was a huge outburst of cybernetics. I suppose on behalf of people who have realised that Descartes was a bit of a trap this is the - I think, therefore, I am, - chap [in Latin] I'm pink therefore I'm Spam.

More jokes about that than I've had hot dinners.

So, Coufinion, Gilbor and Pierre de Latile. The three men I remember straight away.

They're all dead now. Were really active in France doing all the same sort of thing. That seemed to die on the vine. I only know of one person in France who understands any of this and he is a Mathematician.

I was really trying to dispose of history in the first session. This is sort of left overs.

I wanted to give you as balanced a picture as I could of what was happening at that time.

The next thing of course is what is all this about and what can I do about it when all the fun and games is over well not really over, suspended, and we start to think about it seriously about what to do.

In science the first thing is to try recognise what you are dealing with and then to try and measure it. What are we dealing with here? The word system leaps to mind as soon as you think about regulation.

Just as the word control is a bit of a no no, for the reasons we looked of earlier on. Various words get into the vocabulary and are seized on. When I wrote my second book in the early the 60's everything was scientific. This was the catchword. I made a big thing, in that book, complaining about Scientific Toothpaste. What the hell is that supposed to mean, of course it's scientific? You don't put cyanide in toothpaste, to that extent, it's scientific. It's the catchword.

Now, system is now a catchword and I saw an advert of a beautiful young woman doing things to her legs, in Canada just before I left there, and up on the screen comes "The Remington Shaving System"

Now I used to call this a razor.

What the devil are they talking about?

Shaving system?

So you see, words get de-valued, and it's an awful pity, but it's real life. It behoves us, if we are serious and thinking about these matters, and I assume we are. What actually do we really mean by a system? Especially how would you measure it? There is a social comment here. What do we measure normally? .....

Somebody?

We look at social systems, what is it that we measure?

Unemployment

It's a very special kind of social system. Well go on ....

How good their performance is

How do we measure it?

Statistics.

Statistics of what kind?

Sample

What is the unit of measurement?

Wealth of Society

Absolutely, the unit of measurement is the Buck, the pound, the Deutschmark.

Because our culture has gone that way. It measures value in terms of money.

Now I would think from what I've learned about you lot all ready that you would seriously question whether that is the whole story. I certainly hope so, I don't even think it's the start of the story.

I have always regarded money as a constraint and not as anything else. In other words, you can't do it if you don't have the money. Or you can't stay in business unless you are meeting your costs.

These are essentially constraints and the image of the business man trying to make a lot of money is quite false in my experience.

I was in business for a very long time. People in business are essentially having fun. They are stuck with this constraint that the balance sheet better work, or they are not going to have much fun for very long. They'll be in jail somewhere or dumped off a boat into the sea!

He was a friend of mine!

So if we are going to look at system we are going to have to find some kind way of talking about it and we are going to have to find some way of measuring it and that's what I mainly want to talk to you about right now.

How do you recognise it? It's all very well, it looks obvious. For instance, I know the man who was appointed Chairman of Via Rail, Chairman of the nationalised railways of Canada. So, that looks like a system, okay.

Now how are you going to define the railways of Canada as a system? What would you think of first?

It looks well defined, why does it look well defined? Why does it look well defined?

The tracks , the station,

The trains on the tracks

The passengers on the train.

Looks good doesn't it? That's the system?

You've just been appointed Chairman, so what you discover is, you don't own any of that. It belongs to somebody else.

Can you believe it?

You have to rent all that from the guy who owns it.

How did they get into that kind of fiasco?

Well British Rail is showing us the way, in a big big big...

So you begin to say. What is a railway? If I don't even own all this hardware what is it actually about.
Well what is it actually about?

Somebody help me.

Getting from one place to another.

Getting from one place to another.

Which place Jane?

You're on the track,

I want to go to Vancouver

Right

From Toronto

You did it

Know I'd like to

Right so there is a station in both these cities, and ...

Yes, and it will take me I don't know

A long time

Four days

That's not what I'm interested in

Do you live in a railway station? Do you live in a railway station?

No

Do the people you want to visit live in a railway station?

