method of preparing concentrated serum and its application in war wounds was perfected. Simultaneously the investigations on antidotes for poison gas were being carried out in the various scientific laboratories in the University. Dr. Banting must have scored a success in his spectacular work on the new gas defence method. This work is as great as his discovery of Insulin. The new formula has been made known to others and it will therefore be available. Mr. Mackenzie, President of the Canadian National Research Council, is reported to have made the statement that the story of this discovery is a great one and will be told after the war.

Besides being a sympathetic teacher, Dr. Banting was a delightful colleague. All those who have had the pleasure of association with him will cherish his memory with affection and admiration.

N. K. IYENGAR.

SIR SHAH MOHAMMAD SULAIMAN

THE news of Sir Shah Sulaiman's passing away came as a shock to the whole country. But perhaps no one was shocked more than those (of whom the present writer is one) who had enjoyed his overwhelming hospitality just before he fell ill, and who had seen him only three weeks ago taking the most active part in the annual session of the National Academy of Sciences, India, of which he was the President. It is heart-rending to think that he has been snatched away when his mental faculties were at their zenith, and when he was making valuable contributions to human knowledge. His countrymen and others would mourn his irreparable loss for a long time to come!!

Shah Mohammad Sulaiman was born in Jaunpur in 1886. After an exceptionally brilliant school and college career at Jaunpore and at Allahabad, he proceeded to England in 1906 with a State scholarship and joined Christchurch College, Cambridge. He took the Mathematical Tripos in 1909, and the Law Tripos in 1910. That he was no ordinary student pursuing only the prescribed course, is proved by the fact that he had pondered deeply over the prevalent theories of matter and light, and had made notes of his "ideas about radions" which he developed into a coherent theory twenty-five years later. He was also called to the Bar in 1909, and obtained the LL.D. of Dublin in 1910. Returning to India, he joined the Allahabad Bar, and had such a distinguished record that he was offered a seat on the Bench at the unusually early age of 34. In 1929 he was appointed the first Indian Chief Justice of the Allahabad High Court when still comparatively young. When the Federal Court of India was created in 1937, his was an obvious choice for one of the two posts. His work there elicited praise and admiration not only from his colleagues but also from the celebrated English jurist, J. H. Morgan. His was a meteoric rise, and it is not difficult to imagine what further heights he would have attained if he had been spared a little longer. He had an equally phenomenal career as a Scientist. He appeared suddenly and most unexpectedly on the scientific horizon, shone with an ever-increasing lustre for an all too brief period, gained some recognition, and disappeared just as suddenly.

In spite of his being engrossed in the heavy duties of a lawyer and a judge, he took a keen interest in educational matters, and did a great deal for the education of his people. He was a member of the court and academic committees of several Universities and presided over various educational conferences of an all-India character. He was invited to deliver the Convocation addresses of the Agra, Aligarh, Dacca and Osmania Universities. For a number of years he was Vice-Chancellor of the Muslim University, and discharged the exacting duties of his office up to the time of his death. Though his enthusiasm sometimes carried him too far in trying to model the working of the Institution according to his ideas, the whole nation owes him a heavy debt of gratitude for the sacrifice of an immense amount of his time and energy in the cause of education which was so dear to his heart.

All this by no means exhausted his capacities. His energy and vitality knew no bounds. He was a versatile reader, and his library contains one of the finest private collections of manuscripts and books to be found in the country. The present writer had an opportunity of seeing in his possession about a hundred rare Arabic and Persian manuscripts on mathematical and scientific subjects. He was thinking of editing the most important among these and of having them published. We hope that his family would see their way to having his dream realised. It would be a fitting tribute to his glorious memory.

For the last several years in the midst of his multifarious activities he still found time to do creative scientific work, and he had gradually acquired a more intimate knowledge of modern theoretical physics than many a professional physicist. He had never lost the enthusiasm for this science acquired in his Cambridge days, but it was only in 1933, a quarter of a century later, that he could find time to develop his ideas. Though in this long absence from the field of science he had lost touch with modern developments, it should be remarked to his great credit that he made up the deficiencies very soon. There is a world of difference between his early papers, which were rather amateurish, and his later ones which bear the stamp of a recognised scientist. Such examples are indeed rare in the history of science.

