

from Boohtarminsk, on the right bank of the river, just at the entrance into the Kozlovskoe gorge, and is known among the local inhabitants under the name of Slepoy Borok (Little Blind Forest). But the illustrious travellers have made rather a blunder in defining, after only a rapid examination from the deck of an Irtyshian karbaz, the mutual relations of the rocks. A section at right angles to the stream shows that the granite lies not *on* the slates, but *in* them, and that it occurs as a main vein, with some secondary ones, all having the same strike and dip as those of the slates. The main vein is some 30 or 40 metres thick, the secondary 0.5 metre, or still less. From the river one can see only the lower limit of granite, and as the joints of this rock are nearly horizontal, whilst the bedding of slate stands almost vertical, the appearance is presented which suggested the original inference that the granite has been poured out over the ends of the slates.

My measurements gave the following results:—On the level of the current the strike of the slates varies between 9h. 45m. and 10h., dip = 82°–85° north-north-east; lower limit of granite strike, 7h. 30m., dip = 73° north-north-east; upper limit of the same, strike 8h. 45m., dip 43°–45° north-north-east. The contact of the two rocks can be observed occasionally exceedingly well. In the vicinity of the granite the slate loses all traces of fissility, and becomes a very compact rock, with abundant scales of muscovite. Generally the slates are schistose, phyllitic, and chistolitic. Both rocks are welded together. The secondary veins of granite somewhat differ in structure from the main vein, which is of a normal fine-grained variety, with little scales of biotite. The main vein is covered with young forest, consisting of pine, birch, and aspen trees, while on the slates nothing grows but rare bushes of gooseberry, honeysuckle, some species of horse-tail, and some grasses.

The conclusion of Humboldt and Rose, that some Altaic granites are younger than local schists and slates, remains indisputable. I wish to add that they are also younger than some local greenstones, as may be seen at Beshbanovskoe crags on the Irtysh, near Oostkamenogorsk, where a dioritic breccia is cemented with granitic matrix.

A. BIALOVESKI.

Oostkamenogorsk, Western Siberia, September 20.

#### Rankine's Investigation of Wave Velocity.

THE investigation relating to the propagation of waves contained in chapter xv. of Maxwell's "Theory of Heat," and based on that of Rankine (pp. 530–31 of "Collected Papers") presents peculiar difficulty to most readers. "The kind of waves to which the investigation applies are those in which the motion of the parts of the substance is along straight lines parallel to the direction in which the wave is propagated, and the wave is defined to be one which is propagated with constant velocity, and the type of which is not altered during its propagation."

Two cross-sections of unit area at a fixed distance apart are conceived to travel through the substance with the velocity of the wave, inclosing between them a cylindrical space within which things are always in the same condition though the matter is continually changing. The momentum of the matter which enters through the front section in the unit of time is duly expressed, and also the momentum of the matter which escapes at the rear section. The difference of these two momenta is then equated to the difference of the pressures before and behind. The puzzle is to justify this *quasi* deduction from the second law of motion; and in connection with this puzzle, the question of sign occurs. For instance, if the momentum of the entering fluid exceeds that of the issuing fluid are we to attribute the gain of momentum to the fact that the contents of the cylinder are more strongly pushed forward behind than they are pushed backward in front? Such is the impression produced on the reader's mind by Maxwell's words: "The only way in which this momentum can be produced is by the action of the external pressures"; but it is not correct.

The momentum included between the two travelling sections is changed in two distinct ways: first, by convection—that is, by gain and loss of moving matter; secondly, by pressure before and behind. *The change from pressure must be equal and opposite to the change from convection; since, by hypothesis, the momentum included between the two sections remains always the same.*

Rankine merely says, "Then in each unit of time the differ-

ence of pressure  $p_2 - p_1$  impresses on the mass the acceleration  $u_2 - u_1$ ," and gives no explanation.

I remember being puzzled by this reasoning of Maxwell's some years ago, when I was writing Note A in Part 4 of "Deschanel," and getting over the difficulty by taking the two sections very near together; but my attention has been drawn to it afresh by the receipt of a paper by Prof. MacGregor, of Nova Scotia, in which the difficulty is pointed out, and evaded in the same manner in which I evaded it. Prof. MacGregor points out that Maxwell obtains a correct result only by help of a mistake in the algebraical work—the sign of a difference being changed in obtaining equation (7) from equation (6). This is certainly true as regards the fourth and fifth editions, which are now before me. In a later edition, Prof. MacGregor remarks, the sign of the difference is changed in equation (6), thus making the algebra right, but at the expense of making equation (6) inconsistent with what goes before it. The explanation contained in the sentence printed in italics above clears up the difficulty.

