of the Federal Bureau of Investigation whose personal sacrifices have made possibe its achievements.

The history of the development of science throughout the world reflects a long combat with scorn, ridicule, sacrifice and even torture. Despite temporary setbacks from these sources, the march of science never has been permanently impeded. All obstacles and barriers have been hurdled because truth has triumphed. The development of science in the field of crime detection has not been without its annoying interruptions. With the inauguration of the Technical Laboratory of the FBI in 1932 came ridicule and scorn. On more than one occasion our men have been ironically depicted as impractical young men pursuing criminals while clad in academic gowns carrying magnifying glasses.

Old-line police officers of another school were ever ready to scoff at the special agents who photographed crime scenes, processed everything for fingerprints, and then sought the assistance of the white-garbed scientist often hundreds of miles away to analyze and identify some tell-tale bit of evidence left behind by a fleeing criminal. They denounced the new method of seeking facts rather than the old one of seeking men with the hope that if enough were rounded up the guilty one might be found. Even unenlightened judges claimed the right to ridicule the science of the test-tube, the microscope, the spectrograph and other precise methods of identifying bits of evidence that pointed an unflinching finger at the guilt of the wrong-doer and cleared the innocent suspect. This was circumstantial evidence, they claimed, and was at its best open to doubt.

Then with the development of scientific crime detection came the fakir and the pseudo-scientist whose testimony was determined by the side that retained him and the size of the fee that was paid him. To-day, fortunate for the cause of justice, the pseudo-criminologist is justly held in disrepute. The once ready ridicule and scorn for the investigator who utilized the scientific aids available in crime detection have changed to praise.

The evidence from laboratory analyses to-day is regarded as far more unbiased and certain than eye-witness testimony. Certainly, it is safer because the photo-micrograph made by the honest expert of physical bits of evidence, revealing to the eyes of jurors the basis for expert conclusion, does not and can not falsify, neither is it affected by the vagaries of the human senses.

If the record of the Federal Bureau of Investigation means anything, it has proven that science is the greatest weapon next to intelligent, well-trained personnel that society possesses to cope with the criminal. No longer do courts question the validity of the qualified scientific expert.

The experiences of the past few years have demonstrated conclusively that science protects the innocent and convicts the guilty. Surely a record of over 95 per cent. convictions in all cases tried in court after investigation by special agents of the FBI is a tribute to the place of science in the world of law enforcement. There can be no question that we have been justified in investing the taxpayers' money in the equipping and maintenance of a Scientific Crime Detection Laboratory that is regarded as a model throughout the world, when over a period of years every dollar spent in the cost of operations of the FBI has resulted in a dividend of over six dollars for the taxpayers of America.

Thus it is with pardonable pride that I accept the Public Welfare Medal of the National Academy of Sciences for and in behalf of the entire personnel of the organization that I have been proud to head for the past sixteen years; for ours is truly a "We" organization and not an "I" organization, and no finer recognition could be bestowed upon the FBI for its part in furthering science in the detection of crime than this award. May we regard the past as a period of introduction of science into the profession of law enforcement which will blossom and bear fruit in the years to come in every community in America, in order that justice may ever remain triumphant.

JOHN EDGAR HOOVER

PRESENTATION OF THE CHARLES DOOLITTLE WALCOTT MEDAL AND HONORARIUM TO A. H. WESTERGAARD

THE Walcott Medal was founded by Mrs. Mary Vaux Walcott in honor of her husband, a former president of this academy, Dr. Charles Doolittle Walcott. Dr. Walcott was an exceedingly active and influential figure in the scientific development of the United States. For many years chief of the U. S. Geological Survey, he was also a pioneer in promoting conservation, especially in forestry. He took a leading part in organizing the Carnegie Institution, the National Research Council, the National Advisory Committee for Aeronautics and in the expansion of the National Academy of Sciences. For twenty years he was secretary of the Smithsonian Institution.

But Dr. Walcott's first love, and the subject which he indefatigably pursued throughout his career, was the discovery and investigation of the earliest forms of life. Measured by present radioactive means, the Cambrian period, wherein were laid down the earliest fossil forms yet known, dates from several hundred million years ago. Yet at that remote period creatures of great complexity and beauty of structure had already evolved. Knowing so intimately Dr. Walcott's great love for the study of the Cambrian

and Pre-Cambrian deposits, Mrs. Walcott has established the medal for especially meritorious research in this field. The committee in charge of its award comprises the secretary of the Smithsonian Institution, *ex officio,* two eminent geologists of this academy, a representative of the Institut de France and a representative of the Royal Society of London.

