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THE TIMES NEWSPAPER
AND
THE CLIMATE OF ROME

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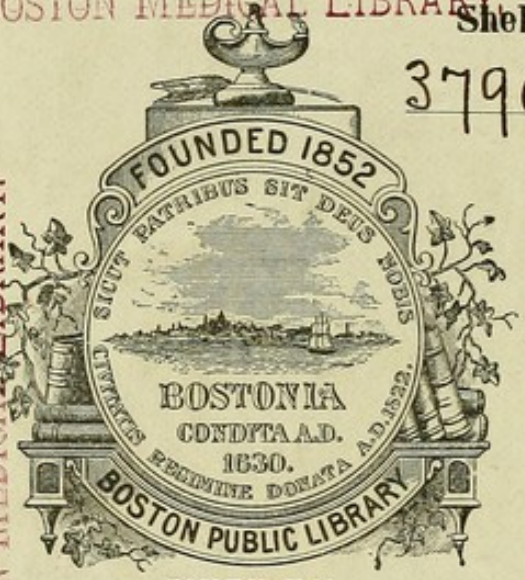

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THE TIMES NEWSPAPER

AND

THE CLIMATE OF ROME.

BY

STROTHER A. SMITH, M.A.,

LATE FELLOW OF ST. CATHARINE'S COLLEGE, CAMBRIDGE.

AUTHOR OF "THE TIBER AND ITS TRIBUTARIES," &c.

London:

LONGMANS, GREEN, AND CO.

1878.

Prof. F. J. Sebley,
May 19, 1896.

ROME:
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NOTICE.

The last sheets of this Volume had scarcely been revised and returned to the press in Rome, when the Author died. If the reader may regret that it is no longer possible to obtain his reply to criticisms which his experience might have enabled him to meet effectually, the manifest care taken to rest his arguments on the evidence of facts and to examine impartially the conflicting theories on the subject of Roman malaria will at once justify the publication of this Work as an honest attempt to grapple with notions which, if not true, must be mischievous. A sojourn of many years in Rome, during the Summer as well as the Winter, had convinced the Author that these notions were almost wholly fallacious. It seems desirable, therefore, that the reasons which led to these convictions should be laid before the public.

W. Metcalfe & Son,
Cambridge, *June*, 1878.

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PREFACE

No work in English on the Climate of Rome has yet appeared from any one qualified by long residence, and attentive study of the weather, to form a correct opinion on the Meteorology or the Hygiène of the city. Those who have written on the subject have either been Physicians who spent only a few months in the place, or residents who knew nothing about Natural Science, and had never been in the habit of keeping registers of Temperature and Rainfall. All the notices, therefore, of the Climate in Medical treatises, or in books descriptive of Rome and its environs, are utterly worthless, expressing, as they do, nothing but the fallacies current among the ignorant natives, who never think for themselves, but are content to take their Science, like their religion, upon trust.

This being the case, as a resident of twenty years at Rome, during which time I have spent 10

or 11 summers, and 15 Winters, in the city, and have attentively observed, and carefully recorded, the phenomena of the weather, I may claim to possess a greater knowledge of the peculiarities of the Climate than any one who has written upon it before. Whether the reasoning from my premises is sound, and the conclusions at which I have arrived are correct, must be left for the reader to determine.

As most persons derive their opinions from others, and have neither leisure nor inclination to investigate the grounds of their belief, it is easy for the interested, or the vindictive, to misrepresent facts, and produce a false impression on those who visit Rome, and have no suspicion of the motives by which those who describe the climate may be actuated. I have, therefore, told the story of the correspondent of the Times, in order that intending visitors may see with how large a measure of falsehood the question is overlaid, and what deduction must be made before it can be argued on scientific grounds. They will learn, also, I hope, from what I have subsequently said, to require better evidence than that which is usually offered for the small residuum of truth which, after such deduction, will remain.

Another source of error on which I have remarked is the quotation of isolated lines from Latin authors by persons whe possess only an imperfect knowledge of the Latin language, and no acquaintance at all with the classical authors. The lines so quoted, when read by the light of the context, would often convey a different meaning from that which is intended by those who quote them. Thus the lines of Horace. Ep. I. 7. 5...9.

. . . . dum ficus prima calorque
Designatorem decorat lictoribus atris,
. . . . . .
Officiosaque sedulitas, et opella forensis
Adducit febres, et testamenta resignat.

are cited by one person after another to prove the unhealthiness of Rome in the time of the Poet, though the verses merely express the fact that fevers are more prevalent during the hotter than the cooler months of the year, and even these are described as due in a great measure to the neglect of those precautions against overheating and overexertion which are indispensable in every warm climate, however pure the atmosphere may be. "It is sedulous attendance upon clients," says Horace, "and the business of the Forum, which brings on fevers, and leads to the opening of wills." Besides, we must make allowance for the unwillingness of the Poet to quit the cool air of his Sabine villa, and his anxiety to excuse himself for breaking his promise. The Epistle thus begins:

Quinque dies tibi pollicitus me rure futurum
Sextilem totum mendax desideror . . . I. 7. 1.

"Though I promised you that I would remain but five days in the country, I have broken my word, and stayed away the whole month of August." Horace, therefore, in order to account for his behaviour, naturally exaggerates the unhealthiness of Rome. I have repeatedly remarked upon the absurdity of quoting the lines of poets as evidence on a scientific question. The

province of a poet is to amplify his images, in order to move the feelings more strongly, and this licence has been conceded to him in every age.

Pictoribus atque Poetis
Quidlibet audendi semper fuit aequa potestas. Ars Poet.. 9. 10.

Besides, his verses often express merely his natural temperament, or the frame of mind in which he happens to be at the time when they were written; his images are magnified, or coloured, by the state of his feelings, and, as a natural consequence, the descriptions of one poet are often contradicted by those of another, as I have pointed out in various instances in my treatise "On the Climate of Rome in Ancient Times." I may observe, in passing, that Maecenas, to whom the Epistle is addressed, was not afraid of remaining at Rome during the month described as so pestilential.

Having thus stated the three points on which I purpose to insist, namely, imperfect observation of facts by the unscientific, misstatement of facts by the interested and the vindictive, and incorrect interpretation of Latin authors by those that are ignorant of Classical scholarship, I will proceed to treat the subject of the Climate after a fashion of my own; rejecting as utterly worthless the evidence of the vulgar herd as to what the Climate *is*, and trying to deduce from general principles what its character *must be*.

STROTHER A. SMITH

Rome 1877.

ERRATA

p. 10. l. 28. for , read .
p. 34. l. 3. for *Peters* read *Peter's*
p. 25. l. 5. for *compenent* read *component*
p. 39. note ** l. 3. for 44 read 41
p. 40. note l. 1. for 52 read 57 ½
p. 44. note * l. 1. for 1676 read 1876
p. 46. l. 22. for *suns* read *sun's*
p. 60. l. 5. for *as* read *is*
p. 67. l. 7. for *Natnre* read *Nature*
p. 120. l. 15. for *there* read *there*
p. 122. l. 4. add " after *lie* .
note l. 5. for . read ?
p. 124. l. 13. for 26 read 23. - See p. 20
p. 126. l. 10. for *fveer* read *fever*
p. 127. note l. 9. for *oceur* read *occur*
p. 132. l. 21. for . read ?
p. 142. l. 11. for *te* read *to*

THE TIMES NEWSPAPER

AND

THE CLIMATE OF ROME

The title which I have chosen will doubtless appear strange to the generality of readers, and they may be curious to see by what chain of ideas I can connect the climate of Rome with the journal called the Times; but, strange as it may appear, the connexion does exist, et the connecting links can easily be supplied. At first sight it may seem that the question of climate must belong to the domain of pure science, or that its nature must be determined partly by the evidence of its action on the numan frame, and partly by the principles of Atmospheric Chemistry. But, though its true nature can never be altered, the notions of men regarding it may be influenced not only by popular ignorance, but by considerations wholly foreign to the subject, the self interest of individuals, or their vindictiveness, on account of some real or imaginary slight. The motives of the innkeepers of Florence, Venice, and other cities which are rivals of Rome, may be readily appreciated, as well as those of the Professional

men who practise in those cities; but few persons would suspect that the revengeful spirit of the correspondent of a leading journal has been the means of keeping up, and extending, a prejudice which, if left to be dealt with by the investigations of science, and the logic of facts, would long ago have died away. The case to which I refer occurred sixteen years ago, and if the author of the article which I shall shortly quote had altered his language, or essentially modified it, it would be unfair to reproach him, after so great a lapse of time, with what he may have written under a momentary feeling of anger, and while he was still imperfectly acquainted with the facts of the case. But, so far from retracting what he said at first, he has persistently reiterated all the absurdities and exaggerations which appeared in the letter to which reference has been made, ignoring all the facts and reasonings which are opposed to his own conclusions, and leading his readers, who may never have seen any thing on the other side, to suppose that his statements were not only incontrovertible, but uncontroverted. If a person is blamed and punished for publishing a libel against a single person, and thereby injuring his prospects in life, one who under the influence, not of conscientious conviction, but of revengeful feeling is continually making attacks upon a place, and by this means, affecting the interests of hundreds who reside in the place, ought not to be free from reproach.

But, before telling the story of the correspondent of the Times, I will give some account of that journal, and explain the nature and the source of the influence which it enjoys. The Times is usually styled the " Leading Journal", and between forty and fifty years ago, the designation of "Fourth Estate of the Realm", now applied to the Press

as a whole, was not unfrequently given, half in joke, and half in earnest, to the Times. At that time the allegiance of the Liberals was divided between the Times and the Morning Chronicle; but the majority ranged themselves under the banners of the Times. This paper bore, also, for many years the now forgotten sobriquet of the "Thunderer", bestowed upon it on account of some strong expression which it used during the agitation which preceded the passing of the Reform Bill. The Times is, as most persons are aware, the property of an association of gentlemen of fortune, and social position, who have, of course, an entrée into the best society, and, as may be supposed, an extensive correspondence, both in their individual and corporate capacity. (1) From the conversation of the society in which they mix, and still more from the letters which they receive, these gentlemen gather the views of the best informed and most intelligent portion of the community; they watch the ebb and flow of public opinion, and their journal, being placed in the van of the movement which they foresee, appears to lead, when, in reality, it only follows. The most talented writers are then engaged to advocate the views which the proprietors think are likely to prevail, and to influence that large portion of the population which is incapable of thinking and judging for itself, and requires to lean on some external support. It is the belief of many that public opinion is in a large measure formed by the Times; but this is true only of that section, unfortunately the largest, to which I have just referred, and in the sense of a medium, or a go-between. The Times, in fact, in common with other journals, though, perhaps,

(1) The late Mr. Walter told Disraeli, that he sometimes received a hundred letters in a day, and the number addressed to his son, the present proprietor, and M. P., must be greater still.

in a greater degree, serves merely to reflect the deliberate convictions of the higher to the lower stratum of intelligence.

