ness of the cover glasses and inclined to the axis of the cylinder at as near $32^{\circ}.5$ as possible.

The cover glasses are then fitted into the slot, care being taken to avoid soiling them with the fingers and the whole assembled as in Fig. 1. The glass tube TT is then covered with photographic black paper to prevent the entrance of light except through the diaphragm DD.

The mounting of the tube is shown in Fig. 2 where BB is a base carrying a support SS through which the polarization tube TT passed at right angles. Over the tube TT is slipped a ring cut from a cork, CC, and into this is fastened with sealing wax a knitting needle P which serves as an index or pointer of the circular dial DD which may be graduated into four quadrants.

The complete apparatus may now be used in connection with another similar piece in studying the phenomena of polarization, one half performing the function of polarizer while the other acts as analyzer.

The alterations in brightness at intervals of 90° can be followed very satisfactorily and by interposing sheets of mica or stained glass between the two tubes very beautiful effects can be observed.

FIG. 2.

BIOGRAPHY OF GEORGE ALBERT WENTWORTH.

By B. F. FINKEL, PH.D.

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George Albert Wentworth was born in Wakefield, N. H., July 31st, 1835, and died while waiting for a train in the Boston and Maine Depot in Dover, N. H., May 24th, 1906. He was the youngest of eight children, five sons and three daughters.

Professor Wentworth received his elementary training in the district school and an old-time academy in his native town. In 1852, at the age of sixteen, he entered Phillips Exeter Academy, the institution to which he gave afterward his life service. While a student in this institution, he defrayed his expenses by his own earnings. From Exeter Academy, he went to Harvard, entering the sophomore class and graduating from Harvard with high honors in 1858.

During his undergraduate course at Harvard, Professor Wentworth taught several terms at Kingston and in the spring of 1858, was called back to Phillips Exeter Academy as instructor in Ancient Languages. A year later he was elected to the chair of mathematics which was made vacant by the call of its occupant, Professor Joseph G. Hoyt, to the chancellorship of Washington University at St. Louis. This position Professor Wentworth occupied and filled with consummate skill and ability until his resignation in the spring of 1892. In the spring of 1899, he was elected a member of the board of trustees of the Academy, rendering valuable service in that capacity until his death. In 1889-1890, the interval between the administrations of Principals Walter Q. Scott and Charles E. Fish, he was acting principal. Thus, as pupil, teacher, and trustee, Professor Wentworth was identified with the Academy for 45 years. He was liberal in his gifts to the Academy and to his influence it is indebted for gifts from others.

More than a generation of American youths came under the moulding influence of Professor Wentworth's wise, bracing, and stimulating instruction. The term "moulding" is here used advisedly; for he was a man keenly conscientious of his duty to his pupils. He had a strong determination and a carefully studied and fixed purpose and therefore was relentless in his efforts to obtain the highest expression of the student's powers. After all, it is not the lenient, unstable, catering, fawning teacher who moulds character and stamps his impress on his pupils, but rather the teacher with strong convictions, resolute purposes, a keen conscience, and lofty ideals.

In the recitation, Professor Wentworth would "roast" the indifferent and the disinterested. He reveled in both irony and sarcasm in his efforts to bring out the student's best thoughts, and it is said that the most sensitive could not help laughing even though they themselves were often the victims. All students coming under his instruction soon learned to look forward to his recitation hour and prepare themselves for it the more zealously. A lesson committed to memory was very distasteful to him; he wanted the student to work out results in his own way, and to this end he would employ his wits to trip those whose only reliance and recognized authority was the testimony of the text-book. One of his students says: "A student noted only for boundless good nature and a genius for sliding along without

taking the trouble to study, was sent to the board to work out a demonstration in geometry. He had scarcely begun when Wentworth cried out, 'Hold on, there, you are not doing that right.' The reply was, 'Mr. Wentworth, your book is wrong and I can prove it.' 'Go ahead and prove it,' came from Wentworth instead of the basting we were all looking for; but he watched the proceeding on the board with intense interest until it was finished and then promptly said, 'You are right, Darlington, the next edition of the book will give it your way.' The same student says: "We knew he would stand by us if right and we knew what to expect if wrong without good and sufficient reason. He would flunk a boy who had made a perfect lesson but who was otherwise deserving of censure, as easily as he was ready to help the poor recitation of one who was faithful to the purpose of the school."

Out of the recitation room, Professor Wentworth was kind and sympathetic in his dealings with the boys, but he had no patience with the lazy or deceitful and after they were found out, they soon left school. The climate of Exeter Academy did not agree with them, as was explained by their parents.

Those were comparatively few and they naturally hated him; the others liked him and respected him and for years afterward they remembered him as "Bull" Wentworth, a name applied to him in recognition of his virile qualities and as an expression of affectionate regard. His appearance at alumni reunions was always an occasion to do him honor, and of all his possessions none was more highly prized than the silver plate inscribed with the demonstration of one of his theorems and the names of the donors, presented to him at the last reunion of the New York Alumni.

But were Professor Wentworth's reputation to rest solely on his services as a teacher, he would soon be forgotten. His merited reputation rests more largely on his ability to write teachable text-books. He was among the foremost writers of elementary mathematical text-books in America. Professor Cajori says: "If we were called upon to name the writer whose books have met with more widespread circulation during the last decennium than those of any other author we should answer, Wentworth."¹

¹History of the teaching of Mathematics in the United States, p. 294.

In the latter '70s, Professor Wentworth being dissatisfied with the classification of the theorems and demonstrations as given in all then existing geometries, began teaching geometry by giving demonstrations of his own, the pupils committing the same to note-books. This method was followed until 1878 when, in January of that year, the results of his method of teaching geometry was published under the title of *Elements of Plane and Solid Geometry*. This book immediately sprang into favor, and became the most widely used text-book on geometry in America. Although the book lacked in logical rigor, it was a real innovation in respect to attractiveness of appearance, method of arrangement, and form of expression. The book contained a number of characteristic features which readily commended it to thoughtful teachers. These features are enumerated by Mr. Wentworth in the third and fourth paragraphs of his preface to the first edition. The defects of the book have been pointed out by Dr. Halsted and others in the *American Mathematical Monthly* and elsewhere, and in most cases these defects have been rectified. The encouragement received from the recognition of his geometry led Professor Wentworth to publish other books on elementary mathematics. However, some of the works bearing his name were prepared almost entirely by other men.

The most important of the books bearing his name are, *Elements of Plane and Solid Geometry*, *College Algebra*, *Plane and Spherical Trigonometry*, *Complete Algebra*, *Advanced Algebra*, and *Analytic Geometry*.

Algebraic Analysis, Part I, by Wentworth, McLellan, and Glashan contains a large collection of examples and problems with hints and solutions of many of the more difficult ones. Wentworth's *Arithmetics*, *Algebras*, *Geometries* and *Trigonometries* number about 40 books. Many of them are only physical divisions of a chief book, gotten out to supply the peculiar needs of various schools.*

*The chief source of information from which this biography was prepared was *The Exeter News-Letter*.