effect of this is probably less important as the voltage is raised. The precision of the method would be enhanced if steps were taken to standardise apparatus and technique, so that all work could be done by the use of, say, three or four spectra the distinctive features of which, including energy distribution, could be determined and specified.

Among the other interesting aspects of the X-ray tube is the distribution of the rays in different directions from the target. With the usual 45° target the rays are most intense at right angles to the cathode ray beam. For radiographical purposes it is often better to mount the target face more nearly at right angles to the cathode beam and thus employ a pencil of rays which leaves the target face at a relatively small angle. The width of the focal spot is thus foreshortened and definition enhanced.

If penetrating power is the important factor, then we may well endeavour to utilise the X-rays leaving the tube in the direction of the cathode rays, which X-rays are of appreciably shorter wave-length than in other directions. Thus a tube in which the target also served as a metal window would offer advantages on this score.

The proper choice of filter may do much to increase the effectiveness of a tube. For example, it is known that, weight for weight, silver is relatively more transparent than lead to short waves, but is relatively less transparent to longer waves. Again, copper is relatively superior to aluminium in letting through short waves, but relatively inferior as a filter if long waves are required.

What has the future in store for us as regards X-ray tubes? Higher voltages are coming—one hears rumours of 500,000 volt tubes in Germany; and both the United States and Germany have, I understand, developed transformers giving 1 million volts. The life of 200,000 volt tubes is none too long; there will be many difficulties to overcome before a 500,000 volt tube will become a practical proposition.

A crying need is more robustness in the X-ray tube, which must become more of an engineering job. The portable Coolidge tube with lead-glass walls ¼ inch thick and a window of soda-glass for letting out the rays is to be commended on this score. Equally robust is the new miniature dental tube of similar design which measures only 4 to 5 inches long and has a diameter of about 1½ inch. It is operated at 45,000 volts and 10 milliamperes, is mounted in the same oil-tank as the transformer, and gives excellent definition. It also contributes substantially to the protection which the radiographer has a right to demand. In this connexion we may confidently look forward to a time at no very distant date when, in the interests of the operator, all protective material and apparatus shall be certified by the National Physical Laboratory. This will be realised when I mention that different makes of lead-glass on the market differ by 100 per cent. in protective value. The same remark applies to lead-rubber.

What should be our ideal in radiography? To make the process as simple and noiseless as taking an ordinary photograph. The patient should hear nothing untoward, the apparatus should look no more formidable than a camera. Spark and brush discharges should be taboo; the rumble of rotating machinery anathema. Standardised technique must be the order of the day for much of the radiographer's work. The number of variables must be cut down.

It is possible that the future may witness the fuller development of the metal X-ray bulb of a design radically different from the present. Much work is being done on them at the present time. But in almost every section of a radiographer's X-ray equipment there is room for great improvement. How low the efficiency is may be gathered from the following. We may take it that the efficiency of the high-tension generator is of the order of 50 per cent., that of the X-ray bulb 1/1000. We may assume that half the rays emitted by the bulb are utilised, that half these useful rays are arrested by the object, and that 1 per cent. of the remainder is recorded by the photographic plate or screen (rather more, say 5 per cent., if an intensifying screen is used). Thus the overall efficiency of an X-ray equipment is of the order of 1 in 800,000.

An Inquiry into Dog Distemper.

FOR some considerable time it has been felt in this country that an investigation might be undertaken with advantage on the mystery of dog distemper, and the matter has recently been brought to a head by an appeal from the editor of the *Field* to dog lovers. A considerable sum of money has been promised, and the Medical Research Council has undertaken to organise an experimental inquiry with a view of finding out the causal agent of the disease and possibly a prophylactic. As announced in NATURE of March 10, a committee has been appointed under the chairmanship of Sir William Leishman, the other members being J. B. Buxton, S. R. Douglas, F. Hobday, and C. J. Martin. Other workers, it is suggested, will be co-opted for special investigations later on.

Distemper is an acute highly contagious disease, presenting symptoms somewhat analogous to measles in man. While some have regarded it as specific for the dog, others consider that it occurs in cats, young foxes, wolves, jackals, hyænas, and even monkeys. From its contagiosity it is certain that the cause is a microbe of some kind, which, however, has hitherto remained unmasked. Indeed, there is very little real scientific knowledge extant on the disease. This is in part, at any rate, due to the fact that what veterinary surgeons and the laity call distemper is almost certainly not one but several different diseases. That one of these is the specific disease distemper is, however, very probable.

At present the concept of "distemper" is entirely clinical. Thus, one finds descriptions in the literature of catarrhal, gastric, nervous, and exanthematic types of the disease. There is a great body of evidence to show that one attack of the malady confers a durable immunity on the survivor. The disease occurs in all countries and was apparently known in antiquity. On the other hand, there is a tradition—it is little more—

that distemper was introduced into Europe from South America in the seventeenth century. There have been many researches on the probable cause, and from the time of Semmer (1875) down to the present, every known type of microbe has been incriminated, many authors with great assertiveness having maintained that they had found the specific micro-organism.

