tabulated in our previous article¹, but no comment was made upon the evident differences in histone content until confirmatory work had been done on the subject. It has now been possible for us to examine nuclei from further types of tissue, and we are presenting our new analytical results, together with those previously obtained, in the accompanying table.

Origin of nuclei	Percentage content of dried, lipid-free nuclei		
	Histone	Nucleic acid	Chromosomin
Ox spleen	16	34	50
Fowl's erythrocytes	24	43	33
Calves' thymus glands	21	44	35
Cod sperm	12	28	60
Walker rat carcinoma	1.6	26	72.4
Mouse carcinoma 2146	3	32	65
Chick embryos	3	35	62

The main result of our investigation can at once be seen from the above table. It is that in the two types of carcinoma tissue examined, and in the embryonic tissue, the content of histone in the nuclei is markedly smaller than in nuclei from normal tissue. We believe this to be the most significant result of our experiments. Nevertheless, it should be noted that the nuclei from the carcinoma and embryonic tissue contain a greater amount of chromosomin and, on the whole, a somewhat smaller amount of nucleic acid than the nuclei from normal tissues.

In order to make the meaning of these results clearer it is, perhaps, not superfluous to point out that, of the normal nuclei examined, those from the fowl's erythrocytes can be regarded as homogeneous and entirely in the vegetative state. Those from the thymus gland, while not completely homogeneous, consist to a preponderating degree of thymocytes which, again, must be considered to be in the permanently resting condition. On the other hand, the nuclei from the carcinoma tissue of both types, and from the embryonic tissue, are derived from cells undergoing frequent mitoses. We conclude from this that a high content of histone in the nucleus of a cell produces an inhibition of both the processes which lead to mitosis and those which lead to the synthesis of the chromosomin necessary for the duplication of the chromosomes.

The work described above is not sufficiently advanced for us to discuss all its implications at the present time, particularly its bearing on the cancer problem. There are, however, some tentative suggestions which can, we believe, be usefully made regarding the mechanism by which the histone regulates the growth and division of a cell. As we have pointed out, the histone is a protein with pronounced basic properties and is, in fact, the only basic substance present in appreciable amount in the nucleus. It appears to us to be an indisputable chemical necessity for this base, when present in the nucleus, to be in salt-like combination with the nucleic acid, and it is therefore presumably this combination which prevents both the synthesis of chromosomin and the division of the cell. So much seems to follow with certainty from our results. How this effect is produced can to some extent be visualized if one accepts the suggestion, which we have made elsewhere¹, that the spindle which is formed in the cell during mitosis is composed of nucleic acid. By its combination with the latter, the histone would, when present in sufficient amount in the nucleus, so

alter the properties of the nucleic acid that the formation of a spindle would be impossible, and hence the processes which lead to cell division would be inhibited. On the other hand, in the absence of large amounts of histone part of the nucleic acid would combine with the basic groups of the chromosomin, causing the latter to be dispersed in the nucleus. In this condition, which would correspond with the resting state of the cell, the synthesis of chromosomin would occur, following which the chromosomes would begin to separate and the spindle to appear. Such a picture of the control of mitosis, although incomplete and possibly inaccurate in detail, serves a useful purpose in emphasizing the part played by the histone in cell division.

We desire to thank Mr. F. Pettigrew for carrying out the necessary implantations of the tumours, Dr. Greenwood and Miss Peace for supplies of fowl's blood and chick embryos, the Moray Research Fund for defraying the cost of the mice, and the Medical Research Council for a grant to one of us.

¹ Stedman, E., and Stedman, E., *NATURE*, **152**, 267 (1943).

² Kossel, A., "The Protamines and Histones" (London, 1928).

³ Kossel, A., *Z. physiol. Chem.*, **8**, 511 (1884).

⁴ Ackermann, D., *Z. physiol. Chem.*, **43**, 299 (1904).

⁵ Mirsky, A. E., and Pollister, A. W., *Proc. Nat. Acad. Sci.*, **28**, 344 (1942).

OBITUARIES

Dr. F. J. W. Whipple

KEW OBSERVATORY has had a long line of superintendents, including Balfour Stewart and Charles Chree, and F. J. W. Whipple was a worthy member of it. He retired in March 1939 with the prospect of much useful scientific work ahead; but to the regret of his friends and old colleagues he died from heart failure on September 25 this year.

Francis John Welch Whipple was born on March 17, 1876. He was educated at Merchant Taylors' School and Trinity College, Cambridge. His university career was brilliant: he graduated as second wrangler and his Smith Prize paper was highly commended. For a few years he returned to Merchant Taylors' as mathematical master; then in 1912 he joined the Meteorological Office. For thirteen years he worked at the headquarters office in London, first as superintendent of the Instruments Division and then of the Climatology Division. In 1925, Dr. Charles Chree retired from the superintendentship of Kew Observatory and Whipple was appointed to succeed him, being promoted at the same time to the rank of assistant director of the Meteorological Office. This change was welcomed by Whipple for personal reasons, for his father, G. M. Whipple, had been superintendent of Kew Observatory during 1876-1893, and his maternal grandfather, Robert Beckley, had been on the staff in the eighteen-fifties and had designed the Kew self-recording meteorological instruments, which became almost as famous as the Observatory itself.

