fruits of Singapore and the Malay States are still further removed by time and distance.

At the Exhibition there is shown, from India, a small dried apricot (*Prunus armeniaca*, L.), an important article of food in the Punjaub Himalayas and in the North-west Provinces, which deserves attention as a probable source of an import trade for the English market. This fruit is known in India as the mish-mush, or "Moon of the Faithful." Dr. Watt remarks that it is largely eaten by all classes, fresh or dried, but chiefly fresh, and sometimes in preserve by Europeans. Sometimes the apricots are pressed together, and rolled out into thin sheets or "moons," 2 or 3 feet in diameter, like a blacksmith's apron. From Afghanistan large quantities of the dried fruit are imported into India, and distributed by trade far into the plains of Bengal.

Kew D. MORRIS

MICROSCOPIC ORGANISMS IN AIR AND WATER[1]

THIS Report is part of the "Annuaire de l'Observatoire de Montsouris" for the year 1885, and is worthy of careful study at the present time, when bacteriology is recognised as a special and important department of science. These investigations have been carried on at Montsouris since the year 1875, and through them Dr. Miquel has been enabled to throw much light on the meteorological aspect of the subject—an aspect that has received but little attention from investigators, as compared with the pathological. Every one will acknowledge that in entering upon a new field in scientific investigation it is extremely important that the line of research should proceed upon as broad a basis as possible, and that the work of experimentation and observation should not be confined to one aspect of the new study, however important it may be. Fallacies are sure to arise when any department of science is too narrowly specialised, from want of that more general knowledge which would prevent the adoption of erroneous views. This is especially liable to be the case in bacteriology, in which the objects of study are so minute and yet so widely distributed in nature. Dr. Miquel's researches—important as they are in themselves—are doubly welcome at the present time, as tending to popularise a field in which workers are urgently needed, as well as contributing largely to our knowledge. The example of Paris—the only city in which systematic investigations of the sort are now undertaken—should stimulate other towns which possess properly equipped meteorological laboratories, to conduct observations on the bacterial organisms contained in air, rain, and soil. The results obtained at Montsouris could then be confirmed or confuted by the results obtained at other laboratories under widely different climatic and meteorological conditions, and the enunciation of general laws and principles would in time become possible. We shall endeavour to place before our readers in this article some of the more important results and deductions made from them by Dr. Miquel, from the observations at Montsouris; but it should be distinctly recognised that any conclusions arrived at by Dr. Miquel are applicable only to Paris and its neighbourhood, and cannot at present be accepted as true for other places where the climatic conditions are different.

Tables are given in the Report, showing for each week of the years 1883-84 (*a*) the average number of bacterial micro-organisms present in a cubic metre of air, (*b*) the average barometrical pressure, (*c*) the average temperature of the air, (*d*) the average state of humidity of the air [percentage of saturation], (*e*) the amount of rainfall, (*f*) the electrical state of the air, (*g*) the direction and average velocity of the wind, (*h*) the average amount of ozone present in the air. From the observations recorded in these tables, Dr. Miquel has arrived at the following conclusions:—(1) An increase in the number of bacterial organisms contained in a cubic metre of air generally takes place when the barometrical pressure is high: this rule is not absolute, but the exceptions are rare. (2) Temperature does not cause such sudden increments; very often, it is true, a large increase in the number of microbes present in the air takes place in summer, but it is important to note that a sustained high temperature causes a manifest lessening in their number. The thermometer is capable of explaining certain seasonal variations, but not the weekly variations. (3) The maximum number of bacterial organisms present in the air corresponds almost always with a low hygrometric condition of the atmosphere; this is explained by the fact that the degree of humidity is always very high during rain, and when the superficial layers of the soil are soaked in water, periods during which the air is always very poor in bacteria. (4) It would appear *a priori* that the number of bacteria should increase with the strength of the wind, but observation negatives this assumption. A maximum number of microbes is found frequently during periods of calm—when the velocity of the wind is only 5-10 kilometres per hour—and minima have been observed during periods when the velocity of the wind was more than 30 kilometres per hour. (5) The direction of the wind exercises a considerable influence at Montsouris. The greatest number of maxima are noted when the wind is N.E., and the greatest number of minima when the wind is S.W. (6) When the amount of ozone in the air is large, the number of microbes present is small. The north winds blow over from Paris and contain but little ozone. They are rich in microbes. The presence of ozone in the air appears to have the power of destroying bacterial organisms, and, on the contrary, absence of ozone and humidity of the air—unless rain is falling—allow of an increase taking place in their number.

