Explanation via Chaos – Paper VI

The Inexplicable Nature of Crisis

At the current point we have reached in in the TV programme, an equation appears on the screen, without any mention of it, and certainly no explanation. Yet it is a significant form.

It is as shown here.

$$\frac{dz}{dt} = xy - z$$

It seems a very simple form, but that is not true. It is what is termed a **non linear equation**. The terms "non linear" and "linear" are used throughout by the contributors, but none of them explain what they mean. The devisor of the programme, Malone, does not feel that the viewers should be burdened with such technical stuff. But he is wrong!
This equation is just the kind as can display Chaotic behaviour.
Now there are all sorts of discussion and explanation of Chaos in terms of complex systems, but here we have a very "simple" equation which is a mere abstract form, yet can be shown to display this remarkable chaotic behaviour when used to generate results. This is important!
Such forms are special in that they involve "rates of change" in them. To ***start*** with a relation that includes a rate of change, we have to somehow integrate it to be able to lay out values of the involved parameters, Now z, in the equation, doesn't only exist as a variable, but also in the derivative $\frac{dz}{dt}$ - a rate of change. And t only appears in that same derivative. Now mathematicians will explain that a rate of change does not include the information of ***at what values*** of z and t the rate of change was measured, and such information will certainly be required. The process by which mathematicians produce variables from derivatives is termed **integration**, but that process alone is insufficient to give us all we need. The reason is that the same derivative could occur in many different circumstances. To pin down which particular circumstances we must bring in extra information. The process of integration always produces an unknown – the **constant of integration**, and this can only be found by substituting known values of all variables into our result to determine the value of this constant.

This is usually achieved by substituting into our equation known INITIAL CONDITIONS.
We often do it (in the abstract) by using very trivial cases, where most turn out to be zero or something equally useful.
BUT, isn't this very similar to Sensitivity to Initial Conditions, which we term Chaos?

This vital consideration is not addressed.
The equation displayed on screen seems as irrelevant as the accompanying music in this TV programme.
Malone instead designates the computer, not as saviour, but now as the "engine of instability"
Cox adds that before we had computers, we merely simplified our models in such a way that they were ALWAYS LINEAR (remember this term?), while the advent of computers allowed us to include factors we had previously ignored. But inclusion, though most of the time could be negligible in effect, turned out to be the SOURCE of the chaotic calamities.
It seems impossible that such means ever delivered useable forms, but they did. To merely state that including other elements led to Chaos which was not present in the previous form, does not explain the two clearly evident modes. Only in special circumstances did the chaotic behaviour appear. In the vast majority of circumstances the old, linear version proved adequate. We have to explain the two-mode behaviour NOT just describe it, as seems to be the case in this "revelation".

Once again essential clarity is NOT included here. It might "muddy up" the thesis, so it is omitted!

As it happens, we only very rarely use equations "as they stand" in computers.

The reason is that many cannot be solved directly. What we do instead is use what are termed Numerical Methods, which are essentially iterative techniques, which can, in appropriate circumstances, actually deliver solutions bia a cyclic process of increasing accuracy. The algorithms involved and the forms used constitute infinite "homing in" processes (see Zeno), but computermen are pragmatists, and as soon as it is clear that the process is getting adequately close to a useable solution (though it would take forever to actually get to the "perfectly accurate" result) they truncate the process by means of a termination test which ends the process when an accrued condition is finally surpassed.

The trouble is that though the trajectory of the steps in these iterations maybe ultimately towards the desired solution, it is NOT a continuous, connected sequence. Unlike approaching the point required by inching along the relation towards the solution, these processes instead "circle around" the result, like a wrestler looking for an opening.The series of interim values are widely separated, and each such set of solutions, are used to determine the next, closer set in a very special way. Instead of a direct path to the solution, we instead have the "scenic route", which "takes in" a goodly slice of the surrounding countryside on the way to a solution. It is as if the solution "contains" that wider reach – like the building in of new initial conditions with each and every iteration. Now applied mathematicians would be astounded by such a fanciful narrative about their pragmatic methods, but it interesting to see that the use of such methods also frequently ENHANCE the possibilities of consequent Chaos. Interesting isn't it?

I know this because I personally wrote the computer programs in the 1980s, which delivered results reflecting the behaviour of a model of the human heart (originally due to Van der Pol, but delivered to me via a series of modifications produced by the mathematician Jagan Gomatam), which were iterative equations and seemed to deliver surprisingly REAL results, resembling both fibrillations and heart attacks.

At the time I constantly asked the mathematicians involved what they were doing, but was never let into the secret. I assume in retrospect that perhaps they didn't KNOW!

A remarkable phenomenon of the current use of computers is the amazing sight of a group of excited programmers surrounding a computer looking avidly at the results of their OWN iterative program as if they were studying nature!
They wrote the program!
It is exactly obeyed according to the fixed set of instructions within it, and yet they expected it to INFORM them!
I am forced to compare such a spectacle with the worship of Baal in the Bible.
There the people carved their own mighty image, and they fell down and worshipped it, and even asked for it to solve all their problems. Amazing!

To be concluded

(1,099 words)