No

So what is all this about, with two stations.

What are you actually trying to do? Jane
I am trying to cover a vast distance well I could walk it ...

I wouldn't try it, I think the distance is a red herring here.

Suppose you wanted to go from Victoria to Dorking. You can't do that because it's on the wrong bloody line. Typical.

Forget the distance. What I'm saying is that you are not living in the two stations so what are you actually trying to do?

You're trying to get to the nearest point.

Yes but I mean

Get closer

But where do you live?

Yes, so you live in a house.

How far is it from the station?

Quarter of a mile.

Quarter of a mile.

You're lucky.

And you're going somewhere which isn't the station. So as soon as you start thinking about the real systemic character of this. You are trying to sell tickets to people who want to go from A to B and nothing of that has anything to do with the railway, except that at some point between A and B there may be a chunk of railway that you can use. You were volunteering to walk just now Jane the best of Canadian luck I can tell you. If you want to take the train, you're going to have to get to the station then get transport at the other end. That's what I mean by a system. You are looking at the operational reality of what you are trying to do and not what somebody says to you is "Oh there's the railway". Now managers never do this, you see.

When I tried to tell the Chairman of Via Rail, he was astonished. He said well where does that get us? And I said you need to address the problems of people who are going from this house to that house and not people who are trying to get from one railway station to another, where nobody lives.

If you start doing that, where do you go?

Would you like to offer the passenger, that he be picked up at his house in a taxi, or helicopter or something? We will get you from your house to her house because that is where you want to go.
Now that is the total system. What I'm arguing is that we are always dealing with little bits of what is the relevant system because it's convenient, and it's convenient to measure it in terms of money. Now I'm much more concerned in comfort than money personally.

I have this pain, I'm sitting in a comfortable chair, and that matters more to me than the fare. I would prefer a comfortable seat. British Rail has abandoned all of that, as you must have noticed.

What we have to do is loosen up our notions of what a system might be and look at the reality. Look at the operational reality.

The next problem about this system is that because of reductionism, which you are now used to that concept, we have a very odd idea of cause, because cause, in our culture, follows what is known technically as a linear system.

Now, linear is a line okay, what do I mean by this?

It means something here then something else and so on. It's a linear system.

Real life isn't you see. Real life isn't, everything else is going on. You give me an example of a linear system, as normally conceived. It's likely to be mechanical. Think in those terms. You get in a car what do you do?

Put your foot down

Acceleration to the junction

You've got to start it first.

Mine doesn't always start.

God I would pick on you wouldn't I

Think of getting into the car. You put in the clutch before you put it into gear. Not a bad idea?

You've got to put the ignition on you've got to press the starter, release the brake, look in the rear view mirror, and off you go. Now that is a linear progress. Not many things are like that. You turn to social systems and you will find it hard to find anything that works like that. People insist that it does, because that's what they know how to describe and that what they know how to measure.

And so you get all sorts of nonsense coming out about the criminal justice system, is a very good case, education, is a very good case, all being treated as if it were linear, which it ain't, and all being measured by money which has nothing to do with it, except that it is a constraint.

How about that?

Punchy argument

Do you go with this?

Good.

I will give you an example of a linear system in society in the social context. It so obviously works in the mechanical context like starting the car; it doesn't in the social context. But I will give you an example where it did.

This is a true story.

In Middle America, somewhere, they were very proud of having a local symphony orchestra. So they appointed a new conductor, so he had his first concert and the whole township turned out.

Big deal. He selected the 1812 overture and why not. He is up to date. He decided to have all these cannons and he lined up the local Professor of Electronics and said "I want these cannons programmed to go off at these points in the score. Beautiful idea, harnessing technology and art, nice.

Unfortunately, it didn't work; it did in rehearsal.