That Whipple had outstanding ability as a mathematician his university career had given evidence, and throughout his life he maintained his interest in mathematics; but he was also a physicist of no mean order, and the physical problems of meteorology, or rather geophysics, were entirely congenial to him. Whipple was not by nature original; but if in his reading or in conversation he came across a mathematical or physical problem he would devote time and

energy to its solution. In this way seismology, atmospheric electricity and meteorological optics with their innumerable concrete problems interested him immensely and he became an authority on all these subjects. It was the exhibition by Sir Napier Shaw at the British Association meeting in Dublin of a diagram showing unexplained pressure waves on a microbarograph record which led to his outstanding paper on the great Siberian meteor, and it was the audibility in England of gun-fire on the Western Front during the War of 1914-18 which led directly to his major work on the transmission of sound, which has given us so much information about the temperature of the upper atmosphere. Practically the whole of Whipple's numerous publications deal with problems of this nature. Whether interest in such matters to the exclusion of more fundamental problems is in itself a good or a bad trait I am not prepared to say; but it played a great part in Whipple's success at Kew. Instead of being absorbed in his own investigations he took a personal interest in the work of the young men of science working under him, leading and helping them without any thought of credit to himself. The consequence was that the staff at Kew produced during Whipple's control a series of papers on seismology and atmospheric electricity which are of fundamental importance, and of which he and the Meteorological Office had every reason to be proud. With the passing of Dr. Chree, Kew Observatory ended an epoch of geomagnetic research; with Dr. Whipple commenced an epoch of research in seismology and atmospheric electricity which will be equally remarkable and has already enhanced the great reputation of Kew Observatory.

Whipple served on the National Committee for Geodesy and Geophysics of the Royal Society and was one of the British delegates to the International Geophysical and Geodetic Conference which met in Washington in September 1939. For a number of years he was chairman of the Seismological Committee of the British Association. He served on the Council of the Royal Meteorological Society and was president in 1937 and 1938. From 1930 until 1932 he was a member of the Board of the Institute of Physics.

From all this it will be seen that Whipple was an able man of science who was always ready to help and serve others; it is therefore not surprising that his death is felt in a very wide circle of friends. His wife died in 1926, as the result of a motor accident, and he leaves one son, who is following the scientific traditions of the Whipple family.

G. C. SIMPSON.

Dr. G. T. Bennett, F.R.S.

IN Dr. Geoffrey Thomas Bennett, who died after an operation on October 11, Cambridge loses one of her most characteristic sons: able in diverse ways, conscientious and thorough in all he was willing to undertake, and, for the most part, conservative in his scientific interests.

Born in London on June 30, 1868, he was at University College School, under Mr. H. W. Eve, and became in due course a scholar of St. John's College, Cambridge. Even then, the finish of the style of everything he wrote was remarked. In 1890 he was the senior wrangler, with distinction also in the second part of the Mathematical Tripos in 1891. It was in 1890 that Miss Fawcett, who, I believe, afterwards gave herself to the service of education

in London, under the L.C.C., was placed above the senior wrangler. Soon after Bennett's consequent election to a fellowship at St. John's College, he followed a precedent set by A. G. Greenhill, and became mathematical lecturer and fellow at Emmanuel College. Here he continued to live, in rooms increasingly in tune with the rising style of amenity in Cambridge, and for many years, until his death, had presided, as senior fellow, at the College dinner.

Until after the War of 1914-18, mathematical lectures in Cambridge were organized for groups of colleges separately, and Bennett would lecture for the group of which Emmanuel was part, possibly an enigma for some of his hearers; and he offered, besides, an algebraical lecture on line-geometry open to the whole University. His masterly instinct for the geometry of mechanism was doubtless a bond of union with James Bennet Peace, who had graduated in 1887 from Emmanuel College, then teaching in the Engineering School (afterwards secretary of the Syndics of the University Press). In the afternoons he would often be seen sallying out on his summer or winter bicycle (according to the season), for which the gearing had been arranged from a formula he gave to the cycle-agent, G. B. Howes. In the evenings he would often be found at the University concerts, and you would learn on inquiry that he had been giving attention to the mathematical aspects of music.

During the War of 1914-18 Bennett was for some time one of the party engaged, at Whale Island, in research in anti-aircraft gunnery; and passed to the gyrostatic compass department of the Admiralty at Slough, where he continued until after the armistice; one remembers his characteristically trenchant remarks in regard to English knowledge of this compass. Since about 1920 he had withdrawn from any overt connexion with the mathematical school at Cambridge; but his touch could be recognized in various disclosures of his continuing interest in mathematical curiosities of many kinds, including models, of which he encouraged a fine collection at Emmanuel College, and boomerangs. The late Major MacMahon, for example, in his painstaking work in regard to the regular division of the plane, was in close touch with Bennett; and his help is acknowledged in a certain striking book on school algebra. It is to be expected that his drawers, when explored, will bring many interesting mathematical results to light.

In 1892, in more halcyon days than these, Cayley presented to the Royal Society a paper of 150 quarto pages, devoted to the investigation of the primitive roots of a composite modulus (complex as well as real). This was presumably developed from the essay he wrote for the Smith's Prize two years after his degree, and would amply suffice to establish his status as a mathematician. He became a member of the London Mathematical Society in that year; of that Society he was later (1908-11) on the Council, and secretary during 1915-16. He became a fellow of the Royal Society in 1914, and served on its council during 1936-38. At the time of his death he was a fellow of University College, London.

The evidence of his interest in the kinematical questions, in which he was superlative, may be indicated by reference to several of his published papers. In the *Philosophical Magazine* for June 1905, he wrote a historical note in regard to the parallel motion remarked by Sarrut, in 1853, giving a drawing of the mechanism employed. This seems not to be mentioned