

may be regarded as lying on the line (1) when  $k$  is infinite, because they are both so distant from the finite portion of the plane.

The equation of a line at infinity should not be written as  $0 \cdot x + 0 \cdot y + c = 0$ , but as  $akx + bky + c = 0$ , where  $k$  is infinitely small. Thus the equation of a line at infinity is

$$ax + by + \frac{c}{k} = 0.$$

Hence a line at infinity may have any direction according to the ratio of  $a$  to  $b$ . By giving different values to this ratio, the lines at infinity which are parallel to a given system of parallel lines at a finite distance are obtained.

Our conception of a parabola, which is usually supposed to touch the line at infinity, must be modified. A parabola is a curve which enters and leaves the region at infinity at two points which, with regard to points at a finite distance, may be regarded as coincident; although they may be, and usually are, at a finite distance apart. Hence the inconsistency of supposing that two parabolas whose axes are at right angles touch the same straight line at infinity is done away with.

JOHN L. S. HATTON.

## Obituary.

### CHARLES SAMUEL JACKSON.

CHARLES SAMUEL JACKSON was born at Winchester on the 6th of December, 1867. His father, George Jackson, was a Yorkshireman, and is described as having made his way, without initial advantages, by sheer force of character and great natural ability. His mother is still alive. Charlie, or, to use the "title" rather than "nickname" of later years, "Slide-Rule Jackson," was one of a family of three. It is probable that from both parents he inherited the gifts and attributes which won him distinction, and the affection of all who knew him.

The boy was sent to a Preparatory School at Worthing, and from thence to Uppingham. On the death of George Jackson the family moved to Bedford, Charlie entering the Grammar School in 1881. He rose to be Captain of the School, won a leaving Exhibition, and a Scholarship at Trinity College, Cambridge. He was Eighth Wrangler in 1889, and obtained in the next year a First Class in the Law Tripos.

Of the teachers at Bedford who had exercised the greatest influence upon his intellectual development he used more particularly to refer to W. S. Phillips and E. B. Buck. His frequent letters from Cambridge to the latter were fairly divided between mathematical problems and subtle questions of Law.

For some time he hovered between these two attractions. He read in chambers with Chancellor (now Sir Lewis) Dibdin, K.C., devilling for him during periods of special pressure. But his interest in Mathematics was not allowed to suffer eclipse after he was called to the Bar.

Two Cambridge men write:

"Jackson as an undergraduate was very much the same as we knew him in later life. He thoroughly enjoyed Mathematics and worked hard, but at the same time entered into and appreciated life at college and its opportunities of forming friendships. He and I attended the same lectures in college and were private pupils of Mr. Webb's, of St. John's College, the class consisting of about half-a-dozen people who came out high in their Tripos. One day Webb told us, not altogether seriously, that we were enjoying the May term and not doing enough

work. 'Be industrious, gentlemen,' said he sententiously, 'and you will be happy.' 'But,' replied Jackson, 'you will have very little fun.' Somehow he managed to do plenty of work and have plenty of fun. He formed friendships which lasted all his life, and those who knew him as an undergraduate know what a kindly and joyous spirit has been taken from us." [F. W. D.]

"I recall C. S. Jackson very vividly at Cambridge in 1890. We together attended lectures at Downing by that eminent legal historian, the late F. W. Maitland, and other lectures by Dr. Courtney Kenny. The Maitland lectures on the early history of English law were probably the most brilliant university lectures delivered for many generations at Cambridge. We were all spell-bound, and eagerly entered into the discussions that followed. Jackson was far and away the most striking member of that class, and his industry in becoming acquainted with all historical work and early case-law made a great future for him at the Bar more than probable. On coming down for a time it seemed certain that his great promise at Cambridge would be fulfilled. I saw him occasionally in the Middle Temple Hall on happy festive evenings, and elsewhere, as we were both at the Bar, and his keenness and great knowledge still seemed likely to give him a notable future. But, like Maitland himself, he was constrained to abandon practice, and devoted himself to his life work as a teacher. Later, as we both lived in the same suburb, we talked over the past, its joys and promises, and also over educational problems in which we were both keenly interested. His views were very sound, cautious and wise. I remember well that while he was in favour of the early teaching of calculus he was emphatically opposed to this at an earlier age than fourteen. The C. S. Jackson of 1916 was the C. S. Jackson of 1890. He never aged mentally, and the cheeriness of his outlook, the boyishness of his heart, always remained unaltered. His life was essentially happy, a great deal happier and a great deal more useful to the world than it would have been had he achieved his first ambition and secured fame and fortune at the Bar." [J. E. G. de M.]

Perhaps it was circumstance as much as taste that led to his acceptance of the post of Instructor in Mathematics at the Royal Military Academy, Woolwich, and, much to the advantage of many generations of cadets, he devoted almost five-and-twenty years of his life to his responsible work at that institution. Others, too, have had no reason to regret that the greater part of his energy and ability was given to Mathematics until his death on October 19th, 1916.

