H2B, while Bonner and Pollard (*Biochem. biophys. Res. Commun.*, **64**, 282; 1975) have generated an H3–H4 dimer using carbodiimide. Thomas and Kornberg (*Proc. natn. Acad. Sci. U.S.A.*, **72**, 2626; 1975) are the first to report the isolation of cross-linked histone octamers. Chromatin is treated with dimethyl suberimidate (Me_2Sub) or dithiobis (succinimidyl propionate) (Lomant's reagent). At *p*H 9, reaction with Me_2Sub produces a series of protein oligomers ranging in molecular weight from dimer to octamer, but there is little or no oligomer of larger size. Using Lomant's reagent, the principal low molecular weight product is octamer, but higher molecular weight products (16-mer and higher) also occur. It is not yet determined whether the octamer represents a single species or a mixture of several complexes varying in histone content, but of about the same molecular weight. Examination of the dimers produced as reaction intermediates by Me_2Sub has led to identification of $(H3)_2$, H3–H4, H2B–H4, H2A–H4, and probably H2A–H2B. The same pairs were obtained when chromatin monomers (isolated single nucleosomes) were crosslinked, suggesting that these pairs are representative of short-range interactions within the monomer.

Are all nucleosomes identical in histone content and arrangement? That is the simplest and most reasonable working hypothesis, but it remains to be demonstrated. If there is some variation in the histone content of nucleosomes, it must be subject to certain rules of substitution, since nucleosomes seem to be fairly homogeneous in protein mass, and there is some variation among histones in molecular weight. If the nucleosomes are all identical in histone content, it is still possible that variations in internal folding or arrangement exist. This is an unattractive hypothesis because multimeric protein complexes tend to have unique arrangements. On the other hand, naturally occurring histone modifications such as phosphorylation are known to have a major effect on physical properties that might affect the way histones fold or interact.

An attempt to probe the internal arrangement of histones has been made by Weintraub (*Proc. natn. Acad. Sci. U.S.A.*, **72**, 1212; 1975) who has examined the products obtained when chromatin is digested extensively with staphylococcal nuclease, and then with trypsin. The trypsin digestion removes only 20 to 30 amino acid residues from the histone N-terminals; when the resulting nucleoprotein fragments are examined by electrophoresis on acrylamide gels, eight discrete nucleoprotein bands are observed. Four of these can be shown to carry C-terminal portions of histones H2A, H2B, H3 and H4, one carries only H3 and H4 C-termini, and three bands are altogether free of protein, presumably because they carried the trypsin-sensitive N-termini. If chromatin is digested first with trypsin and then with nuclease, results consistent with this hypothesis are obtained: the protein-free bands generated by nuclease-trypsin treatment are not present in the trypsin–nuclease digest because the N-terminal attachments which protect these bands against nuclease attack have been destroyed. Weintraub's results reflect a well-defined architecture of histone–DNA attachment sites within the nucleosome. But the number and size of the fragments is too large to have arisen from a single kind of nucleosome particle undergoing degradation along a single pathway. It is possible that there are several paths of degradation leading from the same starting point to different sets of products, so that the appearance of multiple fragments in the digest cannot be taken as unequivocal evidence for heterogeneity of nucleosomes. Proof that there is only one kind of nucleosome, however, also awaits definitive quantitative experiments. If nucleosomes are homogeneous, the hope exists that they can be crystallised, and their structure determined by the direct methods of X-ray diffraction. □

Jupiter XIII

from David W. Hughes

YET another satellite of Jupiter has been discovered, the thirteenth. Unlike new comets and asteroids, which seem to pop up at frequent intervals, new satellites are much less common, Jupiter XII being found in 1951 and Saturn X in 1966. Needless to say planetary discoveries are rarer still, coming at a rate of about one every 75 years (Uranus 1781, Neptune 1846 and Pluto 1930).

The discovery, observations and attempts to determine the orbit of Jupiter XIII are discussed in a recent paper by four American astronomers Kowal, Aksnes, Marsden and Roemer (*Astr. J.*, **80**, 460; 1975). They used the 122-cm Schmidt telescope at Palomar Mountain and on three consecutive nights during September 1974 photographed a $6° \times 6°$ field centred on Jupiter. The plates were exposed for 120 min, the telescope being guided to follow Jupiter. At the time Jupiter was near opposition (at its closest to Earth, about 3.98 AU away) and of magnitude −2.5. The authors estimated that the faintest images that could be detected on each plate, for an object sharing Jupiter's motion, were of magnitude about +0.22, equivalent to a brightness 6×10^9 times less than Jupiter's.

The satellite was discovered during the course of 'blinking' the plates—a process in which two plates are looked at in quick succession and any image which has moved relative to the fixed background stars appears to jump to and fro as each plate is successively observed. Accurate measurements of the first three plates showed that the object's motion during September 11–13 could lie on two possible orbits, a direct jovicentric one and a heliocentric orbit similar to that of an asteroid. This confusion was only resolved after seven more plates were taken, the latest on December 12 when Jupiter was more than three months past opposition and at a distance of 5.03 AU. Four of these were obtained using an image tube attached to the Steward Observatory's 229-cm reflector on Kitt Peak, the plates requiring only 1.5 min exposures.

Just considering their distances from Jupiter, the Jovian satellites seem to fall into three distinct groups, (I-V), (VI, VII and X) and VIII, IX, XI and XII), these being within 1.8, around 12 and between 21 and 24 million km from the planet with wide empty gaps in between. The new satellite XIII is a member of the second group having an orbit with semi-major axis 0.074 AU (11.1 million km), eccentricity 0.147, inclination 26.7° and period 239 d. Its photographic mean magnitude is close to 21, about 1.5 magnitudes fainter than Jupiter XII. The radius of Jupiter XII is estimated to be around 8 km so Jupiter XIII is probably smaller. Whether these outer satellites are true-born children of Jupiter, formed in the same epoch, or whether they have been adopted at some later date remains as yet uncertain. Jupiter's seven outer satellites all have radii less than 12 km and could easily be captured asteroids probably with shapes and surface features like Phobos and Deimos, the moons of Mars.

Interestingly, Kowal *et al.* state that for the next few years there is about an even chance that each annual Jovian opposition could see the discovery of a new satellite, of comparable brightness to Jupiter XIII. The satellite would however have to be near its extreme elongation east or west of Jupiter. The opposition in 1975 (around October 13) is especially favourable as Jupiter is at the perihelion of its orbit and only 3.96 AU from the Sun.