EDWARD MANN LANGLEY.

HONORARY SECRETARY OF THE MATHEMATICAL ASSOCIATION, 1885-1893. FOUNDER OF THE *Mathematical Gazette*, EDITOR 1894-1895.

I.

MORE than eighty-two years have passed since the day of Langley's birth, 22nd January, 1851 His grandfather, Edward Langley, surgeon, died at the age of ninety-five, falling short in years of his parents who had lived for ninety-three and one hundred and five years respectively The surgeon had three sons, the eldest, John Gace Langley, being the father of E. M. The second son lived to be ninety and his son G. E. has already seen ninety-three years. Hence Buckden in Huntingdonshire, where E. M. spent his early childhood, can at least boast of longevity

On the removal of the family to Bedford, E. M., at the age of twelve, was entered at the Commercial School, now called the Bedford Modern School. Having returned there as a master his connection with it extended over fifty-six years. After taking his B.A. degree (London) as an external student he won a scholarship at Trinity and was placed eleventh Wrangler in 1878, Hobson and Steggall being Senior and second respectively

In 1874, to the great joy of his aunts, who had contributed liberally to the cost of his education, he made the acquaintance of his cousin Clara Maples of Hedon, near Hull. Their married life lasting till 1916 was, for his six children and himself, one of continuous felicity, raising his ideal of the possibilities of human nature.

As a boy he loved quiet and solitude so as to exercise undisturbed the constructive ability which marked the rest of his life. If a substitute for a necessary tool had to be provided it was always in the form of a triangle, and throughout life " triangles " were much in

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evidence. Recreations at Bedford such as boating, football and singlestick were exchanged in Huntingdonshire for tramps with a gun and a retriever. His love for the countryside was evinced by a fine collection of wild birds, for which during his closing years he expressed deep regret—the destruction of living things being replaced by a desire for their protection. His garden was always furnished with a bird-table, a bird-bath and perches, being so placed that the habits of his feathered guests could be observed from his window   As far as possible he catered for their tastes—teasles being cultivated specially to attract goldfinches.

On taking his country walks he was generally to be seen provided with a large green tin case slung over his shoulders. From early years he was a keen botanist and ultimately became an authority on hybridisation, particularly of blackberries. The well-known cultivated blackberry " Edward Langley " was so named in acknowledgment of his researches. Another branch of botany specially attractive to him was that of Fungi, the more succulent and edible varieties frequently enriching the family diet.

No account of his activities would be complete without reference to his great love of languages, particularly English, French and German. At the age of seventy, being unsatisfied with these and a working knowledge of Dutch and Italian, he took up the study of Spanish.

As far as knowledge was concerned he believed in Free Trade, " like wealthy men who care not how they give " and, though somewhat combative and provocative in conversation, he was always ready to impart his information. He was always willing to explain and exhibit his geometrical models or to lecture on mathematical, botanical or other subjects to the W E. A. and other similar bodies.

The wide extent of his intellectual interests, his helpfulness and patience, and his kindness of feeling towards mankind and towards animal life will keep alive affectionate and grateful reminiscences in the minds of his many friends and of his pupils scattered over the world.   J P K.

II.

At the editor's request, I shall try to give some conception of the late E. M. Langley's extraordinary powers as a teacher of mathematics, as they appeared to one of his pupils thirty-odd years ago. Every detail of his vigorous, magnetic personality is as vivid to-day as it was on the afternoon I first saw him, thirty-five years ago, when I had my first lesson from him, as a new boy in the Upper Fifth at what was then the Bedford Modern School.

The class was in algebra. Almost before he had entered the room, the powerfully built man with the auburn beard had begun. It must have been evident even to those who had no particular liking for mathematics that they were listening to a mathematician. To those whose previous training in mathematics had been at the hands of

classical scholars, the lesson was a revelation. Since then I have listened to many lectures by other mathematicians, some of them famous, but I have yet to hear a mathematical subject presented with the force, the conviction, the clarity and the all-sufficient brevity which characterized Mr Langley's expositions.

Looking back, I believe a large part of Mr Langley's brilliant success as a teacher was due to his complete mastery of what he taught. His mind was as powerful as his body, and his intellect as straightforward as his character It was impossible for him to deceive himself as to the validity of a proof. An assertion was either proved or it was not, and Mr. Langley never descended to the shabby trick of passing off as proof a tissue of hidden assumptions which might easily but falsely convince immature minds and, possibly, satisfy a professional examiner If a chain of reasoning rested on demonstrable assumptions beyond the complete comprehension of the class, he said so, emphatically. Later on, a closer approach to the central subtlety would be made, and sometimes the difficulty would be disposed of for good. But no student of Mr. Langley's with normal intelligence ever left him with the delusion that some-thing had been proved when it had not.

Other aspects of Mr. Langley's complete mastery of what he taught came out in the private lessons which I began taking from him after the first year. These continued for about two years, and were occasionally shared with another pupil. As I was not preparing for any examination, Mr Langley let himself go. At the time he was reading proofsheets of a book (by one of the Taylors, I think) on geometrical conics, and his amazing skill in pure geometry found a free outlet in devising concise proofs for the theorems and the multi-tude of exercises, many of them of exasperating difficulty His own first efforts seldom satisfied him , if he had given a proof in six steps, he was not content till he got it down to five or less. From his pupils he demanded the same striving after finish—when they were not cramming for competitive examinations. One part only of his beloved conics failed to rouse his energetic enthusiasm he always referred to the dreary stretch on the asymptotes of a hyperbola as " the desert of dining room tables ", and heaved a sigh of thankful-ness when he had dutifully passed through the wilderness of un-exciting propositions.

