somes of transformed cells and tumour cells but these were considered secondary rather than causal. Pretreatment of the fibroblasts by irradiation or with methyl methanesulphonate enhanced the effect of some chemical carcinogens. Some compounds, including nitrosamines, were negative in the *in vitro* system but gave positive results if the embryos from which the fibroblasts were derived were exposed to the carcinogens transplacentally. The replica plating technique of Lederberg has been applied by T. Kuroki (University of Tokyo) to the selection of ultraviolet sensitive clones from mouse cell lines and of mutants induced in BHK-21 cells exposed to N-methyl-N'-nitro-N-nitrosoguanidine.

Testing for mutagenesis

Possible damage to the genetic material of man and animals from exposure to pesticides in the environment was pointed out by R. Fahrig (Zentral-laboratorium für Mutagenitätsprüfung, Freiburg), who described a range of tests for mutagenicity of such environmental chemicals with emphasis on the reasons for negative results. These included insensitivity of the system used, lack of activation of the compound and failure of penetration of the compound to the critical sites in the cells. Little is known about long-term exposure of animals to mutagens. The known liver microsomal activating systems for chemical mutagens were surveyed by N. Loprieno (Institute of Genetics, Pisa) whose group has used forward mutation and mitotic gene conversion and recombination with *Saccharomyces* as the test organism. The mutagenic activity of ethyl methane-sulphonate, a direct alkylating agent, is enhanced by mouse liver microsomes, but this effect was not explained. T. Sugimura (National Cancer Center Research Institute, Tokyo) summarised current work on AF2, a nitrofurant derivative used for about 7 years as a food additive in Japan. This compound gave positive results for DNA damage in repair tests and was positively mutagenic in *Escherichia coli* although negative in the *S. typhimurium* mutants of Ames. Carcinogenicity testing has so far proved negative and the compound was inactive in the sebaceous gland inhibition test in mouse skin. The great difficulties in extrapolating these results to man were discussed.

The positive correlation between the mutagenicity of selected chemical carcinogens in *Neurospora crassa* and their carcinogenicity in laboratory animals was emphasised by F. J. de Serres (National Institute of Environmental Health Sciences, Bethesda). He described a system of specific locus mutations in *Neurospora* which showed that chemical carcinogens produce

mainly base-pair substitution mutations, by contrast with the conclusions of some other workers that many potent carcinogens induce frame-shift mutations. He concluded that it may eventually be possible to develop a battery of tests that will permit the reliable prediction of carcinogenicity and mutagenicity. Finally, G. Röhrborn (University of Heidelberg) reviewed the mutation theory of cancer, emphasising that most human cancers do not show a definite mode of inheritance, though chromosomal aberrations are seen in human tumours (for example, Bloom's Syndrome) and carcinogens of various kinds interact with DNA. Rats treated with N-nitrosomorpholine or N-butyl nitrosourea showed evidence of chromosomal damage in the bone marrow and work is in progress to develop tests for carcinogenicity and mutagenicity in the same species of animal.

Superconductivity of metastable alloy films

from our Materials Science Correspondent

In the early fifties, Buckel and Hilsch in Göttingen deposited mixtures of metals such as bismuth and tin by evaporation on to substrates cooled by liquid helium, and so made supersaturated alloy films some of which showed superconducting behaviour to unexpectedly high temperatures. The method has been designated vapour quenching. This work has in recent years stimulated a fluctuating follow-up, first at IBM and now at Bell Telephone Laboratories, research which has gone in parallel with the growing amount of research on alloys cooled ultrarapidly from the melt. Both vapour-quenched and melt-quenched alloys are apt to be supersaturated, sometimes grossly so, and are thus in metastable form. Uncovenanted phases, not indicated by the phase diagram, are also apt to be formed.

The group at Bell Telephone have now published a detailed account of their recent researches on the superconductivity of vapour-deposited films (Testardi, Wernick, Royer, Bacon and Storm, *J. appl. Phys.*, **45**, 446; 1974). One novel feature here was that the substrate was not cold, but on the contrary held above room temperature during deposition. Instead of evaporation, the comparatively new method of getter-sputtering was used, in which the vapour species are generated by bombardment of metal targets by argon ions, in an atmosphere cleaned by gettering. The alloys, mostly high-melting compositions with superconducting major constituents, were found to produce metastable phases, as evidenced by X-ray diffraction. Com-

binations such as Hf/Nb, Mo/Nb/Re, Re/W, Rh/Zr were examined.

The superconducting transition temperatures, T_c , are plotted as a function of deposition (that is, substrate) temperature, and the generalisation emerges that T_c peaks for deposition temperatures which are close to phase-transformation temperatures in the equilibrium diagrams. The alloys studied mostly have equilibrium phases of δ , α -Mn or similar structural type near the temperatures which led to the highest values of T_c . The investigators conclude that structural instability enhances the superconducting transition; presumably, the phase which is in process of being formed is one which, in its normal state, is especially favourable for superconduction. But Testardi *et al.* were generally not able to identify with certainty what phases, metastable or otherwise, were in fact present in their films; they did establish that some X-ray lines at least corresponded to abnormal structures. This work shows that getter-sputtering is an effective technique for forming alloy phases with unusual properties, and that this virtue of the technique is by no means restricted to experiments with cold substrates.

At first sight, deposition of these alloys on a heated substrate is entirely distinct from deposition of bismuth or copper alloys on substrates held at 4 K. In fact, the difference is only apparent. Testardi's alloys are so refractory that even at temperatures around 400–600°C, diffusion in the bulk is very sluggish. Where the alloys have phase transitions in this temperature range, the new phases form very slowly when the alloy is cooled from the melt, whereas formation from the vapour permits the newly arriving, momentarily mobile atoms to form themselves readily into the equilibrium phase or a metastable transition phase of related structure. (It seems that the metastable structures form most readily in the immediate vicinity of a temperature at which a phase change would take place according to the phase diagram.) What Testardi and his colleagues have introduced is a form of vapour-quenching at elevated temperatures in which the film is transiently in a labile, adaptable state and is therefore at once frozen into instability.

Two of the alloys investigated, Mo₃Ru₃ and Ru₃W₃, also show exceptional hardness and corrosion resistance (Testardi *et al.*, *Met. Trans.*, **4**, 2195–2198; 1973) which might make such alloy films interesting for use as thin-film resistors, optical mirrors, razor blade coatings and so on. Since these alloys have now also been shown to have useful superconducting characteristics, they may also prove of value for use in superconducting memory devices.