every part except the very sutures, as in *G. Andrewsii*, *G. crinita*, &c. Examining some other genera, we found this to occur also in *Bartonia*, Muhl. (*Centaurella*, Michx.); equally so in both species, *B. tenella* and *B. verna*. In the former species, in which, as in *Obolaria*, four re-entering angles render the cell cruciform, the resemblance to *Obolaria* is striking and complete, as you will see from the enclosed sketch of a transverse section of the ovary of *B. tenella*. The only anomaly of *Obolaria* as a true *Gentianea* which remains, is the imbricative (instead of convolutive) æstivation of its corolla;—of which no parallel instance is known, so far as I am aware. It may however be expected to occur; for useful and reliable as the æstivation of the corolla often is, as an ordinal mark, it is seldom altogether constant.

I think I once mentioned to you an exception of this sort, or rather a variation, which occurs in a family in the arrangement of which you have employed æstivation of the corolla to great advantage, viz. the *Scrophulariaceæ*, in characterizing the *suborders* (as I would suggest they ought not to be called) *Antirrhinideæ* and *Rhinanthideæ*. The same accurate observer, Mr. Clark, long ago showed me that this character occasionally failed in *Mimulus*, especially in *M. ringens* and *M. moschatus*, which almost as frequently present the æstivation of the *Rhinanthideæ* (*i. e.* have some part of the lower lip exterior) as that of the *Antirrhinideæ*, to which the genus belongs. Last summer I noticed a second exception of the kind in a *Pentstemon* (*P. heterandrum*, Torr. & Gray, in Beckwith's Report of a Pacific Railroad Survey), which besides the anomaly of having the fifth stamen sometimes antheriferous and sometimes sterile, had also, in about half of the flowers examined, the lateral lobes of the corolla external in the bud, and covering the two posterior lobes as well as the anterior one.

On the Action of Sea-water on the Germination of Seeds. By Charles Darwin, Esq., Vice-Pres. R.S., F.L.S. &c.

[Read May 6th, 1856.]

During the spring of last year it occurred to me that it would be worth while, in relation to the distribution of plants, to test how long seeds could endure immersion in sea-water, and yet retain their vitality. As far as I knew, this had not been tried by bota-

nists, who would have been far more capable of doing it efficiently than myself; and I now find that M. Alph. DeCandolle, in his admirable work, "Géographie Botanique," regrets that such experiments have not been tried; I think, that had he known even the few facts here to be recorded, some of his opinions on the means of distribution of particular families would have been slightly modified. The Rev. M. J. Berkeley has likewise tested fifty-three different kinds of seeds, and has published a report in the "Gardener's Chronicle*," to which periodical I have also sent two brief notices on the same subject†. I intend here to give, with Mr. Berkeley's kind permission, an account of our joint experiments. I may premise, that not knowing, at first, whether the seeds would endure even a week's immersion, I selected a few by simple chance, taking, however, the seeds of different families; subsequently I have been aided by suggestions from Dr. Hooker.

I must briefly describe how my experiments were tried: the seeds were placed in small bottles, each holding two or three ounces of salt water, carefully made according to Schweitzer's analysis: as both *algæ* and marine animals have, as is well known, long survived in water thus made, there can be no doubt that the experiment was thus fairly tried. Mr. Berkeley sent his seeds to Ramsgate, tied up in little bags and placed in the sea-water, daily renewed; and they were thus immersed for three weeks, and when partially dried, but still damp, were sent off, but by accident were not unpacked for four days subsequently, so that their total immersion "was equivalent to one of more than a month." Some of my bottles were put out of doors in the shade, and were exposed to an average weekly temperature of from 35° to 57°; the other bottles were kept in my cellar, and were exposed to much less variation of temperature, viz. to a daily mean average of from 46° to 56°. Further, to test the effect of temperature, I immersed eighteen different sorts of seeds in salt water, in a tank, which, from containing much snow, was for six weeks at the temperature of 32°, slowly rising for the next six weeks to 44°; but the seeds thus tested did not seem to withstand the injurious effect of the salt water better than those exposed to a higher but variable temperature. I may remark, that amongst the eighteen kinds of seeds immersed in the cold salt water, there were seeds of a somewhat tender constitution, as capsicum and vegetable marrow, but the exposure to the cold in no degree injured their germination. In the case of some of the seeds which I first tried,

* Sept. 1st, 1855. † May 26th and Nov. 24th, 1855.

