electronics had just begun to emerge and, by the end of the war, had exploded into a vast applied science, applicable to every conceivable area of information handling and the control of virtually any electrical or mechanical device, machine or mechanism. The war had triggered the enormous development that mushroomed forth in the fifties and sixties and after.

Dr Trevor Lloyd Wadley

At the start of these developments, in 1920, Trevor Wadley was born in Durban, the son of a former mayor of that city and one of a family of twelve children. As a schoolboy, he was very much a loner and had few close friends. He was never one for strict rules and regulations and had a particular aversion to getting up in time for roll-call in the mornings. Following the path taken by all bright boys, he elected to take Latin, and was generally highly respected for his brilliance at mathematics and science. He paid little attention to subjects that did not interest him, nor did he take much interest in school sports, except for one memorable occasion when, for no ascertainable reason, he entered for the mile race for boys under sixteen.

When asked why he had entered, all he would say was that he proposed to set a record time for the race, and that his record would stand for more than fifteen years. Presumably he had become aware of the times recorded for the race and had decided that he could do better. The race started and Wadley shot ahead and, to everyone's astonishment, not only did he keep up the pace, but pulled away from all the other runners and won the race in record time! It turned out that he had calculated how long it should take to cover the first 100 yards, then how long to cover the second 100 yards, then the third, and so on. He had marked off 100-yard divisions up Burman Drive and practised running each 100-yard stretch in the time he had calculated. He trained vigorously and ultimately achieved what he had set out to do. Fifteen years were to pass before his record was beaten!

During his years as an electrical engineering student at Howard College (later the University of Natal), it was commonly known by his

Trevor Wadley

fellow students and his lecturer, Mr Eric Phillips (later Professor Phillips), that he never took notes in lectures. Professor Phillips recalled that, very occasionally, Wadley would take out a small pocket notebook, and write a word or two with a blunt, stubby pencil. He had no need for notes because his remarkable mind understood and remembered every item of a lecture, and in particular, the way to derive any formula. He refused to remember formulae and preferred to work them out from first principles should they be needed. In examinations, he never confined his answers to the minimum number required, but would answer all the questions and then repeat them all as a check, still finishing well before the allotted three hours were up. In this way, it was possible to score more than 100% !

When he registered at Howard College in 1936, the electrical engineering course he attended was still largely concerned with electricity and magnetism, motors and generators, telegraphy and telephony, and radio communication was just being introduced into the curriculum. During the four years of his course, he afterwards admitted, he had planned to do only just enough work in his non-engineering subjects to pass them, which left him enough time to indulge his hobbies, yet he left the university with an extraordinarily deep understanding of both science and technology.

The Head of the Department had been enlisted to provide special training on behalf of the Special Signals Services, the highly secret unit in Johannesburg engaged in developing radar at the beginning of the war, and Trevor and five of his fellow graduates were selected to join the unit. The party of six was shipped to Britain to undergo specialised training in radar and was soon exposed to the 'army method' of instruction.

Typically, the sergeant instructor would read out a statement from the instruction manual, the class would take notes and memorise it, and so the lesson would proceed. Wadley, who was capable of understanding immediately the most abstruse and complicated ideas, and without effort could form a mental picture of an entire process without committing anything to paper, found this boring in the extreme, made himself very unpopular by asking searching questions which the instructor was quite incapable of answering, and was soon

allowed to transfer to a unit where he could learn more. He finally returned to South Africa not very much wiser..

On his return he was posted to an operating radar station in the Middle East as the officer in charge, and immediately set to work with good effect to improve the performance of the equipment. After some years of service, he ended up as the Staff Officer Radar attached to the Cape Command, about to be demobilised.

When the war ended, the President of the CSIR, Dr Schonland, who had been the first commanding officer of the SSS in 1939, believed that the considerable talent exhibited by the young engineers in that unit should not be dissipated and could be put to good use in the CSIR. He established a Telecommunications Research Laboratory, initially in the Electrical Engineering Department at the University of the Witwatersrand, and later in a new building of its own on the same campus. It was renamed the National Institute for Telecommunications Research, the NITR. Dr Frank Hewitt was appointed Director and some five or six engineers and technicians from the SSS were drafted to form the nucleus of the staff. Two members of the unit, Trevor Wadley and Jules Fejer, who had shown great potential for research both agreed to accept appointment and in 1946 the TRL got under way.

Wadley's inventive genius became evident very soon. One day, Feyer, an Hungarian immigrant, complained that while he liked to have the radio playing during working hours, he found that the interruptions to the musical programmes by talks or news broadcasts disturbed him. He wished for some device which would discriminate between speech and music and switch the radio to another channel when a talk came on. Wadley heard this and the next morning he produced an attachment that did exactly that. Only one problem remained. When all three channels broadcast speech simultaneously, the gadget kept switching from channel to channel and this was even more disturbing than speech alone!

