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SCIENTIFIC METHOD IN EDUCATION

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EDITOR'S INTRODUCTION

PRIOR to the time of Horace Mann and the other educational revivalists, the improvement of teaching practice was so gradual that it scarcely attracts the attention of the educational historian. Tradition clutched the classroom firmly. Individual experience, with its endless trial and error, wove new patterns of procedure, but not many. A single inspired writer of textbooks with a new plan for organizing subject-matter had more professional effect than the numerous innovating but isolated teachers who may have discovered desirable changes. Teachers were not coöperative. They were not a group with a common association which permitted them to share one another's successes.

With the period of educational revival, the profession acquired organization. It was crude as compared with present standards, but it was epoch-making in its usefulness. Teachers were brought together for study and discussion. They exchanged experiences. Practice was cross-fertilized and enriched by exchange of ideas.

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Specialized leaders were called into service as the supervisors or managers of State and city school systems. Their function was to discover good teaching methods and to disseminate them among their associates. But the good went beyond the exchange and appraisal of individual skills. Some of the leaders had looked outside their own domains into the systems of adjoining States, and a few had traveled in Europe to note the working of a different tradition in foreign school systems. Contrasts are always unsettling. They raise questions and encourage borrowing and adaptation. But progress under such conditions remains empirical, being based on mere personal experience or observation. It was the exchange of practical technique among teachers which led to the new results. No new mode of inquiry had been utilized.

With the beginning of the last quarter of the nineteenth century, a new influence was brought to bear upon American education — the theories of European philosophers where general concepts were applied to the psychology and pedagogy of childhood. A considerable number of American educators had pursued their university training in European universities, particularly those of Germany, and these eager and enthusias-

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tic students of education brought the speculations of Herbart and Froebel to bear upon American practice. Other philosophies became a part of current discussion. Americans soon developed, largely through reflection upon their own experiences, educational philosophies of their own. It was a period of great stimulation and heightened experimentation. Infancy, childhood, youth, and adolescence began to be observed under the promptings of diverse theory and practice, preparing the way for something better than the appeal to ordinary experience and deductive applications of novel theories.

Early in the twentieth century the wedges of inquiry and experimentation had pushed their way into professional thinking, promising another significant turn in the road of professional progress.

A discriminating analysis of the kinds of thinking which have characterized the sessions of educational leaders, particularly during the past ten years, would probably show few new varieties of thought. It does, however, reveal two very significant facts. First, the usual empirical and speculative thinking of teachers has lost its dominance, its place being taken by reports and discussions based upon inquiries made in a rigid

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scientific spirit and pursued by the accurate modes of modern science. Second, the professional mind itself has developed a new sensitiveness, becoming tremendously receptive to suggested reforms based on scientific inquiry and exceedingly skeptical of proposals which do not possess a firm fact basis.

From such observations it is clear that the scientific movement in education is well under way. Its promise can scarcely be predicted in detail. We are, indeed, at an important turn in the road of educational advance, perhaps the most significant in all our history. From every field of science, both natural and humanistic, we are taking specific scientific procedures and utilizing them to understand the determining factors in education; in addition we are developing special scientific ingenuities of our own.

To understand the contemporaneous scientific movement in the educational profession is not a simple matter. Yet such comprehension is the need of every teacher. An inclusive yet simple summary is required. To this end the book here presented has been written. It records the various modes of advance with adequate concrete illustrations; it leads us into an understanding of our present circumstance with its apparent con-

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flict and confusion; it explains the canons of sound scientific procedure which are to influence us from now on. It should be read by every alert and progressive teacher.

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I

INTRODUCTION

TO-DAY more than ever before science is looked upon as the giver of gifts, the panacea for all ills. The mythical man in the street wears shoes whose composition soles are made by a new scientific process; they were sold to him through scientific advertising or by a scientific sales talk. He climbs into his motor which was but recently the scientific wonder of the age, and enjoys the comfort afforded by his balloon tires, the most recent gift of science to transportation comfort. When he comes to his home he "listens in" on some distant speech or concert over his new radio set, the latest marvel of science.

So popular has the term become that to call a product scientific is to sell it by the million, if we are to judge from the advertising which now comprises so large a part of our newspapers and magazines. And in no field has the term been used with greater prodigality than in the field of

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human thought and action. The older 'sciences' of palmistry and phrenology are decked out in new guise so that we have the science of reading character at sight, the science of personality-building, the science of auto-suggestion, and many others; and there are scientific memory courses, and scientific lectures on sure and easy ways to secure health, happiness, and success.

As a result of the widespread publicity given to such charlatanism through the rapid expansion of advertising, the word 'scientific' has come to mean to the man in the street a kind of combination of the highbrow, the up-to-date, and the crooked. And science is a kind of scheme that can be counted on to get results by a short-cut route. We often hear the phrase, "He's got it down to a science," which may apply to making train connections to get to the office on time, or to breaking the law consistently without being caught.

It is doubtful if those engaged in the profession of teaching are influenced particularly by this widespread, loose usage, though it may sometimes creep into their non-professional vocabulary. Nevertheless, there are two ways that the term, if thoughtlessly used, can bring numberless disasters in its wake.

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The first of these is a too greedy acceptance of what purports to be scientific in the educational field. It has been known to happen that a tentative hypothesis of a scientific worker has been pounced upon by a school administrator who wished to profit by whatever science had to offer, or who may have had less commendable motives, with the result that the smooth-running of a school has been interfered with and no advantage gained. The history of the measurement movement in education, for example, could furnish many instances of such action, as could another very excellent movement, namely, that for bettering the health of school children. Without adequate knowledge or preparation, the incorporation of the newer findings of science brings about more harm than good. People come to refer to them as 'half-baked' schemes, and the cause of progress is set back many years.

