Some Aspects of Scientific Methodology Applicable To Orthodontics

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A very cursory survey of the field of orthodontics reveals the fact that there are two attitudes, or differences of emphasis with which practitioners approach the problems of their profession.

On the one hand, we find a concern for the theoretical or scientific. This attitude is characterized by emphasis on research, by insistence on controlled experiment, by an attitude of objectivity, by a willingness to consider all types of evidence. Precise definitions of meanings and a scrupulous regard for logical consistency are its hallmarks. Furthermore, its influence on diagnosis and therapy has everywhere been great.

On the other hand we find the practical man who looks askance at research which he neither understands nor trusts. His concern being almost wholly with mechanisms, at meetings he may be seen hovering around the table clinics, or feverishly seeking information about such matters as the latest technic of moving a cuspid distally, etc. To him, the cephalometer is inaccurate and its finding inacceptable; and as for histology or anatomy—they are dry as dust and can have no bearing on considerations of therapy.

Oppenheim recognized and decried this point of view when he wrote, in 1944: "Everywhere in America the marvelous results of research are highly appreciated and put into practice by the professions and gratefully accepted by the laity. But from this generally accepted attitude that research should be the basis for practice, orthodontics seems to be the glorious exception. Little attention is paid to the results of research, to the demonstration of what is happening invisibly below the mucous membrane; most of the interest is still concentrated on mechanics alone. Orthodontics is now confronted with a chaos of individual philosophies not based on research. Unless that is changed, histologic research will have little chance."[1]

This schism in the orthodontic household — this dichotomy of conflicting points of view which has vitiated the efforts of the researcher on one hand and deprived the clinician of much material of undoubted value on the other will disappear if orthodontists can orient themselves properly to the real meaning of the scientific point of view — that is, if they can apply the principles of scientific methodology to their problems.

When Galileo dropped two cannon balls, one heavy and one light from the leaning tower of Pisa and demonstrated that the heavy ball and light ball fell at the same speed, he did more than make a noise; he shook the world as it had never been shaken before — for he ushered in the era of science.[2] What he had done was to question the teachings of Aristotle who for 2000 years had taught that the speed of a falling body was proportional

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to its weight. The idea of subjecting the word of authority to the test of experience and if need be, revising it, no matter how firmly intrenched that authority might be — this idea was new to a world that had for centuries accepted the word of authority without question.

"What ails most people," says Adolph Meyer of John Hopkins, "is not that they are ignorant, but that they know too much that isn't so." That is, they have certain preconceived notions to which they cling with great tenacity and with considerable emotional bias.

Science teaches basically that these ideas shall be reexamined in the light of experience and if found untenable, to be discarded or modified even if that idea be the normal occlusion concept of an Angle or the mandibular incisor upright theory of a Tweed. A scientist is ever ready to admit his error. He seeks the simplest explanation — and distrusts it.

The word science seems to have various meanings. One of them refers, by way of definition, to certain techniques involving the use of apparatus, i. e., a scientist uses certain techniques. But pushing buttons and reporting results isn't science. Such a definition fails to catch the full meaning of the term. It would be better to refer to such men as technicians rather than scientists. Einstein, one of the world's greatest scientists, never performed an experiment.

Another definition of science seeks to identify it with a body of knowledge such as chemistry, physics, anatomy, etc. Viewed from this aspect the assumption is that a certain compilation of facts is a science, which another compilation, such as history, for example, is not. Evidently science is more than a body of knowledge.

The notion that science involves abstract theories, couched in abstruse mathematical language is likewise inadequate. For few people understand these things, and if science is to be useful, it has to have a meaning for the average man.

The concept of science which has proven most useful to me is the notion of science as a method. This is Galileo's approach. It is a certain way of looking at facts — it is a certain orientation of reality. Briefly, it is the policy of subjecting the word of authority to the test of experience and of revising it, no matter how old the word of authority may be or who defends it.

For many years, philosophers, semanticists, logicians, mathematicians have been engaged in a thoroughgoing analysis of the fundamental concepts of Science. This study, known as scientific method or methodology examines the bases on which science rests. Being highly technical in nature, only some of its results can be indicated here. As a result of this study certain interesting facts have emerged, some of which have a direct bearing on our specialty.

