registering apparatus, which were exhibited recently at the anniversary meeting of the *Société de Physique*, and will be sent up very shortly with a 113 c.m. balloon inflated with pure hydrogen. So a new departure may be said to have been taken for the scientific exploration of the air at an altitude where no human being can penetrate. The series of prizes proposed by M. Hodgkins for 1893 and 1894, and the creation of the Hodgkins medal by the Smithsonian Institution, certainly add new interest to these experiments.

M. Janssen intends to establish an apparatus for making pure hydrogen in the Meudon Observatory in order to help M. Hermite to send his sounding balloons to a higher level if possible. He will, moreover, try to measure by direct observation the altitude of the balloons sent, as long as they remain visible from his Observatory.

This last scheme was adopted by Le Verrier, who says in the *Bulletin de l'Association Scientifique de France* for October 1874: "La hauteur du ballon est toujours déduite de la mesure du baromètre et du thermomètre, au moyen d'hypothèses sur la repartition de la pression atmosphérique. Il s'agit d'écarter ces causes d'incertitude, et de mesurer directement par des opérations trigonométriques la hauteur même du ballon; ce qui permettra de vérifier les lois admises ou de les modifier. Les opérations trigonométriques à terre seront faites par les astronoms de l'observatoire sur le charge de cette partie des dépenses. La direction de l'aerostat fourni par l'observatoire est confiée à M. W. de Fonvielle." The protracted illness of the illustrious astronomer and his subsequent death, prevented the series of ascents from being tried as contemplated.

The experiments already tried by M. Hermite, namely, on March 3, prove that the balloon will remain long visible from an Observatory, if the ascent is executed on a clear and calm day with a considerable ascending force, which gold-beater's skin can support without being torn by the friction.

The ascent of March 21, when ordinary gas was employed, took place with such velocity that the balloon was seen always nearing the zenith, independently of the diverging direction of the air, the mean recorded velocity having been eight metres per second from the time of starting to the time of maximum, which was reached in three-quarters of an hour, according to the automatic barometer.

The inflating pipe (*appendice*) which the balloon carried with it, was 30 cm. diameter and 90 cm. long, and air took the place vacated by the retreating gas, when the balloon descended. Consequently it was found quite full when discovered, just the same as when the balloon was liberated. The only differenec was that the gas had been expelled and replaced by air.

Since the volume of the balloon remained quite constant during the whole of the operation, it would have been quite easy to determine the absolute distance from the observatory by measuring the apparent diameter with a micrometer. By taking simultaneously a reading of zenith distance and azimuth, it would have been quite easy, by a series of observations conducted from a single station, to ascertain the altitude of the balloon and every circumstance of its motion.

The principal object of M. Janssen will be to determine the absolute minimum of temperature at the maximum altitude, which can be done more or less precisely, and the direction or velocity of the winds blowing at different altitudes. Then the indications of the registering instruments can be submitted to the rational control which is necessary before coming to any definite conclusion.

It is interesting to notice that these preliminary results are in conformity with the Joule and Clausius theory, which asserts that celestial space is at the temperature of $-273°$ C., or even with the opinion that there is no limit to the refrigeration, as asserted by other natural philosophers.

Another question is raised by these experiments, when coupled with Dewar's and Cailletet's discoveries relating to the liquefaction or solidification of the elements of the air. If the temperature descends to such a degree it is necessary to admit that the air loses its gaseous condition and becomes changed into a series of minute crystals or drops, which follow the earth in its motion through space, and are constantly vapourised when falling in regions where the temperature is somewhat above their point of liquefaction or evaporation.

Such are some of the questions raised by this new exploration of elevated regions, rendered very easy by the unexpected facility with which balloons and instruments in working order are recovered. This has been rendered possible in France by the interest taken in the matter by public schoolmasters, who have been notified of the experiments by the newspapers, and have found special instructions printed on a paper pasted to the basket. It is certain that similar results may be obtained in every civilised country in the world, and we trust this new method will develop and improve so that unquestionable facts will be discovered with regard to the mysterious cosmical frontiers of our globe.

W. DE FONVIELLE.

DISINFECTANTS AND MICRO-ORGANISMS.