J. D. EVERETT.

Belfast, November 2.

#### Alpine Haze.

PROF. TYNDALL'S letter in NATURE about Alpine haze induces me to say that as a non-scientific observer I have never, I think, during a residence of many years here, seen so much *local* fog or haze as this autumn.

On October 29—a perfectly clear and cloudless day here (Vevey and La Tour), with no appearance of fog, haze, or cloud, anywhere in the distance—I received a letter from Lausanne saying, "While I write (11.30) so dense a fog has suddenly come up that we fear for the boats on the lake." Other friends took a trip to Lavey les Bains. They were in perfectly clear air until a little beyond Villeneuve, when they found the whole Rhone Valley thick with fog, but on turning off at St. Maurice Station to Lavey les Bains (ten minutes' walk, and on perfectly flat ground) they again came into a quite clear atmosphere. As no fog whatever came here all day, I cannot say whether it was aqueous or not. We have both sorts here from time to time, but most commonly *dry*; this year has been rather an exception. I should say fogs had been more frequently damp than usual, and by observing the grass morning and evening I have found that there has been much more dew than is common in this locality.

*Streaky* hazes or "long horizontal strise," as Prof. Tyndall calls them, have certainly been unusually prevalent this year.

La Tour de Peilz, November 4.

M. C. C.

#### The Animals' Institute.

THE long-continued suffering of animals fatally injured in our streets, before the services of a slaughterer can be obtained, or the owner be found to give his permission, has often been referred to. Poor animals with incurable abdominal wounds, or, it may be, complete fracture of a limb, not infrequently lie in the streets for hours before being put out of their misery. The police have no power to order their destruction until the person in charge assents, and he frequently cannot do this until his master has been communicated with. I remember one case where eight hours elapsed. I have recently found that complete absence of pain can be easily induced by subcutaneous injection of morphia, and perhaps you would allow me to publicly state that the apparatus and drug are always here at the service of the police gratuitously in cases of street accidents.

JOHN ATKINSON.

9 Kinnerton Street, Wilton Place, Knightsbridge,  
November 5.

#### N. M. PRJEVALSKY.

A TELEGRAM from Vyernyi—one of those small Russian towns which have grown of late in the outspurs of the Tian-Shan Mountains—announces the death of Prjevalsky, the bold and indefatigable explorer of the wildernesses of Central Asia. In September last, immediately after having terminated the work which embodies the results of his fourth great journey to Central Asia, he started on a new journey, the fifth, thus prosecuting again what has been the aim of his life during the

last twelve years—that of reaching Lhassa in Tibet, and opening to science the lofty plateaus and highlands which separate East Turkestan from India. This time he proposed to start from Russian Turkestan, and his expedition had to be equipped at Vyernyi, on the north of Lake Issyk-kul. He arrived at Tashkend in October, and had left it on October 13 (old style?) on his way to Vyernyi, but he seems not to have reached that town, and must have died on the route, as far as we can judge from the telegram. The new expedition, which promised to be even richer in scientific results than all those which preceded it, was thus prevented. But Prjevalsky has left, in the travelling companions who remained so true to him in his adventurous journeys, a staff of young men who will certainly continue his work, and sooner or later open to science the dreary highlands which have baffled so many a bold explorer.

N. M. Prjevalsky was only in his fiftieth year, and usually enjoyed robust health. He belonged to a noble family, and was born in 1839, in the Government of Smolensk. At the age of seven he lost his father. During the early years of his life he was trained by his mother (whose maiden name was Karetnikoff), a teacher who stayed in their house, and a brother of his mother. He soon became an eager hunter, and spent all his holidays in hunting in the Smolensk forests with his uncle. This taste he retained during the rest of his life, and he frankly admitted that his first journeys in Central Asia were due as much to his passionate longing for rich hunting-grounds as to his desire to conquer for science the unknown wildernesses. Scientific interest developed more and more during and after his first Central Asian journey, when, accompanied only by three men, and possessing ridiculously small pecuniary means, he crossed the Gobi, reached Peking, and, pushing westwards and south-westwards from the Chinese capital, explored the Ordos and the Ala-shan, and reached the Kuku-nor as well as the upper parts of the Yang-tse-kiang—the mysterious Dy-tchu of the Chinese geographers. And yet, when we saw him on his return from that wonderful journey, his eyes glittered and his face radiated chiefly when he was telling us of his achievements as a hunter and a discoverer of the ancestors of our domesticated animals—much more than when he was talking of his geographical discoveries, about which he always was, in fact, remarkably modest.