The scientist is engaged in making observations and in arranging experiments. To this extent his activities are practical in nature. But coincident with this there is another part of his work that is definitely theoretical and of which he is seldom aware. That is the fact that while engaged in observing, he is also constantly theorizing, he is attempting to explain his observations. Thus a good part of his work is theoretical in nature. To explain his findings he formulates a theory. Then by the aid of the theory he attempts to predict whether a case will be successful if a certain treatment is carried out.

These theoretical activities of which we are seldom aware always involve deduction and calculation and thus whether we like it or not, we have to employ Logic and Mathematics.

In the application of deduction, we first set up certain basic principles or facts which are assumed to be true. These assumptions which cannot be proved are called postulates or axioms. Then by the process of reasoning these postulates are built up into a theory, or to use a better word, an hypothesis.

The strength of an hypothesis lies in the success with which it explains the facts of clinical observation. Its weaknesses are several: one lies in the fact that its postulates are always assumed to be true but can never, from the very nature of their formation, be proved. Another and more subtle weakness is that an abiding affection for the hypothesis may develop in the mind of the investigator. In that case the latter will cling to the hypothesis tenaciously and defend it at all costs, and with a lively display of emotion. Facts that tend to support it are magnified, while phenomena that fail to support it are minimized or neglected.

Every man who attempts to explain or predict the outcome of any orthodontic procedure employs these processes whether or not he is aware of them. Therefore too much emphasis cannot be placed on the fact that the fundamental bases of every orthodontic hypothesis rests on unproved assumptions. Any one knowing and fully appreciating this fact will hesitate in becoming dogmatic and categorical about his assertions when he realizes the flimsy nature on which they rest.

Not only does this fact hold for scientific laboratory finds — it also holds for clinical observation.

The current controversy over the extraction of dental units in orthodontic treatment is a case in point in which the failure to recognize the unproved character of the assumptions upon which the conflicting hypotheses rest has caused confusion, created emotional blocks, and impeded calm rational thinking, the true scientific ideal.

The notion of uprighting teeth over basal bone should be recognized as merely a postulate in a hypothesis which seeks to explain stability of orthodontic end result. Those who champion it close their eyes to the many cases of denture stability following treatment in which mandibular incisor segments were positioned in a protruded relation.

On the other side of the fence, the principle of a full complement of teeth in normal occlusion as a basis for stimulating growth through function and hence normality must, likewise, be recognized as a postulate upon which Angle built his theory. It is not a concept to be defended at all costs but is an assumed premise precisely like Tweed's assumption.

Recognizing the character of the postulates and their place in the deductive process should reconcile these conflicting ideologies. On the one hand while many protruded dentures are stable, there are others which promptly relapse following removal of retention. On the other hand, extraction is not a panacea since its use often results in dentures with undesirable spacing between teeth, deep overbites, dish-faced profiles and frequently protrusions in spite of heroic measures to prevent it due to loss of anchorage as

a consequence of the disturbance resulting from the extensive movements employed. These are surely undesirable sequelae of treatment by all standards.

To help resolve this difference of opinion, both sides should assiduously direct themselves toward impartial collection of the evidence, both corroborative and contradictory. As the evidence accumulates and the old hypotheses are no longer adequate, the underlying assumptions will have to be modified or discarded in favor of others chosen on the basis of the newer knowledge gained. Only in this way can progress be attained.

In conclusion we have tried to show, rather sketchily, how an inquiry into the nature of the scientific method is useful in ordering our orthodontic thinking. Such an inquiry leads to the development of a more tolerant attitude between contending and conflicting ideologies on the orthodontic scene. The development of keen insight into the unstable nature of our fundamental concepts will unify rather than divide opposing philosophies, so that emotional resistance will be replaced by the cold light of reason with revivifying effects upon the future development of orthodontic research. We must realize, moreover, that beliefs, even if long cherished, must be modified or discarded as the evidence indicates. In conclusion, I am reminded of these words of Fredrich Jensen:

"What we think we know today shatters the errors and blunders of yesterday and is tomorrow discarded as worthless. So we grow from larger mistakes to smaller mistakes — so long as we do not lose courage. This is true of all therapy; no method is final."

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