The committee has unanimously recommended the award this year to Dr. A. H. Westergaard, of the Swedish Geological Society of Stockholm, for his eminent researches on the stratigraphy and paleontology of the Cambrian formations of Sweden.

Westergaard's major work, published in 1922, "is a complete description of the trilobite species of which about 28 were new. The beds of Norway and Denmark are correlated with the Swedish formations." Now a man of 60 years, Westergaard is still active in the Cambrian field, having published frequently and regularly right up to the present time. His latest publication, in 1938, describes a deep boring through the Cambro-Silurian at File Haidar, in Gotland, and contains accounts of Lower and Middle Cambrian deposits therein and of the contained faunas.

In view of Dr. Westergaard's valuable contributions to both stratigraphy and paleontology of the Cambrian period, and his continued zeal in these investigations, the committee of award has much pleasure in recommending that the Charles Doolittle Walcott Medal and Award be presented to him.

C. G. ABBOT

The medal was received for Dr. Westergaard by the Minister of Sweden, the Honorable W. Bostrom, for transmission to him through diplomatic channels.

ABSTRACTS OF PAPERS

The probability concept: EDWIN C. KEMBLE. The long-standing controversy over the nature of probability may be resolved by the type of operational analysis so fruitful in physics. Probability is related to our subjective sense of expectancy in much the same way that a thermometer reading is related to our subjective sense of heat and cold. Probability can be defined as a number derived by standardized mental operations from a definite state of information. In so far as it is dependent on information it is subjective. In so far as the evaluation of probabilities from given data is standardized in a manner acceptable to many persons the concept becomes objective. There is no *a priori* necessity for a *single* rule for evaluating probabilities from all states of information, and one must admit that where the information is vague *no* calculation of an acceptable probability is possible. Evaluation of probabilities on the basis of a principle of indifference is appropriate to one type of informational situation, whereas calculation from relative frequencies in a collective is appropriate to another. There is use for both types of probability in practical and scientific matters. Either one can be used with the standard calculus of secondary probabilities from primary probabilities. However, there is a sharp distinction between the totality of implications which can be drawn from the two corresponding states of information. Failure to observe this distinction is a common and serious error in probability calculations.

Recent experiments on cosmic rays at high altitudes: WILLIAM P. JESSE (introduced by A. H. Compton). During the past year the cosmic ray investigators at the University of Chicago have carried out three different experiments to investigate some of the interesting phenomena associated with cosmic rays at altitudes of twenty thousand feet and higher. Marcel Schein and E. O. Wollan in collaboration with the writer have been able by coincidence counter apparatus carried by balloons to determine as a function of altitude (1) the vertical intensity of the mesotrons in the atmosphere and (2) the number of mesotrons generated in a block of lead 2 cm thick by non-ionizing radiation. The mesotron intensity was found to increase rapidly with altitude up to a maximum value at about 6.6 cm pressure and then to decrease. The production of mesotrons in the lead block becomes noticeable at an altitude of 5 km and from this point on increases with altitude at about the same rate as does the soft component of cosmic rays. In a second high altitude experiment by G. Herzog a counter-controlled cloud chamber and magnet were carried in an airplane to a height of 29,000 feet to obtain photographs of slow mesotron tracks. Mesotrons can be distinguished from electrons in a cloud chamber by reason of the increased ionization along the tracks only when the momentum of the mesotron lies within a range of relatively low values. Mesotrons of such low momentum values occur so rarely at sea level that from thousands of cloud chamber photographs made at the surface of the earth not more than a dozen tracks have been clearly distinguished as mesotron tracks, and mass estimates made. Above twenty thousand feet such slow mesotrons were found by Herzog in much greater abundance. From 230 photographs obtained, more than twelve tracks could be definitely identified with the passage of a mesotron. A third experiment by the writer has consisted of a series of thirteen balloon flights in which an ionization chamber was carried up to an altitude of approximately 25 km in an attempt to determine a possible time variation in the total intensity of cosmic rays near the top of the atmosphere. Time changes of more than fifteen per cent. have been observed during the past year. Such changes follow quite closely the "world-wide" variations of Forbush and others and are probably due, in part at least, to intensity changes in the magnetic field surrounding the earth. However, when the high altitude values are corrected on the basis of ground values for the "world-wide" variations, a residual effect remains with a maximum in the early spring and minimum in the late summer. Further experiments are necessary to determine whether this is a true seasonal effect.

Toxicity of alpha and fast neutron radiation: ROBLEY D. EVANS (introduced by John C. Slater). Results of experiments on neutron tolerance in animals can not be accurately extrapolated to man because the relative radia-