and which were put out of doors, I did not change the salt water for fifty-six days, and it became putrid and smelt offensively to a quite surprising degree, especially the water with the cabbage, radish, cress and onion seed, which also gave out strongly the odour of each kind; so that I thought the putridity would infallibly have been communicated to the seeds; but judging from the seeds of some of the same plants (but not actually from the same lot of seed) placed in salt water often renewed, and likewise kept in the cellar under a less variable temperature, neither the putridity of the water nor the changing temperature had any marked effect on their vitality. Cress seed (*Lepidium sativum*) and that of *Phalaris Canariensis*, after twenty-two days' immersion, were thoroughly dried for a week and then planted; they germinated pretty well, but the seeds themselves of this particular lot were not very good. At first I tried the seeds after each successive week's immersion, and they germinated at the same period as did seeds of the same kind which had not been salted; celery and rhubarb seed, however, were somewhat accelerated in their germination. Some kinds of seeds, as of *Trifolium incarnatum*, *Sinapis nigra*, peas, kidney and common beans, swelled much in the salt water, and they generally were killed by a short immersion; but the swollen seeds of *Lupinus polyphyllus* germinated better than those which did not swell. I was surprised to observe that most of the seeds of *Convolvulus tricolor* germinated after seven days under the salt water and lived for some time in it; as did likewise the fresh seed of *Tussilago farfara* after 9 days; after 25 days I took out some of the young plants of the *Tussilago* and planted them, and one of them grew: some of the seeds of the garden orache (*Atriplex*) also germinated under water after 56 days' immersion, but I failed in raising the seedlings; the other seeds of the same lot of the orache germinated excellently after 100 days' immersion.

The total number of seeds tried by Mr. Berkeley and myself amount only to 87, for unfortunately we happened to select some of the same kinds; in one respect, however, this has been fortunate, for we have thus tested each other's results, and they accord perfectly as far as they go; the seed of the tomato, however, germinated better after a month's immersion with Mr. Berkeley than after only 22 days with me; but my seed appeared to be old. And this leads me to remark, that I suspect that fresh seed withstands the salt water better than old, but yet good seed; this was the case with *Trifolium incarnatum*, *Phlox Drummondii*,

and I believe with *Sinapis nigra*. Of the genus *Godetia*, Mr. Berkeley found one species was killed by, and another survived, a month's immersion: but a far more curious case is presented by the varieties of the cabbage; for I found that good seed of the "Mammoth white broccoli" germinated after 11 days' immersion, but was killed by 22 days; seed of the "early cauliflower" survived 22 days, but was killed by 36 days; "*Cattell's cabbage*" germinated excellently after 36 days, but was killed by 50 days; and lastly, fresh seed of the wild cabbage from Tenby germinated excellently after 50 days, very well after 110 days, and two seeds out of some hundreds germinated after 133 days' immersion.

Of the 87 kinds of seeds tried, 23 or more than one quarter did not endure 28 days' immersion: capsicum has endured the trial best, for 30 out of 56 seeds germinated well after 137 days' immersion: of celery seed after the same period of 137 days, only 6 out of several hundreds germinated. The worst germinators have been dwarf kidney beans and *Hibiscus manihot*, both killed by 11 days' immersion; common peas were killed by 14 days'; *Tussilago farfara* germinated under water after 9 days, but the young plants kept alive for some time: the next worse germinators have been *Phlox Drummondii*, *Trifolium incarnatum*, *Linum usitatissimum*, and *Sinapis nigra*, very few of which survived 15 days' immersion.

From such scanty materials it is, perhaps, rash to draw any sort of deduction in regard to the power of resistance to salt water in the different divisions of the vegetable kingdom; but a few remarks may be permitted. Three out of the 17 Endogens and 20 out of the 70 Exogens were killed by a month or 28 days' immersion: this fact, together with the marked power of endurance in the *Atriplex*, *Beta*, *Spinacea*, and *Rheum*, lowly organized exogens, accords with, and is perhaps connected with, the fact, insisted on so much by M. A. DeCandolle, of the wider range of the Endogens and of the lowly organized Exogens, than of the higher Exogens*. The four *Solanaceæ* and two *Umbelliferæ* endured the salt water very well, and each included the longest survivor of all the species tried. Ten *Compositæ* were tried, and only one was killed by a month's immersion, that is excepting the *Tussilago* which germinated under water. Eight *Cruciferæ* were tried, and all withstood the influence well, excepting *Sinapis nigra*, which

* Godron in his "Florula Juvenalis," p. 16, states that the seeds of some plants, as of *Atriplex* and certain *Gramineæ*, germinate perfectly in salt-marshes, where they have been immersed during all the winter under salt water.