Here we have all these big wigs out in their finery. The first official concert, opening with the 1812 Overture. The conductor has a button to press to set the programme going for firing these cannons in order. My linear system begins when he presses the button. What happened then I don't know, the internal part of it, but they all went off at once. The whole bloody lot, bang. All the lights went out. Not surprisingly, fused. This is a linear system. These are real

cannons. The whole place fills with smoke. The big wigs sitting there going..... Can't see, can't breath. What the Hells happened? Next thing that happened was, modern America, good system, smoke gets to the smoke things, water comes down on all these poor devils. That sets off automatically, this being a linear system, an alarm in the Fire Brigade office, the Fire Brigade turn out to the Opera House. By accident they were trying out new equipment for the first time, they hadn't mastered it. They were all wearing new space age stuff and all the masks fogged up and they couldn't see anything.

So now they put hoses all over everything just imagine being on the receiving end of all these. Can you just imagine it? I think it's cripplingly funny. I'm glad I wasn't there.
That is a linear system, everything triggers the next action, and that's okay.

Let's look at real life.

Here you are, you personally and you're okay.

Let's suppose, God forbid, that you do something silly.

Get sloshed, or something.

Here is the linear system

"I am okay", "I've done something silly" " I feel lousy".

What's the next thing?

You must have done this; it's the real world.

Go to bed, take Paracetamol

Well you can't go to bed "Take two tablets" and the next box says, "I'm feeling better" and the next box says, "I'm okay"

Now there is your linear system.

Now what does this conceal?

How do you know about these tablets?

Maybe you went to your GP

I'm very deliberately not drawing this out in detail; we've got the linear system.

Here you are feeling lousy you go to your GP you come back with the tablets or you've done it before so you know what the tablets should be so now you've got the GP involved in this then we've got the feedback, which I mentioned earlier, from where you feel okay which is supposed to go back and say don't do anything like this again. But that doesn't work altogether well does it?
That means that this feedback circuit back has all sorts of filters and self confusions on it and stuff so that's going to be complicated.

Now where the Hell has the GP got all this information about these tablets?

There is a whole pharmaceutical industry here somewhere. Try and imagine the system I'm drawing. [Stafford draws a diagram in the air!] We started with a simple line - the whole pharmaceutical industry is at it feeding the GP at enormous expense - I hope you're taking that in. What they spend in trying to seduce General Practitioners is just unbelievable, in order that you will hear about these particular tablets.

But if the GP doesn't work, then it will be through advertising so there is a loop through here from the pharmaceutical industry through advertising to television telling you that you've got a particular kind of headache which means that you need to have a particular kind of tablet - this subject of analgesics is fascinating to me.

You take one kind of tablet for one kind of headache and another for a different kind - its unbelievable and so all this goes on.

The cybernetic research into what you do if you have a headache produced a very simple answer. Do you know what it is?

Have a guess.

Don't drink.

Don't drink, would be a very good one but let us supposed you have done it. - Too late,

What you do is stop what you're doing.

I mean I made a joke about the drinking but people get headaches for all sorts of stress related reasons and you get these bogus brain diagrams with arrows going up here, if you stop what your doing its just as good as taking a tablet, because the pain is a direct result of what you are doing and if you stop it, it will go away.

Unless you are in some pathological state it works perfectly well.

I haven't taken an analgesic pill in for 40 years and if I get some discomfort I stop.

This is the way social systems build, is what I am saying to you.

Now you take the girlfriend or the boyfriend, depending on your sex, or not, as the case may be.

Somebody got that one.

Who says why do you do this?

I care for you, why do you do this?

Stop it.

Now this is a learning loop down here which is a social learning loop, and it has a lot of pressure on that one - so you've got all this pharmaceutical and advertising stuff up here and now all this social pressure down here and we're supposed to learn and up at this end of the diagram your saying well I feel better and I now I feel fine. And the girl or boyfriend says "Yes but you're feeling fine now but you have forgotten what a mess you felt last night".

"I wasn't in a mess last night!".

Have any of you heard that.

Oh, yes you were.

No, no, no, no, I wasn't. You're imagining it. So you have this oscillating loop going on which is a kind of learning loop which doesn't work, which is dysfunctional. While people argue with each other. And I have drawn all this out and I will give it to you if you really want it but I prefer to wave my arms about and carry you with me.

Out of this linear system, you've got unimaginable complexity and if you try and treat it as a simple linear system, you're sunk.