Almost every day, Trevor Wadley came out with some totally novel thought about a scientific topic and would put his idea to his colleagues, or to any appropriate member of the university staff who happened to be present. His ideas always seemed to be outrageous at first sight, and resulted in vigorous arguments, with Wadley sticking to

his guns and the rest disagreeing. At some stage he would take bets and then proceed to prove beyond doubt that he was right, and he always *was*. His exasperated colleagues were determined to discover some issue on which they could beat him, but failed to find any intellectual or technical point that he would not be sure to shoot down. Eventually they hit on something physical and, producing a roll of mutton cloth, bet him that he could not crawl through five metres of the tubular knitted material. Although Wadley was decidedly tubby, he knew that mutton cloth could stretch enormously, and took the bet. The end was stretched open for him and he began to crawl. When he was well and truly in the middle, his tormentors quickly tied a knot at each free end of the tube. For once in his life he had failed to set preconditions and, worse still, had no pocket knife with him. This was probably the only bet he ever lost.

The only other occasion on which he was not entirely right was when he became interested in the weight of his first child. Like most parents he carefully recorded the baby's weight every day. Always conscious of the fact that he was quite a fat man, he plotted the curve of weight versus time and extrapolated the curve to the age of ten. To his dismay he believed his child was on the way to becoming an overweight monster, and forced his wife Madge to cut down on its feeding. The unfortunate baby soon became ravenously hungry and cried day and night until an experienced neighbour pointed out to him that nature has a way of keeping growth within bounds and the feeding was restored to normal, to everyone's relief.

His first major contribution to electronics was the development of an ionosonde, an apparatus for measuring the height of the ionised layers of air high above the earth's surface. The principle was the well-known one of transmitting a pulse of radio energy towards the ionosphere and measuring the time taken for the echo to return to earth – the principle of radar. The ionosonde was required to sweep the frequency of the transmitter and the receiver simultaneously over the entire radio spectrum, from the bottom of the lowest frequency medium wave band to the top of the highest frequency short wave band. The time taken for the reflection to return was recorded automatically and displayed as a distance on a cathode ray tube.

All existing ionosondes used complex switching mechanisms to switch from band to band, usually in three steps. Wadley believed he could dispense with the switching, and devised a novel heterodyne method of covering the entire radio spectrum in one sweep, for both transmitter and receiver. This greatly simplified ionosonde was installed on the University's experimental farm at Frankenwald and for many years was the source of ionosphere data for the international service that predicted conditions for radio communication over long distances.

His next invention was an allwave radio receiver using the same principle as the radiosonde, which dispensed with wave band switching and also maintained virtually perfect frequency stability through the use of a single crystal oscillator. Until this time all precision allwave receivers used a number of crystals, but his novel heterodyne system reduced the number to one. The principle was patented by the CSIR who set out to find a manufacturer prepared to produce the set commercially. Manufacturers were generally sceptical, but ultimately a large British firm took it over and produced the famous 'Wadley Receiver' widely used by the British Army and Navy.

Because the TRL was within the Faculty of Engineering of the University, its staff came into close contact with members of the Faculty. One such contact developed in 1958 between Trevor Wadley and Professor Gordon Lauf. Wadley believed that he could adapt the radar principles to making survey measurements over land. The current method made use of surveyors tapes to establish base lines and then theodolites to measure angles to high precision for extending surveys beyond the baseline.

Col H A Bauman, then Director of the South African Trigonometrical Survey, came to hear about this idea, probably through Professor Lauf, and initiated research by framing the operational requirements for 'a man-portable equipment for distance measurement over the range from 5 kilometres to 50 kilometres to an accuracy of not less than 1 part in 100 000'.

Wadley set to and soon produced a transmitter/receiver device at one station with a transponder at a distant point. A signal from the transmitter would trigger a response from the transponder, and the receiver would be used to measure the time taken for the double

journey and translate this into distance. The accuracy of distance measurement by the normal radar techniques was in no way sufficient for survey purposes and Wadley devised a method of superimposing a low frequency wave on the signal, using a highly precise method of phase comparison to determine time and therefore distance. He put the idea to Lauf who was sceptical but agreed to a test, and made a bet that Wadley could not make measurements to a sufficient degree of accuracy.

