Nothing comes from Nothing

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A very important idea in Ancient Greek Philosophy was that “Nothing comes from Nothing”. What exists now has always existed and no new matter can come into existence where there was none before. So the principal components of all our food, the elements, have always existed and can never be destroyed.

This simple, fundamental principle now seems lost in the modern world we live in.

Have you ever heard that we humans are:

1. "using up" the world's resources,
2. "running out" of oil,
3. "reaching the limits" of the atmosphere's capacity to cope with pollution,
4. "approaching the carrying capacity" of the land's ability to support a greater population?

The assumption sitting behind such statements is that there is a fixed amount of resources and that we risk exhausting it through our consumption.

Environmental groups love to make statements such as “by 2030, even two planets will not be enough”. Are they correct??? What can be done???

The real issue is the definition of consumption. Environmental groups and ecologists use it to mean "the act of using up a resource" but economists would define consumption as meaning "the purchase of goods and services ". This is the root cause of much of the debate and conflict when matters relating to the environment are questioned.

Consider the end of the stone-age. It did not end through lack of stone, the bronze-age did not end because of the lack of copper and tin; they ended because the use of stone and bronze were superseded by superior materials.

People are always creating new opportunities for themselves. They are modifying their surroundings in ways to make life easier. Agriculture is the classic example. We stopped relying on nature's bounty and substituted it for a much larger and controllable artificial bounty.

This type of innovation leads to a constant lifting of the limits imposed by static thinking. Who would have believed that you did not need to hunt whales to get oil, that it could be sucked from the ground???

With this in mind we should look at the macro-nutrients we all need, where they traditionally came from, where they currently come from and where they could come from, given the innovations that will surely happen as the squeeze comes on supply as demand increases.

Nitrogen

Naturally occurring nitrogen deposits have been known for thousands of years.

Sal-ammoniac (ammonium chloride) has been used to colour dyes, saltpetre for the production of gunpowder and guano for fertilisers. However the use of natural deposits cannot compete with the cheap and pure production from the Haber process.

The Bosch-Haber process was patented in 1910 and allowed Germany to continue its war efforts in WW1 when naturally occurring Chilean nitrates were blockaded. The process is very energy intensive and relies on the combustion of natural gas or the gasification of coal. Today, the production of ammonia, the starting point for almost all nitrogen fertilisers, consumes 1% of all man-made power.

Nitrogen compounds can be manufactured directly from air using electrical energy but the cost is high and the technique is not currently practised commercially. The production of nitrogen compounds from urine has also been practiced for centuries. The “re-birth” of such techniques only requires a push from the market, driven by supply and demand imbalances and could provide nitrogen fertilisers indefinitely.

Phosphorus

Phosphorus is not found free in nature, but it is widely distributed in many minerals, mainly phosphates. Historically important but limited commercial sources were organic, such as bone ash and (in the latter 19th century) guano. Inorganic phosphate rock, which is partially composed of apatite, is the chief commercial source of this element. Eighty percent of the currently mined phosphate rock is actually derived from ancient biological processes.

In 2012, the USGS (U.S. Geological Survey) estimated there are 71 billion tons of world reserves, where reserve figures refer to the amount assumed recoverable at current market prices. Only 0.19 billion tons were mined in 2011. Critical to contemporary agriculture, its annual demand is rising nearly twice as fast as the growth of the human population.

Recent reports suggest that production of phosphorus may have peaked, leading to the possibility of global shortages by 2040, however phosphorus comprises about 0.1% by mass of the average rock, and consequently the Earth's supply is vast, although dilute.

The collection and re-distribution from urine, food wastes and even estuarine muds are all possible, given the demand from the market.

Potassium

The first US patent of any kind was issued in 1790 for an improvement "in the making of Pot ash and Pearl ash by a new Apparatus and Process". Potash was used in making soap and for the preparation of wool for yarn production. Vast areas of woodland were burnt to make way for settlements and a good income was derived from the production of potash from the burned trees. Today and for the foreseeable future, potassium will be derived from the vast salt deposits found in Russia, the US and Canada. The deposits were formed from the evaporation of ancient seas and are composed of potassium chloride and sodium chloride.

Evaporation of salty water from the Great Salt Lake in the US and the Dead Sea is still practised today for the production of potassium sulphate and chloride and could be scaled up should issues arise in the Russian and Canadian mines.

Sulphur

Sulphur is the tenth most common element in the universe. On Earth it is one of only a handful of elements found in their native state. It has been mined from volcanic areas for centuries and comprised 13% of gunpowder. It can also be formed by the action of anaerobic bacteria on sulphate minerals such as gypsum. Significant deposits under salt domes still exist in the US, Russia and Poland, although only the Polish mines are still operating today.

The vast majority of sulphur using in agriculture today is sourced as a by-product of the petrochemical industry or the metal industry during the burning of sulphide ores.

While the element sulphur can be applied to pasture and crops by the addition of the abundant and inexpensive gypsum (calcium sulphate), elemental sulphur is critical as it is the starting point for the production of sulphuric acid. Sixty percent of all the sulphuric acid produced is consumed in the production of phosphate fertilisers.

In summary, while the Earth has plentiful supplies of all the elements required to create our food, we are currently using coal, natural gas and oil, either directly or indirectly, to create our fertilisers. When petroleum and coal resources become scarce, economic and social pressures will force the world to resort to ancient sources, or develop new innovative ways, to reverse the human induced movement of the elements. For us to imagine how this can be achieved would be like Edison and Bell predicting the development of the I-Phone…….