The most useful service performed by the press is opening its pages to the ventilation of questions of political, social, or scientific interest (*), as well as to the complaints of those who consider themselves aggrieved by public bodies, or the government of the day. The Times, as the most influential of the journals, receives the largest, or at least the most valuable portion of these contributions, and becomes the arena on which various intellectual gladiators exhibit their feats of arms. By these the public is sometimes instructed, sometimes amused, and not unfrequently bored, when rejoinder succeeds rejoinder, and the contest, like the game of "Beggar my Neighbour" at cards, never seems to come to an end. In these contests the Times sits as umpire, sometimes giving the signal for bringing them to a close, and sometimes awarding the palm

(*) Cobden, before he quarrelled with the Times, used to say that one who read nothing but that journal would be a well informed person. This has reference mainly to the miscellaneous contributions and to the comments of the Times upon them. For myself, I may say that, while my studies are not confined to the Times, I read every article in that paper from which a scrap of information, political, literary, or scientific can be gleaned, though I do not always assent to the conclusions of the writers. It is well known that Cobden took offence at some articles which appeared in the Times opposed to his own views, and that there was a feud between him and the paper to the day of his death. From the date of his estrangement he did his best to damage the journal which he had lauded so highly; but: "nescit vox missa reverti"; the praise once uttered could never be recalled, while the censure was naturally set down to the account of offended pride.

to the combatant who, in its estimation, is the better man. But the value of these decisions varies with the nature of the subject under discussion. On questions relating to Politics, Morals, or Literature, the Times is as competent to pass judgment as any other journal, and, when it is not biassed by party feeling, or the prejudices of its proprietors, or its correspondents, its verdict may usually be accepted. But in scientific matters it is liable to err itself, or to be misled by its correspondents (*). Its staff are selected, not for their scientific attainments, but for their industry and literary ability; for their diligence in collecting information on questions which interest the public, for the elegance of their style, for their power of word-painting, and last, but not least, for their cleverness in writing against space, and expanding a simple idea into a mist of words.

It should be observed in regard to articles inserted in the Times, that it is only on questions where the paper

(*) This was clearly shown by its printing, and commenting upon the scheme for turning the water of the Black Sea into the Caspian, without any suspicion of the fallacy of the preliminary statement; "that the area of the Caspian is continually diminishing, owing to the mud brought into it by the Wolga and other rivers". It is astonishing that none of the readers of the Times should have had sufficient knowledge of the Chemistry of nature to see that this is a physical impossibility. As long as the volume of water discharged into a lake which has no outlet continues the same, so long must the evaporating area remain unchanged. Supposing the Deltas of the Wolga, the Ural, or the Araxes, to protrude so many square miles into the Caspian, the diminished area, not being able by its evaporation to carry off the water of those rivers, the sea must *necessarily* overflow in some other direction, and extend its surface, until the equilibrium was restored. The Caspian may eventually become a great marsh, but, as such, its superficies would be greater, instead of less than at present.

itself is neutral that a fair field and no favour is allowed to the disputants. When once it has committed itself to an opinion, it allows no letter opposed to its views to appear in its columns, unless it is from somebody of such importance that it is afraid of giving offence by rejecting it, or unless the arguments are so weak that it finds no difficulty in demolishing them. It then selects from the crowd of its antagonists some puny individual that it may display its prowess by knocking him down. On the other hand, a correspondent, whose sentiments are in unison with those of the Times, however flimsy his arguments may be, is pretty sure of having his letters inserted. The Times is in favour of vivisection, with little or no restriction. Accordingly, some very silly letters in defence of the practice have been allowed to appear in its columns, and of these, the silliest, perhaps, was that of Sir Henry Thompson the well known surgeon. The gist of Sir Henry's argument is, that as long as we continue to kill game, and to shoot pigeons for sport, and to practise such cruelties upon the lower animals, catching fish with hooks, and using worms as bait, we cannot consistently interfere with vivisection. Sir Henry appears to think that it is as cruel to impale a worm on a hook, as to drive tubes into the entrails of a dog. Surely, he must be aware that cold blooded, and especially invertebrate animals, are far less sensible of pain than those more highly organised. Their actions prove it. I have seen the head and legs of a flea, attached to a minute portion of the thorax (or chest) — so minute that there appeared to be nothing remaining but the head and fore legs, — walking away very composedly, after the creature was supposed to have been completely crushed. I watched its progress for some time; but, having occasion to turn away my head, when I looked again, it had dis-

appeared. Now, what warm blooded quadruped, except Baron Munchausen's horse, would live and move after its hind quarters had been separated from it; to say nothing of the loss of nearly the whole of its chest? The pain caused by such a mutilation, even if vitality were not extinct, would cause complete prostration. Another correspondent, who signs himself "Fair Play," tells us that, until we cease to perform experiments upon oysters by cutting off their Cirri and Cilia, and to tear them from their shells in order to consign them to our stomachs, we have no right to cry out against vivisection. Such is the stuff which is admitted into the columns of the "Leading Journal."

But even on subjects which come within the scope of a journal mainly political and literary the sagacity of the Times is frequently at fault. Sometimes it fails to gauge correctly the state of public feeling, and sometimes it underrates the strength of the opposition which it will have to encounter. It tried to write down the Anti-corn law League, and the British Association (*), and in both instances

(*) Since this was written the Times has sung its Palinode, and, after many years of silence following its first attack, has in a leading article of Sept 7th—76 formally recognised the advantage to science of a periodical meeting like the British Association. To reproach the Times with changing its opinion after the lapse of between 30 and 40 years would be not only unjust, but absurd. "Tempora mutantur, et nos mutamur in illis", if not taken as its motto — and a better could not be found — may always be quoted on its behalf. If the times are changing we may be excused for changing with them. But, in the case of which we are speaking, there is no reason to suppose that public opinion has undergone any change, or that the British Association had not from the commencement the approbation of the Literary and Scientific world. The charge against the Times, therefore, is, not that it has changed with the public opinion which it represents, but that it neglected to sound public opinion, so as to avoid the necessity of a recantation.

it signally failed. The Anti-cornlaw League set at defiance the bolts of the Thunderer, increased in power, and finally accomplished its ends. The British Association held its sittings regardless of the Times, and that journal soon desisted from its attacks. The battery of the Times was brought to bear upon the Arctic expedition; but the arguments of its promoters prevailed over those of the Times, the assent of the government was obtained, and the expedition was dispatched.

There are questions, however, on which the public is indifferent, divided, or uninformed, where the Times does not fear to risk its popularity by taking either side, and there are the hobbies and crotchets of its individual proprietors, on which, whatever may be their moral character, it knows that it will have the support of the majority of its readers. Among the former is the question of the climate of Rome, among the latter the character of field sports. Only a small fraction of the population of England ever visits Rome, and of that fraction scarcely one is competent to judge of the truth of the facts, or the soundness of the arguments brought forward on the subject. The Times, therefore, is free to adopt the feuds of its correspondents, and to lend them all the support derived from its influence and extensive circulation. These correspondents are thus enabled to carry on a warfare, which may be purely personal, under the protection of the Ægis of the Times, as Teucer shot his arrows from behind the broad shield of his brother Ajax Telamon,

The principal proprietor of the Times, Mr. Walter, is, as was his father, what is called a keen sportsman. And accordingly, his hobby is represented in the Times, and an attempt is made, whenever an opportunity presents itself.

not only to idealise sporting, but to represent it as an essential part of a manly character. In a leading article which appeared in the Times many years ago, an observation of Rogers the Poet. "It is a fine day, let us go, and kill something," directed against sporting, and intended to show the incongruity between the feelings which Nature in her softer moods ought to awaken, and the delight in inflicting pain and death, was quoted with contempt, as the expression of a mean and cowardly feeling, and the writer went on to prove to his own satisfaction, that nobody who was not a sportsman was worthy of the name of man, or capable of playing a manly part in the world (*). But

(*) Modern sporting is often mere butchery, and requires no courage, and, with the exception, perhaps, of deer stalking, little endurance. Skill in shooting is all that is necessary to success. In former days the inferiority of the weapons in use placed the beasts more on an equality with man. It required some bravery to attack a lion or a tiger with a sword or spear. But what courage is there in firing with a weapon of precision from a tree at an elephant, as the Prince of Wales did in the Terai, or from a houdah, on the back of an elephant, at a tiger just roused by the beaters from his siesta in the jungle, gorged, perhaps, with prey, and dazzled, and bewildered by the scene into which it is forced. The following sickening account of a South African battue in 1860 is from the Times of the 26th Apr. 1876. « A widely dispersed circle of native beaters had been closing in from great distances on all sides, until a plain, supposed to be nearly a hundred miles in circumference, or more than thirty miles across, was one moving mass of game, Antelopes, Zebras, Ostriches, etc. The slaughter was terrific, and indeed (as the Times itself confesses) degenerated into butchery. Fast as the guns could be fired and recharged, volleys were discharged into the moving mass. When shooting palled upon the hunters, some of them took to the spear. Most of the sportsmen looked more like butchers than sportsmen, from being so covered with blood. His Royal Highness — Duke

enough of this; let us return to the question of the climate of Rome, and the story of the correspondent of the Times. It was, I believe, in the year 1860 that this correspondent, on some public occasion, expressed himself too freely regarding the Papal government, and received notice to quit Rome within — hours. He took his departure boiling with indignation, and, as soon as he was beyond the reach of the Papal authorities, he sat down in his chamber, and pondered on the means of revenge. It would be useless, he said to himself, to write against the religion or the government of Rome. The staunchest Protestants have no scruple about flocking to Rome to witness the gorgeous ceremonies at the Easter festival, and the most confirmed Liberals visit that city to view the ruins and the works of Art, without troubling themselves about the misgovernment, or repressive policy of the Pope. No sympathy, will be shown for my wrongs, and the story of the salary which I paid my gardener in advance, and which will now be lost to me, will only call forth laughter, or be met with the observation, that people at Rome, if they wish to avoid inconvenience, must do as the Romans do, and keep their religion and their politics to themselves. Suddenly a bright thought flashed across his mind. I will write, he exclaimed, against the healthiness of Rome, and, by so doing, I shall inflict more injury on the city and the government than if I filled a thick oct° with declamation against the superstition of the catholics, and the oppression of the Pope. Accordingly, he

of Edinburgh — and Carrè, were red up to the shoulders with using the spear». Can any one say that there is any thing noble in this butchery, or that it can have any other effect than that of blunting the feelings?

sat down and penned a furious article against the climate of the place, which occupied 3 or 4 columns of the paper, and went on in this style. "The Malaria has taken up its head quarters in the valleys, and is slowly climbing the hills, and enveloping one spot after another in its deadly embrace" etc. etc. etc. I am sorry I did not preserve a copy of the N.° in which this extraordinary composition appeared; for it would have been a literary curiosity in the present day. I am unable to procure it for the purpose of reference; but my impression is, that I have quoted the very words, and I am sure that I have given the substance of what was written. That the article in question was called forth by the expulsion of the writer there can be no question, for it appeared immediately afterwards, and it could not have expressed his deliberate convictions; for he had made arrangements for a prolonged stay, and had hired a gardener, a very unusual thing for the correspondent of a newspaper, and he could not, therefore, have thought the place so pestiferous. How, then, did he become so suddenly enlightened as to its character? For many years afterwards the mention of Rome as the future capital of Italy had the same effect on the Times as a red flag on a bull, and never failed to set it off writing against the folly of the Italians in desiring to fix the seat of government in such a pest house, which ought to be abandoned to ruins and recollections; in other words, to that desolation to which the malaria is generally attributed, and which, as it increased, could not fail to aggravate the unhealthiness of the place. During these years, but at longer intervals, there appeared articles praising the superior salubrity of Florence, and enlarging upon the advantages which it enjoyed over Rome as a place of residence. That the hotel keepers and professional men of

Florence should not have got up a testimonial to the Times has always appeared to me an instance of the basest ingratitude. For even the devil should have his due, and surely so influential a touter as the Times was deserving of a reward. When it was found that the Italians were bent upon making Rome their capital, and that they paid no attention to the ravings of the "Leading journal," the paragraphs in the letters of the correspondents from Rome on the subject of the climate became less and less frequent, until at length nothing was heard but an occasional inuendo, like the faint growl from a thunder cloud on the verge of the horizon (*). After the occupation of Rome, it was thought that these attacks had ceased altogether; when in the Oct of 1875, in a review of Galenga's "Italy revisited," an opportunity was seized of reopening the subject, and the cloven foot was again displayed. A passage in that work was made a text for a commentary on the pestilential and irreclaimable character of the climate of Rome, which was a good specimen of the "suppressio veri" and the "suggestio falsi" by which the Times so

