

‘SELF’-ASSEMBLY AND ‘SELF’-REPLICATION ARE NOT ‘LIFE’

No one says a telephone is alive because it ‘speaks’ and ‘hears’ or that a backhoe is an arm although it has similar rigid members, joints and actuators as a human arm. These aren’t scary because there is a clear distinction between the mechanical mechanism and living tissue. Yet when you combine it with sensors and a computer we do speak of robotic arms – so it’s the computer/control function specifically the software bit (AI especially) that is scary. Although the difference between ‘grey matter’ and silicon is clear, the general public are uncertain about the distinction between signals and reasoning in software and thinking¹.

So being able to reproduce some of the characteristics of ontological development, from fertilized egg to developed organism, is not scary if the analogy is –

Engineer → CAD design → machine tool → parts → assembly

– that’s just like a car factory. Even when, if we need new machines or to build a new factory, we add in ‘Tool Maker > machine shop’ to manufacture the ‘machine tool’ it’s not scary. If we add automation it’s still not scary (although a little bit).

Engineer → Tool Maker → machine shop →

Engineer → CAD design → automated machine tool → parts → automated assembly

Similarly, if we catalogue the quite limited types of machine tools and known mechanisms (machines are compositions of mechanisms) and create a database of this information, it’s still not scary. But providing this machine catalogue to an engineer as a database accessible from the CAD software is KBE CAD [CAD with Knowledge-Based-Engineering]. There are international standards (ISO STEP) to enable KBE CAD. So, machine design and manufacture already have some of the characteristics of ontological development which is no scarier than a telephone, backhoe or car factory.

It gets scary with the idea that this technology can reproduce itself – yet it’s known a lathe is the simplest machine that can (with a human operator and provision of the necessary steel stock) reproduce itself. So, it’s probably not so much the idea that a machine can make another like itself (although maybe a little scary) – it’s replacing the human (engineer) with automation (computer) and ultimately software that’s scary. But teleoperated machines aren’t scary as they still have a human operator – which is what NASA proposed – more like video games.

Now construction automation (like a brick-laying machine) is not scary, nor is an aquaponic food supply and recycling is fine – so we are just about there. This is pretty much all we need to build a NASA ‘Space Seed’. The key is to start with a general-purpose, teleoperated, tool-makers workshop and use that to build the factory machines that manufacture other teleoperated machines for construction (of a biosphere spacebase), life support systems etc.

However, a ‘Space Seed’ has to use the locally available material (lunar regolith) and transform it into useful stock materials first, hence NASA’s ongoing research into ISRU (In-Situ Resource Utilization) and ISFR (In-Situ Fabrication and Repair). The range of materials available to a Lunar ‘Space Seed’ is quite limited.

The ‘Space Seed’, has to have a stock of energy and material to start (NASA proposed a 100 ton Space Seed), which it uses to begin mining and mineral processing (analogous to metabolism) before ‘development’ can progress to construct a local energy harvesting system – just like an organic seed with its root and leaves. The proposed lunar base is the size of an industrial estate and building a copy was estimated to take three years.

The challenge of ‘Space Seed’ design is understanding and designing the sequence of machines, starting from a small, simple fundamental set, able to build ‘any’ other machine or structure, via a minimal number of stages, while constrained by a limited set of materials having required properties (rigid, flexible, magnetic, conductive etc). None of this is scary, especially if the difference between machines and living tissue remains clear and its teleoperated, rather than AI controlled. It’s just being very organized and disciplined about manufacturing that we already do, which is however currently uncatalogued and not fully integrated.

Applying the ‘Space Seed’ developmental architecture on Earth to produce an Earthbase is significantly easier because a wide range of materials are available and rather than mining and processing ore to produce stock materials the focus can be on recycling an initial stock of materials selected because they are recyclable.

¹ No help here from Turing with his famous AI IQ test, when a conversing AI program is indistinguishable from a human!