

SPECULATION IN SCIENCE AND PHILOSOPHY.

BY JOHN WRIGHT BUCKHAM.

AMONG laymen natural science is supposed to be strictly non-speculative, factual, practical. It has the reputation of being concerned solely with facts, not with theories. How far this is from the truth all who have the slightest acquaintance with modern science know. Natural science is intensely speculative. No freer confession and abler justification of *speculation* in the field of science has been made, perhaps, than that of George J. Romanes in the introductory chapter of his *Darwin and After Darwin*. After pointing out how seriously science was limited, from the sixteenth century onward, by the notion that "science ought to consist in a mere observation of facts, or tabulation of phenomena," Romanes goes on to show that it was no less a person than Darwin himself who broke this bondage. "To begin with," he writes of Darwin, "he nowhere loses sight of the distinction between fact and theory, so that thus far he loyally follows the spirit of revolt against subjective methods. But, while always holding the distinction clearly in view, his idea of the scientific use of facts is plainly that of furnishing legitimate material for the construction of theories." "Not facts, then, or phenomena, but causes or principles," concludes Romanes, "are the ultimate objects of scientific quest." "The spirit of speculation is the same as the spirit of science, namely a desire to know the causes of things."

Whether one agrees with this estimate of the value of speculation or not, he cannot but be struck by the extraordinary prevalence of speculation in present-day science. A good instance is that of Arrhenius's theory of the transmission of life. How the imagination exults in trying to follow one of those infinitesimal life spores falling for eighteen hundred years or more through space, conveying life from planet to planet. It is interesting, not to say romantic, suggestive, yes, and in a sense scientific, but boldly, strikingly, speculative. Even more speculative, because more intricate and involved, is Weismann's germ-plasm theory of heredity. Biophors and determinants and a sturdy struggle for existence within

the spacious domain of a single cell,—has speculation ever gone to greater length than this? And yet if it explains the facts better than any other theory it will win the right to stand.

The *test* of scientific speculation, Professor Romanes goes on to say, is “adequate verification,” “an appeal to objective proof.” But is not this too heavy a demand for even scientific speculation to meet? Surely neither of the above theories can appeal to objective proof, and adequate verification is a very flexible standard. Can science really verify her hypotheses? They stand until some as yet undiscovered fact appears to overthrow them. Their truth is empirical, relative, contingent. Verification is always progressive, never complete. It is not impossible that some fact may be discovered that will modify or annul the undulatory theory of light, or even the descent of species.

Moreover scientific explanation is at best partial, never thoroughgoing and exhaustive. The unreflective mind may think that science has a complete and sufficient understanding of electricity, but the physicist understands very well that, as for any knowledge of what electricity really is, science is as ignorant as a child and is likely to remain so for some time to come. And as for the most familiar forces and objects in nature, it is very little at best that is known of them. Light may be defined as ether waves, but what is ether? The definitions of science are at best but descriptive. The law of gravitation—what is it in itself? How it works we know, how to measure it, how to use it, but what is its nature and how did it come to be? Science bulks large, its deeds are mighty, its conquests marvelous, but after all it works in a world of mystery, handling forces that it cannot comprehend, dealing freely and familiarly with facts that it grasps only in part.

What then? Should science cease to experiment, to achieve, to speculate? Surely not. Experiment, application, speculation, have accomplished marvels. Together they have won great things for humanity. Only let not science assume that her interpretation of the universe constitutes the sole and absolute truth. Self-sufficiency and dogmatism tempt her to-day as they once tempted theology.

When we turn to the realm of the rational, the moral, the spiritual,—lying quite outside the realm of natural science and belonging to philosophy, ethics and theology,—we find that we start, as in the realm of science, with certain facts of experience (though facts of a very different order from those of science), such as

consciousness of self, worth, freedom, other selves, God. These experienced facts of consciousness, though invisible and intangible, are not less real than those of science, but more real. They touch more nearly our integrity, our happiness, our higher life. Without them science itself would be but an inconsequence, not to say an impertinence.

