

is simply a convenient way of expressing it in one line; and it is *not* printed as he has misquoted it above.

GEORGE HENSLOW

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[I am obliged to my friend Mr. Henslow for correcting my oversight in not accurately noting the form of his formula. The fact, however, that the sentence is, as, Mr. Henslow admits, put in a form which is adapted for "mathematical students only," in a work intended for beginners, seems to furnish a strong justification of the main point of my criticism.—A. W. B.]

Alumina

It may interest your readers to know that pure alumina dissolved nearly to saturation before the blowpipe in an *acid* flux, such as a bead of phosphoric acid, invariably causes that to assume a pale but beautiful sky blue on cooling.

In an *alkaline* flux such as a bead of boric acid containing sufficient soda to dissolve it to saturation, alumina causes the bead to assume a pale red colour on cooling.

The greatest care has been taken to ascertain that the materials are absolutely free from any metallic or other oxide which might produce such colours, and the resulting beads have been shown to several gentlemen, as Messrs. Hunt and Roskell, Mr. Hutchings of Freiberg, and others.

Might not these facts then afford us some clue (so much wanted) to the cause of coloration in the sapphire and ruby?

London, July 1

W. A. ROSS

A Subject-Index to Scientific Periodical Literature

I HAVE been occupied for years in drawing up a classified index, not only to the titles of papers, but to what is still more wanted, to the facts contained in those papers. As yet I have met with scant encouragement.

A. RAMSAY

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CLUB-ROOT

ALL our readers who are agriculturists or practical gardeners will be familiar with the disease called in England "Club-root," or "Finger and Toes," or "Clubbing." It seems almost to confine its ravages to cruciferous plants, and often causes great destruction to large crops of turnips, cabbages, cauliflowers, not to mention what disappointments it may occasion to the growers of wallflowers, Brompton stocks, candytufts, and many other favourite flowers belonging to this large natural family. Not only is it well known, but it has often been written about, as the pages of our contemporary, the *Gardeners' Chronicle*, and most works on the cultivation of gardens, will abundantly prove.

The question of what did it consist of was often asked, and the answer was that it was caused by some insect or another, and some poor beetles and flies were signalled out as those which laid their eggs in the tissues of the young roots of the plants attacked, and, if we are not mistaken, this is the general belief to this present moment. The explanation never was, however, satisfactory. True, in the advanced stage of this disease insect larvæ were to be found in the club-like swellings of the roots; but in the very early stages no trace of larva or egg of any insect was to be seen, and yet the club-root disease was clearly there.

In the *Botanische Zeitung* for May 14, 1875, there appeared a short abstract of a paper read by M. Woronin, before the Botanical Section of the Natural History Society of St. Petersburg, on the 5th of March of the previous year, on the cause of this disease, and within the last few weeks we have received the full memoir, illustrated with upwards of fifty figures. This memoir is in Russian, but, thanks to a colleague (Prof. R. Atkinson), the writer has been able to glean a notion of its most interesting contents, in which he has been much assisted by the beautiful figures. The disease is

known in Russia as "Kapustnaja Kila" (Kapusta = Cabbage, Kila = Hernia). About three years since it was so extremely prevalent that the vegetable crops about St. Petersburg failed, and the government ordered an investigation, from which much information was obtained as to the means adopted in different countries for its cure: such as sowing the ground, before planting the crop, with common salt, wood ashes, or, before all, soot. Every one knows, too, that in transplanting the young crucifers into their permanent beds that it is customary to pinch off the swollen portions, and then, if favourable weather followed, the newly-formed roots could well keep ahead of any fresh appearance of the disease. But M. Woronin went scientifically to work, and he was not long in discovering that the cause of the disease was a parasitic vegetable which seemed to have some affinities with the Myxomycetes on the one hand, and the Chytridiaceæ on the other, and the result of constant researches carried on through 1875, 1876, and last year, have resulted in nearly the whole life-history of this new plant being discovered. It is called *Plasmidiophora brassicæ*, and is decidedly very nearly allied to the Chytridia, but the new forms of this group daily coming to light, appear so different in their development, that much more must be known about them ere any satisfactory classification can be attempted. One most striking feature in the new plant is indicated by its generic name; this will be best understood by a short history of the plant's life. Take an old well-developed knob off a club-root, and examine the tissue; most of the parenchymatous cells will be found enlarged, their starchy contents gone, and they themselves gorged with a mass of spore-like bodies; by the ordinary disintegration of the cellular tissue these spores will get released, and after a lapse of six days, out of each spore will proceed the whole of the contents, which, colourless, but nucleated, will move about like so many minute amœba; these plasmodia will then attach themselves to the delicate root-hairs of the nearest young cruciferous seedling. One end of the plasmodium is attenuated like a cilium. The spores soon penetrate into the cells, where they will look just like Myxamœbæ. Filling the cells up with delicate plasmodic projections, they will next soon develop lots of spores, which will further contaminate the cellular tissue of the root, and in process of time the formation of the clubbing will be seen.

Sometimes the ripe spores are spherical, sometimes they are twin-like, or lenticular. If cabbage or turnip seeds be sown in a watch-glass and supplied with distilled water, and shortly after the first appearance of germination, a number of spores of *Plasmidiophora brassicæ* be added to the water, these will be found to at first float freely in the water, but sooner or later will sink and attach themselves to the delicate root-hairs of the little seedlings, and in this way their whole history, so far as now known, may with facility be traced. It seems noteworthy that the whole mass breaks into spores all at once, as in Chytridium proper. There would seem to be as yet no conjugation detected, and the plasmodia would appear as if they absolutely engulfed the starch granules on which they feed.

It must be a matter of regret that this memoir is written in a language known unfortunately to so few scientific botanists. If the learned author knew only Russian it would be absurd and unreasonable to record this regret, but to one knowing French and German, as M. Woronin does, it would have been no trouble to have increased a hundredfold the grateful readers of this important memoir.

E. PERCEVAL WRIGHT

SCIENCE IN SCHOOLS

THE following article on Sir John Lubbock's Bill on the introduction of science in elementary schools appears in Monday's *Times*:—