was killed by 25 days' immersion; three of the *Cruciferæ* survived 85 days: this power of endurance in the seeds of this family is, perhaps, surprising, considering the oil in their seeds. Nine *Leguminosæ* were tried; these all resisted the salt water badly, with the exception of the hard thin seeds of *Mimosa sensitiva*, which germinated pretty well after 50 days; three species of Lupine seemed just able occasionally to withstand about 36 days' immersion; the seeds of the other *Leguminosæ* having all been killed by much shorter periods. I suspect that it is the water, and not the salt, which kills the *Leguminosæ*; at least I found that a lot of fresh "Thurston Reliance" peas were all killed by 13 days' immersion in pure water*; and I have been assured that a much shorter immersion will kill kidney beans. Lastly, seven species of the allied families of *Hydrophyllaceæ* and *Polemoniaceæ* (six having been selected by Mr. Berkeley) were killed by a month's immersion, and so great a proportion can hardly be accidental.

From the great difference in the powers of resistance to the sea-water in the different families just specified, and even in the varieties of the same species; and from the *Leguminosæ* being apparently in this respect the tenderest, whereas they are generally believed to keep longer than any other seeds in a dry state, I think we may learn a lesson of caution, not to infer with too much certainty which seeds will endure longest when naturally buried in damp earth, from knowing what kinds will keep best in an artificial state.

I had intended trying many more seeds, as I at one time thought that these experiments would have thrown more light on the dispersal of plants than I now think they do. I soon became aware that most seeds, in accordance with the common experience of gardeners, sink in water; at least I have found this to be the case, after a few days, with the 51 kinds of seeds which I have myself tried; so that such seeds could not possibly be transported by sea-currents beyond a very short distance. Some few seeds, however, do float, as I have tried with some of those cast by the Gulf Stream on the coast of Norway. From knowing that timber is often cast on the shores of oceanic islands far from the mainland, and from having met with accounts of floating vege-

* Loiseleur-Deslongchamps says (Consid. sur les Céréales, Part ii. p. 234) that in wheat put into water the embryo comes out in the course of two days; as Mr. Berkeley's wheat survived after 30 days' immersion in sea-water, one may suspect that in this case, the seed would survive longer under sea-water than under fresh water.

table rubbish off estuaries, I assumed that plants, with ripe seeds, washed into the sea by rivers, landslips, &c., might be drifted by sea-currents during a period of some weeks. The closing of the capsules, pods, and heads of the *Compositæ*, &c., when wetted, and their re-opening when cast on shore and dried, the seeds being thus allowed to be driven inland by the first stormy winds, seemed to favour such means of transport. But in putting 34 plants of different orders, with ripe fruit, into salt water, one alone, the *Euonymus*, floated for a month, being buoyed up by its fruit; the others all sunk in 21 days, some in 5, and several in 7, 9, and 11 days. But I am not sure that I have made the trial fairly, for I kept the floating plants in too warm and dark a place, which might have favoured their decay. Finally I may remark, that the seeds of very few species are, as far as we yet know, all killed by 10 days' immersion,—that some plants will float for this period,—that the average rate of the ten currents in the Atlantic Ocean, given in Johnston's "Physical Atlas," is 33 miles per diem (the main Equatorial current running at the rate of 60 miles, and the Cape Stream at 80 miles per diem); and therefore I conclude, under the existing extremely scanty materials for forming any opinion, that some plants might under favourable conditions be transported over arms of the sea 300 or even more miles in breadth; and if cast on the shore of an island not well stocked with species, might become naturalized.

In the following list, to save repetition, I have marked the plants tried by Mr. Berkeley, and which germinated after a month's immersion, with †; when they did not germinate, this is expressly stated. The "cold water" refers to the seeds placed in salt water in the tank with snow.

I have arranged the families in accordance with Lindley's "Vegetable Kingdom."

ENDOGENS.

(Gramineæ.)

Avena (common oats): after 85 days' immersion germinated excellently; after 100 days some germinated; after 120 days some half-germinated.

Hordeum (common barley): germinated well after 28 days, but none after 42 days; in the cold water well after 30 days (†).

†*Triticum* (wheat).

Phalaris Canariensis: after 70 days nearly all germinated; in

another lot after 85, most of the seeds germinated, but the seedlings died off; after 100 and likewise after 120 days' immersion, in each case, a single seedling came up.

Holcus saccharatus: after 36 days germinated fairly; after 50 days all died.

†*Zea Mays*: none germinated after a month's immersion.

†*Arum maculatum.*

†*Anomatheca cruenta.*

†*Babiana plicata.*

†*Trichonema pudicum.*

†*Sisyrinchium iridifolium.*

Canna Indica: after 50 days several germinated, but not very strongly.

