

IV-23 Unintended Consequences

Humans arrived less than a million years ago compared to the evolution of the earliest single cell life-forms about 3500 million years ago. Fossil records show that complex species tend to disappear after one to ten million years. Even if humans evolve much slower than most other organisms, one may wonder if the epigenetic technological changes could change the pace of evolution and human behavior pattern.

Human interference with breeding in selection and co-evolution is but one reflection on our ability to make far flung choices. Just as bees coevolved with flowers, human liking for flowers may be a predisposition for potential foraging of the fruit that are likely to follow. With such tendencies the first technological revolution of post ice-age, about 8000 years ago, brought agriculture and domestication of animals. In this coevolution humans have selected certain grains, flowers, fruits and nuts at the expense of others. Dogs and other pets continue to coevolve to provide for the human need for emotions and desires. In search for drugs selected strains of laboratory mouse and rat have come to represent the laboratory norm. Options offered by nature, coupled with vicissitudes of economy and political whims, have unintended consequences. Certainly civilization has not become rationality.

Plagues. Living with animals means being exposed to their diseases. Humans adapt to disease-causing bacteria by developing resistance. Such human carriers of diseases have

brought misfortune and annihilation to the unsuspecting and innocents. Epidemics of black plague, that has periodically destroyed large populations, appeared with the emergence of the organized human societies. Egyptians noted that the presence of snakes in the human surroundings offered protection. Romans carried snakes to the colonized parts of Europe. Their gratitude to snake is still celebrated in the Emblem of American Medical Association: two intertwined snakes in eternal bliss! No useful connection was made between snakes and the cause of Plague. A Papal bulletin attributed plague to the *wrath of God*. The Medical Faculty of University of Paris attributed the contagion of Black Death to *poisonous air spread by a conjunction of the planets*. Popular rumors in the Christian world attributed the problem to Jews, and acted accordingly.

It took another 500 years to develop a clear understanding of how the contagion is spread in humans through bites of rat-fleas. Such an understanding based on the life-cycle of the flea provided a basis not only for the ancient observations but also deeper insights into ways to prevent plague in a reliable way. Episodes of plague are intricately related to the ups and down in the rat populations that coexist with humans in homes and fields. Extensive convulsions and dislocations in the 14th Century Europe were wrought upon by wars of Crusaders, feudal republics, Papal States, knights and other mercenaries banded as Free Companies (possible models for French, Dutch and British Colonies). As environment hospitable to rats was created, both the soldiers and the plague contagion spread in search of new victims. Now it appears that the descendents of the survivors of the black plague carry a gene that also offers protection against the HIV and AIDS.

Practices developed by animals

- * Cats go into ecstasy by nipping catnip (*Nepeta cataria*): A pheromone found in cat urine, Nepetalactone, is also found in the plant.
- * Tukamo Indians of Amazon say that bark of Yaje vines, also eaten by jaguar, give them *jaguar eyes*. The effect is attributed to a hallucinogen found in the bark.
- * Bighorn sheep grind their teeth on ledge rocks, presumably to scrape off hallucinogenic lichens.
- * By middle of 9th century Abyssinian herders of Kaldi noted that goats became frisky after eating certain red berries. These are now cultivated as the coffee beans.
- * Peruvian Indians noted that puma restore themselves to health after eating bark of cinchona tree. The active principle, quinine, has strong anti-malarial action.
- * People of India noted that pigeons look spaced out after eating cannabis seed - a source of marijuana and hashish.
- * Dogs eat certain grasses when infected with worms.
- * Chimpanzees eat and rub certain tree barks when indisposed.
- * The story of tea is not known but the first Handbook of Tea in China appeared in 779 CE. Tea seeds were stolen and smuggled out of Wyui mountains of China in 1840s for planting in India by Robert Fortune, an officer of the British East India Company.

Famine. The work force for the industrial revolution in Europe was fed on potatoes. Potato was introduced to Ireland through a shipwreck in 1588. The cargo found a perfectly hospitable environment. The soil and climate were well suited. At that time virtually all the arable land where wheat grew was under the British occupation. Since potatoes could be left underground, landlords and marauding armies could not confiscate the crop. It

needed little processing between field and the plate. Served with some milk potato formed a ready source of nutritious meal.

