though partial, index of the density of the air at any height. From this the third step followed—the idea of a ballistic temperature such that when used in conjunction with surface pressure the ballistic density was arrived at. Methods of computing density weighting factors were developed by the A.A.E.S., M.I.D., and by using these factors temperature weighting factors were computed (which allowed for the variations in the vertical pressure distribution consequent on any variation in the temperature distribution). Here, again, the factors vary for each trajectory, but the differences between trajectories are considerably less than in the case of winds, and there was little difficulty in arriving at the best average factors to employ for field use.

By the employment of wind and temperature weighting factors, very numerous meteorological observations were made available for the use of gunners in the most convenient form. Ballistic winds and temperatures for several selected times of flight were telegraphed to the batteries at frequent intervals, and the information given in the meteorological telegrams, in conjunction with the barometric pressure measured at the battery, gave the gunner data which required no reduction, but could be used directly for applying corrections from the range table. It is, of course, essential that the results of meteorological observations should be provided "red hot" to the gunners, and methods of computation were so perfected, and so high a degree of skill was attained, that the calculation of ballistic winds from pilot-balloon observations kept pace with the observation of the balloon itself, and no time was lost in putting the information in the form in which it was readily usable by the gunner.

A single concrete example may suffice to illustrate the importance of the methods which were introduced by the meteorologists.

If a projectile were fired due south, with a time of flight of 50 sec. (*i.e.* rising to a height of about 10,000 ft.), under the following weather conditions, viz. :—

Height in ft.	Wind Velocity f.s.	Wind Direction °	Temperature ° F.	Barometer
Surface	8	110	50	
2,000	40	175	40	30·00 in. (Normal)
4,000	45	185	30	
6,000	50	190	19	
8,000	45	190	8	
10,000	60	185	−2	

Then, if surface conditions are used for arriving at the appropriate corrections to apply, we have for a certain gun that the wind will reduce the range of the gun by 13 yards and deflect the projectile towards the west 60 yards. The surface temperature being 10° F. below the range table normal of 60° F., the range will be further reduced by 42 yards—a total loss in range of 55 yards.

But the ballistic wind for the above conditions is a wind of 44 f.s. from direction 185°, and the ballistic temperature is 36° F. For the same gun and projectile this wind would produce a deflection towards the east of 35 yards, a decrease in range due to wind of 600 yards and to abnormal temperature (and density) of 407 yards—in all more than 1000 yards. Thus the corrections applied by pre-war methods would have entailed in this case an error in range of about 1000 yards, and in line of about 100 yards.

Instead of anti-aircraft gunnery being considered as a special department of gunnery, it is more logical to consider fire on the flat as a specially simple case of the more general science of gunnery. In a very real way the development of the science was due to the researches of the A.A.E.S., M.I.D., and to the methods employed by that department in the analysis of fuse trials and in the calibration of guns. For anti-aircraft fire under active service conditions the application of meteorological corrections did not reach the same degree of organisation as for fire on the flat, for the application of corrections is a much simpler problem in the latter case. But in experimental work full account was taken of all the meteorological information available. Thus one of the main sources of errors in shooting was eliminated, and the investigation of many ballistic problems made possible.

Obituary.

S. RAMANUJAN, F.R.S.

SRINIVASA RAMANUJAN, whose death was announced in NATURE of June 3, was born in 1888, in the neighbourhood of Madras, the son of poor parents, and a Brahmin by caste. I know very little of his early history or education, but he became a student in Madras University, and passed certain examinations, though he did not complete the course for a degree. Later he was employed by the Madras Port Trust as a clerk at a salary equivalent to about 25*l*. a year. By this time, however, reports of his unusual abilities had begun to spread, and, I believe owing to the intervention of Dr. G. T. Walker, he obtained a small scholarship which relieved him from the necessity of office work and set him free for research.

I first heard of Ramanujan in 1913. The first letter which he sent me was certainly the most remarkable that I have ever received. There was a short personal introduction written, as he told me later, by a friend. The body of the letter consisted of the enunciations of a hundred or more mathematical theorems. Some of the formulæ were familiar, and others seemed scarcely possible to believe. A few (concerning the distribution of primes) could be said to be definitely false. There were no proofs, and the explanations were often inadequate. In many cases, too, some curious specialisation of a constant or a parameter made the real meaning of a formula difficult to grasp. It was natural enough that Ramanujan should feel a little hesitation in giving away his secrets to a mathematician of an alien race. Whatever reservations had to be made, one thing was obvious, that the writer was a mathematician of the highest quality, a man of altogether exceptional originality and power.