He received his first school education in the Smolensk Gymnasium, but he soon left this institution, and entered in 1855 an infantry regiment as a subaltern. Next year he became an officer, and five years later he entered the Academy of the General Staff. His love for geographical exploration had been to some extent developed by that time, and the dissertation he wrote on leaving the Academy was upon the Amur region, which was much spoken of in Russia. But he had not yet the means of satisfying his desire for travel, and he was compelled to return to his regiment and take part in the suppression of the Polish insurrection. He soon withdrew from active military service, and accepted the position of teacher of geography at a Warsaw Gymnasium, devoting his leisure hours to studies in natural history. It was only in 1867 that he was admitted into the General Staff and sent to Irkutsk, whence he immediately started for the exploration of the very little known highlands on the banks of the Usuri—the great southern tributary of the Amur. Here he found a wide field for exploration and hunting, and wrote a book on the Usuri region (published in 1869), partly of an ethnographical character. The Geographical Society awarded him for this book only a small silver medal; and, when Prjevalsky applied for means to enable him to explore Southern Mongolia, the Society was anything but generous in its response. Had it not been for his own small economies—he always lived a very simple life—and for the help he received from the then Russian Ambassador at Peking (M. Vlangalli), himself an explorer of

Mongolia, Prjevalsky could hardly have started on that remarkable journey. When he began the exploration of the land of the Tangutes, he possessed only 178 roubles (about £25); and when he reached, with his three companions, the sources of the Yang-tse-kiang, after having crossed the province of Han-su, the Tsaidam, and part of Northern Tibet, he had only 10 roubles left, and his camels were quite exhausted. The whole expedition, which lasted thirty-four months (November 1870 to September 1873), had cost only 6000 roubles; yet this undoubtedly was the most remarkable journey that had been made in Asia in the nineteenth century. Prjevalsky proved that, for resolute and enduring men, travelling on the Central Asian plateaus was much easier than had been supposed. He twice crossed the Gobi, reached the Kuku-nor, penetrated as far south-west as the spot where the Yang-tse-kiang rises from the confluence of the Mur-usu and the Nantchitai River, and returned with exceedingly rich zoological and botanical collections, after having travelled no less than 7320 miles across formerly quite unknown deserts and highlands. The work in which he embodied the results of that wonderful journey, "Mongolia and the Land of the Tangutes," was immediately translated into all civilized languages. The Russian Geographical Society hastened to present him with its great Constantine Medal, and most of the Geographical Societies all over Europe congratulated him on his discoveries, and awarded him medals, honorary diplomas, and the like.

Prjevalsky, in the meantime, was trying to find the means for continuing his explorations; but it was only in 1876 that he succeeded in obtaining from the Ministry of War the 25,000 roubles which were necessary to enable him to push as far as Lob-nor. His aim was not only to rediscover the basin of the Tarim and the great lake of East Turkestan, which had not been visited by any European from the time of Marco Polo; he desired to cross East Turkestan and the northern plateaus of Tibet, and to reach Lhassa. This time he started from Turkestan, and, following the upper part of the Ili River (the Kunges), he reached Kurla in East Turkestan, whence he crossed the desert and reached the Lob-nor. The great lake was thus rediscovered. But it was impossible to reach Lhassa by this route, and Prjevalsky returned to Kulja, and thence to the Russian post Zaisan. His aim was to penetrate into Tibet *via* Hami, the Tsaidam, and the sources of the Blue River. So he started again, from Zaisan to Gutchen. Unhappily, the skin disease of the steppes (*pruritis scroli*) overtook him, and he was compelled to return from Gutchen. Still, next March, he was again on his way to Lhassa, when the frontier authorities ordered him to postpone his expedition. He then returned to St. Petersburg.

The Lob-nor journey was made in 1877, and although only eleven years have elapsed since, it is almost impossible now to realize the imperfection of our knowledge of Central Asia at that time. When it became known that Prjevalsky had visited the Lob-nor, Baron Richthofen contested the fact, and maintained that the lake which receives the Tarim must be situated further north and due east from the mouth of the Ughen-daria; while now Lob-nor is perfectly well known. As to the natural history collections which were brought in from this second journey, they were even more valuable than those gathered during the first journey. They gave us a clear insight into the flora and fauna of those parts of East Turkestan; while the barometrical measurements enabled us to form, for the first time, a correct idea as to the characters of the Tarim depression of the great Central Asian plateau. It was also from this journey that Prjevalsky brought the wild camel—the ancestor of the domesticated species.