From observations at Montsouris, extending over a period of five years—1880-84—the average number of bacterial organisms in a cubic metre of air is stated to be: in winter 260, in spring 495, in summer 650, in autumn 380; the mean annual number being 445. In February the air is poorest in bacteria [the average of these five years is 165]. Towards the middle of summer the maxima present themselves [July 700].

Observations have also been conducted for a period of four years—1881-84—on the state of the air, as regards bacteria, in the centre of Paris. These observations were made on the air of the Rue de Rivoli, and afford a marked contrast in the number of micro-organisms to the far purer air of Montsouris, a suburb of Paris, and where, it is important to remember, the Observatory is situated in the centre of a park. The average of these four years' observations shows that the air of the Rue de Rivoli contains 3480 bacteria per cubic metre. The seasonal fluctuations are nearly the same as at Montsouris, the minimum being in February (1700) and the maximum in July (5010). The average number of bacteria present in a cubic metre of air, for the year 1881, was 6295, whilst the average number for 1884 was only 1830. This enormous decrease—which is observed in the intervening years to a slighter extent—is attributed by Dr. Miquel to the better drainage and scavenging of the city, and to the better cleansing of the gutters and watering of the streets in dry dusty weather, in 1884 than in 1881. The death-rate from zymotic diseases—in which are included typhoid fever, small-pox, measles, scarlatina, whooping-cough, diphtheria, dysentery, erysipelas, puerperal fevers, and choleraic diarrhœa of infants—has also fallen very considerably—27 per cent., if increase of population is taken into account—during this period. The death-rate of

[1] "Septième Mémoire sur les Organismes Microscopiques de l'Air et des Eaux," par M. le Dr. Miquel, Chef du Service Micrographique à l'Observatoire de Montsouris.

phthisis or consumptive diseases has, however, increased during the same period, although those of acute bronchitis and pneumonia have decreased. Acute pneumonia is now considered by many to be propagated by infection from specific organisms occasionally present in the air. The curves for the year 1883–84, representing the average weekly number of bacteria present in a cubic metre of the air of the Rue de Rivoli, A, and the weekly deaths from zymotic disease, B, are shown in Fig. 1. The curves are seen to present somewhat similar fluctuations except at the end of July and the first half of August, when the number of bacteria suddenly decrease—owing to the hot weather and sustained high temperature—whilst the deaths from zymotic disease undergo a large increase, owing to excessive mortality from infantile diarrhœa. The variations in the number of bacteria from week to week will be seen to be very much larger and more sudden than the variations in the zymotic death-rate. Very little can be deduced from comparisons extending over one year only, and although we are far from asserting that there can be no mutual relation between the number of micro-organisms present in the air, and the greater or less prevalence of epidemic disease among the community who breathe such air, still it is unsafe to found any arguments on such obviously inadequate data. It is only just to Dr. Miquel to say here that he recognises these difficulties, and is rightly cautious in drawing any conclusions except such as are founded upon an extended series of observations.

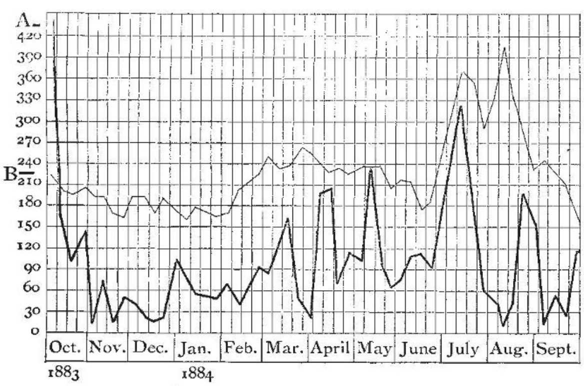

FIG. 1.

At the commencement of June 1884, Dr. Miquel, who was then in London, made some observations on the number of bacteria contained in the air of Ryder Street, St. James's. A cubic metre of this air was found to contain only 240 organisms, but this low result was probably due to the wet weather which prevailed on four out of the five days on which the experiments were conducted—the air being remarkably free from dust. In Paris at the same time the air of the Rue de Rivoli contained 360 organisms per cubic metre. Dr. Miquel would not, however, be surprised to find that the air of London was habitually fairly pure and free from organisms, owing to the proximity of the sea, and the fact that the houses of London being generally of no great height—unlike Paris—the streets are continually being swept by currents of air. The air of sleeping-apartments is very impure as regards the number of contained micro-organisms. One such room in Paris was found to contain on the average in the winter and spring of 1882, 73,540 bacteria per cubic metre, and the air of the Hôpital de la Pitié has been observed to contain 79,000 bacteria per cubic metre. In contra distinction to these large numbers, the air over the Atlantic Ocean (Moreau and Miquel) has been found to contain from 0 to 6 bacteria per cubic metre, and the air of the higher mountains an average of only 1 bacterium per cubic metre (Freudenreich).

