BOX 3. Translation

The last step of the central dogma is known as translation. In this step, DNA base sequence in the form of messenger RNA is translated into amino acids which are subsequently joined together to form a functional protein. The process of translation proceeds in a quantized fashion, i.e. at a time three bases on the messenger RNA are read (genetic code) and translated into a single amino acid. The synthesis of proteins or translation takes place over an organelle called the ribosome. From prokaryotes like *Escherichia coli*, the ribosome is called 70S, defined according to its sedimentation value during centrifugation (Svedberg unit). It has two subunits, 50S and 30S, which have two ribosomal RNA molecules and 31 proteins and one RNA and 21 proteins, respectively.

sible to collect synchrotron X-ray data on the crystals in Russia. They eventually moved with the crystals in 1996 to the USA, where beam times were available. They finally solved the structure as a part of a large team led by Harry Noller[9]– (Figure 1).

In the case of the ribosome structure determination, a wealth of data obtained earlier from immuno-electron microscopy of the whole 70S particle was of great help. However, X-ray analysis for the first time showed the functional relay that was involved in numerous contacts at the subunit interface.

Just as immuno-electron microscopy helped in interpreting X-ray data in the case of the ribosome, 2-D crystallography of RNA polymerase oriented on a lipid bilayer, gave the initial models that helped in the total structure determination of this macromolecule. However, single X-ray structure analysis has repeatedly proved that there is no real substitute. It is interesting to understand how the results of several major efforts, to obtain structural information by chemical and biochemical methods evaporate when the near atomic resolution structures are determined. Usually, if the previous data support evidence obtained from X-ray crystallography then such studies are acknowledged; on the other hand, if they do not then they are sacrificed and forgotten! It is indeed a part of history today that not too long ago, there was an institute at Germany totally devoted to work on the ribosome and they produced several hundred papers on its structure by various means other than X-ray crystallography.

Where does one go now from this point? With the background of these structures and more refinements to come very soon at atomic dimensions, it is expected that we will know exactly how the transcription and translation processes occur, mechanistically. Single-molecule studies[12] of RNA polymerase and ribosome movements over respective templates will finally tell us about the detailed working of the nature's tiny machines.

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Random selections

Molecular motors

'Molecular architecture of the rotary motor in ATP synthase'
D. Stock, A. G. W. Leslie and J. E. Walker
Science, 1999, **286**, 1700

The ATP synthase of mitochondria is a key element in the process by which the energy stored in a transmembrane proton (electrochemical) gradient is converted into chemical energy in the form of adenosine-5′-triphosphate. The complex mechanisms involved are slowly coming to light as X-ray diffraction coaxes the monstrously large, multisubunit, membrane protein, to yield its secrets. These molecules are probably the smallest known rotary motors. This report defines the structure of the *Saccharomyces cervisiae* ATP synthase at 5 Å resolution, pro-

viding a model with important functional implications.

Climate changes

'Abrupt climate change at the end of the Last Glacial Period inferred from trapped air in polar ice'
J. P. Severingham and E. J. Brook
Science, 1999, **286**, 930

'16°C Rapid temperature variation in Central Greenland 70,000 years ago'
C. Lang, M. Levenberger, J. Schwander and S. Johnsen
Science, 1999, **286**, 934

Two papers in the 29 October 1999 issue of *Science* provide evidence for rapid changes of temperature, unconnected with current concerns on the effects of human activity. The clues are provided by analysing the isotopic composition ($^{15}N/^{14}N$ and $^{40}Ar/^{36}Ar$) of air bubbles trapped in ice cores.

Selective tranquilisers

'Benzodiazepine actions mediated by specific γ-aminobutyric $acid_A$ receptor subtypes'
U. Rudolph, F. Crestani, D. Benka, I. Brunig, J. A. Benson, J.-M. Fritschy, J. R. Martin, H. Bluethmann and H. Möhler
Nature, 1999, **401**, 796

Pop a pill and relax, is an attitude that has become widespread. Sleeplessness, anxiety and unexplainable tensions are all treated widely, often without proper prescriptions, by consuming the drug Valium, a pre-eminent member of the benzodiazepine class of molecules. Valium and its analogs act on the γ-aminobutyric acid (GABA) receptors in the brain; a process rendered mechanistically complex by the multiplicity and heterogeneity of receptors. Using transgenic mice containing a point mutation (His 101 Arg) in the murine α1-subunit gene, this study shows that mutant animals failed to exhibit the sedative, amnesic and partly, the anticonvulsant action of Valium. In contrast, the anxiolytic, myorelaxant, motor-impairing and ethanol potentiating effects are retained. Pharmacology has traditionally probed receptors with drugs and analogs. Now specific modification of receptors may permit selective dissection of pharmacological effects.

Diffraction from a light-crystal

'Dynamical diffraction of atomic matter waves by crystals of light'
M. K. Oberthaler, R. Abfalterer, S. Bernet, C. Keller, J. Schmiedmayer and A. Zeilinger
Phys. Rev., 1999, **A60**, 456

It is common knowledge that periodic structures like real crystals diffract waves be they light, X-rays, electrons or neutrons. What happens when particles are incident on a periodic structure made of standing waves of light? This paper deals with realization of 'perfect crystals of high purity' using light and that matter and waves can swap their roles satisfying a dynamical theory of diffraction; a beam of particles, namely that of argon atoms get diffracted from a crystal of light (made by a red laser beam) at the expected Bragg angle. There are many other novel aspects discussed in the paper.

Interference of C_{60} molecules

'Wave–particle duality of C_{60} molecules'
Markus Arndt, Olaf Nairz, Julian vos-Andreae, Claudia Keller, Gerbrand vander Zouw and Anton Zeilinger
Nature, 1999, **401**, 680

Interference of de-Broglie waves associated with light particles like electrons, atoms, neutrons has been known for nearly 70 years. Of late atom interferometry has addressed itself to observe interferometry of matter waves of much larger objects, which has remained quite challenging. For lighter particles the associated de-Broglie wavelength is generally larger than the size of the particle itself; for heavier objects the associated wavelength is much shorter than the size of the particle. In this paper, the interference of C_{60} particles using a material-absorbing nano-fabricated SiN_x grating consisting of nominally 50 nm wide slits with a 100 nm period, is reported.

OPINION

The amoral scientists – The tragedy of Hiroshima

M. V. N. Murthy, R. Shankar, Madan Rao, J. Samuel and A. Sitaram

The life and times of the chemist, Fritz Haber, as recounted by S. Ramaseshan, in his article 'The amoral scientist – Notes on the life of Fritz Haber' (*Curr. Sci.*, 1999, **77**, 1110–1112), makes excellent reading. Haber became famous for synthesizing ammonia from nitrogen in the air. This led to the synthesis of nitrogen fertilizers, which helped grow more food to feed the world's population. Ironically, Haber can hardly be described as a humane person. Haber was the father of chemical warfare. He started the use of chlorine gas in warfare and was quite clear and logical about its 'advantages': it produces violent coughing, corrodes the eyes, nose, mouth, throat and lungs. Being heavier than air, it sinks deep into the trenches and forces soldiers out into the open, where they can be effectively killed! The translation of this cold clini-