†*Colchicum autumnale*: did not germinate.

Allium cepa: after 56 days' immersion, 3 out of 15 germinated; after 82 days in the cold water, most of the seeds grew well; after 100 days, 2 or 3 grew out of about 25 planted (†).

†*Bulbine annua.*

†*Asphodelus luteus.*

†*Uropetalum serotinum*: did not germinate.

EXOGENS.

Ricinus communis (*var. major* and *minor*): both germinated after 36 days.

Cucurbita Melopepo (vegetable marrow): germinated after 100 days; of 4 seeds immersed in the cold water for 82 days, 2 germinated.

†*Cucumis Melo* (melon).

Cistus (mixed shrubby garden varieties): germinated well after 36 days, and some germinated after 70 days.

(Cruciferæ.)

Lepidium sativum: after 85 days' immersion only one out of many germinated; after 56 days $\frac{6}{57}$ grew: in the cold water, after 63 days, $\frac{4}{60}$ grew. (†*var.*, golden cress.) These seeds gave out an astonishing quantity of slime in the salt water.

Brassica oleracea, var. "Mammoth white Broccoli:" germinated after 11 days' immersion, but after 22 days all died.

——— ———, *var.* "Early Cauliflower:" after 22 days, 5 out of 100 germinated; after 36 days all dead.

Brassica oleracea, var. "Cattell's Cabbage:" germinated excellently after 36 days; all dead after 50 days.

——— ———, *var.* growing wild on the Castle Rocks of Tenby; fresh seeds, after 50 days germinated excellently; after 110 days germinated very well; after 133 days only two out of some hundreds germinated (†).

†*Brassica Rapa* (*var.* yellow turnip).

Raphanus sativus: after 85 days, $\frac{2}{3}$ germinated; the cold water seemed to be injurious to these seeds, for after only 30 or 50 days all the seeds were dead (*var.* black radish) (†).

Erysimum Perowskianum: after 36 days germinated well; after 50 only one seed; after 70 days all dead (†).

Matthiola annua: germinated after 28 days; all dead after 54 days.

Sinapis nigra: seeds much swollen; germinated after 11 days; all dead after 22 days: *fresh* seed germinated pretty well after 15 days, but were all killed by 25 days' immersion.

Crambe maritima: after 37 days germinated well.

Tropæolum majus: after 37 days nearly all germinated, but after 50 days none did.

†*Limnanthes Douglasii.*

Hibiscus Manihot: all were killed by 11 days' immersion (†).

†*Malope grandiflora.*

Papaver somniferum: germinated well after 28 days; was killed by 54 days.

Argemone Mexicana: came up excellently after 50 days, and pretty well after 70 days.

†*Chryseis crocea* (germinated very imperfectly after the month).

Linum usitatissimum: after 7 and after 14 days only two or three seeds, out of very many, germinated; after 28 only one seed came up; after 42 days not one germinated. These seeds gave out much slime.

†*Silene compacta.*

Rheum Rhaponticum: germinated well after 82 days.

Atriplex (garden orache): some of the seed germinated under water after 56 days' immersion; the remaining seed germinated excellently after 100 days.

Beta vulgaris: excellently after 100 days (†).

Spinacea oleracea: excellently after 70 days; a few after 120 days; all killed by 137 days (†).

(LEGUMINOSÆ.)

Vicia Faba (*var.* "Johnston's Wonder"): two out of six lived

after 11 days' immersion; one half-germinated after 14 days; after 22 days all dead: many of these beans swelled greatly. I tried sixty after 28 days and found all dead. None survived 30 days in the cold water.

Pisum sativum: after 11 days some germinated; none survived 14 days; none survived 30 days in the cold water. Another lot of *fresh* seed ("Thurston's Reliance") all died after 12 days; none survived 30 days in the cold water. I found 13 days' immersion in pure water killed these latter fresh peas. (†None germinated.)

Phaseolus vulgaris (*var.* "early frame dwarf"): all died after 11 days' immersion; after 28 days' immersion, 80 were planted, but all dead. I tried another lot of *fresh* seed, but none of them resisted even 10 days' immersion; nor did they resist 30 days in the cold water: many of these seeds swelled much (†).

Trifolium incarnatum: all died after 11 days' immersion, and after 30 in the cold water. *Fresh* seed germinated excellently after 5 days' immersion, well after 12 days, and one single seed out of some hundreds germinated after 20 days. These seeds swelled much.

Ulex europæus: after 11 days germinated well; after 14 days two germinated; after 28 days all dead.

