



The University of Bradford Institutional Repository

<http://bradscholars.brad.ac.uk>

This work is made available online in accordance with publisher policies. Please refer to the repository record for this item and our Policy Document available from the repository home page for further information.

To see the final version of this work please visit the publisher's website. Access to the published online version may require a subscription.

Link to publisher's version:

<http://www.cnstedu.cn/cms/contentmanager.do?method=view&pageid=view&id=cms060f152cc8195&type=tz>

Citation: Baruch J (2016) The Robots are coming – the 4th Industrial Revolution: Part 1. China Science & Technology Education. 245(8).

Copyright statement: © 2016 cnstedu.cn. All rights reserved. Reproduced in accordance with the publisher's self-archiving policy.

The Robots are Coming - The 4th Industrial Revolution

1. Science and Technology feeds innovation and changes the World.

Early humans' understanding the world around them was the primitive science and technology that fed innovation to bring about the farming revolution over 10,000 years ago and lay the basis for the development of villages and cities. The modern world has been built on a science driven revolution that started in 1600. Today we are on the verge of an even more dramatic revolution.

In 1600 China was the most advanced country in the world. By the year 1900 China was on its knees, overtaken and ravaged by the first industrial revolution. No part of planet Earth was untouched. It completely changed the world and more importantly it dramatically changed the lives of nearly everyone who lived through that period. How can we ensure that the revolution that is about to engulf us does not beat us down to our knees and that there are benefits for all?

China in 1600 was a nation of great cities, thriving and bustling industry, and trade. It produced everything that it could want. It was surrounded by seas, snow-capped mountains, vast deserts and forests. It felt as if it was the centre of the universe and the only nation that mattered. There seemed to be little of value in the worlds beyond their seas and deserts, and the Chinese regarded these worlds as being inhabited by barbarians. By 1900 China was enslaved by a set of gangster nations, intent on ripping out all the wealth they could find and China was broken up by regional war lords making things even worse for the Chinese people.

People in the West have heard of the Opium wars but there is no general understanding that these gave the Western-supplied drug dealers a free hand to do whatever they wished by getting as many people as possible addicted to opium. In this way the West would make vast profits selling the drug, and did not have to pay the Chinese in silver for their tea and fine porcelain chinaware. How was it that these nations that China regarded as barbarians, completely outpaced and then destroyed Chinese leadership?

In Europe the first industrial revolution rested firmly on the destruction of 'Heaven'. This was really the destruction of the old views of heaven and that included the idea that the Christian God had created everything, put us here and had a plan which we had no right to question. This unchangeable world defined and created by God was shattered by Tycho Brahe in Denmark who discovered a new supernova in the sky in 1572 and showed decisively that it was not an atmospheric phenomena but was in the distant spheres of the stars. He equally showed that comets too were not from the Earth. The new revolutionary idea driven by these discoveries, was that it was ok to research the world that God had created.

Printing opened up the basis of the religious ideas to many more people and heralded the religious revolutions of the Reformation. The Christian Bible and the ideas it contained were first claimed to be the property of the kings and queens. They used these ideas to steal the land and wealth of the Church, which was done most dramatically by King Henry the 8th of England. The Bible (as the word of God) and its ideas were then claimed by the new propertied classes in the English revolution, destroying the power

of the King. This was followed by the American War of Independence in 1786 and then the French revolution in 1789. All these events wrote in large letters in the minds of the people the idea that people themselves could make their own history; it was not made by Gods, Churches or Kings. The world was changed for ever.

The view that people made their own history opened the door to Science. Early scientists like Newton and Galileo felt, initially, that they were working to understand God's world. The first scientific society was born in England, The Royal Society, to discuss science and its development. They and many other people also felt that they could use their knowledge to build a new world and England was midwife to the first industrial revolution.

This revolution changed first England, Wales and Scotland, then Europe and America. People came to live in cities and work for wages in factories. The advanced countries of the world didn't just use their industries to make all the old products, they invented hundreds of new products, built the infrastructure for industry and transport, and then developed a consumer society.

That first industrial revolution was qualitative in every way with steam, steel, canals, railways, agriculture, navigation, factories, mills and guns used to build a very different world. The new world used steam engines to pump water out of the mines, power the mills, factories, ships and trains and produce the steel with which to make them. The people migrated to the cities to work in the factories and mills. New agricultural methods provided the food to feed them, and the new transport systems ensured that famine was consigned to the past. England's development of accurate time keeping for navigation enabled them to rule the seas, build an empire and beat all the opposition, including the French.