(*) I have lately heard a story which illustrates the wide spread belief among the residents in Rome, that the letters which used to appear in the Times on the unhealthiness of the city did not express the conscientious convictions of the writers. A lady was discussing with a party of friends an article in the Lancet suggested by a letter of the Times correspondent, on the fevers reported at that time to be prevalent at Rome. « Oh! said a Doctor, who was present, the correspondent, I suppose, has got a bad apartment, and has paid dear for it, and so he vents his spleen on the unoffending climate ». As some persons, when they are out of temper, will give a kick to a luckless dog, which happens to come in their way, so the correspondents of the Times, when any thing goes wrong with them, will have a fling at the Roman fever.

often tries to make "the worse appear the better cause." As an illustration of the latter, it was observed that the winter of Rome was not sufficiently bracing to enable the resident to withstand the heat of summer; leading the reader to suppose that no place could be healthy if the summer was hot and the winter mild. If the writer did not intend to mislead, he must have been very ignorant not to know that there are hundreds of places where the summer is at least as hot and the winter much milder than at Rome, and which, nevertheless, have the reputation of being perfectly healthy; such is Melbourne in Australia. It was also said that the atmosphere of the city was poisoned by the vapours arising from the excavations. A little reflection will show the absurdity of this. If two or three cesspools were opened in London, on any given spot and at any season of the year, nobody would expect the air to be poisoned over an area whose radius was a mile, which is about the distance of these excavations from the quarter inhabited by the English and Americans. Even the workmen, whose heads were held over these same noxious fumes, were very little affected, and Mr Parker, the Archaeologist, considers that the few cases of illness which occurred were due rather to their mode of life than to any climatic influence.

To those who do not read the Times regularly, or do not notice all that it contains, it may seem that the tone of that journal has undergone a change with regard to Rome, and that it has desisted altogether from its attacks. To rake up old stories, therefore, may appear both illnatured and absurd, especially, when the present correspondent of the paper, who resides at Rome, is as much convinced of its healthiness as myself. But the article of Oct—75

shows that the Times is animated by the same feeling as before, and that there are others of its staff who take their cue from it, and are ready to give expression to its hatred of the place. On the other hand, the Roman correspondent is naturally afraid of running strongly counter to the known feelings of those who conduct the paper, and is, therefore, obliged to express his opinions in too subdued a tone. Hence the attack has naturally an advantage over the defence. But, whether, or not, a change has come over the Times, it is essential to my purpose to recall to recollection the history of the feud between the Times and Rome. In arguing the question of the climate of this place, we are continually met with the assumption, that the wide spread and deeply rooted belief in its unhealthiness must have a solid basis of truth. It is necessary, therefore, to point out what are the various sources of that belief, in order that by eliminating successively those which are due to deliberate misrepresentation and popular ignorance, we may show how small is the residuum of truth with which we have to deal. Our belief is rarely a logical conclusion from well ascertained facts. It is usually the result of various influences, and is unconsciously imbibed, when, or how, it would be impossible for most of us to say. The articles in the Times against the healthiness of Rome, continued, as they were, for eight to ten years, must have produced a great and permanent effect upon those who read them. A generation has grown up since that time, who have adopted the opinions of their parents without knowing how they originated, and who naturally suppose them to be derived from the experience of the Romans, and of the visitors to Rome. It is for the sake of these that I have given the origin of the dislike of the Times to

Rome, and also some account of that journal, in order that they may see, 1.st that the articles against the climate were dictated by revenge, and 2.nd that, even if they had expressed the deliberate and conscientious convictions of the writer, their endorsement by the Times would give them little weight, seeing that the Times itself is no authority in matters of science, and that the opinions expressed in that paper may represent merely the crotchets of its individual proprietors, and not the resultant of the intellectual forces enlisted in its service.

Having thus cleared away the rubbish with which the question has been overlaid, I will proceed to consider the subject in its scientific aspects, treating first the Physical Geography and Meteorology of the Campagna, and then the theories which have been proposed to show why the climate of the place must necessarily be unfavourable to health.

PART II.

CLIMATE OF ROME

IN

ITS SCIENTIFIC RELATIONS

THE CLIMATE OF ROME

IN

ITS SCIENTIFIC RELATIONS

On no subject has so much nonsense been talked, and such lamentable ignorance displayed as on the climate of Rome. Those who have written on it have usually been persons who were ignorant of the first principles of the Chemistry of Nature, and who contented themselves with collecting all the popular traditions, and vulgar errors which are current in this superstitious town. A réchauffé of these was then served up to the reader, as if they were facts which the writer had ascertained by experiment or observation, or conclusions at which he had arrived by an independent process of reasoning. Yet, these so called facts, or conclusions, are opposed not only to the experience of mankind in every other quarter of the globe, but to the dictates of common sense. We are called upon, for instance, to believe that the massing together of human beings, which every where else begets typhus fever, and many other

forms of disease, is conducive to health in this exceptional city (*).

Thus the crowded and filthy Ghetto is said to enjoy an immunity from malarial fevers for the same reason that the rookeries of London and of Liverpool are so prolific of those of a typhoid character; and this absurdity is repeated by one traveller after another, as if it were an incontrovertible fact, and nothing remained but to ex-

(*) The emanations from the skin and lungs are, when concentrated, a deadly poison. Of the 23 who, alone out of 146, escaped suffocation in the black hole of Calcutta every one was seized with Typhus, or, as it was then called, putrid fever, and many died of it. Modern science has enabled us to explain this melancholy result of overcrowding. When the supply of oxygen is abundant, and the ventilation perfect, the substances thrown off from the lungs undergo complete oxydization, and are converted into water, nitrates, and carbonic acid; which last, through deleterious to breathe, is carried of rapidly by the ventilation supposed. But when the supply of oxygen is deficient, and the ventilation imperfect, various putrescent matters are formed, which have a tendency to induce a putrid fermentation in the blood, when inhaled by the lungs. It is impossible to conceive how such putrescent substances can destroy the malarious principle, which is popularly supposed to be connected with decaying vegetable matter. It is contrary to all analogy. One Chemical substance is neutralised by another of a different nature, as caustic Potash by Sulphuric acid. But putrid animal is too like to decaying vegetable matter, and is more likely to afford a pabulum for it than to destroy its properties. A densely populated country is healthy, because a dense population supposes a high state of cultivation, and a high state of cultivation implies the fixing in the tissues of plants of those vapours which, though so deadly to man, form, as we know, the food of vegetables and trees. But the congregation of human beings in a town can have no other effect than that of vitiating, in a greater or less degree, the purity of the air, though judicious sanitary arrangements may correct, to a certain extent, the amount of such vitiation.

plain it by some theory equally absurd. Other statements, though not so irrational in themselves, are equally at variance with the observations of scientific men. Thus it is a received notion that there is a great and sudden fall of temperature at sunset, though any one who takes the trouble to watch the thermometer will find that sunset is the very time when the temperature varies most slowly, and that during the first hour after sunset it rarely sinks more than a degree, and sometimes remains nearly stationary (*). In a popular work by a well known resident in Rome it is stated, that the temperature at Rome rarely rises above 80°, and that it is owing to some peculiarity in the constitution of the atmosphere that the air feels so oppressive in summer. Now, I have spent nine summers in Rome, and never knew a July when the Temperature did not rise above 90°. With the exception of one season, the maximum always reached 95°, and one year it ranged for a fortnight together between 95° and 98°. This assumption of a peculiarity in the constitution of the atmosphere is a favourite mode of accounting for a fact, or what is believed to be a fact, with those who, being ignorant of the Chemical and Mechanical properties of the gases,

(*) Common sense, independent of scientific observation, ought to teach us the absurdity of this notion. If the sun were withdrawn in its meridian fervour, or even at 3 or 4 P. M. in summer, the temperature would undoubtedly sink rapidly during the first hour. This may constantly be observed, when the sun is overcast with clouds, at an early hour in the afternoon, or disappears behind an overhanging mountain. But, since the power of the sun's rays diminishes with their obliquity, and is reduced to nothing at the instant of sunset, its disappearance can no more cause a sudden fall of temperature than the removal of an extinguished brazier from a room.

love to call in the aid of occult causes, and to explain the "ignotum" by the "ignotius."

In many books, also, we are told that one of the peculiarities of the climate of Rome is the stagnation of the atmosphere, and people are recommended to ride for the purpose of procuring, by their motion through the air, an artificial breeze. This, like most of what is said about the climate of Rome, has no foundation in truth; for high winds, from every quarter of the compass, occur not unfrequently in the winter half of the year, and even in the summer half, there is scarcely a day when there is not some movement in the air.

What reliance, then, can be placed upon any thing which is written by travellers, or by residents ignorant of the principles of Natural Science, about the climate of the city, when such absurdities as those to which I have referred are adopted without examination, and pass unchallenged from mouth to mouth, and from generation to generation.

Nor can we put implicit trust in what the Doctors say. Physicians are naturally disposed to be cautious, and inclined to hold fast by tradition. It is true that most of the great discoveries in Medicine have been made by Physicians, as the circulation of the blood by Harvey, and vaccination by Jenner. But in every science men are slow to adopt new views, and to adapt their practice to them; and this is especially the case in Medicine, where life itself is at stake. Medical men, whatever may be their private convictions, shrink from the responsibility of recommending to a patient a place which has got a bad name, or a new mode of treatment, for fear that, if he should catch a fever, or his complaint should take a fatal

turn, the blame would fall upon them. Every body has heard the story of the bread pills which a Doctor recommended to a hypochondriacal patient whose disease existed only in his imagination. The patient thought they had done him a world of good, and was astonished when he heard how simple was their composition. (*)

The practice of Physicians is analogous to the prescription of the bread pills. They prefer to prescribe something which all the faculty prescribe, or to recommend some thing which, if it does no good, can do no harm, hoping that Nature, or imagination, may work the cure for them. The only question is between bread pills and potato pills, or something equally harmless but equally inert. It may be argued that this is all right, and that a Doctor is not at liberty to try the "experimentum in corpore vili" upon the body of his patient. But, if this be conceded, — and I do not see how we can refuse to concede it — no dissipation of a popular error can be hoped for from a medical man, who must, from the very conditions of his

(*) A curious story is told by Combe in his "Principles of Physiology" which illustrates in a striking manner the influence of the mind over the body. Combe cites as his authority F. V. Mye "De Morbis et Symptomatibus" etc. who is quoted by D.r Johnson in his treatise "On the Derangements of the Liver etc." During the siege of Breda in 1625, the garrison was on the point of surrendering from the ravages of scurvy, when it occurred to the Prince of Orange to introduce a few phials of a sham medicine as an infallible specific against the disease. This given in a few drops at a time produced astonishing effects: "Such as had not moved their limbs for months before, were seen walking in the streets, sound, straight, and whole; and many, who declared that they had been rendered worse by all former remedies, recovered in a few days to their inexpressible joy".

profession, adapt his treatment to the popular notions of the day, unless he is prepared to risk his practice as a Doctor on the chance of increasing his reputation as a man of science.