Lupinus polyphyllus: after 22 days, out of seven swollen seeds three germinated; seven others did not swell and were all dead; after 36 days' immersion one began to germinate and then died.

Lupinus luteus (pale *var.*): after 22 days $\frac{4}{12}$ lived; after 36 days' immersion $\frac{3}{18}$ germinated; after 50 days all dead.

†*Lupinus pubescens* germinated after a month, but Mr. Berkeley says the greater number were rotten.

Mimosa sensitiva: germinated excellently after 36 days' immersion, and pretty well after 50 days.

Geum coccineum (*var. splendens*): after 36 days germinated well, and after 70 days one single seed germinated.

Saxifraga incurvifolia: did not germinate after 30 days' immersion.

——— *aizoides*, nor did this species, but the seed was not very good.

(SOLANACEÆ.)

Capsicum annuum: after 137 days' immersion, 30, *out of* 56 planted, germinated well (†).

Solanum tuberosum: germinated excellently after 70 days, well after 100; all dead after 120 days.

——— *lycopersicum* (common tomato): one seed germinated after 22 days' immersion, the rest were killed by 36 and 50 days' immersion. († But Mr. Berkeley found that they germinated after a month.)

†——— *melongena.*

Convolvulus tricolor: after having been 7 days in the salt water, many of the seeds germinated, and the embryos came out of the husks: of those which did not germinate under water, one germinated after 36 days' immersion.

(Polemoniaceæ and Hydrophyllaceæ.)

Gilia tricolor († was killed by a month's immersion).

Phlox Drummondii: of old seed none germinated after 11 days; but of fresh seed, 3 out of many germinated after 15 days, and none after 25 days' immersion.

Eutoca viscida.
Nemophila insignis.
——— *atomaria.*
——— *maculata.*
——— *discoidalis.*

† None of these were found by Mr. Berkeley to germinate after a month's immersion.

Borago officinalis: a few came up after 14 days' immersion, one after 28 days, and none after 42 days.

†*Nolana grandiflora.*

Satureja (common savory): after 42 days, 3 seeds out of many germinated.

Campanula Pentagonia († did not germinate after a month's immersion).

†*Fedia graciliflora.*

†*Fedia* (corn salad).

(Compositæ.)

Lactuca sativa (common lettuce): after 56 days' immersion $\frac{1}{20}$ of the seed came up; after 85 days only one out of several germinated. Cold water had no marked effect, but after 65 days they germinated rather better than the others (†).

†*Cichorium Endivia.*

Galinsoga trilobata: germinated after 22 days.

Aster Chinensis (mixed German varietes): germinated after 28 days; all dead after 54 days' immersion.

Ageratum Mexicanum: after 100 days, one seed out of many germinated; at much shorter periods these seeds did not germinate well.

Leontodon Taraxacum: germinated excellently after 61 days' immersion; the seeds were fresh.

Tussilago Farfara: fresh seeds being placed in the salt water, after 9 days, many of them germinated under water. After 25 days, I took out some of the young plants and planted them: one grew. The germination of these seeds is the more remarkable, as this is not a sea-side plant.

†*Monolopia Californica.*

†*Cenia turbinata.*

†*Cosmos luteus*: did not germinate after a month's immersion.

Clarkia pulchella: germinated well after 28 days; was killed by 54 days' immersion.

†*Godetia rubicunda.*

†——— *Lindleyana* was killed by a month's immersion.

Apium graveolens (*var.* "Cattell's white"): after 137 days only 6 seeds out of some hundreds germinated; after 85 days the seeds germinated excellently; they did not appear to germinate quite so well after 82 days in the cold water (†).

Daucus carota: a very few germinated after 85 days; after only 56 days $\frac{3}{30}$ grew (†).

On the Vitality of Seeds after prolonged Submersion in the Sea.

By JAMES SALTER, Esq., M.D., F.L.S. &c.

[Read May 6th, 1856.]

I SHOULD not have thought the observations which are the subject of this little communication of sufficient importance to occupy the attention of the Linnean Society, had it not come to my knowledge that one of our most distinguished British naturalists is at present engaged in investigating experimentally the question of the vitality of seeds after prolonged submersion in sea-water, especially in reference to the influence which that circumstance would have in explaining some of the problems of geographical vegetable distribution.