But all our managers and all our Ministers try and treat it as a linear system, the whole penology system is like that. You are a naughty boy: Go to jail. And the causes, do you want to use the word cause. After what I have just said I would warn you against it frankly.

Now the English philosopher, oh maybe he was Scottish David Hulme

Scottish

Okay I was just in time with that one. He blew the notion of cause, out of the water. Now, the notion of cause that we have, I really want you to think about that, because it's very simplistic

and it's based on the linear system, so if you've got a linear model clearly in mind. Then you say this - smoking causes lung cancer, and that totally ignores all the rest of this going on and the obvious fact that people smoke for different reasons, and maybe its the different reasons that are giving them the lung cancer and not the smoke.

It is very confused, in short.

As soon as you can make it simplistic, and then underwrite it. The Americans write on their cigarette packets. The Surgeon General has determined, it's an interesting word, that smoking harms you and so on. I've never been happy at all about these arguments and you can certainly argue about it would be better if we didn't smoke but the reasons given are bogus, they are false. They are absolutely scientifically wrong, because all these connections are attributes which can't be underwritten as scientific phenomena, they are at the most probabilistic, in character. Now I find this more and more amazing.

I've set you the task of looking at newspapers and you could try that out tomorrow on this part of the argument. What are people treating as systems? What are they treating as causes, which is totally unjustified by a really thoughtful look at these things. Now, most obvious example in penology is to say, that there is a wickedness, this is a favourite Tory argument, that people are wicked and have to be beaten. Whereas, the social phenomena that creates all this are just disregarded. As you all know, this is becoming a national scandal I think in this country. That the things that you could do that would have an impact on crime you don't do and you try and deal with it somewhere up here in the system when it's all far too late.

After all you can demonstrate this.

We have more people in jail than anywhere else in the civilised world, in this country and much good does it to us.

So don't look at systems as linear. Don't look at the transfer functions if I can get a bit more elaborate. You go from this box to this box what happens here is mathematically a transfer function this is an input to that, and the transference has some kind of characteristics which is mathematically a transfer function. You can't measure those things so you make them up. So you say obviously ...

Now look here I saw some statistics recently which said, "Don't drink and drive".

Now listen 25% of the people involved in accidents have had too much alcohol. So there.

How do you like this argument?

75% of the people involved in accidents haven't been drinking. Don't you think it's about time you started?

Now obviously this is absurd. Please don't go away and say this chap wants us to go away and get sloshed and kill ourselves.

I am just trying to show you that the way we talk about systems is lunatic, it's over simplistic and this why we need the cybernetic insights and we want to train ourselves to look at the total system.

I remember a Chairman of a very big company complaining to me when I was consulting to his company. "Trouble with you Stafford is that if I ask you a question you want to go down a gold mine and find out where the money is coming from at source" And there was something in this.

Unless you do that. All my successful consulting has been to do with things that the person asking me the question has not even considered, because they are reverberations of this complex system.

I have made a career out of it.

Now I am increasingly, because of the emphasis on money, people are saying, "Before you hire a consultant you must know what he is going to do and that he is going to produce these results".

That is a linear concept.

I wouldn't take a job.

I can show you a whole load of Government Regulations particularly in Canada where they are anxious, the Auditor General, is anxious to highlight probate in government affairs. And I wrote to him and said there are 20 things that I have to fulfil to be a consultant. Pick any one of them, any one of the 20 and I will show you why that stops me from giving you an answer.
What are you going to do? I don't know what I'm going to do. What are you going to investigate?
I don't know what I'm going to investigate.

What methods are you going to use?

I've no idea what methods I'm going to use. Until you get into it you don't. All my most interesting assignments.

I have wondered alot about this week, as to how far I can go into. For instance I worked a lot for the native Indians in Canada, who are faced with this kind of systemic dilemma. That everybody says, okay we are guilty of genocide which isn't a very good start because people are terribly guilty, as they are in the United States as you know Catherine.

We have to put government money into it.

Government money, what are you going to do with the government money you wretched Indians? You see the tone changes immediately. What do you want us to do with the money? You've got to be self-sufficient. Look after your Indian heritage, be self-sufficient. Fine.