The other way that a lack of proper understanding of the meaning of Science can work a positive harm is by forswearing her and all her works. This is the attitude of the reactionary who distrusts innovations, who determinedly falls back upon his old and habitual way of doing things, and cannot be forced out of his groove.

It is clear that positive harm can come from

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either of these two attitudes. And although they are in part due to temperamental differences, they are to a still greater extent due, I believe, to ignorance. Those who have worked up to their present positions through gradual promotion, and whose training was in the normal school of the older type, may have had little opportunity to comprehend what is meant by the scientific method particularly as applied to educational problems. Their high-school science courses probably supplied little. Their normal course was taken up with methods of teaching usually of a formal character, in that they learned ready-made principles, and with instruction in the content of the subjects they were to teach. Since that time, they have been busy in the day-to-day tasks of instruction and administration, and few have had any opportunity to break away and become thoroughly grounded in scientific study.

Those whose preparation has been more recent, or who have come by way of the college, have, in many cases, fared little better. College courses in the sciences — physics, chemistry, biology, etc. — are all too often actually little more than training in following directions as given in the laboratory manual, half-hearted note-taking during lectures, and copying the notes or ‘find-

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ings' of others. Even when college teachers of science are aware of these dangers and do what they can to guard against them, they are too busy covering the required work to assist pupils to generalize their experience to see that it applies in other fields. They all too frequently have no realization, themselves, that the method of science can be brought to bear on the problems of education. No wonder students leave college regarding the scientific method as applicable merely to certain particular parts of the curriculum rather than as *a method of approaching any subject-matter*.

When the sciences are taught in an unscientific spirit, it is too much to expect that the usual courses in education will fill the breach. History and Principles are still in many places the maximum requirement, and the course too easily follows the old track. The addition of a few other courses likewise fails to inculcate the scientific viewpoint in such a way that students can appreciate it, or use it to grapple with educational problems they are soon to meet.

Clearly no book can take the place of rigid scientific training; and certainly a book of this size can do no more than point out certain facts, and show certain relationships. But even in

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these few pages it should be possible to clarify the thinking of students in regard to the relationship of science to education, and to assist teachers and administrators to avoid being either wild-eyed innovators or dyed-in-the-wool conservatives when they come to a consideration of the contributions of science to education.

As has been said earlier, the word 'science' is sadly misused in common speech. Literally, it means 'knowledge' (Latin, *scientia*), though certain quite legitimate, specific meanings have been attached to it. It is more commonly defined as a systematic and orderly arrangement of knowledge referred to the general truths or principles from which it is derived. More narrowly still, it is used to refer to certain branches of learning such as chemistry, physics, and biology.

But this idea of orderly arrangement quite overlooks the method of acquisition of the knowledge which is to be arranged in orderly fashion. It is the *method* of science which is by far the most important thing about it. One's appreciation of the meaning of this word is likewise enhanced by an understanding of its derivation. Etymologically, it means a 'pursuit of' (Greek, *methodos*). The scientific method, then, means literally the pursuit of knowledge. But it is a particular kind

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of pursuit, for a method is a way of reaching a given end by a series of acts that tend to secure it. It is an orderly procedure or process.

To this extent, therefore, the word is applicable to any number of situations. These may be quite objective, for one may speak of a method of attack used in war, or on a smaller scale of the method of attack of a salesman in the effort to sell his goods. Or, we speak of the method of attack upon a problem, the solution of which we seek. In education, the word is usually confined to classroom procedure, so that we consider methods of teaching geography or spelling. Or we use the term more broadly to apply to any of a number of school subjects and speak of the method of measurement, the developmental method, or the problem-project method. In all of these cases, we are considering an orderly procedure or process in the direction of a given end, whether that end be taking a city, selling some goods, or teaching children.

In this book, we are discussing the application of the scientific method to educational problems. It will be necessary to give detailed consideration to this method as it has been developed in the process of the pursuit of knowledge. But before doing this, we shall ask what other ways man-

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kind has used to acquire the knowledge sought.

This seeking has seldom come except as difficulties are felt. In the face of the multitude of difficulties confronting every one — difficulties of adjustment to the vagaries of nature, difficulties of adjustment to the complexities of human society, difficulties of doing what we want to do and of finding out what we want to find out — it is natural that some easy way should be sought. It is natural that the 'orderly procedure,' the 'series of steps,' should be passed by in favor of some simpler way. We shall now review briefly some of these simpler ways.

II

THE APPEAL TO AUTHORITY

Sources of Authority

1. *Universal need for guidance.* In the total number of a man's activities comparatively few will be brought consciously to his attention so he will not need to choose between them, much less ask any one's advice. The great majority of things that he does he will do because he knows or desires no other way. The *customs* of his folk and his own *habits* will make his decisions for him without his realizing that they are decisions. The clothes he wears, the gatherings he frequents, the food he eats, the shelter in which he lives, the language he speaks — these things are for the most part decided for him.

But some of the most important things that must be done cannot be decided by custom or habit; in times of crises these are frequently insufficient. In public life there are issues over which men clash, and the people call for a leader to solve their problems for them. One of the most pitiful things in the world is the prospect of a great people calling for a leader, some one to