All instructors in Mathematics belong to the distributing class. Of the rare few who also belong to the producing class, says Mr. J. P. Kirkman, Jackson was a signal instance. Metaphorically speaking, he was a Builder, an Architect, and an Artist. He was one of those whose career gives support to the theory that given abilities may be made to run in any groove. He might have won distinction in Classics or in Science. He might have been distinguished as a Musician.

He had quite an extraordinary power of concentration: whatever was the business in hand, it was done as if his life depended upon it. Out of everything he touched he extracted all the good—"I will not let thee go, except thou bless me." Of those who knew Jackson well, and whose opinions are worth recording, all are independently unanimous in using the same epithet with respect to him—the epithet *thorough*.

From the first he was a popular instructor, and the delightful caricature of "Slide-Rule Jackson" that appeared a short time before his death in the "Shop" magazine was, with the accompanying letterpress, sufficient evidence that his popularity had long reached a permanent basis. He had a pleasant and easy way of imparting information, and

the ingenuity of his methods was a revelation to the majority of the students in his classes. He was always on the look-out for new methods of presentation, and for new fields in which the principles of mathematics might be applied with effect. To this end he had accumulated an excellent mathematical and scientific library, and with fruitful results.

"Many an officer of the R.E. or R.A. whom one meets out in France," writes a colleague, "still asks for news of 'Slide-Rule Jackson,' and such enquirers always refer appreciatively to his great gifts as a teacher, and to the care and trouble he spent on their training." His modest and tender pride in the performances of the young men who had passed through his hands was infinitely touching to those who knew the depth of feeling of which he was capable. He also spoke with delight of those who responded to the call of duty on the outbreak of the war, appreciating the older and more seasoned material with which for the moment he had to deal, and the surprising results obtainable, under the spur of the intense emotion aroused by the crisis through which the nation was passing, from men whose careers had already opened in other fields. Of all alike, from his earliest pupils, many of whom now are of outstanding rank in the army, to those who had but just left his classes, he was supremely proud. Should these lines by some chance meet the eye of any of those pupils to whom the famous "Ubique" is as the sound of a trumpet call, it will quicken their pulses to learn how much his thoughts were with them in their hour of trial. His voice would swell as he told the tale of some gallant deed. It would break, and his eyes grow dim, as he recalled the lengthening roll of those who had made the great adventure, and who had greeted "the unseen with a cheer."

When the history of the educational changes of the last twenty years comes to be written, the name of C. S. Jackson will not be forgotten. We need but refer *en passant* to his work for the Association as Member of the Council, as a constant contributor to the *Gazette*, and as Chairman for three years of the London Branch. But, as an old colleague writes, the main work of his life was the breaking down of the barrier that so long existed between Statics and Dynamics, as taught in our schools, and the Applied Mechanics of the engineer. Here he instinctively appealed to his extensive knowledge of the literature of mathematics. The historical development was always of profound interest to him, and he was seldom in fault in assigning the name of the author of a mathematical treatise, or of the discoverer of some out-of-the-way theorem. His mind was stored with a fund of anecdotes, illustrations, and paradoxes, which enlivened the study of the dry bones of the subject, and delighted the budding sappers and gunners. Most of the articles or reviews which he contributed to the pages of the *Gazette* contained instances of these aptly selected historical touches and illustrations.

At Woolwich he was naturally brought into contact with the problems of Gunnery and Military Engineering. This gave the needed impulse to his mind, and he devoted himself *con amore* to the task of breaking down the artificial barrier of which we have spoken. In the early years of the present century it showed signs of giving way. He lived to see its complete demolition. To this desirable and necessary end he contributed in various ways. He preached the new gospel in and out of season. He was able to exert a subtle and wholesome influence by the extensive examining work which he undertook for the Admiralty, Civil Service Commission, and other examining bodies. And by the text-books which he wrote in collaboration with his colleagues at Woolwich, characterised as they were by a delightful freshness of

illustration and fertility of example, he materially hastened the final result. If imitation be the sincerest form of flattery, Jackson and his colleagues were much flattered men.

Jackson died at the post of duty. The war had made holidays impossible for any teacher at the Academy. For nearly two years he had had no rest. One batch of students succeeded another without a break. To some extent the work was new. Lecture-room routine was supplemented by new work for which adequate special preparation was necessary. Surveying, map-reading, and the like were added to the usual duties, so that all the work was, so to speak, on the top of his brain. He responded bravely like the gallant man that he was. He lighted it all up with his quick wit and fertile imagination, but still it was an unwonted strain. All the time there were other preoccupations. The *res angusta domi*, common to so many scientific men in this country, obliged him to add to his exhausting labours a mountain of examination work, and the wonderful thing about it all is that he never let it sink into mere routine. A co-examiner writes: "This side of his work, and his scrupulousness in performing it, have been borne in on me during the recent years in which I have been associated with him. As to his mathematical ability, his invariable courtesy to colleagues, the sparkling wit and humour which often lit up a debate, his generous hospitality and kindness of heart, I have no need to write."