In treating the subject of the climate of Rome, I shall take a course the reverse of that followed by all those who have written hitherto upon it. These writers, not knowing the real origin of the popular notions regarding the unhealthiness of the place, have taken for granted their truth, and tried to explain them by some theory more or less plausible to the ignorant, and more or less absurd in the apprehension of the scientific. I, on the contrary, who do not consider the "Vox populi" as the "Vox Dei", but rather hold with Phocion (*) the Athenian that the prevalence of an opinion among the vulgar is a presumption of its falseness, will try to show that there is nothing in the Physical conditions of Rome and its immediate neighbourhood to render the city unhealthy as a whole, and that the spots which in the heat of summer might generate unwholesome vapours are too few in number, too limited in extent, or at too great a distance, to infect the atmosphere within the circuit of the walls. I will then try to explain by causes independent of any malarious influence many of the cases of fever, and of illness in

(*) When Phocion had occasion to address a large assemblage of people, a thing which he was not very fond of doing, some observation which he made called down thunders of applause. Upon which, turning to a friend beside him, " Have I, " he asked, " said any thing very absurd "? Such was his contempt for the judgment of the vulgar herd that he thought the worst part of his speech would be the most applauded. See Plutarch: " Life of Phocion. "

general, which go to swell the death rate, and to perpetuate the prejudices which exist on the subject.

But first I will examine those passages which are usually quoted to show that even in the latter days of the republic, or the early times of the Empire the valleys between the seven hills, and the Campagna immediately outside the walls, were still infested with malaria. A favourite passage with the malaria - mongers is that from the Republic of Cicero, where he praises Romulus for having chosen a healthy spot in the midst of a pestilential distriet. « Locum delegit, et fontibus abundantem, et in regione pestilenti salubrem; colles enim sunt, qui, cum perflantur ipsi, tum afferunt umbram vallibus.» Lib. II. §. 11. "He selected a spot abounding in springs, and healthy in the midst of a pestilential district; for it consists of hills which, while they are swept themselves by the wind, afford a shade to the valleys". The only thing that can be gathered with certainty from this passage is, that the whole of Rome was considered healthy in the time of Cicero, the hills, because they were swept by the winds, the valleys, because they were shaded by the hills. This is plainly the meaning of Cicero, though the shaded valleys, in the present day, are not considered the most healthy.

But, are we to consider that Rome was an oasis of health in a region reeking with malarious vapour? This is very improbable, and indeed, impossible; for, if the malarious country came up to the walls of Rome on every side, it must necessarily have infected the air of the place. Besides, such a notion is inconsistent with what we read of the condition of the Campagna and of the environs of Rome about 100 years after the time when this was written. Pliny describes the suburbs as extending in every direction

to such a distance that new cities might be said to have grown up around the old one (*). We know, also, from passages in the poets, and from modern excavations, that villas of the rich were erected along the banks of the Tiber, and the margin of the highways. It is absurd, therefore, to suppose that people would have gone on building cities and erecting country houses, in a plague stricken district, where they would occupy their houses only to sicken and to die. The more probable supposition is, that the "pestilenti" refers to the time of Romulus, when the land was undrained, and even the valleys between the hills were occupied by marshes, the Curtian lake, and a creek, the Velabra, running up from the Tiber between the Aventine, the Capitoline, and Palatine hills, and that it merely expresses Cicero's opinion of what the surrounding district must have been, when Rome was founded. But, what was the condition of the Campagna beyond these extensive suburbs? Let Seneca and Tacitus furnish a reply. Seneca thus answers the enquiries of his friend Lucilius (**). Ep. Lib. XVIII. I (104) "You ask me how I enjoyed my journey. The moment I left behind me the stifling atmosphere of the city and that sickening smell of smoking kitchens, I felt a sudden change in my health. You may imagine, then, how greatly my strength was recruited when I reached the vineyards. But, as soon as I was let loose into the pastures, I attacked my dinner with a ra-

(*) Exspatiantia tecta multas addidere urbes. III. Section 67 at the end. These were the Chelsea, Kensington, Paddington etc. of Rome.

(**) Seneca lived a few years before the Pliny who describes the extent of the suburbs; but, little change could have taken place in the interval.

venous appetite (*) ". Seneca, who was proceeding to Nomentum (Mentana), a place celebrated for its wine, so far from encountering the malaria beyond the limits of the city, and its far stretching suburbs, found his health invigorated, and his appetite sharpened, by the purer breezes of the Campagna. It is true that the time of the journey must have heen the early summer, when the vines were in leaf, while the meadows were not yet burnt up by the heats of July and August. But, though what is considered the malaria season in modern times had not yet commenced, the extensive cultivation of the vine is inconsistent with the notion of the unhealthiness of that part of the Campagna, at any season. For the vine requires a dry soil, and a good deal of attention in pruning and training the plants, and watching the fruit when ripe; and this supposes the residence of a certain number of persons; to say nothing of the effect of cultivation on the air. Tacitus complains that Italy, which once not only fed her own inhabitants, but exported corn, was now dependent on foreign countries for the staff of life (**). Some have inferred from this that a great deal of land had gone out of cultivation, or had become less productive, and have explained the result by the large properties (latifundia) which Pliny declares to have been the ruin of Italy,(***) and

(*) Invasi meum cibum " I made an onslaught on my food ".

(**) At Hercule olim ex Italiae regionibus longinquas in provincias, commeatus portabant; nec nunc infecunditate laboratur; sed Africam potius et Egyptum exercemus, navibusque et casibus vita populi Romani commissa est. Tac. Ann. XII. 43.

(***) Verumque confitentibns latifundia perdidere Italiam. Nat. Hist. XVIII. 35. Six persons, Pliny tells us further on, owned the half of Africa, when Nero put them to death; but on what pretence we are not informed.

by the culture of the land by slaves. But large farms in the present day are more remunerative than small ones, and land may be in a high state of cultivation which is tilled by slaves; of which we have an example in the Southern states of America before the civil war. There is no sure ground, therefore, for supposing that a large portion of the Campagna had reverted to a state of Nature in the time of the Emperors, or that the malaria had begun to make its appearance. Certainly Adrian would never have planned his villa on so grand a scale, or placed it on the site where the ruins now stand, if the Campagna had been esteemed unhealthy in his time. It is more reasonable to suppose that land, instead of going out of cultivation, had increased in value, as is always the case in the neighbourhood of populous cities, and was partly occupied by the mansions of the rich and noble(*) and partly had become the vineyard, orchard, and kitchen garden of the Imperial city. For the Romans were great consumers of fruit and vegetables, and these could not, like corn, be imported in the slow vessels of those times. Where, then, did the malaria hide its diminished head? In what holes

(*) Among other causes of the presumed increase of unhealthiness under the Emperors, the conversion of fields into luxurious mansions, and pleasure grounds is usually mentioned. But this conversion of arable land into lawns, and ornamental plantations, whatever might be its political and social evils, would not necessarily render the land less healthy than before; for, in that case, who would have inhabited these country houses. If the ground was well drained, the grass mown, or pastured with cattle, and the plantations kept clean, there is no reason why it should breed malaria. Uncultivated ground is not unhealthy, merely because it does not grow wheat or clover, but because the drainage may be imperfect, and decaying matter is sure to accumulate.

and corners did it skulk; for the ancient authors appear almost to have ignored its existence (*). The journey of Horace to Brundusium is by most commentators supposed to have taken place in the Spring; but " the tormenting gnats, and croaking frogs which banished sleep", would indicate that the summer heats had set in. For gnats are most abundant in July and August, and frogs croak most lustily when the weather is hot. Yet the party which Horace accompanied had no apprehension about travelling through the Pomptine marshes during the night, when the poisonous principle of malaria is supposed to be most highly concentrated. They proceeded at a very leisurely pace, and even slept in the canal boat. Nevertheless, nobody seems to have caught the "perniciosa". The allusions, in short, to the unhealthiness of Rome and its neighbourhood, are so few in the Latin authors, and apply to spots of such limited extent, that they may rather be considered as the exceptions which prove the rule of the general healthiness of the country. As to the quotation from Horace, "adducit febres et testamenta resignat" it expresses only the belief, which prevails in every country, that Autumn is the most unhealthy season of the year. What, then, is the conclusion? That, either the malaria had been banished by a cultivation which must have commenced before the earliest recorded history of the Latin nations; —since at the most remote period of whuh we have any authentic account, the Campagna was covered with little

(*) Strabo speaks, indeed, of the unhealthiness of the neighbourhood of Ardea, and of the strip of country between that place and Antium. Yet Pliny's Laurentian villa, which he describes as such a delightful residence in summer, was in that district. Strabo notices, also, the malaria of the Pomptine marshes.

cities which contended for supremacy with the infant republic of Rome — or that the ancients were less fanciful than we are, or less disposed to attribute to climatic influences the consequences of their own indiscretion or excesses (*).

(*) Pliny the younger refers (Lib. V. Ep. 6) to the unhealthiness of the Tuscan Maremma, and expresses his gratitude to his friend Apollinaris, who had dissuaded him from passing the summer there. But I can recall no passage where he speaks of any part of the Campagna of Rome as malarious. On the contrary, he describes his Laurentian villa, situated between Antium and Ostia, as a delightful residence, in summer as well as winter. "Haec jucunditas ejus hyeme, major æstate". In the same letter Pliny pictures the rich pastures surrounding his villa, grazed by flocks of sheep and herds of sleek kine and horses. If this district, now considered so deadly, could be described in these terms, a fortiori must the drier parts of the Campagna have been free from any miasma. To me it appears that the very mention of the unhealthiness of the Tuscan Maremma implies the healthiness of those places about which Pliny is silent.

CLIMATE OF ROME

IN

MODERN TIMES

As the nature of the soil, and the configuration of the surface have an influence on the climate of a place, I will commence with a short sketch of the Physical character of the Campagna, and then proceed to give in greater detail its Meteorological peculiarities; not only those which affect the health of the inhabitants of Rome, and of its vicinity, but those which may interest the general student of Nature.

PHYSICAL GEOGRAPHY

The verses of Goldsmith:

> Or where Campania's plain forsaken lies,
> A weary waste expanding to the skies,

would convey the impression that the Campagna of Rome is a dead level, bounded only by the circle of the horizon.

That this is incorrect is known to every one who has visited Rome, or is acquainted with Physical Geography. At the distance of eighteen miles to the N. E. rises the lofty limestone barrier of the Apennine mountains, while the intervening country, Northward of the Anio, is an undulating plateau intersected by little valleys, some of which, as at Veii, have the character of ravines. The same kind of country extends in a semicircle, from the Anio on the E round by the N to Palo, which lies nearly due W of Rome. To the S. E. the Campagna is comparatively flat, but dry with the exception of the lake of Gabii, once a Focus of disease but now drained and healthy. To the S of the city rises a range of low flat topped hills, which run parallel to the coast as far as the promontory of Circeium. It is the slip of land lying between these hills and the sea, including the Delta of the Tiber, and the marshes of Ostia, which has the reputation of being the most unhealthy, and it is here, if any where, that the malaria originates. An inspection of the map will shew that this region forms but a small part of the area of the Campagna. Five of what are called the hills of Rome, are nothing but the escarpments of the table land above mentioned, the Capitol, Palatine, and Aventine, being detached eminences.

The subsoil of the Campagna, including the plateau above described, is mainly of igneous origin, and consists of a volcanic conglomerate called "tufa" (the tophus of Juvenal). This " tufa" is divided by geologists into two distinct formations, according to its age, and the conditions under which it was deposited. The older variety is formed of scoriæ, volcanic minerals and fragments of older rocks, which are supposed to have been discharged

from submarine craters at the time when the Campagna was still covered by the waters of the sea. These loose materials were heaped up by the action of the waves into irregular masses, and cemented into rocks, either by pressure, or by the peroxydation of the iron which they contained. The rock, called "Tufa lithoide", which is of a reddish brown colour, was extensively used by the ancients for building purposes, the old walls of Rome being formed of it. It is also quarried in modern times with the same object, though the "Peperino ", or grey tufa, seems to be preferred.