Why aren't you guys assimilating into the Canadian society? Because we are just looking after our heritage.

No, you're citizens of Canada join in. Now, there is a total absolutely total split in the systems analysis of this thing.

I went and tried to persuade my clients, who were in Ottawa, the Federal Governments Dept., of Indian Affairs of all this.

It was absolutely bizarre and I said "You have got the whole of the press up against you because of this dilemma and you haven't even seen it and you are spending all this money and the citizen can't seeing any result. Why is this? Here is your balance sheet, published, what percentage of this enormous amount of money do you think is spent on administration?"

Have a guess.

80%

Close - 85%.

It's just unbelievable. So my appeal to you.

What I'm trying to show you is you move into a situation, not with the accepted reductionist view of it but actually looking at what is happening, that is good science. Now we come to the question of measurement.

What the hell are you going to measure if it isn't money?

Now that is a really big problem.

It's not just money, of course, we measure, I was trying to get this answer out of you earlier on, and I didn't succeed. It's a fairly sophisticated answer really that I want and I'll just produce it. We measure what it is convenient to measure.

So you've got people going through a tunnel, you can count them, so we measure that. It's not a question of whether the measure is any use.

So the whole of the census says we can measure that so we do it. Now what we really need to measure if systems are much more complicated than we think they are obviously something quite different, isn't it?

So what?

Whatever is most appropriate

Well yes, but who is deciding it becomes the whole thing, doesn't it.
What I have been trying to suggest to you today is that systems are subjective phenomena, they are not given in nature. They are whatever you say they are, and if you want to be the Chairman of the railway company who sees the stations, and if you want to be the Chairman who sees Bloggs getting from A to B, where there are no stations, it's a very different perception.

We do live in a world of perception and let us please take due note of that. We are very fond of thinking that there is a reality out there and I'm on thin philosophical ice now. After all what we have about the world is a model of the world isn't it? It's coming to us through our senses.

You know very well that the band-width of the visual spectrum is quite narrow. There are all sorts of wavelengths we don't know anything about and some of them give us skin cancer, we are just discovering. We work within this narrow band with hearing, we can't hear what a dog hears.

We are stuck at about 20,000 cycles and a dog can hear 40,000, now his world must really be very different, and who says which is the real world. I think it behoves us to look at our senses and think about what we can possibly understand, because leaving out mysticism for the moment, which I won't leave out in the end. Look at yourself as the natural human piece of machinery that we call a person, you've go to look at the available information that you are getting that builds the model of reality. Limited vision limited sound, very limited touch even worse of factory of the smell sense is very limited smell and taste combined, are very very small range.

What is it like out there, we really have no any idea. We go to the stake for saying what we think and what we believe, and it's really a belief system we are talking about.

If you are prepared to break this up. Just think of the impact on your social beliefs, and ultimately political beliefs. If you see a world like that, then all sorts of other things follow. If you can't open it up and say well maybe it isn't like that maybe it's just my model. After all if you had, in front of your face a red piece of glass you would go to the stake for saying that the universe is basically red, and we all know, so we say get rid of that piece of glass man, for Gods sake, and you'll see it isn't.

All of you have seen the very amusing things that can be done with optical illusions, or much more complicated, magicians on stage doing quite incredible things. You can't work out how they've done it.

Our perception of the world is this bad. If we want to get into the question of how to manage things better. Then we have to open the prospect of looking at things in a completely different way, which is very very difficult to do.

Let us get to the notion of measurement.

I have tried to break up the idea of the system. We are prepared now I hope to go and look at things and say what the hell is going on here with as little filtration as we can. But when we get to measuring we are in problems. I've already said we measure what is convenient for us to measure but probably we want to measure something quite different. If I say to one of my clients. I've done this all my life. We ought to measure this and he says well we can't.

Stop.

Now give you an instance of that.

I told you I worked in steel all that time, 13 years as a matter of fact. A steel works is a very linear place, on the face of it, because you shove iron ore into a blast furnace and you get, out hot iron and then you send that to a steel furnace and then that comes out of there and you make an ingot and then you roll the ingot, and it's very linear.