And this brings us from Jackson the official to Jackson the man. His long and intimate association with the *Gazette* is more than sufficient to justify that personal tribute in which we are sure that the troops of his friends, both within and without the bounds of our Association, will long to share. We may well despair of finding adequate terms in which to express the singular fascination of the rare and beautiful character that has vanished from our midst. The warmth of the affection he inspired in so many different types of man and woman throws a vivid light on those elements in his nature which were not long concealed from those with whom he was brought into frequent contact. All recognised an attitude to the world which is variously characterised along the whole gamut from "cheery in temperament" to "animated by a serene optimism." "God's in His heaven. All's right with the world!" may well have been the motto of Jackson, for he was

"One who never turned his back, but marched breast forward,  
Never doubted clouds would break."

His indomitable industry impressed those who saw the determined resolution with which he faced the future. That future was made doubtful by insecurity of tenure, and this fact necessitated arduous toil outside the duties of his official position. This doubtful future is, unfortunately, shared by almost the whole teaching body of which he was so conspicuous an ornament. But he rarely allowed himself to complain of the harassing conditions under which he fought his life's battle, and with serene and splendid courage he continued to spend and to be spent in the service of his fellows. He combined, alas! in too literal a measure, the two ideals illustrated in the lines:

"That low man seeks a little thing to do,  
Seeks it and does it.  
This high man, with a great thing to pursue,  
Dies ere he knows it."

Such a life was not "roses, roses, all the way." But if the outward circumstances of life pressed hardly on him, he was amply fortified and sustained by a home life of unalloyed happiness. In 1898 he married Alice Evelyn, the elder daughter of the late Alfred Watmough,

of East Skirbeck, Boston, Lincolnshire. He is survived by her and their nine children. Those who have been privileged to see him in his family life know how entirely happy it was, and what a help Mrs. Jackson was to him in his life and work. No man so happy in his domestic circle as was Jackson could for long look upon the outside world with austere eyes. There was nothing of the pedant in his outlook on humanity. His ideals were as lofty as his impulses were noble. His sympathies were quick, and he could readily adapt himself to the moods of those around him. He enjoyed—none more—the trivial and ludicrous aspects of life ; and there was no trace of malice in his keen and ready wit.

His taste in literature was catholic. A few weeks before his death he was discussing with the writer of this notice books appealing to literary and historical instincts so diverse as the *Epistolae Obscurorum Virorum*, Hardy's *Dynasts*, and the satires of Anatole France. In such discussions one was always struck by the breadth and sanity of view, the width of his interests, his dialectical skill, and the transparent sincerity of his convictions.

The richness of his intellectual endowments did not obscure his natural genius for human relationships. The keen edge of his mind was never suffered to conceal his natural sweetness and charm.

Long intimacy and deep personal affection for one, from whom courage and inspiration were being constantly drawn by precept and example, must justify this halting endeavour to convey the salient points in the personality of one who diffused around him something of his own life-long enthusiasm for all that is honest and just, true and pure, lovely and of good report. Suddenly he went to his rest, and has left us older men with heads bowed and with feet still on the road.

*Manet Exemplum. Manet Amor. Manet Spes.*

MATHEMATICAL NOTES.

506. [C. 2. a. j.] *Squaring the hyperbola and bomb dropping.*

The hyperbola on p. 333, *Math. Gazette*, Dec. 1916, may be considered the equivalent of the figure in the *Principia*, 1713, p. 228, Lib. II, Prop. VIII, employed by Newton for the vertical motion of a body like a bomb, let drop through the air under gravity  $g$ , against a resistance growing as the square of the velocity  $v$ .

Newton takes the velocity  $v$  proportional to  $AV$ ,  $OP$  crossing  $AR$  in  $V$ , on  $NQ$ ; and then

$$(1) \quad AV = OA \tan \omega = OAth \quad u = OA \sin \phi = MQ, \quad v = H \sin \phi,$$

where  $H$  denotes the *terminal* velocity, at which the upward resistance of the air balances the weight of the bomb.

The downward acceleration  $f$  at a velocity  $v$  is given by

$$(2) \quad f = g \left( 1 - \frac{v^2}{H^2} \right) = g \cos^2 \phi,$$

and the increment of velocity  $dv$  is acquired in the moment  $dt$ , where

$$(3) \quad dv = H \frac{Oq \cos \phi}{OA} = H \frac{Qs}{OA} \cos^2 \phi ;$$

$$(4) \quad du = \frac{\text{twice sector area } OPp}{OA^2} = \frac{OY \cdot Pp}{OA^2} = \frac{OM \cdot Pv}{OA^2} = \frac{Pv}{OA^2} = \frac{Pv}{OT} = \frac{Rr}{OR} = \frac{Qs}{OQ} ;$$