As soon as he was back at St. Petersburg, Prjevalsky hastened to prepare for a new journey; and after having written a short account of his Lob-nor journey,

"From Kulja, across the Tian-Shan, to Lob-nor," he left the Russian capital for Zaisan, and began his third journey, the most remarkable of all. He soon reached Barkul and Hami, the two Turkestan oases which were almost less known than some parts of the moon. He crossed the Western Gobi, and reached a spot, Dzun-zasak, in South Tsaidam, at the foot of the highlands which separate Mongolia from Tibet. Thence he went south, in order to reach the longed-for Tibetan city of Lhassa. The journey in the highlands which border the great plateau on the north-east was exceedingly difficult. Ridges, 16,000 feet high in their lowest parts (one of them was named after Marco Polo), separated from one another by deep valleys, the bottoms of which are 13,000 and 15,000 feet above the level of the sea, had to be crossed; and when the expedition reached the upper parts of the Blue River, it was brought by the guide to quite impracticable highlands, and had to find its way amidst the barren mountains, peopled by Tangutes, whose attacks had to be repulsed by force. Nevertheless, Prjevalsky crossed the highlands, and had already reached, under the 32nd degree of latitude, the great valley of the Tibetan river Khara-usu, whence the route to Lhassa was relatively easy; but here a new obstacle rose before him. The Dalai-lama had sent officials, who declared to Prjevalsky that the Tibetan nation would not allow Russians to enter the capital of the great chief of the Buddhist religion. The expedition was thus compelled to return; and so it did, re-crossing the same highlands in the midst of the winter. Having returned to the Ala-shan town Sinin, Prjevalsky did not like to go back to Russia without having visited the Hoang-ho, which makes a great bend to the north in the neighbourhood of Kuku-nor. He reached, in fact, the great river of China at Guidui, crossed it, and explored it for some 200 miles, and only then returned to Kiakhta, after having travelled about 14,700 miles, half of which stretch was surveyed, and bringing in more than 4500 specimens of mammals, birds, and fishes, 6000 insects, and many thousands of plants. The most remarkable "find" was, however, the wild horse—the ancestor of our present horse—which inhabited Russia and Poland some two hundred years ago, and has been described by the late I. Polyakoff under the name of *Equus przewalskii* (*Izvestia Russ. Geog. Soc.*, 1881). It is hardly necessary to say that this remarkable journey produced the greatest impression on the scientific world. The Russian Geographical Society elected Prjevalsky an honorary member; the city of St. Petersburg offered him its honorary citizenship, and many scientific bodies bestowed on him all kinds of distinctions. The general results of this journey were embodied in a work entitled "Third Journey to Central Asia," which also has been translated into many European languages.

As soon as this work was ready for publication, Prjevalsky started again, in November 1883, on a new journey, again proposing to visit Tibet. This time he started from Kiakhta, crossed the Gobi in the winter, and soon reached the spot, Dzun-zasak, whence he intended to start for the exploration of the highlands of North-Eastern Tibet. But all kinds of misfortunes attended him. The expedition, freely provided with money, already numbered twenty-one men, and so it could not move with less than fifty camels and several horses. It was found very difficult to obtain such a number of animals from the poverty-stricken populations of South Tsaidam; and Prjevalsky, usually so mild in his relations with the natives, resorted to violence. The animals he thus secured proved to be quite unfit for journeys across the high ridges which fill up the space in the south of Dzun-zasak; and it seems most probable that by taking a route due south from that point, instead of proceeding south-westwards as he did during his third journey, Prjevalski committed an error. Not taking into account the north-

eastern direction of the ridges, he had to cross the numerous ridges of the Upper Hoang-ho, instead of availing himself of the depressions having a south-western direction, which permitted him to reach the Khara-usu in 1880 without serious difficulty.

It is true that, by taking a southern direction, he reached the two great lakes Jirin and Orin, through which the Upper Hoang-ho flows, and that he thus solved one of the problems of the geography of Asia. But when he went further south, he had to cross such a succession of wild highlands of an Alpine character, that his camels were soon disabled; and when he reached the Dy-tchu, or Upper Yang-tse-kiang, some 120 miles to the east of the spot he visited in 1872, he found it impossible either to cross it or to follow the river downwards. He was obliged to return, and on his way back he even could not fully explore the lakes Jirin and Orin, because the Tangutes, gathering in hundreds, violently attacked the caravan, and were repulsed only after having lost a great number of their warriors.

