the viscosity of water within 0.5 per cent. from 100° C. to 60° C. Equation (2) gives the viscosity of water fairly correctly between 100° and 20° C. as may be seen from the table below. Lewis and Macdonald[5] have measured the viscosity of heavy water between 5° and 35° C. which also agree very closely with the calculated values:

TABLE II

Water: $A = 1{\cdot}23$; $B = 4{\cdot}3 \times 10^{-3}$

Temp. in ° C.	Observed viscosity in millipoises	Calculated viscosity	% diff.
0	17·93	16·56	−7·6
10	13·09	12·71	−3·0
20	10·06	10·00	−0·6
30	8·00	8·048	+0·6
40	6·57	6·613	+0·7
50	5·50	5·534	+0·6
60	4·71	4·71	0
70	4·07	4·069	0
80	3·57	3·566	−0·1
90	3·16	3·162	+0·1
100	2·84	2·837	−0·1

TABLE III

Heavy Water: $A = 1{\cdot}431$; $B = 4{\cdot}74 \times 10^{-3}$

Temp. in ° C.	Observed viscosity in millipoises	Calculated viscosity	% diff.
5	19·88	19·95	+0·4
10	16·85	16·87	+0·1
15	14·51	14·49	−0·1
20	12·60	12·65	+0·4
25	11·03	11·02	−0·1
30	9·72	9·74	+0·2
35	8·64	8·62	−0·3

The applic tion of this relationship at high temperatures will be discussed in a later communication.

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HEAT CONDUCTIVITY AND MOLECULAR COMPLEXITY OF WATER–PART II

THE author has shown previously[1] that the heat conductivity K of water decreases sensibly linearly with its degree of association n. That the data can be represented by the equation $K = 0{\cdot}002282 - 0{\cdot}0002389\ n$ is evident from the following table:

t (° C.)	n	$K_{obs.}$	$K_{calc.}$
10	3·86	0·00136	0·00136
20	3·60	141	1422
30	3·40	1455	147
40	3·24	1493	1508
50	3·12	1527	1536
60	3·01	1563	1563
70	2·90	1589	1589

The variation with t of K for water[2] follows the equation $K = 0{\cdot}001325\ (1 + 0{\cdot}002984\ t)$.

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DARLUCA FILUM (BIV.) CAST., A HYPERPARASITE OF *PUCCINIA GRAMINIS* AND *PUCCINIA TRITICINA* IN THE GREENHOUSE

IN INDIA, Butler and Bisby[1] recorded the occurrence of *Darluca filum* on uredinia of *Puccinia polygoni-amphibii*, Ramakrishnan and Narasimhalu[2] on *Puccinia purpurea*, *P. penniseti* and *Uromyces setariæ-italicæ*, Padmanabhan and Rafay[3] on *P. kuehnii* and Padwick[4] on *P. chrysopogi*, *Uromyces inayati* and *U. andropogonis-annulati*. During the course of the study of wheat rusts at Simla, the writer observed the pycnidia of *Darluca filum* on the uredinia of *Puccinia graminis* and *P. triticina* every year in the greenhouse in July, August and September when humidities are high (80–100%). It was found to be fairly troublesome in maintaining rust cultures since, in some cases, the pustules were almost destroyed. The pycnidia which are small, black, spherical and shiny, are found scattered amongst the uredospores. When put in a drop of water on the slide, long tendrils of colourless spores are seen to ooze out through circular openings of the pycnidia. These spores are either aseptate or uniseptate, oblong and straight, with or without small cilia at the ends and measure 3–5 × 9–25 μ.

Inoculations made in the greenhouse during July-September on wheat seedlings with infected material of *Puccinia graminis* and *P. triticina* resulted in the appearance of the rust pustules on which the pycnidia of *Darluca filum* were formed within 4–5 days in every case. Finally the infected pustule fell off from the leaf leaving a shot-hole. When these plants were removed from the greenhouse to a dry place soon after the formation of shot-holes, the rust continued to develop round the shot-holes and *Darluca filum* disappeared. If the plants were removed to a dry place before the formation of shot-holes, the uredinia were formed in the normal way and after some time, no trace of Darluca was left.

Simultaneous inoculations made with infected rust spores on the plants maintained at a lower humidity resulted only in the formation of uredinia without its parasitizing fungus. Among the greenhouse cultures too *Darluca filum* disappeared after the rainy season.

These experiments, when considered with the observations made in the greenhouse for several years, show that *Darluca filum* can develop on these rusts only in very humid conditions as are prevalent in the hills during the rainy season.