It seemed plain, too, that Ramanujan ought to come to England. There was no difficulty in securing the necessary funds, his own University and Trinity College, Cambridge, meeting an unusual situation with admirable generosity and imagination. The difficulties of caste and religion were more serious; but, owing to the enterprise of Prof. E. H. Neville, who happened fortunately to be lecturing in Madras in the winter of 1913–14, these difficulties were ultimately overcome, and Ramanujan arrived in England in April, 1914.

The experiment has ended in disaster, for after three years in England Ramanujan contracted the illness from which he never recovered. But for these three years it was a triumphant success. In a really comfortable position for the first time in his life, with complete leisure assured to him, and in contact with mathematicians of the modern school, Ramanujan developed rapidly. He published some twenty papers, which, even in war-time, attracted wide attention. In the spring of 1918 he became the first Indian fellow of the Royal Society, and in the autumn the first Indian fellow of Trinity. Madras University endowed him with a research studentship in addition, and early in 1919, still unwell, but apparently considerably better, he returned to India. It was difficult to get news from him, but I heard at intervals. He appeared to be working actively again, and I was quite unprepared for the news of his death.

Ramanujan's activities lay primarily in fields known only to a small minority even among pure mathematicians—the applications of elliptic functions to the theory of numbers, the theory of continued fractions, and perhaps above all the theory of partitions. His insight into formulæ was quite amazing, and altogether beyond anything I have met with in any European mathematician. It is perhaps useless to speculate as to his history had he been introduced to modern ideas and methods at sixteen instead of at twenty-six. It is not extravagant to suppose that he might have become the greatest mathematician of his time. What he did actually is wonderful enough. Twenty years hence, when the researches which his work has suggested have been completed, it will probably seem a good deal more wonderful than it does to-day.

G. H. HARDY.

PRINCIPAL SIR JOHN HERKLESS, D.D., LL.D.

SIR JOHN HERKLESS, whose death we regret to announce, was the son of an engineer in Glasgow; he was born on August 9, 1855, and educated in the High School before entering the University of his native city. His career as a student was varied, and his fellow-students did not think it outstanding. He not only studied arts, but also attended medical classes. Like some men who have afterwards made their mark in life, he disliked mathematics, but was fond of philosophy, and finally he decided to study for the Ministry, and was duly licensed, though he obtained no degree from his *Alma Mater*. For a short time he lectured on English literature at Queen Margaret College, then became an assistant-minister until 1883, when he was appointed to the parish of Tannadice in Forfarshire.

The death of the eloquent Principal Cunningham made a vacancy in St. Mary's College, St. Andrews, and it was rumoured that Dr. Herkless would be appointed to the post (divinity). Prof. Mitchell, however, resigned his chair of Church history, and he was appointed, whilst Prof. Stewart, of Aberdeen, was made principal. About this time the strained relations with Dundee in regard to the medical school, and the claims of St. Leonard's Parish in connection with the College Chapel, gave the forceful new professor of Church history an ample field for polemics. He took the side of Dundee, and opposed the parish. Besides stray papers, he afterwards published two books, viz. "Francis and Dominic" and "Richard Cameron," whilst, along with Mr. (now Prof.) R. K. Hannay, he edited a volume of documents pertaining to St. Leonard's College, and four volumes on the archbishops of St. Andrews. He was chairman of the St. Andrews School for Girls Company. He was appointed principal of the University by Mr. Asquith on the death of the distinguished educationist, Sir James Donaldson.

Though not a man of original cast of intellect, Sir John Herkless had great versatility and shrewdness, and was not devoid of ambition (as he himself stated), his main field for advancement being politics. He was diligent in his duties as principal, but he had little time to make noteworthy advances. His lamented death on June 11 occurred after an operation, and whilst he was in the midst of plans for the improvement of the University.

THE death of MR. CHARLES E. RHODES is announced in *Engineering* for June 11, and will be regretted by a large circle who knew him through his activity in colliery developments. Mr. Rhodes was born in 1849, and died on June 7 last. Since December, 1873, he held the position of engineering manager for Messrs. John Brown and Co., Ltd., for whom he sank several shafts and developed a number of pits. He became a member of the Institution of Civil Engineers in 1890, and at various times was president of different institutions connected with mining. He was appointed a member of the Standing Committee on Mining in 1916, and joined the Coal Conservation Committee in the same year.

WE regret to note that the death of MR. WILLIAM SHELDON is recorded in *Engineering* for June 11 as having occurred on May 20. Mr. Sheldon was in his sixty-ninth year, and had been connected with the steam plough works belonging to Messrs. Fowler since 1879. He was president of the Leeds Association of Engineers in 1898–99