Having returned to Dzun-zasak, Prjevalsky went north-westwards along the foot of the ridges which separate Mongolia from Tibet, and, when at the lake Gas, he made a winter excursion into the highlands. This excursion enabled him to get a clear idea as to the series of parallel ridges which separate the Tsaidam from the higher terrace of plateaus of North-Eastern Tibet. Moreover, instead of returning from Lob-nor by his usual route, he pushed westwards into East Turkestan, as far as Khotan, and returned to Russian Turkestan *via* Aksu, thus covering nearly the same ground as that visited at the same time by Mr. Carey.

Years and years will pass before all the specimens of plants and animals brought in from his four journeys can be fully described. Maximowicz's description of Central Asian plants, now being printed by instalments in the Bulletin of the Moscow Society of Naturalists, already gives some idea of the richness of Prjevalsky's collections, which represent a total of 700 specimens of mammals, 5000 of birds, 1200 of reptiles and amphibia, 800 of fishes, 2000 mollusks, 10,000 insects, and from 15,000 to 16,000 plants. All the zoological specimens are in the St. Petersburg Academy of Sciences, the botanical specimens at the St. Petersburg Botanical Garden, the geological collections at the St. Petersburg University, and special funds have been granted by the Government for the publication of the scientific results of these journeys as soon as the necessary work has been done by the specialists.

The volume embodying the general results of Prjevalsky's fourth journey, and entitled, "From Kiakhta to the Sources of the Yellow River, Northern Tibet; and the Journey from Lob-nor through the basin of the Tarim," reached London only a few weeks ago, and the present writer was preparing an account of it when the sad news reached us from Vyernyi. Although less striking than his previous books, so far as geographical discovery is concerned, this work may be even more important for the light it throws on the nature of a wide unknown country. It presents also the clearest view of the traveller himself, and affords a clue to the causes of his success.

In a chapter devoted to the ways and means of travelling in Central Asia, Prjevalsky gives detailed instructions as to how an expedition ought to be organized, and when speaking of the traveller himself he writes:—"As to the person who will have before him the beautiful task of scientifically exploring new regions, his task will not be easy. The explorer will have to pay for the smallest discoveries by plenty of suffering, physical and moral. He must be strong physically and morally. Flourishing health, strong muscles, and still better an athletic complexion, on the one side, and strong character, energy, and resoluteness, on the other—such are the features which best guarantee success." And, after mentioning the necessity

of general scientific knowledge, and of special knowledge in, at least, some one branch, as well as the necessity of a real passion for travelling, Prjevalsky adds:—"Moreover, he must be an excellent shooter, and, still better, a passionate hunter. He must not despise any hard manual work, as, for instance, the saddling of horses and camels, the packing of luggage, and so on—in short, he must never be a 'white-handed' person; he must not have habits of luxury; and he must have a pleasant, lenient character, which will soon acquire for him the friendship of his travelling companions." In these sentences he characterized himself. To renounce, if necessary, every comfort; to live the life of the other members of the expedition, without any distinction between the scientific staff and the simplest soldiers or Cossacks; to sleep in the same tent, to eat the same food, and to do the same work as the rest—such were Prjevalsky's rules. We must add also that, especially during his first two journeys, his relations with the natives were of the most friendly character. He carefully avoided any conflict with them; and when it happened once, during his first journey, that the natives were hostile to him, and this hostility might have ended in an armed conflict, he preferred to win their respect by the following stratagem. He and his three men—all four admirable sharpshooters—opened a fire from their breech-loading rifles upon the carcass of a horse, from a great distance. In two minutes they had discharged thirty bullets each, and they advised the Mongols to see if any bullet had touched the carcass. The Mongols rushed, of course, to the carcass, and, to their great astonishment, after hard work with their knives, discovered most of the 120 bullets in it. They did not fail, after this, to treat their visitors properly.

It is impossible to mention Prjevalsky's name without being reminded of his travelling companions. He himself so often expressed his gratitude to them, and he always wrote with so much sympathy about their common experiences, that we shall only be carrying out his wish in stating that Lieut. Pyevtsoff during Prjevalsky's first two journeys, Lieut. Roborovsky in the last two journeys, and M. Kozloff during the fourth, have their full share in what Prjevalsky modestly described as his "scientific reconnoitings" in Central Asia. Their portraits, as well as his own, are given in his last work. P. K.