SOME important results have recently been obained by Heider, who has been experimenting with disinfectants at higher temperatures and testing the effect produced upon their bactericidal properties. The author's first contributions in this direction were published in 1891. In Heider's original communication, "Ueber die Wirksamkeit von Desinfektionsmitteln bei höherer Temperatur" (*Centralblatt für Backteriologie*, vol. ix. 1891, p. 221), temperatures of 55° and 75° C. were employed, and the spores of anthrax were selected for investigation. Although these spores, it was ascertained, survived an immersion during 36 days in a 5 per cent. solution of carbolic acid kept at the ordinary temperature of the room, they were destroyed in from one to two hours in a similar solution at 55° C. Weaker solutions of this acid (1 per cent. and 3 per cent.), even when maintained at the higher temperature for seven and eight hours, produced no effect upon the anthrax spores. On the temperature being raised to 75° C., however, three minutes' exposure to a 5 per cent. solution of carbolic acid, fifteen minutes to a 3 per cent. solution, from two to two and a half hours to a 1 per cent. solution sufficed to annihilate these spores. Other materials were also investigated at these high temperatures, and equally satisfactory results obtained. Heider has brought together all his researches on this interesting subject in an elaborate memoir, "Ueber die Wirksamkeit der Desinfectionsmittel bei erhöhter Temperatur," which has been published in the *Archiv. für Hygiene*, vol. xv. p. 341. It is pointed out how great an effect upon the powers of resistance possessed by micro organisms may be exercised by the nature of their surroundings, and that it may be taken that they are, as a rule, more refractory in their normal environment than when purposely introduced into various materials. This has been shown by Yersin, in respect to the tubercle bacillus, which succumbs more readily to certain temperatures when exposed in artificial cultures than in sputum. Heider also found that particular culture media had a remarkable effect in this respect upon bacteria, that, for example, those grown in sugar broth (3 per cent. cane sugar) proved far more capable of resisting exposure to a high temperature than those introduced into ordinary broth. In conclusion, it having been distinctly proved that the bactericidal action of the majority of disinfecting materials is markedly increased when they are employed at a higher temperature, the author recommends that in all those cases where the destruction of spores is required, instead of applying these materials in cold solutions, they should be employed hot, or even boiling. The advantages derived by so doing are not alone the greater security obtained and saving of time, but economy in the cost of material, inasmuch as effectual sterilisation may be accomplished by the use of less concentrated solutions.

THE NEW FLORA AND THE OLD IN AUSTRALIA.

A VERY interesting paper on the effect which settlement in Australia has produced upon indigenous vegetation, by Mr. A. G. Hamilton, appears in the new number (vol. xxvi.) of the "Journal and Proceedings of the Royal Society of New South Wales." Mr. Hamilton traces with great care the results which have sprung from the direct action of man. He then deals with the alteration of the flora by the introduction of a new fauna, and the modification of it by the destruction of the native fauna. Finally, he considers the introduction of a new flora, and the consequent modification of the indigenous flora through competition.

The following is the portion of the paper relating to the effects due to a new flora:—

The plants which have become naturalised in Australia naturally come under two headings, viz. those purposely introduced for use, ornament or sentiment, and those which accidentally found their way here.

Of those introduced for use or for ornamental purposes, a large number do not spread to any extent: they are children of civilisation and show no tendency to become feral. Many hardy annual garden flowers come up self-sown in gardens year after year and yet never gain a footing outside. Others again, which have the power of spreading rapidly, are never able to do so, as they are succulent feed, and cattle take care that they never multiply. Such are oats and other grains. Wheat never seems to spread at all away from the fields in which it is cultivated. But still there are numbers of useful plants which are able to hold their own and more. Among these may be mentioned the lemon, peach, Cape gooseberry, tomato, and passion fruit, all of which are wild in many parts of the Illawarra district, and continue to bear fruit. Another species of passion flower (*Passiflora alba?*) is common there and is even more plentiful than the edible species. It is bitter and nauseous, but has spread over large tracts of bush country, converting them into tangle of the densest description. The common bramble or blackberry has been introduced for the sake of its fruit, and is now beginning to be a troublesome tenant of unoccupied lands in the cooler parts of the Colony. It reaches a development far exceeding that attained in its native land.

Sweet-briar and Scotch thistles are said to have been introduced for the sake of the associations clustered round the plants in the mother country. The latter plant is reported to have been introduced into Tasmania by a patriotic Scotchman desirous of having his national plant growing near his new home. He appears by all accounts to have succeeded only too well.

But with regard to most introduced plants, there is much difficulty in discovering the method of introduction. The plants which habitually flourish in European cornfields are certainly easily accounted for—they came in the seeds imported to the Colonies. Such are corn marigold, corn spurrey, and many of the Caryophylleæ, the cornfield poppy and numerous others which will occur to every one. Then again, many noxious weeds growing among grain, were introduced to Australia in straw in packing cases. Such are the Centaureas and others. As an example of this I may note that *Bupleurum rotundifolium* first appeared in the Mudgee District in a yard where a box from England was unpacked.