The facts which I am about to detail, and which came accidentally under my notice some years since, bear directly upon this subject, and while, as it seems to me, they establish the doctrine

I was obliged to lay it aside, thereby incurring a very serious loss, besides all the expense I had been put to in repairing the machine. The framework being totally useless I proposed that the maker should make me an allowance accordingly. This he has refused, and has placed the matter in the hands of the London Trade Protection Society, and as I do not wish to incur legal expenses I have paid the money with the additional charges. I believe, however, I should have done well to have resisted this claim, and exposed the imposition I have been subjected to. I do think that the farmers require a society to protect them from agricultural machine makers, and also manure vendors, from both of whom I and others have suffered; at any rate I should recommend farmers before buying root-pulpers to get some guarantee that they will stand the work required. KINNAIRD, *Veitch's Hotel, Edinburgh.* [We have omitted the name given in Lord Kinnaird's letter. This statement of his lordship's experience will be none the less generally influential, though we do not give its personal bearing.]

Home Correspondence.

Mr. Piper's Balance Sheet.—Mr Piper must not imagine I impute any intentional mis-statement to him in the tables he has published in the *Gazette* of the 24th October of his and the Reverend Mr. Smith's systems of Wheat growing, but I must think there does exist an error in the amount of produce put down to Mr. Smith's account—five sacks—can it be that it should be five quarters, which appears to tally more nearly with all Mr. Smith's former returns? I have not a later pamphlet of his than that of 1852, but up to that date, and I believe according to returns since published in periodicals, his returns have been from 34 bushels to 40, or even over; should there have been no falling off in the years 1855 and 1856 there would evidently be shown a large balance in favour of Mr. Smith's system. Half-a-ton of straw, too, is so very much under what Mr. Smith has usually had, that it throws further doubt on the statement. He used to have from a ton and a half to two tons. We must under such discrepancies, without casting any suspicion on Mr. Piper's honesty, be anxious to have Mr. Smith's own statement of these two years' products. It is barely possible that Mr. Smith's returns of these two years may have fallen short of those of former years, but, whether they have or not, Mr. Piper in giving his own averages for the last eight years ought also to have given those of Mr. Smith's for the same years. As far as my observation goes the returns of the two plans had previously been much upon a par. The two systems are of so much interest, bearing on two such opposite principles, both being conducive to the production of such vast amounts of our staple food, that their merits cannot be too much discussed. It is curious to find so small an amount of manure compensating for all the inorganic substances brought into play by the deep working of Mr. Smith. Mr. Piper's plan shows the mistake we are in, in supposing a change of crop necessary, at least in cereals; as constituting the staff of life this is a matter we should be thankful for, but then he is dependent on foreign supply of manures, which if his plan were brought into general practice might fail, while Mr. Smith's rests on those within the soil which thousands of years may not and cannot exhaust.—*J. M. Goodiff.*

Thin Seeding, Late Ripening, and Rust.—Thin seeding produces late ripening—true, it does delay the period of ripening and so do high manuring and deep working; but is it not jumping to a rather hasty conclusion that it is therefore a cause of rust, which generally attacks the Wheat plant long before the ripening process commences?—it will be seen even in Grass corn. The deep and well fertilised lands are always longer in bringing on plants to the ripening stage than shallow poor land; are we therefore to abandon high farming and our prime lands to other products and only sow Wheat on weak soils? Is not water at the roots a main cause of rust? Is not late sowing also, as Mr. Smith says, in producing a late and spring tillering, a further cause? Do the Hardys find their thin sown grain more liable to rust than their neighbours' thicker sown? Does Mr. Piper find his 2½ pecks more subject to rust or later in ripening even than his neighbours? Does not Mr. Smith produce a plump full grain of Wheat? But in Ireland Wheat is almost all sown broadcast and thickly sown—over two bushels to the acre—and yet for several years very immediately subsequent to the general attacks of mildew on the Potato crop, it so suffered from rust as to throw it very generally out of culture, the rust affecting the leaves when in Grass corn; and although at the same time I believe it prevailed very much in England we do not find that the Hardys or Mr. Smith or Mr. Piper were more severe sufferers from it than their neighbours. In the year 1850 a crop of Wheat was sown in rows four feet apart with Cabbages interlined on a wet, cold, undrained clay—this Wheat promised well but was so severely attacked by mildew that it became of little value; this was a nice bone for the thick seeders, but it unfortunately happened that at the same time another crop of Wheat about a mile off sown broadcast with a full complement of seed on a very superior land—a warm dry limestone soil—suffered so much from rust, that the owner of it, a strong farmer, abandoned sowing Wheat for several years after. The period in which mildew attacks prevail is so dependent on other causes, chiefly atmospheric, that it is very questionable whether we should ascribe it to a late ripening, and indeed during the prevalence of Wheat mildew in Ireland it was observed that the spring-sown Lammas Wheat suffered much less from it than the autumn sown; and this would probably be the case with late planted Potatoes did not the destruction of the tops prevent the growth of the tubers. While noticing the Potato crop I may observe that drilled and consequently thinly-planted Potatoes do not suffer more severely from disease than the thicker sown lazy bed. If to those causes which procrastinate the ripening of our grain we are to attribute a greater prevalence of mildew, we must, then, to avoid a chance danger, sacrifice a certain large produce, abandon high tillage, and be content with the scanty returns of our forefathers. But what are thick and thin sowing? Are they not relative? On poor land that would be thin sowing which on rich land would be thick. If the land is capable of giving a tillering of 80 stems to a plant surely it would be absurd to sow it as thick as land that would only throw up a single stem. But thick seeders like shallow drainers are all verging away from their old practices, few now would sow the quantities of seed they used to do; even the poorest lazy-bed tiller of Potatoes in Ireland eschews the nine-inch distances of his forefathers and plants his sets a foot or more apart, and who now thinks of making his *gridiron* drains but two feet deep? It looks very like a catching at straws this last resource of the thick seeders in mildew, but even were there some little more of liability to disease in thin sown crops the thin seeder rests his practice on so broad a basis, as not to fear its being upset by such a casualty. He finds reckless and wasteful extravagance in throwing into the ground more seed than will healthfully vegetate. He sees that a saving equal to about one-twentieth part of the entire produce of the country may be effected, and he maintains that it is the duty of the agriculturist of a state, which cannot produce sufficient for the demands of its population, to effect such a saving, letting alone his own individual interest in it. In poor land, however, thick seeding may be advisable, and in dirty ground it is absolutely necessary, that our cultivated intruders may keep down the denizens of the soil; the ground must be occupied by one or the other, and these dirty fields I willingly give up to the thick seeders and trust they will make the most of them, as they do in Ireland, and perhaps elsewhere.—*J. M. Goodiff.*