Analytical geometry, not a special favourite with Mr. Langley, he taught like a master Cumbersome masses of uncouth algebra were shoved aside by a stroke of the pen, and he insisted upon an illumi-nating solution or none. Some of the more spectacular higher plane curves with interesting properties gave him more pleasure than even the conics, for a time, and he once expressed the regret that his heavy teaching made it impossible for him to make a thorough synthetic study of their behaviour.

In his teaching of the calculus Mr Langley's uncompromising intellectual integrity was obvious at every step. His method was first to impart technical facility in the formal parts and their usual applications, which he did with superb skill, and then, the formalities

mastered, to go back to the fundamental definitions and proofs and pick them to pieces mercilessly He used a text-book—one of the best of its day by a well-known writer—only as a source of problems and as a basis for critical discussion of the alleged proofs. Some of his strictures on what was presented as proof would no doubt have been thought a trifle meticulous or metaphysical in those good old days of slapdash reasoning ; to-day most of the reputable texts are about up to Mr. Langley's standard. In particular I remember the scorn with which he showed up the circularity in the purported proof by Taylor's theorem of the binomial expansion, and his remark that Abel had given a proof which, he *believed*, was not nonsense. It seems incredible that a man whose teaching duties would have absorbed all the energy of a strong man, could have kept his vigorous freshness of outlook and his high technical skill undimmed well past middle age.

In the classroom Mr Langley's method did not differ markedly from that of any other fine teacher It was his enthusiasm, his vitality, and his perfect mastery of what he taught that made him the conspicuous success he was. Even those who disliked mathematics were forced into attention by the dynamic personality of the man and, in spite of themselves, learned something. His explanations were always brief. No sooner was a principle explained than it was put into practice, and the efforts of the pupils were taken up to his desk for criticism before they cooled. It was somewhat like coaching on a wholesale scale. There never was any question of discipline ; Mr. Langley never blustered or threatened. His talent for keeping everybody busy made discipline superfluous. In private lessons, he gave prospective pupils one disciplinary instruction, and it was sufficient. An unprepared assignment, except for reasons of health or accident, was automatically to sever relations between master and pupil. In private instruction he " made haste slowly " at first, insisting that the pupil find his own way, even if it took a week. Then, when the pupil had begun to acquire the habit of independent thinking, Mr. Langley would rapidly outline the next topic, usually in writing, and give the pupil two or three days to complete a rather heavy assignment on it. He demanded clear expression, and practically all the work was written out in final form before being shown to him for criticism and correction.

One memory which all of Mr Langley's pupils will retain is that of his quick wit and his thoroughly English sense of humour. He was one of the few men I have known who could make a really funny remark about a mathematical difficulty. His humour was always spontaneous.

My personal debt to Mr. Langley's teaching is very great. The first contact with a mind that knows the difference between proof and plausibility is a memorable event in the life of any student of mathematics. Two of the subjects to which I have given considerable study since leaving Mr. Langley's guidance more than thirty years ago were first studied under his direction. Mr Langley, as is well known, had a rare gift for computation , but it is not so well

known that he admired the theory of numbers. Seeing my distaste for geometry, he suggested that I should have a look at the beginnings of the theory of numbers, which I did under his expert guidance. One detail of this remains by an ingenious use of Wilson's theorem, Mr Langley gave a very elegant determination of the quadratic character of 2. The other subject was elliptic functions, in which he gave me no formal instruction, but awakened my interest by showing how some rather abstruse identities concerning homogeneous products followed at once from elliptic identities. This had come up, in some way which I cannot recall, in connection with a theorem due to Clifford, for whom Mr Langley had a limitless admiration as a geometer. In the years since leaving Mr. Langley, I have often thought it a tragedy that a man of his splendid talents was forced by circumstances to devote the major part of his time and energy to elementary teaching. What he sacrificed his pupils have gained.

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GLEANINGS FAR AND NEAR.

933. Why the excitement of intellectual activity pleases, is not here the question ; but that it does so is a general and acknowledged law of the human mind. We grow attached to the mathematics only from finding out their truth ; and their utility chiefly consists (at present) in the contemplative pleasure they afford to the student. Lines, points, angles, squares, and circles are not interesting in themselves ; they become so by the power of mind exerted in comprehending their properties and relations.—W. Hazlitt, *On Imitation*.

934. The power of attaching an interest to the most trifling or painful pursuits, in which our whole attention and faculties are engaged, is one of the greatest happinesses of our nature. The common soldier mounts the breach with joy ; the miser deliberately starves himself to death ; the mathematician sets about extracting the cube-root with a feeling of enthusiasm ; and the lawyer sheds tears of admiration over '' Coke upon Littleton '' . . . He who is not in some measure a pedant, though he may be a wise, cannot be a very happy man.—W. Hazlitt, *On Pedantry*.

935. The scientific attainments of the educated class in the Byzantine empire were unquestionably very considerable. Many were invited to the court of the Caliph Almamun, and contributed far more than his own subjects to the reputation that sovereign has deservedly gained in the history of science. The accurate measurement of the earth's orbit in his time seems to show that astronomical and mathematical knowledge had at no previous period attained a greater height ; and if the Byzantine authorities are to be credited, one of their learned men, Leo the Mathematician, who was afterwards archbishop of Thessalonica, was invited to the court of the caliph, because he was universally recognised to be superior to all the scientific men at Bagdad in mathematical and mechanical knowledge.—G. Finlay, *History of the Byzantine Empire*, Book I, ch. iv, sect. 2.