ON THE SUSPENSION OF LIFE AT LOW TEMPERATURES¹.—Our first experiments were made with organisms possessing varying degrees of resistance, the extremes in this respect being represented by the sensitive *Spirillum* of cholera asiatica and the resistant spores of *Bacillus anthracis*. Ten organisms altogether were used and cooled down to -190°C. , in the first instance for twenty hours, and eventually for seven days. These exposures did not produce any appreciable impairment in the vitality of the organisms, either as regards their growth or their characteristic physiological properties, such as pigment and gas-production, pathogenicity, &c. Amongst the organisms tested were photogenic Bacteria, and these likewise preserved their normal luminous properties; and we were able, through the kindness of Professor Dewar, to apply a still severer test—namely an exposure to the temperature of liquid hydrogen (about -252°C.), a temperature which is as far removed from that of liquid air as is that of liquid air from the average summer temperature. Ten hours' exposure to this temperature had no appreciable effect on the vitality of the micro-organisms tested. At such temperatures it must be assumed that the chemical metabolism of the cell ceases, in the absence of heat and moisture. At the same time it appeared to us advisable to test the influence of a *prolonged* exposure to low temperatures on the vitality of cells. The experiments were conducted with the aid of the liquid air plant at the Jenner Institute of Preventive Medicine. The organisms employed were the *Bacillus typhosus*, *B. coli communis*, *Staphylococcus pyogenes aureus*, and a *Saccharomyces*. The Bacteria were suspended in small loops of platinum wire or on cotton-wool swabs, and directly immersed in the liquid air. The yeast, washed and pressed, was wrapped in rice-paper, and likewise directly immersed in the liquid air. Samples were taken and tested at intervals for a total period of six months. In no instance could any impairment of the vitality of the organisms be detected. The yeast gave a good growth, and exhibited its fermentative powers unaltered; the typhoid *Bacillus* retained its pathogenic and other properties; the *Staphylococcus aureus* gave a characteristic pigment growth, and the colon *Bacillus* responded to all the typical tests that were applied to it. Judging by the results, the experiments might have been prolonged for a much longer period

¹ Abstract of paper read before Section K of the British Association, Belfast, 1902.

than six months without appreciable influence on the vitality of the organisms in question.

The ordinary manifestations of life cease at zero, but at -190°C . we have every reason to suppose that intra-cellular metabolism must also cease, as a result of the withdrawal of two of its cardinal physical conditions, heat and moisture.

It is difficult to form a conception of living matter under this new condition, which is neither life nor death, or to select a term which will accurately describe it.

It is a new and hitherto unobtained state of living matter—a veritable condition of *suspended animation*.

ALLAN MACFADYEN.
SYDNEY ROWLAND.

JENNER INSTITUTE.

RESISTANCE OF SEEDS TO HIGH TEMPERATURES¹.—

Various experimenters have investigated the limits of temperature which spores of the lower plants and animals can withstand. The results they have obtained show that these spores, if dry, can germinate after exposure to the lowest temperatures obtainable, while the upper limit for similarly dried spores lies between 100°C . and 130°C .

For seeds of the higher plants also it has been more recently shown that the lowest temperatures available are without harmful effects. This note contains an account of some experiments on the maximum temperatures which seeds can withstand and after which they will retain their germinative power.

Before exposure to the high temperatures the seeds were either desiccated over sulphuric acid, or dried in an oven the temperature of which was gradually raised to 90°C . After desiccation the seeds were exposed for at least one hour to the higher temperature. After exposure the seeds were sown on moist sand. The following temperatures were obtained as the highest after exposure to which the seeds of the species mentioned could germinate:—

<i>Mimulus moschatus</i>	. 105°C .	<i>Medicago sativa</i>	. . 121°C .
<i>M. luteus</i>	. . . 112°	<i>Avena sativa</i>	. . 118°
<i>Papaver somniferum</i>	. 100°	<i>Hordeum distichum</i>	. 118°
<i>P. nudicaule</i>	. . 100°	<i>Cucurbita Pepo</i>	. . 112°

¹ Abstract of paper read before Section K of the British Association, Belfast, 1902.

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