But with many plants introduced, we can only reason by analogy as to the manner of their introduction. In an article on the weeds of Europe in the *Cornhill Magazine*, an anonymous writer states that a common English weed was introduced into an Antarctic island by the use of a spade which had some mould attached to the blade, and the plant has now spread all over the island. Darwin gives instances of seeds being found in balls of clay attached to the feet of birds, and even to the elytra of beetles. Still, the method of introduction of many foreign weeds must in the nature of things always remain more or less of a mystery. Many aliens have arrived in the colony attached to the wool of sheep or the hair of other animals as in the case of the Bathurst Burr—a species of vegetable stowaway.

As to the methods of spreading, they are various. Cultivation of the soil brings the weeds in its wake, and they manage to spread somehow. Some have specially constructed seeds to float through the air—any one who has seen thistle-infested country on a windy day will have a good idea how thistles spread. The Composites are especially rich in plants adopting this contrivance. Others stick to the wool and hair of animals by hooks, barbed hairs, or sticky glands. Others again have seeds so minute that a high wind will carry them, although they are not furnished with special apparatus for the purpose.

Railways and roads are active helpers in the dissemination of aliens, especially the former. The land being fenced in is protected from the depredations of stock, and thus protected the weeds flourish and spread rapidly. In 1887 I remember noticing on the Mudgee Railway near Lue that there were miles of the embankments one tangled mass of *Meliotus parviflorus*. And in the neighbourhood of Bowenfels the railway line enclosures are thickly covered with a species of *Hypochæris*: it is pretty plentiful outside but inside the land is a golden sheet of the yellow flowers. Rivers also act in the same way, and especially carry weeds when in flood and deposit them on the flooded lands. I first noticed *Ranunculus muricatus* and Fool's parsley on the river banks at Mudgee. The following year they had reached Cullenbone, and the next year had got as far as Guntawang, a distance of seventeen miles by road but at least twenty-five or thirty by the river. A curious instance of the spread of a plant from one locality to another was afforded me in 1886 and 1887. During a journey from Guntawang to Wellington, a distance of forty-two miles, I noticed at Wellington, on the river banks, great quantities of *Cassia sophora*. At that time none of the plant was found in the Mudgee District, but in the same year a mail coach commenced running from Wellington to Gulgong passing through Guntawang. The following year, two plants of the *Cassia* appeared at Guntawang, and soon after it began to be common in the district. The Rev. Dr. Woolls, at a meeting of the Linnean Society of N.S Wales, in September 1890 exhibited plants of *Calotis scapigera* and *C. hispidula* from Concord and Burwood. These are strictly denizens of the interior and were probably brought down by sheep travelling to the sale yards. Indeed I feel pretty sure that an examination in the neighbourhood of the Homebush sale yards would show that many western plants are brought down by the sheep, etc. In collecting introduced plants, I have always been most successful by roadsides, river-banks, and railway enclosures, and there can be no doubt but that they are the principal lines of travel for these plants.

The plants which have edible fruits containing indigestible seeds are for the most part dispersed by birds and mammals which eat the fruit and void the seeds in new localities. In this way passion fruit, blackberries, *Phytolacca*, tomatoes, solanums, Cape gooseberries, and many others are distributed.

It is a significant fact that horehound—*Marrubrium*—is always plentiful in the vicinity of a sheep station. Two other plants commonly found in the same situation are the introduced nettles, *Urtica urens* and *U. dioica*, whether from the plants being eaten by the sheep and the undigested seeds voided, or because that in sheep-manured land they find a congenial soil, I am unable to say.

Australian plants from their long isolation, and their having little competition of a severe kind, settled down into a state of balance or rather of slight oscillation, governed by a few causes, which themselves varied but little. In the older continents, however, from the intercommunication of the various nations, and from the fact that men continually add to their stock of cultivated plants, there is severe competition; the struggle for existence goes on continually and aided by natural selection and domestication some plants gain an advantage.

Among other, useful habits acquired by plants under competition is a certain plasticity of constitution which enables them to bear changes to different climates with equanimity. On this account the old world weeds when brought to Australia are able to beat the native plants. They are mostly plain dwellers, and as such accustomed to the heat of the sun in the open, and the bitter blasts of the winter, better than forest plants. When forests are cleared and brought under cultivation, the weeds soon beat the former occupants out of the field. Again many old world weeds are plants of wide range, and on this account have an advantage over those of more restricted habitat.

