reaction being quite analogous to the formation of 2-alkylthiothiazol-5-ones from N-dithiocarbalkoxy-glycines observed by Cook, Harris, Heilbron and Shaw[3]. The attempted cyclization of (II) with phosphorus tribromide or trichloride gave a crystalline product which was not (IV) and which was formed irrespective of the nature of the alkyl group, *R*. The same product was obtained on treating (IV) in moist benzene with phosphorus trihalides. Its identity as thiazolid-2 : 5-dione was indicated by analysis (found : C, 31·2 ; H, 2·65 ; N, 11·6 ; S, 27·1 per cent ; $C_3H_3O_2NS$ requires C, 30·75 ; H, 2·55 ; N, 11·95 ; S, 27·4 per cent). It forms inch-long laths (m.p. 110°) from water. Its aqueous solution decomposes on heating or prolonged standing to give an insoluble precipitate, believed to be polyglycine, and a gas containing labile sulphur.

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Bleaching Reactions with Jute Fibre

BLEACHING of lignocellulosic materials with chlorine gas or with hypochlorous acid has been shown, in the case of unbleached wood-pulp[1], to take place through a series of reactions involving chlorination, demethoxylation and oxidation of the lignin. The reaction products are of relatively small molecular weight and are readily soluble in solutions of sodium sulphite. The rate of bleaching appears to depend upon the presence of the free phenolic or enolic hydroxyl group, known to exist in lignin, for Brauns[2] has shown, in the case of unbleached wood-pulp, that when this is blocked by a methoxyl group the rate of reaction of the lignin with a bleaching solution is greatly reduced.

Partial acetylation of jute with a mixture of acetic anhydride and pyridine, as well as methylation with an ethereal solution of diazomethane, has now been shown to lead to a similar retardation of the rate of bleaching. For example, while a lignin-free fraction can be isolated from raw jute, by the Cross and Bevan method, after three chlorinations and sulphite extractions, an acetylated sample requires as many as seven such treatments to achieve the same result. Moreover, the colour reactions associated with lignin after chlorination in acid solution and addition of sodium sulphite are much less marked with the acetylated sample. Unlike the non-acetylated material, in which an intense red colour develops in the cold immediately on adding sodium sulphite to the chlorinated lignin, the solution containing the acetylated material must be warmed, or even boiled, before any colour develops. The colour reactions can be restored to the acetylated sample by hydrolysing it with a cold solution of dilute alkali.

Another interesting property of partially acetylated jute is its behaviour to the action of light. While raw jute, like most other lignocelluloses, becomes yellow or brown on exposure to light, similar treatment of a partially acetylated sample results in photochemical bleaching and there is a loss of acetyl groups from the sample[3]. A comparison of the bleaching-rates, and colour reactions, of acetylated jute before and after exposure to the light of a mercury-vapour lamp has therefore been made. Since this leads to no change in either bleaching-rate or colour reactions, it is clear that those acetyl groups removed during irradiation are not those primarily responsible for retarding the bleaching reactions of acetylated jute.

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Chess-playing Machines

IN the account in *Nature* of October 14 of machines which carry out strategic sequences of moves, it is stated : "No machine can learn from its mistakes—to improve the play the programme must be improved"[1]. It is, of course, true that a machine cannot learn unless it is provided with a programme or mechanism for learning. But it is quite possible to devise such a mechanism.

Machines can be designed to make the best move at each step in a game of noughts-and-crosses or (in theory) draughts or chess. But when playing against a series of human opponents, such a machine may never do much better than draw. A good human player against the same opponents may score more wins by making unsound but more puzzling moves. Can a machine be made to imitate the human player ? Instead of playing perfectly, can it be made to play well ? It can, by the inclusion of an empirical or statistical mechanism, in three units. One unit makes the machine experiment with different alternatives each time certain positions are reached ; the second unit counts the results and relates them to the alternatives chosen ; and the third steers the machine into the lines of play which have been winning most often.

Indeed, the mechanism may be made more subtle. The second unit could also be made to classify players, say by their opening moves, into the bold and the timid. The third unit would then, in a given end game, choose the move which had won most often against players of that type.

Thus it is possible to programme a machine so that it learns, matures and even develops a style. We do so by putting in a mechanism which estimates the probability of success in the future by analysing the distribution of successes in the past. Perhaps this is not the way in which animals learn ; or perhaps, on the contrary, it is the very reason why animals play games at all. But I am confident that the inclusion of such statistical mechanisms will be an important development in machines. I can speak for its usefulness in strategic problems, for I myself used it in a rudimentary form in bombing studies, in those spacious days when we worked with punched cards.

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Oct. 15.

[1] *Nature*, **166**, 614 (1950).