Many have believed that Carré came nearest the truth with the idea that the *causa morbi* is an invisible microbe which can traverse bacterial filters. With filtrates obtained from nasal secretions he obtained lethal effects which were claimed to be identical with true distemper, and he regarded the visible bacteria found by others as of the nature of secondary invaders, which obtained a hold on the tissues as a result of the depressing effect of the real filter-passing virus.

This view is largely accepted without criticism, and is said to be the line along which the new committee will work. It may be pointed out, however, that Carré's work, which is not given in any great detail, has been adversely criticised by Galli-Valerio, and especially by Kreganow, who worked under the direction of Frosch, himself a known and successful worker on the filter-passer of foot-and-mouth disease. Filter-passers have been suggested or proved for a number of pathological conditions, notably the mosaic disease of tobacco plants, foot-and-mouth disease, Cape horse sickness, fowl plague, molluscum contagiosum, etc. These filter-passers have much in common. They are highly infectious, invisible, filterable, and non-cultivable. The causes probably constitute a new group of living things, which, if discovered in the case of distemper, may throw a flood of light on many unknown causes of disease in man, and it is for this reason that the work now being undertaken on distemper will be watched with unusual interest.

W. B.

Obituary.

PROF. E. E. BARNARD.

IT may safely be said that the whole astronomical world is mourning the death of Edward Emerson Barnard, which occurred on February 6, and very many will feel it as the loss of a personal friend even more acutely than as the removal of one of the world's most remarkable observers.

Prof. Barnard was born at Nashville, Tennessee, on December 16, 1857; he was left fatherless and destitute by the Civil War, and had to go out to work in a photographic studio in Nashville at the age of nine, after the most meagre opportunities of education. But his subsequent career is a remarkable proof of the adage that "where there is a will there is a way." He worked most faithfully for his employers, and at the same time devoted his evenings to private study; it was not till the age of nineteen that his attention was directed to astronomy by perusal of Dr. Dick's "Practical Astronomer." The next year he had saved enough to buy a 5-inch telescope, with which in 1881 and 1882 he discovered the first two of his large family of Comets.

In 1883 Prof. Barnard obtained a fellowship in astronomy at Vanderbilt University, which gave him the opportunity for perfecting his education and the use of a 6-inch equatorial, with which he did useful work on comets, nebulæ, and double stars.

In 1888 Prof. Barnard went to the Lick Observatory, where he had the advantages of a giant telescope and a splendid climate. Three years later he made the sensational discovery of the fifth satellite of Jupiter, the first addition to the retinue of that satellite since the days of Galileo. In 1889 he had observed an eclipse of Japetus by Saturn and the ring which gave important information on the transparency of different parts of the crêpe ring. He was also doing very useful photographic work, photographing the Galaxy and the tails of comets with the Willard lens. These photographs showed interesting detail, in particular the shattered tail of Brooks's Comet of 1893. He demonstrated the value of a lantern lens for depicting faint diffused nebulosity; in particular, he discovered a huge nebula with many wisps that wandered over the greater part of Orion, the former "great nebula" of which was but a pigmy compared with it. Besides discovering very many new comets, he was frequently first in the field in detecting periodic ones on their return; for example, Pons-Winnecke in April 1921, the position of which had only been roughly predicted. In 1896 he left the Lick Observatory for the Yerkes Observatory, but the change involved no real break in his work.

Prof. Barnard took up a new and fruitful line of work in recent years, making a minute study of the light changes of all the Novæ that have appeared in modern times. Many of them had become excessively faint and difficult objects, but he was able to prove that some of them were still varying in a more or less regular manner.

Mention should also be made of Barnard's discovery of the star of largest known proper motion; this was no mere accident, but a well-earned fruit of careful study of numerous photographs.

Prof. Barnard was both a fellow and an associate of the Royal Astronomical Society, and was awarded its gold medal in February 1897.

It is pleasant to record that Prof. M. Wolf named two of his minor planet discoveries Barnardiana and Rhoda after Barnard and his late wife. It is a testimony to the universal sentiments of affection and esteem that were felt towards them.

A. C. D. CROMMELIN.

PROF. J. RADCLIFFE.

PROF. JOSEPH RADCLIFFE, head of the department of Municipal and Sanitary Engineering in the Municipal College of Technology, Manchester, died on February 16 at his residence in Crumpsall after a brief illness, at the age of sixty-six years.

A native of Rochdale, Prof. Radcliffe was forced by circumstances to commence to earn his own living at a very early age, but managed to attend evening classes with such success that he was one of the first scholarship students sent by the Rochdale Pioneers' Co-operative Society to the then Owens College at Manchester. After serving an engineering apprenticeship in Rochdale, he passed into the Waterworks department, where he gained a special experience, which led to his later