To be able to appreciate his work properly, one must keep in mind the fundamental difference between two schools of thought in the philosophy of to-day. According to the classical school "the purpose of science is to explain the unfamiliar experience in terms of the familiar one by means of the visual images or models". The modern school believes that the explanation of natural phenomena on the atomic scale and the cosmic scale cannot be forthcoming in terms of crude mechanical models of the nineteenth century, and that mathematics is the only tool to deal with the abstract concepts of modern physics. Sulaiman belonged to the classical group, and condemned in strong terms the modern tendency of "accepting such artificial mathematical devices not capable of any real physical significance" and of making ourselves "slaves of mere mathematical symbols". He characterised the current philosophy of knowledge as a "counsel of despair" and an "attitude of defeatism". He believed that "the explanation of the physical world by means of models is important not only for science itself, but also for the general progress of mankind". He was convinced that such an explanation is attainable. Unfortunately for him, the majority of theoretical physicists to-day belong to the second group. This is one of the reasons why his ideas did not find general acceptance among scientific circles, though a few workers here and there agreed with him.

He was a rebel against all authority, and against the "blind faith in the new methods" required of a modern student. He had set himself the task of making a "complete exposure of the various inconsistencies underlying the modern theories", in the hope of inducing the younger generation of scientists "to examine for themselves the full implication of modern postulates". It is quite possible that his open revolt may help to bring about a modern renaissance, just as the revolt against the authority of Aristotle and the Greeks brought about a renaissance of the seventeenth century.

His method was the method of systematic doubt, and like Descartes he began by doubting every axiom on which modern conceptions are based. He questioned the appropriateness of almost every hypothesis about matter and radiation put forward by Newton, Huygens, Maxwell, Planck, Einstein, Bohr, de Broglie, Heisenberg, Schrödinger and Dirac, and rejected them all one by one. But he was not unaware that it is easier to make destructive criticism than to offer constructive suggestions. He submitted alternatives for the two great theories in modern physics, *viz.*, the relativity theory and the quantum theory.

He criticised Newton for assuming (1) that gravitation had an instantaneous effect, thus implying that its velocity was infinite, (2) that the same law of gravitation applied to two bodies whether they were at rest or in relative motion. He criticised Einstein for (1) denying the absoluteness of space, time and motion, (2) making the velocity of light absolute, independent of the motion of observers, (3) giving to space curvature and other properties, (4) making space finite and yet making its finite limit incapable of being attained, (5) denying reality to force and making it a property of space, (6) for introducing a cosmical force of repulsion with the consequent expansion of the universe. He was of opinion that Einstein's "apparently unconvincing assumptions" would not have been accepted if the relativistic equations were not believed to have been confirmed by observation in three remarkable instances, *viz.*, (*a*) the deflection of light from a star when passing close to the sun, (*b*) the displacement of the fraunhofer lines, and (*c*) the advance of the perihelion of Mercury. Sulaiman challenged these alleged verifications. He quoted recent observational data to show that in each of these three cases there was a glaring discrepancy between Einstein's value and the observational value. He therefore found no justification for accepting "the extraordinary hypotheses on which relativity is founded". Against this, he tried to show that "the ordinary principles of dynamics when applied to moving bodies, themselves yield modified forms of equations which, as a first approximation, reduce themselves to Newton's forms; and as a second approximation to Einstein's form" thus restoring Newtonian Mechanics "to the eminent position it occupied before its dethronement by relativity". He believed that he had succeeded in obtaining such modified equations. This is where the present writer differed from him, and argued with him several times. Obviously, his criticism of the existing theories was to a great extent justified, but it was difficult to see that his own theory was a better substitute, or that his methods were quite acceptable. That, however, is another story.

Sulaiman based his new theory on the assumption that gravitation was an internal action, and not due to any extraneous force acting at a distance. At first he assumed that light consists of material particles called radions which are radiated from surfaces of bodies, and that there are still finer particles called "gravitons" which emanate from the entire mass but are at present beyond the range of our perception. Later on, he gave up this idea of gravitons, and assumed simply that the effect of gravitation is propagated with a finite velocity D, which is nearly constant, and which is equal to the velocity of light. By four different methods he obtained the polar differential equation for the path of a planet, which, he believed, included Newton's and Einstein's equations, and yielded better results than these in the three cases mentioned above. He claimed that neither Newton's nor Einstein's theory can explain an increase of semi-major axis and eccentricity of Venus, Earth and Mars nor a decrease in the case of Mercury and that his own theory not only could explain this, but the sign predicted by his formula agrees with Newcomb's observations, as admitted by Dr. R. Hamilton.

He considered it a crucial test that according to his theory the spectral shift of light from the sun would be $(1+\sin^2\alpha)$ times Einstein's value, where α is the angle between the line of sight and the radius of the sun, giving just double of Einstein's value at the limb. According to *Nature* (1937, 140, 13), Dr. Royd's observation with the correction pointed out by Dr. Evershed shows that "the displacement at the limb was twice the predicted Einstein value". Sulaiman claimed this to be a "cent per cent. confirmation" of his prediction.