The next two revolutions of 'electricity', in the first part of the 20th century, and 'computing' in the second part of the century were quantitative; in other words it just speeded up everything, making more products better and faster.

Now it is the 4th Industrial revolution which is about to engulf us and is presenting another qualitative change in everything.

For most people the most dramatic change will be the introduction of self-driving cars. You will get into the vehicle and tell it where to go either by talking to it "take me home," or you will use the satnav to show where you wish to go. The car will then take you there with no more input from you and you will be free to surf the web or watch a film or just read a book. It will revolutionise transport for the old, the young and the disabled. Will people actually buy cars or will they use them Uber style? If they buy a car will they leave it in the garage whilst at home or at work or will they instruct it to cruise the streets Uber style and earn money for them? This all seems amazing but will it happen?

The giants of the world wide web see the time that people spend commuting and driving their cars as time that they could spend surfing the web and increasing the value of the advertising time that Google and Baidu are able to sell. It is for this reason that web companies are putting immense amounts of money into creating self-driving cars. The technology will also give us self-driving buses, trucks, trains and planes. For many living in the countryside who cannot afford to own a car, self driving buses will

greatly reduce the cost of transport and revolutionise their lives. Self-driving trucks will also greatly reduce the cost of transporting goods and are already used in large scale mining operations.

The Robots will take over our Medicine and Banking. Doctors will increasingly be replaced by robots controlled by a nurse to ensure that data you presented to the robot accurately represented your symptoms. The robot will search the web to find all the other instances of medical problems like yours and what treatment was used and how successful it was. They will compare your personal data with the data of the people who have suffered your symptoms before and make a recommendation based on a much wider knowledge than any human doctor would have. In hospital, operations will increasingly be done by robots that will not make mistakes and can have six hands with the smallest of instruments to sew together nerves and fine blood vessels. The medical team of anaesthetist, and nurses will still be there along with a person to control the robot, but many surgeons will have to find other jobs.

Robot bankers will replace humans, if they haven't already, to give banking advice to companies and individuals based on a much wider knowledge than human bankers could have. In terms of investments and gambling on the stock markets the computers will be the ones that make money; the human investors will increasingly be the losers. The robots are coming and threatening to take jobs in every area of industry and commerce, creating growing problems of unemployment the like of which have not been seen before in the developed world. The problem is being approached in different ways in different countries, but most are agreed that practical science has a special role to play in building the skills of technological innovation and creativity. It is suggested that astronomy can play a major role as it is the only practical science that can be delivered robotically. Whilst robot practical Physics and Chemistry requires large and complex robotic laboratories, astronomy only requires a robot telescope and the whole laboratory goes overhead every night.

The practical science of astronomy goes beyond the instruction-following of "hands-on" experience to introduce the skills, knowledge and understanding which underpin innovation and creativity. Practical science focuses on finding explanations, explores how the explanations can be tested, and challenges students to find better tests whilst laying the foundations for a workforce of innovative and creative people and a society of great wealth and diversity. 'Industry 4', as it is called in Germany, will build a completely new world based on robotics, artificial intelligence and the internet; and it will lead to dramatic developments right across society. Cars, trains, trucks, ships and planes will be driverless, doctors and surgeons will increasingly be robotic, along with robotic bankers investing and gambling microsecond by microsecond. The basics of life, like washing machines, fridges, cars, trucks, smart phones, shoes, much food and clothing, will be manufactured robotically on a global scale. These will form the basis of a consumer society delivered at the lowest possible cost.

These enormous changes will change the way we live. Cities will become more and more important as innovative and technological centres bringing together a large range of people with very different skills who can work together to develop new science, architecture, or arts. Bigger cities with excellent transport systems able to bring people together within an hour will be the power houses of this new society, developing their own fashions, food, architecture and design competing on a world scale.

It sounds amazing, and amazing it will be, ... but there is a problem.

The next article, next month, will look at how the new technologies will require people with completely different skills. Today's education system educates for the world of today. The Challenge is to educate our young people for the world of tomorrow.

<http://www.telescope.org>

<http://schools.telescope.org/>

<http://cn.schools.telescope.org/>

JEFB

22nd July 2016