Journal of Tropical Forest Science 24(3) (2012)

GUEST EDITORIAL

DOTS AND PATTERNS IN SCIENCE

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The scientific investigation of natural phenomena is somewhat like the childhood game of joining dots to make patterns. Individual dots have no meaning but meaning is provided by patterns. Science is driven by the belief that we can understand nature by discovering and understanding the patterns of nature. Patterns may themselves act as dots for the making of greater patterns.

Dots are the data that scientists collect and analyse. Patterns are the theories, sometimes referred to as hypotheses, models, maps or explanations, they come up with. Starting from the same dots, different scientists may come up with different patterns, because patterns, although based on the evidence of dots, are theories made up in the mind! Some patterns are obvious from the dots, but the most admired one are the products of mental processes that we cannot fully explain. When asked by a reporter what equipment he used to arrive at his famous Theory of Relativity, Einstein is reputed to have produced a well-chewed pencil from his pocket!

Although we cannot fully explain how creative scientific minds work, we know what constitutes good theory in science. Most importantly, a theory must be in a form that can be critically tested. The usual test of theory is whether it has the ability to predict. If dots belong to a pattern, the pattern itself must be able to predict other dots within the limits of the pattern. For example, if a particular microbe is found in plants afflicted by a particular disease, we may theorise that this microbe is the cause of this disease. We can test this theory by examining other diseased plants to confirm the presence of the microbe. We may even infect plants with the microbe to see if the characteristic disease symptoms appear.

The function of theory in science is to explain and predict. In essence, a scientific theory is an explanation of nature with predictive properties. Modern life is totally dependent on inventions and scientific services based on the predictive properties of the vast body of theories that have been tested and proven. Inventions range from simple thermometers to complex manned stations in outer space. Services include medical diagnostic services; analytical services for soils, water and air; testing services for materials; inventory services for the contents of forests, oceans and other ecosystems; identification services for plants, animals, microbes, toxins, pests, fingerprints and DNA; and monitoring services for human health, air quality, weather and climate.

The ability to predict confers the ability to control hence theory is what gives science its power, fascination and usefulness. Most of what we call scientific knowledge began as theories published in scientific papers and thereby made available for evaluation, refinement and application by the global scientific community.

Due to the pivotal role of publication in science, especially in the development of theory, the main management tool for driving scientific research has been to apply pressure on scientists to publish. As more and more countries apply such pressure, journals are flooded with papers, and editors are challenged to grade papers ever more stringently so that the peer review system does not get overwhelmed. Although most journals do not reveal the figures, it is likely that 50 to 80% of submitted papers are filtered out by editors without being put through the time-consuming peer review process. Most papers fail to make the grade because of low explanatory power—especially data papers with negligible content of theory—and it does not require peer review to identify such papers. The problem has several roots.

In forestry, one root of the problem is that scientists in many research institutions repeat past work that has hardly any room for new theory. We cannot keep on repeating timber tests, germination trials, forest inventories, etc. and expect each effort to get published in a journal. The species, location and other details may be

different each time, but the intellectual content is likely to be repetitious. The best home for such data is in databases maintained institutionally for publication in reference handbooks.

Appointment titles, which define a scientist's area of responsibility, can be intellectual prisons. Forestry research institutions need to review the functions of their research units every few years. Those units that still provide useful testing and diagnostic services may be maintained but the scientists that supervise such units should be required to expand into new areas of enquiry in order to contribute to new theory in their own professional interest, and to keep forestry intellectually alive.

Another root of the problem goes back to the period of decolonisation when many countries became independent just after World War II. The idea was promoted that research could be divided into 'basic' and 'applied' and that basic research, involving the investigation of patterns in nature should be left to the rich countries while developing countries would make most progress by concentrating on problem-solving applied research.

Applied research defined in this way results in papers that culminate in results and conclusions applicable only to the particular place or time of the investigation. Such papers have no global explanatory power and would make little impact in international publication.

The idea that developing countries should limit themselves to applied research on local problems has contributed to 'national' science. Examples are Indian scientists researching 'Indian' questions and Malaysian scientists researching 'Malaysian' questions. In most developing countries, national scientists are discouraged from extending their investigations beyond national boundaries, so that they do not 'waste' national efforts on non-national problems. As a result they do not do enough to internationalise their research and cannot make explanations with global significance. In the life sciences, place and time may have a bearing on a study because living things are variable and adaptive, but the act of joining local dots into global or regional patterns immediately lifts the work to a more useful level of explanation and prediction. A local scientist who thinks globally is a better-informed and more useful scientist.

Global thinking requires mastery of the global state of knowledge of the subject, which is now facilitated significantly by the emergence of one language—English—as the undisputed global language of science. Until two decades ago, there were efforts, now shown to be unsustainable, to promote multiple languages of science. Now, we only need to master one language as our multipurpose tool to access and contribute to the global pool of scientific information.

Multilingualism has distracted scientists and science managers from a more important language issue, which is the level of language-competency needed for scientific expression. Basic English is adequate only for describing and analysing the dots of science. Dots are relatively uncontroversial, and there are simple reporting formats that can be followed. In contrast, theory cannot follow any fixed reporting format because it has to be original and also because it has to be argued against existing and alternative theories on a case-by-case basis. Inadequate language proficiency prevents many scientists from venturing into theory except at a superficial level because, without high language proficiency, it is almost impossible to develop and argue novel theory convincingly. This poses a major challenge for countries where English is not the first language. The Netherlands and Scandinavian countries understood the importance of English competency in science before most other non-English countries and their scientific communities are able to express scientific concepts fluently in English. The scientific communities in most other non-English countries have a lot of catching up to do.

Science managers actually have more ways to influence the development of science than merely to apply pressure to publish. They could look into the improvement of language skills, the reform of obsolete organisational structures and the promotion of global thinking.

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