Acorns.—The crop of Acorns this season is in this neighbourhood unprecedently large. Many women and children have made large sums by selling them at prices varying from 1*s.* to 1*s.* 6*d.* per bushel. At the suggestion of my servant (Joseph Bowyer) I have tried boiling them for pigs, and find it very successful. Much of the astringency and acridity natural to the Acorn seems to be dissipated in cooking them. At first we boiled them till they burst into a kind of jelly; now we boil them about 20 minutes, till they resemble a cooked Chesnut, and then pound them, and having sifted some of the flour from them for the fat pigs, boil the other part again for the lean. We mix the flour, or powdery part, for the fat pigs with pollard. They eat it greedily, and then lie down, which seems to prove that it is good for fattening them. Many of my neighbours have tried this plan at my recommendation, with the same result. Can you inform me what are the principal constituents of the Acorn, and what should be added—Barley-meal, Indian Corn, bran, Pea-meal, &c., to make them most suitable for fat pigs and for lean and growing pigs respectively? *E. G., Runham Vicarage.* [We have no analysis of Acorns. The specimen of Acorn flour sent is sweet and palatable.]

Productiveness of Foreign Seed.—Will the writer of the highly remarkable article on weeds in your last Number have the kindness to state why he supposes that "there is too much reason to believe that foreign seed of an indigenous species is often more prolific than that grown at home?" Is it meant that the plant produced from the foreign seed actually produces more seed, or merely that the introduced stock is more vigorous than the native stock? I have no doubt that so acute an observer has some good reason for his belief. The point seems to me of considerable interest in regard to the great battle for life which is perpetually going on all around us. The great American botanist, Dr. Asa Gray, believes that in the United States there are several plants now naturalised in abundance from imported seed, which are likewise indigenous; and my impression is (but writing from home I cannot refer to his letter to me) that the imported stock prevails over the aboriginal. So again, Dr. Hooker in his admirable Flora of New Zealand has told us that the common Sonchus has spread extensively from imported seed, whilst the same species is likewise an aboriginal; the natives in this instance being able from trifling differences to distinguish the two stocks. Might I further ask whether it is now some years since the seed of Sinapis nigra was accidentally introduced on the farm described; and if so, whether the common Charlock still remains in lessened numbers owing to the presence of the invader, and without, as far as known, fresh seed of the invading S. nigra having been introduced?—whether, in short, it was a fair fight between the two species, ending in the victory of the Black Mustard? Would it be trespassing too much on the kindness of the writer of the article to ask whether he knows of any other analogous cases of a weed introduced from other land beating out, to a greater or lesser extent, a weed previously common in any particular field or farm? *C. Darwin, Down, Bromley, Kent.*