After an unknown period of time, when the Campagna had risen above the level of the sea, the volcanic vents of the Alban hills appear to have opened, and showered down ashes on the surface of the marine deposits, and the older tufa. The later tufa is, therefore, arranged in horizontal layers and is, with some exceptions, more incoherent than the other. In this formation occur the deposits of Pozzolana, used for sand in making mortar, and the Tufa granolare in which the catacombs were hollowed out; and to this also is supposed to belong the hard grey tufa called Gabian stone by the ancients, and " Peperino ", from its colour, by the modern Italians, and which is very generally used for stone staircases, and for foot pavements. Out of the plateau of the Campagna rise, like islands from the sea, the detached limestone masses of Soracte and the Montes Corniculani. The only remaining formations of any importance are the Travertino, a fresh water limestone deposited from springs, and the alluvium of the Tiber. The Travertine region commences about seven miles from Tivoli, and extends to the base of the Apennines. This deposit is still going on, and

gradually filling the sulphureous lake on the road to Tivoli, called Lago dei Tartari. Of Travertine, called Tiburtine stone by Strabo, S.t Peters, and most of the churches are built, and with it the Colosseum was faced. But, though a favourite stone for building, it is somewhat unsightly, owing to the cavities in which it abounds. These cavities represent the place where wood, and other perishable substances, were encrusted by the calcareous matter, and afterwards decayed, leaving an empty space. The valley of the Tiber, lying between the escarpments of the table land is, of course, alluvial, the ground on either side being raised and enriched by the frequent overflowings of the river.

Of the formations which I have enumerated the Tufa and the Alluvium of the Tiber are the only ones which can have any influence on the climate. It is said that the tufa absorbs moisture readily, and that its use as a building stone ought, for that reason, to be discouraged. But, if it absorbs moisture readily, it parts with it as quickly, when the air is dry. Accordingly, during the heats of July, August, and the early part of Sept.r the vegetation on the tufa formations is parched up, with the exception of those thorny or succulent plants which delight in an arid soil. There can, therefore, be no noxious vapours from decaying vegetation, since every thing of a vegetable nature is either growing, or desiccated.

The alluvium of the Tiber is thought by many to generate, miasma; but from its composition and the time of year when it is deposited, it can have little effect upon the purity of the air. The mud left by the receding waters of a flood contains little argillaceous earth, and therefore, dries quickly in exposed situations, and when

dry, possesses little cohesion, and crumbles readily into a sort of sand. If this sand be examined by a microscope, it is found to consist of minute particles of various rocks, among which mica is conspicuous. This mineral is a component of the soil in every part of Rome and its neighbourhood, and may be noticed on all the roads and footpaths, sparkling, like diamonds, in the sun.

Fragments of the dark coloured augite may also be detected, as well as of the white transparent leucite. This latter, which is found in regular crystals, and in great abundance in some of the incoherent beds of the newer tufa, is called white garnet by the Romans, and used in cheap jewelry. There is nothing, therefore, in the mineral components of the deposit of the Tiber to render it noxious.

As to its other constituents, though I have never analysed the deposit, it may be inferred to contain little organic matter from the following experiment. For the purpose of testing the purity of the water of the river, a large bottle was filled with it a little below the Ponte Molle, at a time when the Tiber was greatly discoloured by a sudden flood. The bottle was then set aside for several days, to allow the mud to subside. At the end of the fifth day the water was found to be as clear as crystal, and perfectly sweet to the taste; nor could any unpleasant smell be perceived, either in it, or the deposit. A smaller bottle was then filled with the clear liquid, well corked, and left during my absence in Switzerland, from the middle of July to the beginning of Nov.r On my return to Rome the water was still perfectly clear, and free from either taste or smell. If, therefore, the *unfiltered* water was so free from organic matter that no disagreeable smell or

taste had been developed in the course of three months and a half, we may assume that there could have been only a trifling quantity in the deposit. Since, then, the floods of the Tiber never occur later than the month of February, and the mud left by them contains little organic matter, and is thoroughly dry before the summer heats commence, it is plain that no appreciable quantity of miasma can be evolved from it.

It may be observed, also, that, as the level of the Tiber in summer is ten or fifteen feet below that of the valley through which it flows, the river serves as a natural drain to the country on either side. It, thus, drains its own deposit, which, at the same time, is desiccated by the sun and wind. No marshy ground, therefore, can exist in the valley of the Tiber in its course through the Campagna as far as the apex of the Delta, except, perhaps, where the channel of a lateral stream is choked at the point where it enters the river.

METEOROLOGY

Rain.

In no capital is there such difficulty in procuring accurate information on matters connected with science as in the city of Rome. It is usual to couple Art and Science together, as if they were naturally allied; but my experience of the manner in which Artists and Archaeologists deal with the works of Nature would rather incline me

to the belief that the two are antagonistic to each other, and that, if we except Photographic Chymistry, and certain Mechanical processes employed in Statuary and Painting, Science does not flourish in the atmosphere of Art. Certainly, there is little taste for Nature among the Italians (*). and the Natural Sciences, as they are called, or the Sciences of observation and experiment, are no where so little appreciated, or so little understood, as in this Studio of the world. Hence the fallacies regarding the climate, the inundations of the Tiber, etc., which are so rife at Rome. It was for this reason that it was impossible, until lately, to learn, even approximately, the annual rainfall in this place, and that scientific publications exhi-

(*) Nothing could show viler taste than rooting up the bushes and wild flowers which grew on the ruins of the Colosseum. Rosa, the author of the act, had no more sense of the fitness of things than the officious housemaid in the poem of Pope, who roused the wrath of Vadius by scouring his shield encrusted with " the sacred rust of twice ten hundred years ". Otherwise, he would have seen that there was something incongruous in a ruin stript of its natural drapery. Besides, the sweeping and garnishing a ruin destroys the marks by which we measure the lapse of time, and, by reminding us of the recent presence of man, interferes with the feelings which the ruin is calculated to awaken. It is true that the roots of trees, by insinuating themselves between the joints, have a tendency to wrench the stones asunder. But no art of man can arrest the progress of decay in a building which is open to the weather. The time must come when the Colosseum, by repeated restorations, will be like a knife with a new handle, and a new blade, retaining nothing but its form, dimensions, and associations. Was it worth while, then, for the sake of prolonging its existence as a ruin for a score, or two, of years, to rob it of what lent it so much of its picturesqueness in the eyes of Teutonic nations, more sensible than the Latin races to the charm of wildness in Nature.

bited such extraordinary discrepancies in its amount. Thus in Dalton's Meteorology the rainfall in Rome is given as low as 20 inches, and in the Encyclopedia Metropolitana as high as 40 inches, a difference of 100 per cent. Even in the present day there is a notable difference in the estimates of its amount. In a little pamphlet, published in the year 1854 by one Edwin Lee, who styles himself "Member of the principal Medical Academies and Societies of Europe", the average rainfall is given as 31 inches, whereas 742.56 millimetres, the average of 80 years (from 1782 to 1861), as observed at the Collegio Romano, when turned into inches, gives only 29.245, or 29 $^{1}/_{4}$ nearly. This difference of 1 $^{3}/_{4}$ inches is considerable, and indicates either an error in the observations, or a difference in the conditions under which the observations were made. As the observations at the Collegio Romano were made at a height of 160 feet above the sea or 110 above the level portion of the city, the difference may be due to that cause; for it is a well known fact established by repeated experiments, conducted by such men as Franklin, Dalton, Howard, Arago, and Sir. J. Herschel that the quantity of rain diminishes with the height above the ground. (*)

(*) Thus the quantity of rain collected during a period of 270 days in the winter season, at the following elevations was:

Ground gauge	0 ft.	17,32 in	1.	ratios
Museum	44 ft.	12,17 in	» 7	
York Minster	213 ft.	8,65 in	» 5	

It must not, however, be supposed that rain decreases with elevation above the *sea*. On the contrary, we know that the rains are more copious in the mountains than in the plains. The rainfall at any point, whether on the mountains, or the plains, must be compared with that at any given height vertically above it. Many

As the average of 31 inches agrees with my own observations extending over a period of 18 years and made at an elevation never exceeding 50 feet above the street, I will assume it in my reasonings to be approximately correct. (*) These 31 inches are very unequally distributed among the months of the year, $^1/_7$ of the whole quantity falling in Oct', and only $^1/_{46}$ in July.

I have formed the following table from that of Father Secchi by adding to the rainfall for each month the proportionate part of the 1 $^3/_4$ inches by which I conceive the rainfall for the whole year to be deficient in his table, so as to make up the 31 inches. (**)

explanations of this anomaly have been attempted, of which the most ingenious is that of Mr. James Dalmahoy in an article entitled "A difficulty in the theory of Rain", published originally in the Transactions of the Royal Society of Edinburgh. Vol. XXII — Part I.

(*) If we take the difference between the elevations of the museum and the top of York Minster, which is 169 feet, and the difference between the corresponding quantities of rain, which is 3,52 in., and suppose the difference between the third story of a house in via Bocca di Leone, where my observations were made, and the height at the Collegio Romano where the rainfall is registered by Father Secchi to be 64 feet, we shall find by a proportion

169 : 64 : : 3,52 : 1,33,

which would be the proportionate decrease for the difference of height 64, if the rate of decrease were constant. But, since the difference of rainfall for equal heights is not constant, but decreases fast, the decrease due to the height 64 wonld be greater than 1,33, etc. or 1 $^1/_3$, and we shall not be far wrong, if we set it down at 1 $^3/_4$.

(**) The last edition of Murray's Rome, in a note subjoined to the article "Climate" contains the following astounding mistakes. 1.° that the average annual rainfall is only 16 $^1/_{10}$ inches. (44 millimetres is given as the equivalent of this; it should be centimetres).

Average Rainfall for each month of the year at Rome.

July	.67 in
Aug.	1. 11 »
Sept^{r}.	2. 58 »
Oct^{r}.	4. 32 »
Nov^{r}	4. 01 »
Dec^{r}.	3. 92 »
Jan^{y}.	2. 97 »
Feb^{y}.	2. 37 »
Mar.	2. 63 »
Apr.	3. 01 »
May.	1. 98 »
June.	1. 43 »
	31. 00 in

I will now give the Meteorological character of the different months.

2.nd that the Tiber in 1870 rose 52 feet above its usual level. 3.rd that the greatest heat of a Roman summer is 93.° 7. Now, it will be seen that 16 $^{1}/_{10}$ is about half the quantity of rain registered, whether by Father Secchi, or by me. As to the second statement, the author of it must have been deceived by the hydrometer at the Ripetta, which gives the height of the floods above the level of the sea, not above the summer level of the river. 17. 22 metres, or 56. 50 feet is marked on the hydrometer as the height to which the inundation of 1870 rose. From this if we subtract 20 feet, the height of the summer level of the Tiber above the sea, we get 36. 50 feet as the true height to which the river rose at the Ripetta. Lower down, where the channel is less confined, the rise was less. With the 93.°7 given as the greatest heat I will deal hereafter, and show that it is too little in one sense, and too much in another.

July.