Where I was Production Controller was two miles long and what's going on around that linearity is anybody's business you see. You've got the village there and all sorts of pressures from unions from...We had a wonderful example. I mean this was the early 50's long before "feminism" as such became an issue of what did the women in that village do, and they worked in the umbrella department, and the umbrella department run at a loss in order to employ the women. You come along and say this department is running at a loss I'm an accountant.

Shut it down. And then you find you've got a total social disaster on your hands because you are looking at the wrong thing.

Now what I was going to tell you was I realised quite early on in this steel career that all these departments on the linear system were being looked at separately and were measured separately and there were a lot of interactions of the kind I was doing with the pharmaceuticals and so on going on that nobody was recognising. And I thought well, what I need to do is to measure all these things simultaneously.

Now I built a machine which would measure things to a fifth of a second, nanoseconds, nowadays, fifth of a second looks dead crummy then, compared to two shifts is quite short.

I said to the management "I'm going to measure everything simultaneously and then we can see what the benefits of synergy are, you see by programming things together instead of little bits".

You see, if you programme things in bits you create inter-processed stocks, and you tie up capital and then all sorts of peculiar things happen because you can't find it and you've got a huge problem of bureaucracy and it's all very very difficult. Mostly unnecessary, is what I was arguing you see so how do you do this.

So the management said to me "You want to measure things to one fifth of a second last time we tried work study here and the whole place went on strike. You cause a strike young Beer and you're out".
So, I was a Senior Manager, after all as young as I may have been, I got hold of the union people, and I said "Look, I'm not part of the managerial outlook on this thing I'm trying to investigate the real world in which you guys actually work. It's obvious, isn't it", and they knew it was obvious. The managers didn't. That there are all these interactions and they said "Yes", it's obvious.

I said, "If we can measure everything simultaneously then we could optimise this thing and my calculations are fellas that we could increase productivity by a third. Not 2% or something a third". And they said, "Bloody hell! Do you really think that" and I said "Yes" and I said, "Let's do it!" And they said "Well we should be victimised you know". I said "No! We will set this up so you won't be victimised. How can we do that?" We started a huge discussion. It was very interesting as a piece of social phenomena, this is the early 50's and this sort of thing was not done at all.

So, I put these machines out, and they were on punched paper tape, that would create a record to a fifth of a second simultaneously throughout the plant. So I said, right a lot of this input is automatic and we can siphon information off the load, off a rolling mill for instance by a strained gage and we can use PE cells and all of that, but a lot of it has to be put in by hand, so here is a little key board which we designed and you punch that. All the people that are going to use this equipment are union people, point one. The management said to me "You can't do that! We have our own Engineers, you can't have the unions messing about with this". "Why not?" I said. "They know what it's all about."

Secondly, "The punch paper tape," the union said to me. "What a naive young gentleman, you are." You see, not quite the language they use in Yorkshire, I'm transcribing it for your benefit. "You will have all these records and then the management will analyse all that and then we'll all be crucified". I said "No, when we've done the work, we'll do the work together, you take the tapes and have a ceremonial bonfire."

So we did all this. We got a third increase in productivity. The management tried to get me sacked because I had abandoned the managerial prerogative by letting them burn the data.

Something's wrong here you see isn't it?

This was my introduction to systems. I'm trying to make it clear to you that there is a real bad edge to all of this stuff, I'm not just talking philosophy to you.

I was going to be so careful about time but I didn't and wasn't, how long have we been going will somebody tell me?

Just over an hour

Oh we've done that have we because that is a natural break in that case because I have disturbed you with a bit of luck about the nature of the systems and what we need to look at.
I want to turn now, to how can you possibly measure all this mish mash and that's a perfect break and lets resume that after dinner if that's OK with you are you still with me not tired out or anything.

Go and brood on this.

Now I will make this formal this time. Now lets start the next session with anything you want to ask me. If you find all this is suddenly meaningless and all that, ask me anything you like at the start of the next session and then we will go on specifically to this key issue of how you measure it. Nobody has suggested what you might measure we might brood about that there is a single answer that I am going to give you after dinner, as to what you measure I bet nobody can guess. Goodbye.