Padwick[4] collected *Darluca filum* on *Puccinia chrysopogi* Barclay and *Uromyces inayati* Syd. in the last week of September at Simla. So far as the measurement of spores is concerned there seems to be little doubt that his collections and the fungus described here belong to the same species of *Darluca*. According to Keener,[5] Trayler[6] and Hardison[7] successful infection of several grain and grass rusts has been obtained by means of cross-inoculations with *Darluca filum* and it is quite likely that the greenhouse infections described here may be wind-borne from some grass rust infested with this parasite. Keener's[5] experiments, moreover, indicate that there are physiologic races in *Darluca filum* since any two collections may not behave alike in their rust host range.

Concerning the usefulness of *Darluca filum* in the control of cereal rusts in nature, it is apparent from what has been described here, that the growth of this fungus is largely governed by atmospheric humidities. It develops best where there is high humidity approaching 80-100%. In nature, such a state of affairs rarely, if ever, continues for long periods, specially during the wheat growing season. It is, therefore, useless to attempt to control wheat rusts in the field by *Darluca filum*.

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POTATO NECROSIS

Introductory.—Some of the potato plants of variety *Darjeeling Red Round* raised in the insect-proof house from virus-free seed tubers, stock of which had been built up during the last few years suddenly developed necrosis of the growing point which spread downwards and gave the plants wilted appearance. The leaves became pale and flascid and most of the plants were killed in due course. This was a very serious matter as part of the nucleus disease-free seed of this variety produced after considerable labour and expense was about to be lost. The problem needed immediate attention and investigation into the cause of the disease was taken up. The young leaflets near the growing point of the infected plants show outward, or inward curling of margins and some smalling and narrowing of young leaves may also be observed in certain cases. After about a week light diffused brown areas develop in the top leaves which after a few days turn completely brown and dry up. Later on the outward curling of margins progresses to all the leaves of the plant and the tips of leaves point downwards. Ultimately the necrosis first observed at the growing tip progresses down and the plant is usually killed. Fig. 1 shows a plant of potato variety *Darjeeling Red Round* affected by the disease. In addition, virus-free potato plants of varieties *President* and *Craig's defiance* which were being grown as differentials for analytical work on potato viruses were also found affected by a disease characterised by smalling and curling of margins of younger leaves. The leaves also exhibited diffused light brown areas resulting in drying up of the top leaves. The plants were, however, not killed as a result of the disease.

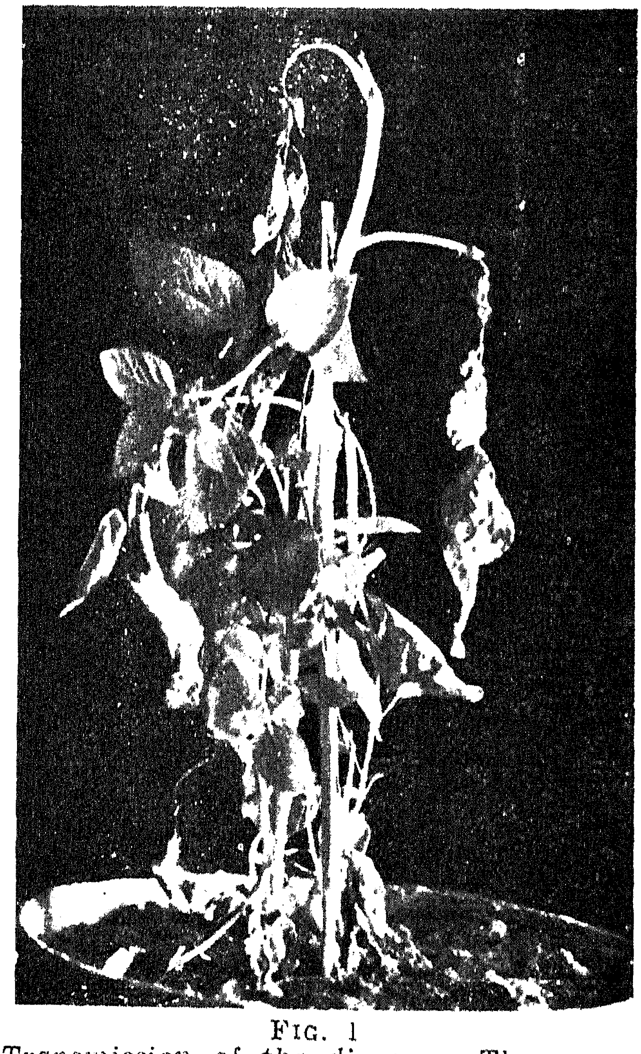

FIG. 1

Transmission of the disease.—The experimental work was carried out in an insect-proof glasshouse and always young vigorously grow-