For 5 or 6 years together (*) only a few drops of rain, or a slight sprinkling, too small to be measured by the gauge, will proceed from the skirt of a shower which is discharging itself over the Apennines, or the strip of country at their base. Dark clouds will collect in the North, and East, and the thunder will be heard to growl in the distance, while to the South and West all is clear, as far as the eye can reach. Sometimes the shower does not extend to the Zenith, and the edge of it only is visible above the Pincian hill. It was, doubtless, on such a day as this that Horace was sitting in a chamber facing the West and South, into which the sun was pouring a full flood of light, while a storm was bursting over the distant Apennines. Hearing the sound of thunder in what he imagined to be a cloudless sky, he saw in it, he tells us, the more immediate agency of the Gods, and forswore the scepticism in which he had long indulged (**). With the exception of these partial overcastings, which occur only

(*) The year 1874 was an exception to the general rule, 1. 41 inches of rain having fallen, the greater part of it after the 24.th.

(**) It may seem strange that Horace, or any one else who believed in the miracle, should not have thought of walking to some spot commanding a view of the whole horizon, so as to see whether there was any cloud from which the thunder might proceed. But the ancients never took the trouble to investigate the cause of a natural phenomenon. They preferred to sit down in their closets, and frame some ingenious theory to account for it; or else to refer it to the direct interposition of the Deity. Thus there are many in the present day who love a miracle, and would be angry with any one who tried to disabuse them of their belief.

two or three times in a month, the heavens are undimmed by clouds, and the sun beats down upon the Campagna with a force which soon dries it up, and gives it the aspect of a brick field (*). At the same time, it so thoroughly permeates the thick walls of the Roman houses that they continue to radiate inwards their heat, and to keep up the temperature of the apartments, during the 9 hours that the sun is below the horizon. The Max. temp^{re} for great part of the month is above 90°, and in the year 1841 it rose to 107° in the shade, which would be considered a very high temp^{re} for Calcutta. On only one occasion during nine summers have I known the maximum of July as low as 76°. This was in the exceptional year 1874, when there were 1. 41 inches of rain towards the close of the month, and the air was cooled by the frequent showers. The average rainfall for this month is only .67 inches, or somewhat more than half an inch.

August.

Sometimes the same kind of weather as in July continues throughout the month of August; but generally there are a few partial showers, which relieve in a slight

(*) This heat, however, is in some degree moderated by a sea and land breeze which, during the settled weather of June, July, and August, blows with as much regularity as within the tropics. In the afternoon there is always a breeze from points between W S W and N W, which dies away towards sunset, at which time the therm^{r} is nearly stationary. About half past ten P. M. a wind springs up from the N, or N. E, and the therm^{r}, begins again to descend. This continues until about 12 or 1. P. M. of the following day, when the wind again veers round to the Westward.

degree the monotonous glare of the sun, and lower the temperature for half a day. The heat is somewhat less than in July; but the therm^{r} frequently rises above 90°. This, as well as Sept^{r}, until the commencement of the rains, is considered the most unhealthy part of the Summer. The rainfall is still small, amounting only to 1. 11 inches.

September.

The early part of Sept^{r} is of nearly the same character as August; but, after the middle, the sky is frequently overcast, and the Autumnal rains commence (*), which continue during the remainder of the month, and the greater part of Oct^{r}. By these the temperature is greatly reduced, and the malaria, as far as it is a reality, receives its quietus. But its ghost still continues to haunt the imagination of the many old women who swear by the Times, and believe in the disinterestedness of the Hotel, and Lodging house keepers, whose interest it is to detain them in their respective cities. It is at this time that the great floods of the Po occur, caused, partly by the Autumnal rains, and partly by the melting of the glaciers of the Alps. Later in the year these glaciers are locked up by the frost, and an inundation of the "King of rivers" is unknown in the months of December, and January. The rainfall rises to 2. 58 inches.

(*) This year (1876) the weather has been altogether exceptional. Not a drop of rain has fallen between the 17th Sept. and the present date Oct 19.

October.

It is in October, as I have observed, that the greatest rainfall occurs, and I have measured as much as 13 ½ inches in that month, or more than half the annual average for London. Nor is it only on the average that this is true; for I can recall only one year when the rainfall in Oct[r] did not exceed that of any other month. Yet, notwithstanding this quantity of rain, Oct[r] is the most delightful month in the year, and is the one selected by the Italians for theis villeggiaturas, or excursions in the country. The rain comes in the form of extremely heavy showers producing sometimes 2, 3, or even 4 inches in a day, and a great deal of it falls at night, leaving many beautiful days, mornings, and afternoons. The country is then in its highest beauty. The deciduous trees are still in full foliage, the meadows, refreshed by the frequent rains, are of a vivid green, while the temperature in the shade never rises to excess, and the power of the sun's rays, (which corresponds to their force in the month of March) is never so great as to occasion inconvenience to excursionists in the country. Yet the bugbear of the Malaria continues to frighten away visitors during this pleasant month, and Rome does not begin to fill until the cold rains and Tramontana of Nov[r] have commenced. The average rainfall amounts to 4. 32 inches; but this quantity, as we have shown, may be doubled or trebled in particular years. (*)

(*) The present Antumn (1676) has been altogether exceptional in its character. The rainfall of Sept[r] was only an inch, and not a drop has fallen between the 17[th] of that month and the present date Oct 19.

November.

The early part of Novr is sometimes as agreeable as Oct.r; but the first fall of rain is sure to bring a great depression of temperature, which renders fires necessary to chilly people. As the first rains of Autumn lower the temperature from a burning heat to the point which is most agreeable to the feelings, so the first rains of Novr render it positively cold, though the large quantity of heat absorbed by the substantially built houses of Rome during the hot weather may allow fires to be staved off for a time. The remainder of the month is an alternation of cold rains, scirocco winds, which bring a higher temperature until they terminate in rain, and sunshiny days with a Northerly wind. Some of these are spring-like, and pleasant, when the wind is gentle; but the Tramontana is often high and cold. The quantity of rain for this month is somewhat less than for Octr, namely 4. 01 in.; but produces a greater effect upon the rivers, owing to the earth being completely saturated.

Decr Jany Feby

The quantity of rain for Decr is 3. 92 in, about the same as for Novr; but for Jany and Feby it is considerably less, being 2. 97 in. in the former, and 2. 37 in. in the latter month. The general character of the weather is, however, nearly the same in these three months as in Novr, except that the Tramontana wind is colder, and often brings a sharp frost at night, though the temperature during the last twenty years has always risen in the daytime

above the freezing point. It is a general belief that the winters in Central Italy were much more severe in the time of the Romans than at the present day. I have treated this subject elsewhere at considerable length, and shown, by confronting passages of the Latin poets with each other, and by the silence of Tacitus and Pliny about frost and snow on occasions when the subject of which they were treating would naturally have led them to mention their occurrence, that the climate could not have altered within the last 2000 years. I may observe, besides, that there is evidence of the occurrence of winters in modern times quite as severe as any recorded by Dionysius or Livy. These were separated, it is true, by long intervals, but not longer than those described by the above mentioned historians. The Abbè Longuerue, for instance, who wrote towards the close of the last century, speaks of the Tiber as being frozen over during his visit to Rome, and even in the Feb^{y} of 1813 the snow lay for two days on the ground, and the thermometer of Fahr descended to 15° below the freezing point.

March.

In March the power of the suns rays is equal to what it is in England in the end of April, and the variations of temperature are very great. Many days are spring like, or even positively warm. Others again are as wintry as January. I have seen the roofs of the houses white with snow for several hours about the middle of the month. The rainfall for this month is higher than for Feb^{y} and amounts to 2. 63 in.

April.

After the first of April the cold days are usually at an end, though the nights are occasionally chilly onough to render a fire agreeable in rooms which do not face the South. The rainfall rises again, and reaches 3. 01 in., somewhat exceeding that in Jan^{r}; for April at Rome in its "laughing and crying days" bears some resemblance to the same month in England. But the heat is much greater, the power of the sun's rays towards the end being equal to what it is in England in the month of June. This is a far less agreeable month than Oct^{r}; for the deciduous trees are not in full leaf before the end of the month, or the beginning of May (*), according to the season, by which time the heat in the sun has become too great for enjoyment in the open air. In Oct^{r}, on the other hand, while the temperature in the shade is a trifle higher than in April, the force of the sun's rays is very much less, and the trees still retain their leaves.

May and June.

May and June present nothing remarkable. In May the rainfull sinks to 1. 98 inches, and in June it descends

(*) It is a remarkable fact that, though the herbaceous vegetation is at least a month and a half more forward in Rome than in London, and green peas begin in March, and are plentiful and cheap in the month of April, the trees do not come into leaf in Rome much, if at all, sooner than the same species in London. Herbaceous plants appear to be more susceptible to the influences of heat and cold than ligneous ones, and while the former may be kept back or forced to any extent, trees, like the almond and horse chesnut, will insist on coming into flower or leaf at the time to which they have been accustomed.

to 1. 43 in. In both months the power of the sun's rays has become too great for exposure to them, though, during cloudy and unsettled weather, the temperature of the former month is often delightful in the shade. In June the great heats may be said to commence, though the thermometer rarely rises to 90°, and an occasional shower lowers the temperature for a time. From the middle of June to the middle of Sept^r the maximum varies between 75° and 107°, though I myself have never seen it higher than 98° in the shade, the very high temperature having, as I said, occurred in 1841, before I commenced residence in Rome.

Winds.

Among the many fallacies which are current with regard to the climate of Rome, is the belief in the stagnation of the atmosphere, and, as I have before observed, in some works visitors are recommended to ride as the only means of procuring a rapid change of air, by creating an artificial breeze. No doubt, if Rome be compared with Ireland, the Hebrides, and the Western coasts of England, or France, the air is comparatively still; but those who are troubled with smoky chimneys, or are keenly sensitive to the breath of the icy Tramontana, will bear witness to the frequency of high winds in the winter months. I have before observed that, during the settled weather of summer, there is a regular sea and land breeze, blowing every day from Westerly points, and from Northerly in the night, and early morning, so that there are few days when there is not some movement in the atmosphere. Even in London calm days occur not unfrequently, as during a fog, for

instance, and some days in summer. The absence of large trees, also, in the quarters inhabited by the English prevents them from noticing the wind, when they are not exposed to it.

The following numbers are given by Father Secchi as expressing the comparative frequency of the winds.

Winds	Frequency
N	288. 4
N E	172. 3
E	144. 7
S E	41. 5
S	274. 8
S W	164. 8
W.	169. 9
N W.	30. 8

The SSE, or wind two points to the E of S, appears in this table to be included in the S. The SSE, however, is the true Scirocco, though the Italians call every warm wind a Scirocco, as they call every cold wind a Tramontana. The Scirocco is the most remarkable of the winds, and always indicates a great disturbance of the equilibrium of the atmosphere. It brings the heaviest rains, the strongest gales, and the most violent storms of thunder and lightning, some of which have all the characters of an Eastern Cyclone. In early winter, if the rain which the Scirocco always brings sooner or later be long deferred, the atmosphere becomes very oppressive, from the combined influence of heat and moisture. In some works the great heats of

summer are attributed to the Scirocco wind; but in summer there is no true Scirocco, except in the rare case of wet weather, when its effect is rather to cool the air by the clouds which it induces.

The Tramontana is the only other wind deserving of notice. It is the opposite to the Scirocco in character, though not diametrically opposite to it in direction; for it blows from any point between N and NE; but cold winds from the N. W. or E. are also called Tramontanas by the Romans. The characteristic of the Tramontana is extreme dryness, rain scarcely ever falling when it blows. There is, however, a superficial current from the N which often blows during rainy weather; but, at such times, dense clouds may be seen moving from the S in an upper current, and at no great elevation. The rain, in fact, comes from the S, and the N wind merely acts as a condenser. This is what the Swiss call the "fausse Bise." The true Tramontana, or Tramontana extending to the upper regions of the Atmosphere, like the true Bise of Switzerland, always brings dry, and, in winter, cold weather. The sensation of cold produced by it is far greater than the thermometer would lead us to suspect, and this is probably owing to the dryness of the air.