Wadley, of course, revelled in the bet and went to work with great energy. When his instrument was ready, he challenged Lauf to a test, and Lauf nominated three stations that had been surveyed many times to the maximum attainable accuracy. The test duly took place and Wadley presented his results to Lauf for comparison with the recorded values. They differed by a small but significant amount, and Lauf naturally assumed that Wadley's figures were wrong. Wadley, however, was an obstinate and determined man and pressed the issue hard enough for Lauf to agree to recalculate the distances involved. To his complete astonishment, the recorded distances proved to be wrong, and Wadley's right. Lauf was convinced.

The next question was what to call the device. Since it was to be used to measure distance along the earth's surface, Wadley's matric Latin gave him 'tellus' for the earth, and the name 'tellurometer' emerged. He went on to develop his tellurometer to a high degree of accuracy and the device soon became known world wide as the standard complementary to the theodolite and has revolutionised land surveying. It later transpired that researchers the world over had been trying for years to develop a similar instrument, but without success. A company was formed in Cape Town to manufacture and market the tellurometer.

Wadley went on to pioneer many advanced changes to the instrument, and in a later model, the measurement was completed automatically and displayed as a digital number within one minute of the instrument being set up. A separate aerial was also developed so that it could be mounted on a mast clear of any obstructions. Since the precision of the measurements depended on the accuracy with which the speed of propagation of light was known, Wadley was next moved to carry out research into this problem, and went on to produce corrections for the effect of moisture and air density.

He was now so well known that he was next retained by the US Government to apply the principle of radar to other military requirements – typically to detect the movement of men or vehicles in a heavily afforested area, but since this research is classified, details have never become known publicly.

In 1964 Wadley retired from the NITR and went to live on the south coast of Natal. He retained his consultancy with Barlows, who supplied him with laboratory apparatus so he could carry on with his researches. He was much in demand by visiting engineers seeking advice. For a short time he was on the board of RACAL-SMD Electronics in Pretoria who were the manufacturers of the 'Wadley' receiver, but once he moved to Natal, he relinquished this appointment, retaining only his position as technical adviser to some of the companies in the Barlow group.

Trevor Wadley had an extraordinary mind, capable of picturing in great detail the working of any system that might be developing. His colleague during his early career in the TRL, Jules Fejer, a young Hungarian who was similarly gifted, but in a mathematical way, complemented his talents and the two men made an ideal pair of scientists when they shared their skills – Wadley the practical engineer, and Fejer the mathematical genius. Wadley was also capable of examining physics and its application to engineering from a philosophical standpoint, but always remained the modest genius for the practical application of scientific principles.

Anecdotes about him are legion and illustrate the nature of the man. Probably as a result of his involvement with land surveying, which has much to do with astronomy, he developed an interest in the planets and the stars, and nine months before a date on which the planet Mars was to be specially visible in South Africa, he decided to make his own telescope and spent about 100 hours grinding an eight-inch reflector by hand. When it was ground to his satisfaction, he had it silvered and mounted with a suitable eyepiece. During a visit from a friend many years later, Wadley insisted on demonstrating his telescope and, after adjusting it in a horizontal position, he revealed how his interests had changed when he said to his friend, 'Right, now take a look at that!' ... the telescope showed a very attractive girl in her lounge across the common.

Another odd interest he developed was in knitting. He would watch his wife knitting and if she ever found herself short of a stitch, would immediately spot where the mistake had been made. On one of these occasions, he remarked that a pursuit as intellectual as knitting should not merely be the prerogative of women but that men had much to offer. His wife responded by challenging him to knit her a pair of woollen gloves. Armed with a pattern he soon knitted a perfect right hand glove. Having proved his point, he resolutely refused to make the other! The intricacy intrigued him and he went on to devise and write out many a pattern for his wife.

During his remarkable career he was honoured by many learned bodies. Academically, his thesis 'Heterodyne techniques in Specialized Instrumentation' earned him the Dsc (Eng), from the University of the Witwatersrand, and the University of Cape Town conferred on him an honorary doctorate. The South African Institute of Electrical Engineers awarded him their gold medal in 1960 and the medal of the Franklin Institute in the USA was another prize. He also received the National Gold Medal of The Associated Scientific and Technical Societies of South Africa and a number of surveying institutions worldwide awarded him medals and prizes, but possibly the most satisfying memory he would carry would be of the prolonged applause that followed his presentation of his paper on the electronic principles of the tellurometer to a distinguished audience at the Royal Geographic Society in London in 1957.

The culmination of his honours came with the issue of a stamp by the South African Post Office in 1979, to commemorate the twenty-fifth anniversary of the invention of the tellurometer. The stamp pictured the original instrument and its inventor. In a thoughtful gesture of paternal pride, the SAIEE drew all members of the Institute into the celebrations by presenting each member with a first day cover of the stamp.

Trevor Lloyd Wadley was a genius in our time.