A considerable part of the Report is taken up with an account of researches conducted by M. Moreau into the number of organisms present in sea-air. These investigations—undertaken under circumstances of considerable difficulty on board ship, and conducted on an elaborate scale—are of much interest as bearing on the treatment of phthisis by high mountain altitudes or by sea voyages—in both cases the special object desired being to place the patient in an atmosphere free from all impurities. We will quote a few of M. Moreau's conclusions on this subject:—(1) Air taken on the coast, when the wind is blowing off the sea from a direction in which land is at a great distance, is in a state of almost perfect purity. (2) In the neighbourhood of continents, winds blowing from the land always bring an impure atmosphere; at 100 kilometres from the coast this impurity has disappeared. (3) During moderate weather the sea does not yield to the air any of its contained bacteria; during rough and stormy weather sea-air is charged with a minute quantity of bacteria. (4) The air of ships' cabins is also charged with a number of microbes incomparably greater than that of the open air at sea, but the purity of the air of these cabins increases rapidly during the first days of the voyage; later on, an equilibrium appears to be established, depending on the amount of purification of the air by ventilation and the number of occupants. (5) The air of ships' cabins is relatively very poor in bacteria; these probably are one hundred times less in number than the air of an occupied room in Paris.

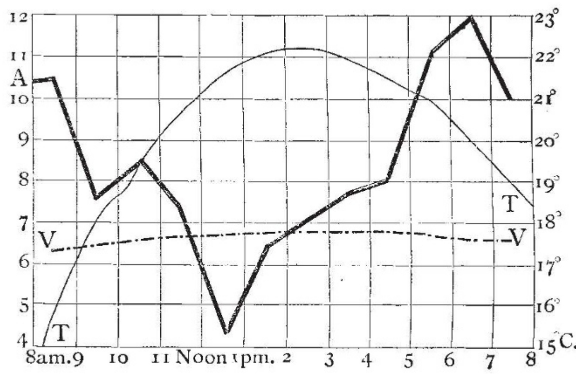

FIG. 2.

Observations have been made at Montsouris on the hourly variations in the number of bacteria contained in a cubic metre of air. These observations go to show that, contrary to the generally held opinion, the air is less pure—*i.e.* contains larger numbers of bacteria—during the morning and evening than at midday. In Fig. 2 are shown curves corresponding to proportional figures which illustrate this phenomenon, as ascertained by forty experiments. A is the bacterial curve, T is the curve representing the temperature, and V is the velocity of the wind. The lowest point of the bacterial curve is between noon and 1 p.m., two hours before the maximum temperature is reached. From 8 o'clock in the evening until midnight the number of microbes generally remains high, but decreases rapidly from midnight to 3 a.m., two or three hours before the lowest temperature is reached, and rises rapidly from 4 a.m.—when the ground and vegetation are covered with dew—until 6 a.m., when the maximum is reached. These night observations, however, are too few in number to be depended upon to give a very correct average. Rain, as has been before remarked, rapidly purifies the air. But when the rain first commences to fall, the number of bacteria increases. This Dr. Miquel explains by supposing that many of the first drops of rain evaporate—the atmosphere not being saturated with vapour—and deliver up the bacteria they hold to the air in the neighbourhood of the earth. Later on the air is saturated with vapour, and the bacteria floating in it are carried down to the ground in the drops of rain, and by this means the air is purified.

Investigation of the organisms contained in rain show that the rain which first falls in a shower and that which falls after a period of dry weather contain far larger numbers of bacteria than that which falls at any other times. Under such circumstances 200,000 microbes per litre is not an unusual quantity. The rain which falls during the warm months of the year—in summer and autumn—contains more microbes than that which falls in winter and spring. During the year 1883-84 the lowest monthly average was 1000 per litre in November, and the highest 6980 per litre in September. As the rain derives its organisms from the air which it purifies in its descent, we should expect the seasonal variations in the number of contained organisms in air and rain to correspond closely—as in fact they do. It is important to note that the organisms exist in the rain to a larger extent in the form of germs than in the adult state. Of 100 bacteriform organisms found in rain, on an average 60 are micrococci, 25 bacilli, and 15 true bacteria. But the numbers here given are subject to great variation in different falls of rain: the bacilli may be more numerous than the micrococci, the true bacteria being almost always fewest in number. Dr. Miquel calculates that during a year at Montsouris 4,000,000 of bacteria are carried down in the rain to each square metre of surface. This number, though not probably representing anything like the real figure, demonstrates that rain is a powerful agent in diffusing aërial bacteria and fungi. We have yet much to learn as to the part these organisms undoubtedly play when diffused into the soil, in altering or rearranging its component parts or constituents so as to render it more fit for sustaining vegetable life and growth.