Temperature

As the health and comfort of the visitors to a city is more affected by the intensity and variations of the heat and cold than by any other Atmospheric condition, it might have been supposed that those who write upon the climate of Rome would have taken some pains to ascertain the real temperature of the different seasons, and to express themselves in language intelligible to their readers. Yet, there is no subject about which strangers are so much in the dark, or respecting which so many absurd fallacies are afloat. I have already instanced two: "that the thermometer rarely rises above 80°," and "that there is a sudden fall of temperature at sunset," though the average maximum given by Father Secchi for the month of July is 91°, and though any one, by watching the thermometer, may satisfy himself that the temperature decreases at a much slower rate after than before sunset. One reason of these erroneous notions is the stupid practice of giving the mean temperature of the day and night, unaccompanied by the maximum and minimum from which that mean is formed. What idea, for instance, can a stranger form of the heat of July by being told that the mean temperature of the month at Rome is 76°? These mean temperatures tell us absolutely nothing about the character of a climate, since they may be derived from an infinite number of extremes. Thus a maximum of 80° and a minimum of 72°, or a maximum of 90° and a minimum of 62°, or a maximum of 100°,

and a minimum of 52° all produce the same mean 76°. But what a difference between the mild and equable climate in the case first supposed, and the great heat and variation of temperature in the third. One is almost ashamed of enunciating principles so elementary; yet, elementary as they are, they seem not to be understood by the writers on the climate of this place.

The drier the air, the greater the variations of heat and cold during the 24 hours, and the greater the mistake we should make in judging of a climate by the mean temperature alone. In the arid steppes between the Caspian and the Aral, the variations of temperature exceed any thing of which we can form a conception in Europe. During the Russian expedition to Khiva, the thermometer of Reaumur, after rising to 30° or 99¹/₂ Fahr. by day, would sink to 5° or 6°; that is 43°¹/₄, or 45°/₂ Fahr. at night, a difference of 56° or 54°, the variation in the 24 hours at Rome being usually under 25.° If we take the lowest minimum 43°¹/₄ and the maximum 99°¹/₂ we shall get the mean 71°, 37 or a little less than 71°¹/₂, which might be that of a climate where reigned perpetual spring, the temperature never rising above 73° or sinking below 70°, As the Russian army advanced, the heat at length increased to such a degree that a thermometer of Reaumur graduated up to 55° marked 52° at 11 A. M., and at noon burst by the expansion of the Mercury, showing that the temperature must have exceeded 156° Fahr. It would be mockery to tell a person exposed to such atmospheric changes, and alternately fainting with heat by day, and shivering with cold by night, that he must set off the heat 99°¹/₂ against the cold 43°¹/₄ and thus he would get about 72°, which was a very pleasant degree

of warmth. Yet this is what is done unconsciously by those who describe a climate by the mean temperature of the day and night alone.

I will now give from the observations at the Collegio Romano, extending over a period of 33 years (1828 to 1860), the mean maximum, and the mean minimum , for each month in the year, as well as the highest maximum and the lowest minimum registered in those months during the same period of time, and compare them with the observations of the last dozen years.

MEAN MAXIMUMS AND MINIMUMS AND EXTREMES

FOR EACH MONTH OF THE YEAR FROM 1828 TO 1860.

	MEANS		EXTREMES	
	MAX.	MIN.	MAX.	MIN.
Jan.	58°. 91	29°. 41	66°. 87	20°. 84
Feb.	60°. 85	31°. 73	66°. 20	17°. 15
Mar.	66°. 05	34°. 81	77°. 00	25°. 25
April.	72°. 84	40°. 49	86°. 00	27°. 50
May.	80°. 92	47°. 41	92°. 75	38°. 97
June.	87°. 47	54°. 33	97°. 70	46°. 70
July.	91°. 65	61°. 91	107°. 06	52°. 25
Aug.	91°. 67	59°. 57	100°. 04	51°. 98
Sept.	86°. 63	53°. 02	93°. 65	43°. 01
Oct.	79°. 63	46°. 81	89°. 96	36°. 27
Nov.	67°. 04	35°. 98	76°. 77	25°. 70
Dec.	60°. 06	30°. 07	66°. 65	20°. 75

From the annual Bulletins of the Collegio Romano, beginning with 1861, and ending with 1874, I have calculated the following table.

MEAN MAXIMUMS AND MINIMUMS AND EXTREMES,

FOR EACH MONTH OF THE YEAR FROM 1861 TO 1874 (*)

	MEANS		EXTREMES	
	MAX.	MIN.	MAX.	MIN.
Jan.	52°. 07	38°. 74	65°. 5	21°. 2
Feb.	54°. 75	40°. 32	64°. 9	26°. 4
Mar.	59°. 07	44°. 33	73°. 9	29°. 1
Apr.	65°. 82	48° 65.	76°. 8	34°. 9
May.	74°. 50	55° 58.	89°. 9	44°. 1
June.	80°. 96	61° 03.	97°. 9	49°. 8
July.	87°. 01	66°. 51	96°. 3	54°. 1
Aug.	85°. 15	65°. 55	97°. 3	52°. 1
Sept.	79°. 00	60°. 98	90°. 5	47°. 1
Oct.	69°. 84	54°. 41	89°. 1	41°. 0
Nov.	59°. 58	46°. 42	70°. 7	27°. 5
Dec.	52°. 81	39°. 90	69°. 6	25°. 2

(*) Both these tables are formed by adding together the maximum temperature of each day in a given month and dividing by the number of days in the month. Let us suppose the month to be July. We thus obtain the average maximum for a particular July. By repeating the process in every successive July, adding

If these two tables be compared, a notable difference will be observed. It will be seen that in every month the mean maximums in the second table are lower, and the mean minimums higher than those in the first by from 4 $^1/_2$ to 9 $^3/_4$ degrees for the maximums, and 10 $^1/_2$ for the minimums, but in such a manner that the mean of the maximum and minimum for eaeh month differs only 1 $^1/_2$ or two degrees in the two tables, and sometimes nearly coincides; as in July and September.

Whence arises this difference, and which of the two tables are we to accept as giving the true temperature of the air? The discrepancy is, doubtless, due, not to difference of altitude, for the observations in both tables were made at the same height above the ground, but to difference of exposure, and perhaps to some imperfection in the thermometer by which the night temperatures were observed (*.) The second table appears to be the

together the averages so obtained, and dividing by the number of years we find the average maximum of July for that series of years. In the same manner we proceed in calculating the average minimums. The extremes are the highest and lowest temperatures registered in the given number of years. We must not suppose that the extremes given for each month occurred on the same day, or even in the same month. For, if so, we should have an incredible variation of temperature. Taking June, for instance; the max. temp. 97°. 9 might have occurred in one year, and the min. 49°. 8 in another.

(*) If this should seem improbable, I may refer to the enormous error in the rainfall registered at the Capitol two or three years ago. This was detected only by comparison with the rainfall measured at the Collegio Romano, and found to be owing to a faulty graduation of the pluviometer. In the thermometer by which the minimum temperatures are registered at night a portion of the spirit in warm weather often evaporates, and condenses

more correct, but the results must differ from those which would be obtained at lower elevations. On a clear day the earth is heated by the rays of the sun and warms the stratum of air immediately above it, which transmits its heat to the next; and so on in succession. Thus on a fine day the heat decreases as we ascend, up to a certain point (*). On a calm and clear night the conditions are reversed. The earth is cooled by radiation into space, and cools by conduction the air above it. Hence, on such a night, the temperature is higher at moderate elevations than near the ground. It is evident, therefore, that at the height of the observatory of the Collegio Romano (about 110 feet above the ground) the average temperatures of the day must be lower, and of the night higher than those observed 15,30, and 45 feet above the ground. Now, it is at those elevations that people usually live, to say nothing of their walking within six feet of the heated ground. To give an idea, therefore, of the heat of summer, and of the effect which it is likely to produce on the human body, a second set of observations should have been made at an elevation not exceeding 30 feet. In the absence of such observations, I will hazard a conjecture that, if the difference between the maximums for any given month in the two tables be taken, and half of it added to the maximum,

in the upper part of the tube, thus causing the remainder to indicate too low a temperature, and this may be overlooked by an unobservant and unscientific official, to whom the observations are often entrusted.

(*) This is independent of the general law of decrease of temperature in ascending considerable heights, which is only at the rate of one degree in 300 feet.

and the other half taken from the minimum of the corresponding month in the second table, we shall have approximately the average maximum and average minimum for the month in question at the height supposed. In this way we get, for July: average maximum = 89.°33, average minimum = 64.°19, for Jan: average maximum = 55°,49, average minimum = 35.°32.

Proceeding in this manner the following table may be constructed,

	MEANS		EXTREMES	
	MAX.	MIN.	MAX.	MIN.
Jan.	55°. 49	35°. 32	65°. 5	21°. 2
Feb.	57°. 80	37°. 26	64°. 9	26°. 4
Mar.	62°. 56	40°. 34	73°. 9	29°. 1
April.	69°. 33	45°. 14	76°. 8	34°. 9
May.	77°. 71	52°. 37	89°. 9	44°. 1
June.	84°. 21	57°. 78	97°. 9	49°. 8
July.	89°. 33	64°. 19	96°. 3	54°. 1
Aug.	88°. 41	62°. 19	97°. 3	52°. 1
Sept.	82°. 81	57°. 17	90°. 5	47°. 1
Oct.	74°. 73	49°. 52	89°. 3	41°. 0
Nov.	63°. 31	42°. 69	70°. 7	27°. 5
Dec.	56°. 43	36°. 28	69°. 6	25°. 2

The figures of this table will, I believe, represent nearly the average temperatures of the months at a height of about 30 feet above the level of the street, influenced, as they are, by proximity to the ground, and by the radiation from heated walls. In other words, they will represent the temperature actually experienced, with which alone we are concerned. It may be observed that, considering the numerous sources of error, all observations of temperature are merely approximations. The pretence, therefore, of accuracy in giving the maximums and minimums to two places of decimals is absurd, though I have copied the figures as they stood in the Bulletins of the Collegio Romano The observations at the Capitol are now made with scientific accuracy; but the time which has elapsed since they were commenced (in 1870) is too short to enable us to form a correct average.

I have dwelt thus long on the subject of temperature, because, next to damp, it is that on which popular errors are most rife. I shall now proceed to treat of atmospherie moistnre, or damp, as it is usually called.

Moisture and Dew.

As the amount of moisture in the Atmosphere, and the frequency and copiousness of the dews, are considered to have a great influence on the Hygienic conditions of a climate, I shall devote some space to explaining the true nature and effects of hygrometric moisture, and the conditions under which alone a deposit of dew can take place.