Plenty of potato had its curse. As the family size grew, increased work force lowered the prevailing wages in Ireland. Potato farming also shifted the economic gravity from south of Europe where wheat grew to the cooler north better suited for potato farming. Not only fewer people are needed to raise the same amount of calories in potato, but virtually no labor is need to store and process potato. Bounty of potato in Ireland also sowed seeds of the dislocation and famine that was to follow. The havoc came when this single variety of potato in Ireland was destroyed in a couple of years by a strain specific rot.

Scourge of Scurvy. James Lancaster, a British ship captain, noted around 1600 that sailors given lemon juice do not develop sore of scurvy. Since he lacked medical credentials his observations were not accepted. Around 1750 Naval Surgeon James Lind carried out the trials with lemon juice and confirmed the earlier results.

These experiments are credited to be the first clinical trials in medical history. As a result citrus as the dietary supplement were adopted by British Navy around 1800 and by merchant marine in 1865. Imagine the number of sailors who needlessly suffered the scrooge of scurvy during the intervening years. Also consider the consequences if we had waited to identify the active principle, ascorbic acid or vitamin C, which was not identified until 1930s.

Past-imperfect knowledge. Humans as a whole do well unless hijacked by humbug and unreal. Without the understanding of the detailed science, plague, smallpox and scurvy were largely eliminated by reasoning with the facts of reality. Diseases that have been sequestered to only certain geographical regions and populations include cholera, tuberculosis, malaria, and Chaga's disease. It is a mixed blessing that for the first time in human

history more people overindulge than starve. Only pockets of hunger remain and malnutrition is on increase. The world-wide number of pot-bellied children suffering from nutritional deficiencies is now far smaller than that of the overweight adolescents that can not effortlessly carry out their daily activities. Obesity and related disorders are wide spread: Over 30% in some affluent populations, and many more in the populations that were not genetically well adapted for overindulgence. As we achieve stable food supply we find it is not necessary to carry around that extra weight. Yet the genes with memories of the leaner times still guide us towards overindulgence.

Ostensibly innovations spread by imitation, education and marketing to promote the new and critique the old without throwing the baby with the wash-water. The successes and the understanding behind such efforts have made us more aware of the necessity of doing something about things that can be done.

In the early stages knowledge can be diverse, incoherent, and even apparently contradictory. Making predictions that turnout to be true is part of the process that moves empirical generalizations towards laws of nature and theories. Such unified knowledge in turn relates to the underlying structure and behavior of at least a part of the universe. This is how we use past to peer into the future. Public perception of science has inspired the vision where prediction is central to decision making.

Around 1790 Laplace imagined: *Consider an intellect, which at any given moment knew all the forces that animate nature and the mutual positions of the beings that comprise it. If this intellect were vast enough to submit its data to analysis, it could condense into a single formula the movement of the greatest bodies of the universe and that of the lightest atom. For such an intellect nothing could be uncertain, and*

the future just like the past would be present before its eyes. This is the Laplace's demon.

It is a physical impossibility because a real entity can not know the complete state of the world at any given time. Even for a perfectly deterministic system, uncertainty in the variables precludes prediction of the future states of the world with any degree of certainty. The flip side of the dialectic is also unacceptable. Imagine the inaction that follows from *god wishes so* or *god moves in mysterious ways*.

Whether either ends of the dialectic are true or false makes no difference to the world. What matter is what it does? By the same token one could memorize all the accumulated knowledge without ever learning anything how a problem can be solved, or internalizing the lessons from the failures. The impact of a change lies in its consequences. Consider a relatively innocuous fact: The volume of steam is much larger than the volume of water it came from. Use of this fact unleashed the industrial revolution with disruptive social and political consequences. It continues to improve the quality of life of many if not most people alive now. Similarly, developments in the understanding of the nature of the atomic structure and the chemical bond ultimately gave us plastics, antibiotics, insecticides, and the computers. We continue to find use for them, and at the same time asymmetric concentration of wealth (power?) is also encouraged.

The power wielded by the products of science and technology has come to represent greater good and also the means of harm (grab and greed). We are learning to live with both. Considering the inevitability of the technological progress and its effect on the rest of society, checks and balances are necessary at all levels. Can only the market-forces deliver the ultimate good?

Room for Doubt

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