He had finally come to adopt the position that even if there are flaws in his physical theory "the law of gravitation

$$-\frac{\mu}{r^2}-\frac{3\mu h^2}{D^2}\frac{1}{r^4}$$

propounded by him, can be taken as an empirical law giving correct values" in the cases mentioned above.

Like J. J. Thomson, Sulaiman was a non-believer in the quantum theory, because, as he believed, it gave rise to a "dilemma in physics", *viz.*, the fact that matter and light could be neither purely corpuscles nor purely waves. To him the idea was philosophically repugnant that they could be both corpuscles and waves. His very last paper, *viz.*, the address delivered at the Delhi Session of the National Academy of Sciences, makes a searching analysis of the whole question, and points out the unreal character of modern physical theories. He sets out to restore reality to nature, and removes the fallacies that there can be any waves without a medium, and that the phenomena of interference and diffraction cannot be explained on any corpuscular hypothesis. As the belief in a medium is demonstrably untenable, he rejects the wave theory altogether and retains only the corpuscular theory of light as well as of matter. But his light-corpuscles are not just the light particles of Newton or the light-quanta of Einstein. For him "light is a binary corpuscle, consisting of one positive and one negative charge, rotating round each other under their mutual force of attraction, the whole system moving forward with high velocity". He has published the mathematical development of this Rotational or Binary Theory as Chapters XIV and XV of his "Mathematical Theory of a New Relativity" published in the various numbers of the *Proceedings of the National Academy of Sciences,* India, between 1934 and 1940. In these papers he has tried to deduce almost all the fundamental results of modern quantum mechanics. Naturally, it will take some time to analyse his work and find out how far his claims are justified.

His work earned him a considerable reputation, and he was the recipient of several honours. The editors of *Nature* (11th May 1935, p. 797), *Science* (16th and 30th November 1934) and *Science News Letter* (1st December 1934; March 1935) wrote encouraging reviews of his theory, and some scientists of renown made appreciative remarks about it. He was awarded the Honorary Degree of D.Sc., elected the Vice-President of the *Calcutta Mathematical Society*, Fellow of the *National Institute of Sciences*, India, and President of the *National Academy of Sciences*, India.

It remains an acknowledged fact that there is a serious crisis in the foundations of modern physics. Sulaiman's ambition was to formulate a rational and unified theory of physical phenomena. Even if he has not succeeded—and it must be remembered that he did not have much time to develop his ideas—it cannot be denied that he did a great service to modern science in focussing our attention on the glaring anomalies in existing theories!

RAZIUDDIN SIDDIQI.

ADVANCE OF EDUCATION ON THE FRONTIER

THE schools are slowly coming to be accepted as a feature of life in North Waziristan and the village schoolmaster is beginning to be regarded as having other uses besides falsifying the dates of births and deaths.

In North Waziristan education has to contend with the fanatical opposition of hostile elements. In October 1939, they kidnapped an old and devout Muslim, a teacher in the Miranshah middle school, and stabbed him in the back. Unsettled conditions have made the inhabitants reluctant to take responsibility for the protection of school buildings, so that four schools have to be housed in hired buildings at unnecessary expense. The eight primary schools, like the middle school, are in the relatively settled revenue-paying areas in or near the valley of the Tochi river.

The newly re-opened school at Spalga, however, attracts a few Wazirs as well as Daurs. In 1939–40 two thousand rupees were distributed in scholarships. The schools held an athletic meeting at Miranshah followed by an entertainment given by the boys. A large number of outsiders attended and immediately petitioned for a high school. The middle school also gave an amusing play at the New Year celebrations.

In the South Waziristan Agency there are lower middle schools at Kaniguram, Ladha, and Kotkai, and five primary schools. The number of pupils has increased appreciably, and there is a keen demand for educational facilities. In 1939–40 five thousand rupees were sanctioned for scholarships. A lot of boys, chiefly Mahsuds, go to the Church Missionary Society's High School at Dera Ismail Khan where Dr. Iliff is running a boarding-hostel for these tribal pupils. Many of the best families send their sons to this school, where attention is paid chiefly to character-building, and the results being achieved amongst the Mahsuds call to mind the progress made amongst the Kashmiris by Canon Tyndale-Biscoe.

The demand for education in the Malakand Agency far exceeds the facilities available. There is a High School at Thana, a lower middle school at Dargai and fourteen primary schools. In Swat State, there is an anglo-vernacular middle school at Saidu. In Chitral State, the primary school at Chitral has been raised to the middle standard and a large new school building has been constructed. There are eighteen schools in all.