The methods and apparatus employed by Dr. Miquel in his researches are very fully explained, and contrasted with other methods—especially those employed by Dr. Koch and other German observers—in terms that are not exactly those which a strict regard for international courtesy would dictate. It is somewhat of a reproach to bacteriologists that their leading authorities in all countries appear unable to keep clear of controversies which are conducted with an acrimony and animus more instructive than seemly. International jealousy would appear to lie at the root of much of this evil, and is plainly discernible in the writings of some of the ablest masters of the science.

THE RECENT VOLCANIC ERUPTION IN NEW ZEALAND

UNTIL the report of a trained geologist has been received we must be content with the narratives, often conflicting, of the surveyors and of the Press correspondents who hurried to the scene of the great catastrophe that has recently devastated the wonderland of New Zealand. In the meantime, however, it is possible from the various accounts to trace the leading features of the eruption, and to note their resemblance to those of other recorded volcanic outbursts. It is impossible not to be struck with the analogy between the phenomena exhibited last June in New Zealand and those that accompanied the great Vesuvian eruption in the first century of our era. In both instances a mountain which had never been known to be an active volcano suddenly exploded with terrific violence, filling the air with ashes and stones. At each locality there were the premonitory earthquakes, the thick black pall of volcanic cloud hanging over the mountain, the descent of dust, sand, and hot stones, the discharge of mud, with, so far as known, no outflow of lava, and the overwhelming of an inhabited district under a deep covering of loose volcanic debris.

In a region so subject to earthquake shocks as that which crosses the centre of the North Island of New Zealand in a north-east and south-west direction, it was natural that no special attention should have been given to any greater frequency or violence of the shocks before the date of this volcanic eruption. But no doubt facts bearing on this subject have been noted by local observers and will in due course be published. From the newspaper accounts, indeed, there would appear to have been various precursory indications which in the light of subsequent events may not have been without importance. It is said, for instance, that the extinct volcano Ruapehu, the highest peak in the North Island, which since the discovery of New Zealand has never been known to manifest any activity, began to steam at the top some three weeks before the eruption. A fortnight previous to the catastrophe a wave 3 feet high suddenly arose on the Lake Tarawera, lying at the foot of the mountain of the same name, and in the very focus of the subsequent disturbance, and washed the boats out of the boat-houses. Doubtless there were other premonitory symptoms, besides earthquake activity, of the approaching event, though only a few days before their destruction, the famous White and Pink Terraces were visited by a party of tourists who observed no unusual vigour in the hot springs there, nor any indication whatever that these fairy-like deposits were so soon to be the theatre of violent volcanic energy.

About half an hour after midnight on the morning of June 10 the earthquake shocks that are familiar to the inhabitants of the Lake District assumed an altogether unusual vigour and frequency. At the settlement of Wairoa, which is about five miles from the warm lake and sinter terraces of Rotomahana, the ground shook violently for an hour or more, the more powerful shocks following each other at intervals of about ten minutes. The alarmed inhabitants, startled from sleep, ran out of their houses or clung to each other inside for mutual assistance and encouragement. At last, a few minutes after 2 a.m., a shock of exceptional severity was followed by a deafening roar, and suddenly what is described as a "pillar of fire" rose up from the crest of the mountain range some five or six miles eastward on the opposite side of Lake Tarawera. The top of Mount Tarawera (about 2000 feet high) had been blown into the air, leaving a huge chasm on the flank of the mountain. The glow of the white-hot lava in the interior ruddied the sky for miles around. Thousands of blocks of glowing lava described as "fire-balls" were shot into the air. The canopy of dark ashes that soon gathered over the mountain and spread out for miles around became the theatre of a violent electrical storm. It seemed to be torn asunder with incessant flashes of lightning, and the continuous peals of thunder, mingling with the bellowing of the volcano, increased the terror of the night.

That an eruption should ever take place from the three huge truncated cones that frown over Lake Tarawera was not regarded by geologists as a future probability. They had been extinct even from the times of early Maori tradition. To their solitary and mysterious summits the natives had probably for centuries been accustomed to carry their dead. The bones of many successive generations lay bleaching on that high lonely plateau, which had thus come to possess a peculiar sanctity in the eyes of the Maoris, who would not willingly allow a white man to approach it. Not only were these great cones to all appearance extinct, but the volcanic action of the whole district was of that type of waning energy which geolo-