"Widely varying species abounding in individuals which have already triumphed over many competitors in their own widely extended homes, will have the best chance of seizing on new places when they spread into new countries. In their new homes they will be exposed to new conditions, and will frequently undergo further modification and improvement; and thus they will become still further victorious and produce groups of modified descendants." ("Origin of Species," 6th ed. p. 319.) As before remarked their success in competition implies a plasticity of organism which is an advantage to them also; on this subject Darwin says, "If a number of species, after having long competed with each other in their old home, were to migrate in a body into a new and afterwards isolated country, they would be little liable to modification or variation; for neither migration nor isolation in themselves effect anything." (*Op. cit.*, p. 319.) The isolated productions of Australia on the other hand, have had uniform conditions and comparatively small range and so they cannot make way against those that have had such competition and range.

"In the same manner at the present day, we see that very many European productions cover the ground in La Plata, New Zealand and to a lesser extent in Australia and have beaten the natives, whereas extremely few southern forms have come to be naturalised in any part of the northern hemisphere, though

hides, wool and other objects likely to carry seeds have been largely imported into Europe during the last two or three centuries from La Plata, and during the last forty or fifty years from Australia." (*Op. cit.*, p. 340.) Wallace says, "There is good reason to believe that the most effective agent in the extinction of species is the pressure of other species, whether as enemies or merely as competitors." ("Island Life," p. 63.)

It is well known that few Australian plants have found a footing in Europe notwithstanding the many facilities which commerce offers for their introduction, and the few American weeds which have found their way to Europe do well only in the Mediterranean region. Even in New Zealand but a few Australian plants have become naturalised, as is shown by Mr. T. F. Cheeseman's paper on the naturalised plants of Auckland (read before the Auckland Institute, November 1892).

In America, the majority of introduced weeds are European, though at first they completely beat the natives, it is noteworthy that now the natives are holding their own, and even beating the strangers, thus showing that competition has gone on long enough for some advantage to be gained by the natives. It is remarkable too that the plants of Eastern America immigrated westward with man, and conquered the western plants at first; but from a consideration of the facts the great American botanist Prof. Asa Gray was led to prophesy a return wave of western plants, and that is now actually coming.

The theory that insulated floras are less able to resist the influx of foreign plants is supported by the fact that only in the Neilgherrie Mountains in India have Australian plants been able to compete with others to any extent. It is, I believe, considered that that part of India long existed as an insular region. Therefore we see that the Australian flora, which though isolated, had a large range, is able to get an advantage over the Neilgherrie flora which was for so long developed in a small centrum.

One cause of the power of spreading of what are commonly called weeds is that they are usually plants with inconspicuous flowers, and as such are generally self-fertilised and so can get along without specialised insects to fertilise them. It is manifest that in a new country where the local insect fauna is being destroyed to some extent, the plants which have not to depend on insects for fertilisation will be the more likely to win. And even cross-fertilised plants seem to manage sometimes to find insects to perform that office for them. Moseley points out an instance in the following passage:—"The orange, lemon, and lime, which grow wild all over Tahiti do not appear to deteriorate at all in quality or quantity of fruit, although in the ferine condition. The fruit almost appears finer for running wild. . . . . Some native insect must have adapted itself completely to the blossoms of the orange tribe as fertiliser, so abundant is the fruit." ("Notes of a Naturalist on the *Challenger*," p. 524.) The same is the case in Australia, for although the orange does not seem to grow wild to any extent, lemons have made themselves at home in the Illawarra district. The flowers of the lemon and the native plant *Synoum glandulosum* are much alike in structure, and it may be that the same insect or insects fertilise them. These plants would be on equal terms in this respect, but the lemon from its wide cultivation has gained a power of bearing diverse conditions, which gives it a better footing. I may remark that *Synoum* is a common plant in Illawarra.

Among wind-fertilised plants are the grasses. The introduced species so far are no beating the natives. They are equal as far as regards fertilisation, but most introduced species are from cool temperate regions, and so the Australian species being warm temperate, are able to hold their own. The dying out of some Australian grasses is attributable to over stocking and close feeding and not to competition.