#### SMOKE IN RELATION TO FOGS IN LONDON:<sup>1</sup>

LONDON fogs are produced by the mechanical combination of particles of water with particles of coal or soot, and require for their fullest development the following conditions: a still air, a temperature lowest at or near the ground in comparison with an elevation of some hundreds of feet, saturation or partial saturation of the air within a moderate distance of the ground, absence of clouds overhead, and free radiation into space. The artificial darkness and peculiar colouring occur with greatest effect at times when a very large quantity of coal is being burnt in domestic fireplaces, and cannot as a rule prevail during the night between 10 p.m. and 5 a.m., or to any great degree in warm summer weather. The early hours of summer mornings are the only ones in which clear views of the whole city are possible. Next in clearness come fine Sunday afternoons in summer, when fires are allowed to go down. The hours of greatest density are those following the time of greatest cold on the earth's surface and of the lighting of large numbers of kitchen and other fires. Thus about 8 to 10 a.m. is frequently the period of thickest and darkest fogs. It may be noted that on Sundays, when factory fires are inoperative, fogs in winter have been densest; on one Christmas Day there was absolute darkness during the

whole day, thus showing the dependence of light-absorbing matter on kitchen and domestic fires. Many distinct conditions may alter the time of maximum density.

The formation of a London fog appears to take place as follows. An ordinary thick white fog covers the city, say at 6 a.m.; about a million fires are lighted soon after this hour, and the atmosphere becomes charged with enormous volumes of smoke—that is, the gases of combustion bearing carbonaceous particles. Now, these particles, as soon as they are cooled to the temperature of the air, or below it, begin to attach to themselves the water spherules already present and visible, and vapour may also be condensed on the particles. A thick layer of these united particles prevents light from penetrating it, and a very small quantity of finely divided carbon may stop the bright sunshine altogether, like the film of soot on a smoked glass. The invariable redness of the sun through smoke seems to show that the majority of particles are comparable in diameter to the length of a wave of blue light. Smoke prevents the warmth of the oblique sunshine from reaching and evaporating the white fog near the ground, and the white fog continues to radiate towards space and towards the ground, if colder than itself, without receiving compensation from the solar rays. A difference of 10° has occasionally been noted between thermometers at 4 feet and 100 feet above the ground, the upper one always being the warmest in fogs. Carbon is a good radiator, and tends from this cause to keep itself cold by radiation into space, and thus to accumulate vapour from the air, like the dewy surface of the earth. The importance of a clear sky and a dry upper air in promoting fogs in this respect is obvious.

It has been supposed, quite erroneously as I believe, that, as even without any visible smoke an enormous quantity of fine invisible dust exists in the London atmosphere, the abolition of coal smoke would fail to give us freedom from dark fogs. Proof is altogether wanting that ordinary invisible dust in cities or plains is of a kind to create an abnormal amount of fog, or to produce those dismal obfuscations of which tarry carbon is capable. Paris, as long as it burnt wood and charcoal, was free from idiosyncratic fogs; so are the wood and anthracite-burning cities of the United States; and so are the towns of South Wales, where anthracite is the common fuel. If London were to cease using fuel in the solid form, it would be as free from fog as the surrounding country.

The accumulation which produces the worst and most dangerous fogs in London cannot, as a rule, proceed for many hours without disturbances arising which tend to reduce their importance. In winter the warmth of the air exceeds by 2° or 3° that of the surrounding country, consequently an upward current is started, which rises to some altitude, and then flows away, bearing with it a stream of murky cloud; a circulation of air consequently takes place in the lower strata. If, however, the cold of the lower layers greatly surpasses that of the strata some hundreds of feet higher, and if the sun dissipates the fog in the surrounding country, thus making the environs warmer than London itself, the black fog may very likely remain on the town all day. For this reason, on a fine cold still morning, with a bright sun, and temperature near the dew-point, persons arriving from the country are pretty sure to find a black fog in town between 10 and 12 a.m. The finest winter days are nearly always very bad ones in London, unless there be any wind between the surface and an altitude of 1000 feet, or the dryness be unusual for the time of year.

When the air is very dry near the surface, no dense fog is formed in London, and when very wet, streaming with fog, in the country, little fog occurs in London. The dry warm surfaces of the houses themselves, and the elevation of temperature above the dew-point, prevents wet fogs from reaching anything like the density they attain in the

<sup>1</sup> Abstract of an Address delivered by the Hon. F. A. R. Russell, on March 1, 1888, under the auspices of the Smoke Abatement Institution.