make: it is that at any rate for an appreciable percentage of researchers—I do not say for them all—we have to do with a factor which the psychologists like to refer to in German (possibly because it is so marked a characteristic of the German nation): a *Wiederholungsdrang*: a repetition urge: a tendency to repeat patterns in life. I would suggest, then, that scientific or technological researches tend to be in some sense grown-up variants of some more youthful form of activity. If this is so, to find the ultimate foundations of success in research, we may well have to go back beyond the university—to the public school, or even to the preparatory school. Here I should like to acknowledge once more the very great debt that I owe to Oundle School, particularly in that they let me experiment with the small-scale semi-technical distillation of coal tar, because I wanted to. Coal tar at atmospheric pressure, 1918: oil in a vacuum, 1928!

“What of education in the future? I look on it as an important indirect contribution to our long-term research policy to provide in our schools facilities for the keenest, at any rate, to follow up almost whatever kind of extra-curricular activity may strike their interest—and this without binding themselves in any way as to their future careers. This foretaste of achievement in following up individual interest provides, I believe, the strongest possible stimulus to education, and if the nature of the interest should change, the stimulus remains the same. The cultivation of enthusiasm I take to form the first requisite in that far-sighted educational policy and that courageous long-term research policy to which I look forward in the future, after the War.”

AGRICULTURAL DEVELOPMENTS IN THE U.S.S.R.*

By SIR JOHN RUSSELL, F.R.S.

PRIOR to the Revolution three systems of farming were practised in the U.S.S.R.: (1) large estates; (2) small peasant farms; (3) peasant land farmed by the peasants under the *Mir*, the village council or commune of very ancient origin.

Some of the large estates were run on good modern lines, some were put into the hands of managers whose business it was to extract all they could for the owner, others were moderately well managed. The peasant farms were small holdings owned by the individual farmers, which had resulted from the various agrarian reforms, the most important of the later ones being those of Stolypin (1905), who had a Danish adviser and was aiming at the Danish model. The peasant land under the commune (*nadel* land) belonged to the body of peasants but not to any individuals; it was parcelled out into many strips which were periodically distributed by the *Mir* among the peasants in accordance with the size of family, etc. These strips were scattered over the whole area so that each man should have his share of good and of bad soil. In the time of the Revolution it was estimated that about 45 per cent of the cultivated land was in the hands of the peasants.

All three systems were disliked by the Bolsheviks, the first two because they involved private ownership of land, and the third because of its grave inefficiency

and the utter impossibility of introducing modern improvements. The Bolsheviks also disliked the peasant mentality, so utterly different from that of the factory worker. The peasant wanted to sell his products at high prices while the factory worker wanted to buy them cheaply. The factory worker was accustomed to work in masses for an employer, and had before the Revolution no sense of proprietorship: the peasant was used to working alone or in small groups and always felt that he owned the land he tilled.

After some experiments, State farms were set up which accorded well with Bolshevik theory. The peasants were employees of the State receiving a weekly wage, living in great blocks of dwellings in a central area developed like a town. The whole organization resembled that of a factory, and it was expected that the peasants would develop the factory workers' outlook and become one with them. But the peasants did not like them and so they never developed: in 1938 only about 10 per cent of the cultivated land was worked as State farms, and they were used for special purposes. A completely different type of farm was set up, on the basis of the old *Mir*. The first were communes in which the whole body of workers was responsible for the full maintenance of each individual family; but this did not answer. The *artel* organization was therefore adopted: another old Russian method which has no English equivalent. In this the workers feed and house themselves but the produce belongs to them, and after all outgoings have been met the balance is distributed according to the work done. The workers are paid in actual produce: mostly grain, potatoes, and vegetables, these being the main constituents of the peasants' dietary; usually also there is hay for the workers' animals, and a small amount of cash. This method after suitable modification proved much more acceptable, and by 1939 a very large part of the cultivated land of the U.S.S.R. was farmed in this way.

The farms were called 'Collectives'. All the cultivated land in the village, whatever its previous ownership, was thrown into one big farm: it might be 1,000–4,000 acres or more, but was not usually unmanageable in size. All the peasants of the village could come into the group, but preference was given to the so-called 'poor peasants'. The plan of production was until just before the War sent from headquarters: it had been discussed during its development, but once settled, it could not be further discussed. The workers elected a committee to carry it out and to allocate the tasks to the different people; the chairman, however, was not freely elected as he had to be accepted by the Party and the Government; he often came from outside and did not usually stay long. The Party always insisted on keeping its hold on the farms, and it had its representative, who was quite independent of the committee.

Payment was always by the piece; a certain job of work was called a 'labour day', and when a man had done this he was credited with one day's work. Not infrequently about two hundred would be done during the year, but specially good workers would put in many more. The worker could eat his share of the produce or sell it to the farm, the Co-operative or in the peasant market.

The workers' share of the produce varied with the yields and the outgoings. The Government's share has varied. For some time prior to 1939 it was a fixed amount per acre of winter grain sown, and of

* Substance of a lecture at the Central Council for Health Education Summer School held in London during August.

spring grain ordered to be sown, also a fixed quantity of milk and meat per animal kept. A small price was paid, much below the market price. In 1939 more latitude in planning was allowed so long as the stipulated Government share was duly delivered. As this was fixed while yields were variable it is impossible to state any definite percentage; but an average of a number would lie between 15 to 20 per cent. Then the machine tractor station, the Government organization that hired out the tractors, combines and other big tackle and supplied the drivers had to be paid: this might take another 15 per cent. Seed for next season and fodder for winter had to be set aside: this also might amount to about 15 per cent. Insurance, administration, sick and needy people, maintenance, capital developments, and other farm overheads had also to be provided for. One way and another, more than half the produce would go, and the workers' share might be 40 per cent or less.