To understand, correlate, interpret, and thus to make best use of these facts of personality, it is necessary to speculate concerning them, just as it is necessary to speculate concerning the phenomena of the outer world. Speculation will not disclose their ultimate nature any more than in the realm of science, but it serves to throw light upon them and to render them more intelligible.

There will always be protest against speculation in the realm of the spirit, just as there has been, and ever will be, in that of science. "Stick to the facts, let theories alone," is a plausible and appealing cry. But it is timid and reactionary. It is not thus that progress is made. There may be temptations and dangers in speculation but it has an important office to fulfil. Two virile movements at the present time represent the reaction from over-speculation,—pragmatism and Ritchlianism,—the one in philosophy, the other in theology. Both have a mission, but both are partial, short-sighted, and if persisted in will prove paralyzing. It is such pleas of nescience and counsels of caution that keep philosophy and theology behind science in the path of progress. Science has dismissed her fear of the unknown; let not philosophy and theology retreat into the cave of agnosticism.

And yet when all has been said in defense of speculation, as legitimate, illuminating, essential to progress, the only defensible plea in its behalf is for *freedom*, not license, in its use. To be an illumination of truth, not an obscuration, an aid and not a hindrance, speculation must recognize its limitations and observe its boundaries. Verification, as far as it can be applied, is the indispensable test and regulator of speculation. And verification is just as possible and just as essential in philosophy and in theology as in science. The facts of self-consciousness are the stable foundation of truth here, just as the facts of sensation-consciousness are in science. Immediately one of these facts is contradicted, speculation needs revision.

A word in closing as to the relation of the two fields of speculation to one another. These fields are contiguous but distinct. Confusion comes from disregarding either their contiguity or

their distinctness. The scientist too carelessly passes from his own field of speculation into that of the philosopher and theologian, forgetting that he is dealing with another order than his own and should first familiarize himself with its *prolegomena*. The philosopher and theologian, on the other hand, sometimes push indiscreetly and heavily into the realm of science, dogmatically asserting what must be true instead of asking what is true. The next step toward a more comprehensive and harmonious life-philosophy lies in the mutual recognition, on the part of truth-seekers in both fields, of the distinctness of their tasks and the relatedness of their results.

EDITORIAL COMMENT.

That progress in science cannot be made without speculation is so obvious that it is generally granted, but that imagination, yes even poetic imagination, plays an important part in it is not fully appreciated. Sometimes the great discoverers in the realm of science themselves are not conscious of the debt they owe to the poetic and artistic part of their natures in guessing at theories and excogitating explanations of facts that strike us as strange. It is well known that Kepler, before he solved the problem of the planetary movements formulated with definite exactness in the so-called three Kepler laws, had tried a most ingenious and fantastical explanation based on a mathematical formula which might almost remind us of a cabalistic imagination, but he was critical enough to find out that his fantastic theory covered the facts only approximately, and so he continued delving into the problems of the inaccuracies and discrepancies of his first guess until he found the truth, a formula which is a mere description of facts, and yet should be called just as beautiful and grand as his prior purely poetic vision. Mythology always precedes the formulation of exact truth, and mythology is not wrong but foreshadows the truth. This is true generally not only in science but also in ethics and religion. The old religious

myths are untrue only if we understand them in their literal significance. They are true if we heed only the spirit of the myth which is an exposition of the truth in its dawn. Light is thrown on this subject in Ribot's book, *Essay on the Creative Imagination*, in which he has devoted much attention to the approximation to truth by speculative imagination. In a chapter of my little book *The Surd of Metaphysics*, entitled "Truth or Mythology," the significance of allegorical formulations with special reference to the terminology in science and also in religious truths has been pointed out, and teaches us to respect the old mythology and pagan superstitions, including the paganism which is still clinging to present-day Christianity, better than we otherwise would be inclined to do.

P. C.

HOW RUBBER IS MADE.

BY A. M. REESE.

ONE of the principal products of the Malay Peninsula is rubber. Like most people who have never happened to investigate the matter my ideas as to the way in which an automobile tire is extracted from a tree were very hazy; so, with another American, who had charge of a mission school in Singapore, I boarded the Jahore express on the F. M. S. R. R. (F. M. S. meaning Federated