

When we think of great scientific achievements, the mind usually turns to a great scientist associated with that discovery. Darwin and his theory of evolution, Einstein and his theory of relativity, and Maxwell for the unification of electricity and magnetism to name but a few. Often, these tales of genius come with a whimsical story, for example Newton discovering the nature of gravity due to an apple falling on his head.

In the modern day, great scientific leaps are rarely achieved due to the genius of a single person. Rather, a group effort is made to solve a problem by research groups across different disciplines and even different countries. Each group makes a plethora of smaller, but significant studies and share their knowledge over a variety of platforms in order to advance the field. It is this shift in the tendency of the modern scientist to more willingly share ideas and collaborate which is a significant contributing factor to the increased rate of scientific advancement in recent years.

What has caused this shift in emphasis from the individual to the collective?

Centuries ago, scientists would have been more guarded about their work. Science was less the open subject for everyone, and more an interest for the elite few. Some famed scientists made massive leaps forwards in understanding, yet these leaps were few and far between for hundreds of years. For the glory these academic achievements offered, scientists of the time kept their cards to their chests so that nobody else may steal their ideas, beat them to publishing and cheat them out of fame, money and the title ‘genius’.

Rivalries, such as that between Edison and Tesla contributed toward this culture. They also made matters worse by discouraging scientists to listen to the ideas of others with an equal amount of respect – preventing effective communication. **The scientific community was pervaded by elitism and egocentrism, with contributions of the individual being hailed and few people working as a team.**

Over time, the need for more than one mind working on a problem was required as understanding became deeper and more specialised, and this began to erode the elitism pervading science. Part of this was the increased inclusion of women and the lower classes into the community due to

societal changes of the time, and also with advances in transport and engineering came ease of international travel. This meant that ideas could be shared between people from a wider range of demographics, with different experiences and viewpoints to bring to the table. Science began to become more open.

How have these cultural changes impacted modern science?

Communication and collaboration are key to the continuation of modern scientific advancement. These aspects of research that were practically unheard-of centuries ago are more realised in laboratories today.

The Nobel Prize is an illustration of the cultural shift within scientists towards teamwork. Set up in the late nineteenth century by Alfred Nobel to award great achievements in chemistry, physics, medicine, literature and peace, the prize may be shared between no more than three people. Recently, people have begun to call into question the relevancy of the prize to modern science. This is largely due to the collaborative way research is conducted – great achievements in science are rarely made by less than three people nowadays.

As science advances more rapidly, it has become harder for one researcher to be multidisciplinary. **In order to stay on the cutting edge of research in their field, it is necessary to specialise.** This encourages a culture of openness and teamwork as the individual may not have all the skills they need to answer a question.

A biochemist studying a class of proteins may discover that a protein is behaving in such a way that will cause disease. They may pass the problem on to a synthetic chemist, the job of whom it is to make a drug to prevent the disease, who may synthesise a molecule and pass it on to a crystallographer to determine whether they definitely made the right thing, and so on. Each of these people may study in the same or different research groups, or even different institutions or countries.

Collaboration is necessary as people with specific skills and institutions with specific high-tech pieces of equipment are needed. Under the old culture in which scientists were reluctant to share ideas so openly, this depth of study would not be possible.

There are many branches to a more open, collaborative type of science. There

is the notion of public engagement and outreach, involving many universities and museums putting on free events to give the non-scientific specialist public access to information about research. Additionally, parts of the literature have become open-source, so anyone can read it without having to pay a large sum. There is also the collaborative culture between researchers, and the communication efforts this involves such as networking, symposiums, projects run between laboratories, conferences and guest academics giving seminars.

Each of these strands are the result of a greater need for easier, more open communication, and the recognition of that need by scientists themselves.

Between scientists, an example of the great achievements that can be made through collaboration is the Large Hadron Collider at CERN, taking thousands of scientists and engineers years to build. Not only was the project a multinational effort to bring to fruition, the data procured by the collider are used by research groups all across the world. It is an example of the new sharing culture in science, as resources were pooled worldwide to build it, and researchers must trust the experimental scientists there to gain accurate, reliable data so that their own work can advance.

Scrutiny and accountability are born from sharing – after all, scientists relying on each other for input need to know that the input being given is reliable and credible. This has resulted in peer review and wider discussion of results to verify them, leading to more reliable and better understanding overall. **This scrutinising style of communication can be used to drive science forwards faster, by identifying theories and experimental results that need more work.**

Sharing and communicating, and therefore scrutiny and accountability comes not only from other scientists, but also from the public. With institutions such as CERN, the Science Museum and universities making a greater effort with public engagement than ever before, more people in the non-scientific public are able to ask questions and scrutinise the way government money is spent on scientific ventures.

Here lies one of the next challenges for science to further improve its culture of open communication. Whilst scientists have vastly improved communication with each other to the end that advancements are made at a higher rate than ever before, communication with non-scientists is not at the same level. An example is the use of

jargon. Technical jargon between scientists to quickly share ideas is an efficient way of doing things, but it can be extremely off-putting to non-scientists.

Whether it is simply that scientists are not trained to communicate concepts to non-scientists, or whether some remnant of the elitist past prevails in throwing around jargon, it closes off communication to non-scientists. This could hold science back from advancing even faster than it already does, by discouraging young people from a career in science due to its seeming impenetrability. This may cause there to be fewer skilled scientists from a narrower range of backgrounds to share and refine ideas. The non-scientific public may also begin to have a lack of faith in science, and consider it unimportant. This could contribute to a reluctance of the government to provide more funding for new research.

The attitude of the modern scientific community to work together to achieve its goals allows for discovery to propagate faster than ever before. Technology has exploded in all areas from the rapid development of mobile phones and the internet to huge leaps in cancer therapies to massive advancements in the

invention of green energy resources. Over the past few centuries, a cultural shift in scientists has been seen by which they have moved away from elitism and a desire for academic glory, and responded to the need to collaborate, share and communicate.

Improvements can always be made. A great future challenge for open communication culture in science lies in involvement of non-scientists. The demystification of science through the expansion of the collaborative, communicative culture may provide more public engagement, more young people training in science and therefore more fresh ideas and viewpoints to bring to research. This in itself would represent another cultural shift: from scientists changing their attitudes as a response to a need, to actively harnessing this open communication model to drive science forwards even further.