A great change in the system, and in the peasants' attitude to it, came when the Constitution of 1936 gave the collective farms the use of their land for ever, and also gave each member the use of his cottage and its garden and a holding varying from $\frac{1}{2}$ acre to $2\frac{1}{2}$ acres on which he could keep such animals as he and his family could look after. So popular were these holdings that by 1939 much of the peasants' time was spent on them and a large proportion of the livestock of the U.S.S.R. was their private property. So decrees went forth that they must put in a minimum of a hundred days per annum on the farm; this number has since been raised.

There is little doubt that when peace returns this modified system will be able to provide the U.S.S.R. with the food needed for a rising standard of life. The theoretical objection still remains: the peasants are not employees and do not come under the labour code: they have, for example, no trade union and are ineligible for old-age pensions. 'Peasant-mindedness' still continues and they are not one class with the factory workers. But so many theoretical difficulties have been brushed aside in the U.S.S.R. for a realistic solution that we may expect this also will disappear and the system will become wholly acceptable.

PREPARATION OF A GIANT STRAIN OF *Torulopsis utilis*

By DR. A. C. THAYSEN and MURIEL MORRIS
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IN the microbiological synthesis of protein it has been observed that the complete separation of the yeast produced from the fermented wort offers certain difficulties when *Torulopsis utilis* is used as the active organism. These difficulties are due primarily to the considerable variation in cell-size of the organism, some cells being as small as $3\mu \times 5\mu$, or less than half the size of the average cell of this organism. Moreover, these smaller cells appear to be particularly numerous towards the end of the fermentation period, when they represent quite an appreciable percentage of the total. Since they remain more tenaciously suspended in the fermented wort than the larger cells, they easily cause a drop in yield when the yeast is separated in the centrifuge or the filter press, through the filter cloth of which they pass more readily than the larger cells. It was felt that if a method could be devised by which the

size of the cells of *Torulopsis utilis* could be permanently increased, the manufacturing difficulties referred to might be largely overcome.

It might be anticipated that the most likely way of producing a strain of *Torulopsis utilis* with cells larger than the standard would be by treating the original strain with colchicine, but Blackslee's¹ and Richards's² attempts at influencing the nuclear divisions of various mycelium-producing fungi, bacteria and strains of *Saccharomyces cerevisiae* in this way were unfortunately not encouraging, as they gave entirely negative results. There seemed little hope for expecting, therefore, that success might be achieved with *Torulopsis utilis*. However, it was felt that an attempt should be made to determine the effect of colchicine on *Torulopsis utilis*, if for no other purpose than to confirm that Richards' observations on strains of *Saccharomyces* apply equally to the non-spore-forming *Torulopsis utilis* type of 'yeast'.

To do so a set of experiments was carried out in which increasing quantities of colchicine, from 1 mgm. to 100 mgm., were added to ordinary wort agar which was poured into Petri dishes, each seeded with about a hundred cells of a fresh culture of *Torulopsis utilis*. The various plates, as well as one or two control plates of ordinary wort agar without colchicine addition, were incubated at 30° C. and the time noted for colonies to appear. In addition, the number of colonies on the plates were counted and the rate at which growth progressed noted.

Even at colchicine concentrations of 100 mgm. per 10 ml. wort agar, no influence could be detected of an action of the alkaloid on the growth of *Torulopsis utilis*, and measurements taken of the size of the cells differed in no way from those of cells of the control strain grown on ordinary wort agar. The observations of Blackslee and Richards therefore apply also to *Torulopsis utilis*, the nuclear functions of which, whatever they may be, remain unaffected by colchicine.

Recently attention has been directed by Bauch³ to substances other than colchicine which influence mitosis and may give rise to the production of giant cells. Among these substances is α -naphthylamine.

The effect of this substance on the cells of *Torulopsis utilis* was studied by us in a series of experiments in which increasing amounts of this chemical were added to wort agar, afterwards seeded with *Torulopsis utilis* cells in numbers to yield approximately a hundred colonies per test culture. Starting with 1 mgm., the concentration of α -naphthylamine was gradually increased to 60 mgm. per 10 ml. of wort agar. It was observed that quantities up to 20 mgm. of α -naphthylamine had no influence on the numbers of colonies appearing on the test plates after incubation at 30° C., nor could any change be seen in the size of the cells produced. On the plates containing 25 mgm. and 30 mgm. of the chemical, only 30 per cent of the seeded cells gave rise to colonies, while the plate containing 40 mgm. of α -naphthylamine allowed only 1 per cent of the inoculated cells to grow. The plate with 50 mgm. of α -naphthylamine remained sterile. It was noticeable that the shape of the cells on the plates with high concentrations of α -naphthylamine had changed from the normal egg-shape to spherical. The volume, however, had not been increased.

A single cell of the spherical type was removed by the micromanipulator and grown in liquid wort at 30° C. The ensuing culture was found to be