The Preservation of Corn and other Ricks.—How much better and cheaper would it be in the long run if a farmer had erections or sheds of a simple and inexpensive kind under which ricks, whether of corn and other cereals, hay, &c., might be safely housed, and thus be free from the effects of storms, but also from incendiarism. There is little doubt that, despite the thatching, much of the rick corn is considerably deteriorated by its exposure, especially crops that are in an inferior condition in bad seasons. A farmer can have no difficulty in knowing how many ricks his acres will raise, and should allow housing accommodation for a maximum number. Lightning conductors might probably be more serviceable and effective if detached from buildings at the distance of a few feet. Wood erections are possibly the cheapest kind, but where present economy is not a primary object, cast iron girder houses (that will also admit plenty of light where desirable), after the system of Sir Joseph Paxton's, as seen on a monster scale in our Crystal Palace at Sydenham, but also successfully made use of in smaller buildings by him on the Duke of Devonshire's estate. Many hundreds, if not thousands, of quarters of grain, &c., are lost to the stock of our produce, the staple food of the majority of our population, from want of due care and management, especially in bad and wet seasons, as is seen in the large proportion of damaged and inferior grain and other crops. This to the farmer bent upon self-interest alone is a matter of indifference, as any deficiency of bulk is made up by increased price, but to the hard-working classes, generally underpaid, this is a matter of serious consequence. I hope the day is not very remote when some means may be devised by our legislature to compel farmers to take efficient means to preserve the hitherto abused bounties of Nature by having ricks under house covering, a system also beneficial in preventing crime by removing the liability to incendiarism from discontented men, who suffering, whether justly or unjustly, from want and destitution, in their ignorance purpose ruining the farmer, whereas they are injuring the community generally, and most of all their own class. I may add that I believe lightning conductors would be more efficient if the top were fluked like an anchor, and it would thus attract the electric fluid more certainly than by a single point. *"Scintilla."*

Lead Pipes.—One of your correspondents wishes to know if a lead pipe to convey water to farm buildings half a mile would be reasonable at 100*l.* Instead of lead pipe I have used common 2-inch pipes of brick earth set in Portland cement, at one-third of the cost, and though I have not yet fully proved the work I trust it will answer, and be so much better than lead that there will be no danger of the water being poisoned. Does any one know of Portland cement having been previously used for a similar purpose? *W. E. H.*

Farmers' Clubs.

LONDON: The following are passages from the Rev. C. James's opening paper on the education of the agricultural labourer:—*The "position" of the British Farmer.*—I maintain that it is a high and dignified one, fraught with immense responsibility, both by precept and example, influencing for good or evil 800,000 families of labourers in husbandry, forming the interest that wields the power, originates the wealth, cherishes the manly freedom, and promotes the happiness of the entire people; and that it is from this interest that the greatest part of the public burdens are borne, and from which the State derives the greatest portion of her subsistence. As to "the holdings" of the British farmer, there are, it is calculated, 78 millions of acres, at a rental of 127 millions of pounds sterling per annum, in the area of these kingdoms; 14 millions of which are unimproveable waste, and 12½ millions uncultivated, but improveable land. The farms occupy two-thirds of the land of England. The number of farms is 223,318; the average size is 111 acres. Two-thirds of the farms are under this size; but there are 771 of above 1000 acres, the large farms abounding in the south-eastern and eastern counties, the small farms in the north. There are 2000 English farmers holding nearly 2,000,000 acres, and there are 97,000 English farmers not holding more. There are 40,650 farmers who employ five labourers each, 16,501 have 10 or more, and together employ 311,707 labourers; 170 farmers have above 60 labourers each, and employ together 17,000. What an enormous trust held by such a body of men, over such a multitude of workmen! And are they alive to their position? Do they know their duties—and, knowing them, dare to perform them? I answer unhesitatingly, for the most part, Yes; and desire to promote and advance the physical, moral, and intellectual training of the labouring classes. True there was a time when, in some parishes and districts of our country, the education of the labouring classes was viewed with distrust, and encountered opposition; but men now begin more fully to appreciate the words of the excellent Dean of Hereford, in his "Suggestive Hints on Secular Education." "The farmers," says the Dean, "and those of the same class in our rural districts, may rest assured that, until they get that education it is desirable they should have, and until they feel that interest in the labourer which is right, they only augment the evil which they dread. The one is advancing in intelligence; the other is standing still; and I cannot but think that, in a very few years, the employers of labour will be the class which, of all others, will take the greatest interest in those very schools of which they now think so little."

Need of increased Skill in the Labourer.—I say that the more artificial position of agriculture, arising from the progress made in machinery, chemistry,