In considering the introduction of weeds in Australia there is a great difficulty viz. that it is hard in some cases to say whether certain plants are indigenous or alien. It is considered a safe rule to take all plants common in the colony in Robert Brown's time as truly indigenous, but as Brown only collected in the neighbourhood of Port Jackson, that course leaves some difficulty still. On this subject Baron von Mueller says in the preface to his "Census of Australian Plants" (1st Edit. 1882) —"The lines of demarcation between truly indigenous and recently immigrated can no longer in all cases be drawn with precision; but whereas *Alchemilla vulgaris*, and *Veronica serpillifolia* were found along with several European *Carices* in untrodden parts of the Australian Alps during the author's earliest explorations, *Alchemilla arvensis* and *Veronica peregrina* were at first only noticed near settlements. The occurrence of *Arabis glabra*, *Geum umbrosum*, *Agrimonia eupatoria*, *Eupatorium cannabinum*, *Carpesium cernuum*, and some others will readily be disputed as indigenous and some questions concerning the nativity of various of our plants will probably remain for ever involved in doubts." As will be seen from this, the origin of some plants will and must remain more or less a matter of personal opinion. And on referring to lists of plants of the various colonies it will be found that their authors differ in their placing of these doubtful plants. If we critically examine the Census of New South Wales plants by Mr. C. Moore, of Queensland plants by Mr. F. M. Bailey, of Victorian by Baron Von Mueller, and of New South Wales by Dr. Woolls, we shall find abundant evidence of diversity of views in this respect. But very many weeds present no difficulty at all, although the record of their plentiful occurrence in very early days may well surprise us. The Rev. J. E. Tenison-Woods ("Proc. Linn. Soc. of N.S. Wales," vol. iv., p. 133) remarks that Leichhardt found *Verbena bonariensis* so plentiful in the neighbourhood of Darling Downs, then only five or six years settled, that he named the place Vervain Plains.

The injury done by introduced weeds will be almost entirely by competition, but it is possible that in time, the Australian plants may begin to hold their own and even to some extent drive out the others. This will be more especially the case with the group of plants which are found on the barren and sandy tracts wherever the Hawkesbury Sandstone formation occurs. In such land few aliens get a footing. On the sandstone about Sydney as a rule, and in the Blue Mountains where the same soil occurs, the foreign weeds have no chance. But wherever the soil is fairly good, or where it has been broken up, there they triumph and exclude the indigenes.

To some, extent however, the weeds will work their own destruction. They increase so rapidly that competition is most severe, not between them and the natives, but between individuals of the same alien species, or between distinct alien species. *Sisymbrium officinale* was once a pest near Mudgee, the fallow and unoccupied land being covered with a thick mass of it; but after the lapse of a few years it became quite rare, and *Erigeron canadense* took its place. I think that in some cases the fact of a heavy crop of weeds occurring in a locality one or more years is a reason for expecting its scarcity in the following years. The soil becomes exhausted of the particular constituents demanded by the plants, and they fail in consequence. I had often read doleful prophecies of the damage that might be expected when the Cape weed (*Cryptostemma calendulaceum*) became common. When I first saw it appear in Illawarra, I was therefore prepared to see much land infested by it in a short time. It spread to a great extent in certain spots for a couple of years and then almost disappeared. In my garden half-a-dozen vigorous plants came up, and as I left them for the purpose of observation, they flowered and seeded plentifully. I fully expected a large crop the following year, but to my surprise not a single plant was to be found, nor has there been on

Mr. T. Kirk, in a paper on the naturalised plants of Port Nicholson, N.Z., says:—"At length a turning point is reached, the invaders lose a portion of their vigour, and become less encroaching, while the indigenous plants find the struggle less severe and gradually recover a portion of their lost ground, the result being the gradual amalgamation of those kinds best adapted to hold their own in the struggle for existence with the introduced forms, and the restriction of those less favourably adapted to habitats which afford them special advantages." (Trans. N. Z. Inst., vol. x., p. 363.) And Mr. T. F. Cheeseman, from whose paper on the "Naturalised plants of the Auckland District" I have quoted the above, coincides with this opinion to some extent and says, "Speaking generally I am inclined to believe that the struggle between the naturalised and the native floras will result in a limitation of the range of the native species rather than in their actual extermination. We must be prepared to see many plants once common become comparatively rare, and possibly a limited number—I should not estimate it at more than a score or two—may altogether disappear, to be only known to us in the future by the dried specimens in our museums."[1] If this is likely to be the case in a territory so limited as New Zealand how much more is it probable in Australia with the vast extent of area, diversified surface and various climates from tropical to cold temperate.

[1] Paper read before the Auckland Institute, November 1892.