There is no term of which most persons have such

vague conceptions as of damp. It is usually spoken of as if it were some poisonous principle, the total elimination of which from the atmosphere would be conducive to health. Yet the very persons who speak of it in this manner are aware that a saucer of water as often placed upon a stove, to correct by its evaporation the too great dryness of the air. Watery vapour, in fact, is not only an accidental, but a necessary constituent of the atmosphere, and among other important purposes, such as refreshing plants by its condensation into dew, it serves to regulate radiation to, and from, the earth, under a cloudless sky. Professor Tyndall has shown that, were it not for the aqueous vapour present in the atmosphere, the rays of a noontide sun would burn up the productions of the earth, while the radiation from the ground during a cloudless night might, even in July, reduce the temperature far below the freezing point, blasting the vegetation which the heat had spared, and leaving the animal creation to perish by starvation. Were the air totally deprived of its moisture, "every night", says Sir. J. Herschel, " would place the earth's surface in contact, as it were, with that intense cold which we are certain exists in empty space; a degree of cold which, from several different and quite independent lines of enquiry, we are sure is not less than 230° Fahr. below the zero of that scale " (*), and this is a temperature more than 150° below the greatest cold ever registered in the Arctic regions. Since, then, aqueous vapour must always exist, to a greater, or less amount, in air, the question arises, what constitutes the damp which

(*) Familiar Lectures on Scientific subjects, by Sir. J. Herschel. Art. " The Sun." Page 48.

is thought to exert such a noxious influence on the human frame. Watery vapour is generally supposed to act by chilling the body, and thus inducing those ailments which follow in the train of cold; but that hygrometric moisture does not produce this effect can easily be shown. Water may exist in two distinct forms, as a liquid, or as an invisible elastic gas. As a liquid, when it comes in contact with the body, it evaporates, and carries off animal heat, producing the sensation of cold, and if the chill be long continued, rheumatism, and various pulmonary diseases, may ensue. The effect is the same in kind, but very much less in degree, when we are enveloped in a mist, or fog; for the mist consists of the liquid water, in a very minute state of division, and each particle, as it impinges on the skin, is converted into aqueous gas, and so robs the body of a portion of its heat, which becomes latent in the particle. But, when water has evaporated, and assumed the form of an invisible vapour, its properties are entirely changed. Having taken up all the caloric it requires to enable it to change its state from a liquid to a gas, it no longer robs the body of its heat, or in no greater degree than the air of which it forms a part, while, by impeding radiation from the ground, it maintains a more equable temperature in the lower stratum of the atmosphere. It is evident, therefore, that the chilling effect attributed to damp is a popular error, and that the cooling influence of the atmosphere on the body can have no relation to the *quantity* of aqueous vapour present in the air, or the number of grains of water in a cubic foot. As long as it retains the gaseous form, water can act only by economising heat. Since, then, it is only as water that damp carries off animal heat, and produces cold, air is said to

be damp, when it approaches those conditions under which aqueons vapour is precipitated in the form of water, and produces the effects of water. The dampness, therefore, is measured by the difference between the temperature of the air and the point to which that temperature must be lowered artificially, or fall naturally, in order to obtain a deposit of dew. Thus, if the temperature of the air be 80°, and it would be necessary to lower it to 50°, to precipitate a portion of its moisture, the air would be said to be dry, and 50° would be called the dew point. If the temperature fell to 55°, the dew point remaining the same, the air would be said to be damp, though the absolute quantity of moisture per cubic foot remained the same, because the probability of a deposit taking place would be increased by the near approach of the two temperatures, that of the air, and that of the dew point. In this sense alone is the night damper than the day; for the actual quantity of vapour is usually less in the night than during the day. The weight of water per cubic foot is called the absolute, and the degree of approach of the temperature of the air to the dew point is called the relative moisture.

But, though damp, in the form of an invisible gas tends, as I have shown, to mitigate the severity of cold, moisture in excess, combined with heat, may have a relaxing effect upon the system; because it impedes the insensible perspiration, or the evaporation from the skin by which the superfluous animal heat is carried off, and the uniform temperature of the body maintained. Every one attributes the oppressiveness of a scirocco wind to the damp with which the air is loaded. Yet the popular notion is that a chill is more likely to be caused by exposure to an

atmosphere at once cold and moist than to air which is cold and dry. Few persons reflect upon the opinions they hold, or they would see the absurdity of thinking that hygrometric moisture could at once make warm air feel more warm, and cold air more cold. (*)

Extreme moisture, also, accompanied with a high temperature, may be indirectly prejudicial to health by promoting the decay of animal and vegetable matter. Organic bodies have the power of condensing aeriform fluids in their pores, and converting them into liquids, and thus in a climate, like that of Sierra Leone, where the air is always nearly saturated with moisture, decay may be going on, and unwholesome vapours be generated, even during the rainless months. But this is never the case in Rome and its neighbourhood, where the air may be considered dry during the heats of summer, the dew point during the hottest weather being usually from 20° to 25° degrees below the maximum temperature.

(*) Hygrometric moisture acts, as I hava said, by impeding the radiation of heat from the earth on a cloudless night. But there is another mode in which it serves to retain the warmth of the air. As soon as the temperature descends to the dew point, a partial condensation of the vapour in the atmosphere takes place, and the latent heat given out arrests the fall of temperature. When this heat is dispersed, the thermometer begins again to descend. Thus, when the dew point has been reached, the fall of temperature proceeds at a much slower rate. The knowledge of the fact that the dew point determines nearly the minimum temperature of the night may be turned to practical account in gardening. For the dew point may be calculated from the difference between the dry and wet bulb Thermometers, and thus we can infer approximately the lowest temperature to which tender plants will be exposed, and take our measures accordingly.

Besides organic bodies, there are many Chemical substances which have the property of attracting moisture from the air. Thus Chloride of Calcium, or Muriate of Lime, which is a whitish powder, if exposed to the air, well absorb water, become a liquid, and unless dried artificially by a strong heat, will remain for ever in that state. Nitrate of Ammonia is less deliquescent, and will melt only when the air is moist, and become solid again when it is dry. It may thus be used as an hygrometer. Tried by this test also, the atmosphere of Rome cannot be considered humid; for Nitrate of Ammonia very rarely melts. Even during wet weather it often remains solid, showing that the lower stratum of the atmophere is some degrees above the point of saturation.

Human hairs, seaweed etc, will contract or lengthen, according as the air is moist or dry, aud have been used as hygrometers to measure the degree of moisture in the air. But the most scientific method is the wet and dry bulb thermometers, from the difference between which we can calculate not only the dew point, but the actual quantity of moisture present in the atmosphere.

The following numbers expressing the relative moisture of some well known cities are given by D^r Taussig

Rome 57, Milan 75, Nice 75
Alexandria 59. Malta 71 (*)

The N^o 57 is from Father Secchi; but D^r Taussig does not tell us where be got the others. It appears from this

(*) After these numbers in D.^{r} Taussig's work ^{mm}, or millemetres, is incorrectly printed. 57^{mm}, 75^{mm} etc. would represent the absolute, not the relative moisture of those cities, and their absolute moisture is nothing to the question.

that Rome, in the conventional sense, is the least damp of the places enumerated. These numbers merely represent the comparative readiness with which the air parts with its moisture to substances which have the property of attracting it, and which are used as hygrometers, 100 expressing the highest degree of readiness; (*) but they tell us nothing about the actual *quantity* of moisture present.

The relative moisture varies at different times of the day, being least when the temperature is highest, and greatest when it is lowest. As the lowest temperature occurs, coeteris paribus, just before sunrise, that will usually be the time of greatest relative humidity. But, if the dew point be high, and the day temperature low, the thermometer, at any time in the course of the night, may descend to the dew point; after which, the air will remain in a state of saturation until it is warmed by the sun.

For the different seasons at Rome the degrees of humidity, both absolute and relative, are thus given by Father Secchi, the millimetres being turned into decimals of an inch,

	Absolute	Relative
Winter	.248 in.	63
Spring	.321.	56
Summer	.551.	41
Autumn	.423.	61

(*) The relative moisture may also be found by dividing the dew point by the temperature, and considering the result as a fraction of 100. Thus, if the dew point coincide with the temperature, the fraction becomes unity, aud the whole expression 100, or complete saturation.

The left hand column gives the decimals of an inch of Mercury which would just sustain the elastic force of the aqueous vapour in the different seasons (*), and as this elastic force is proportionate to the *quantity* of vapour in a cubic foot, it may be put for it, in estimating the absolute humidity. But, to make the subject clearer to the general reader, I will represent the absolute moisture of the four seasons by the number of grains of water contained in a cubic foot of air; which may be calculated from the elasticities given above. Thus we have:

Moisture

	Absolute	Relative
Winter	2. 22 grs.	63
Spring	2. 57	56
Summer	4. 92	47
Autumn	3. 89	61

The meaning of this table is that, while the air in summer contains on the average nearly 5 grains of water in a cubic foot, and in winter only 2 $^1/_4$, its tendency in summer to part with a portion of its moisture is represented by the figures 47, and in winter by the higher figures 63. In other words, the dampness in winter, measured by that tendency, is greater than in summer, though the actual quantity of water in the air is less than half of what it is in the latter season. The difference between absolute and relative humidity may be illustrated by the case of

(*) These, of course, are averages of days and years.

two individuals, one of whom, with a large fortune, spends nothing that he can avoid, and saves all that he can; while the other, with a much smaller income, by judicious expenditure, and liberal contributions, acquires a character for generosity.

Dew.

There is no phenomenon in Natnre more simple in principle, or admitting of a more satisfactory explanation, than that of dew; yet there is none so little understood by the generality of persons. Even some, who profess to write scientific treatises, use language concerning it which would lead to the inference that they did not understand its true nature themselves, and which is certainly calculated to mislead thcir readers. They talk, for instance, about dew "falling", and, if they are medical men, a caution is perhaps given against exposure to the air, "when the dew is falling". Now, it is quite certain that dew does not fall. Two illustrations will suffice to make the matter clear. The finest rime rain will wet all bodies indifferently, whatever may be their temperature — unless, of course, it be so high as to cause instant evaporation — and *whatever the nature of their surfaces;* but dew is deposited *only* on bodies which are *colder* than the atmosphere and in greater quantity on surfaces which are *rough* than on those which are *polished.* Again, if a decanter of iced water be brought into a warm room, dew will be formed, not only on the sides, but on the *bottom* of the decanter. The dew, in fact, is derived from the film of air in immediate contact with a body whose temperature has been lowered by

radiation towards a cloudless sky. To speak, therefore, of dew falling is as absurd as it would be to say that the moisture adhering to my fingers, after shaking hands with one whose hands were wet, had fallen upon them. It may be said that this is a mere quibble about words, and that it is a matter of no consequence whether we say that dew falls, or dew is deposited; but the difference between falling and being deposited is one of great practical importance; for if dew fell, like rain, it would wet the exposed parts of the body and penetrate thin clothing; which is never the case. It is only when the clothing is very thick, so as to prevent the animal heat from passing outwards, and counteracting the effects of radiation, that dew, or even hoar frost, may be formed; as on the filaments of a bear skin great coat, for instance. It is evident, therefore, that dew can never give cold, since it is the consequence, not the cause, of the cold of the bodies on which it is deposited.

Law of the mutual penetrability of the gases.

As I shall have occasion to refer to this law in discussing the question of the supposed transport of malarious vapour from one point to another, I will try to explain it here. It is sometimes expressed by saying that each gas is a vacuum with respect to any other. Thus the mechanical properties of the gases differ essentially from those of liquids. If Mercury, oil, and water be poured into a vessel, they will arrange themselves in the order of their specific gravities, the Mercury will sink to the bottom, the oil

will rise to the top, while the water will take its place between the two, and this order will be maintained for an indefinite time. But, if hydrogen, the lighter gas, be introduced at the top of a room, carbonic the heavier, at the bottom, and common air between the two, after a time the gases will be found to be intimately mixed, so that there is as much hydrogen gas at the bottom as at the top, and as much carbonic acid at the top as at the bottom (*). This law of the diffusion of gases, the discovery of which is due to Dr Graham, is of vast importance in the economy of Nature. Were aeriform fluids, like liquids, to arrange themselves in the order of their specific gravities, the carbonic acid, which is always present in the air, would subside to the bottom, and form a stratum at the surface of the earth in which no animal could exist. It is evident, therefore, that the malarious vapour, which is thought to play as many pranks as the witches of olden time, or to manoeuvre, like an invading army, can never advance from the Pomptine marshes, or the marshes of Ostia, in solid phalanx, or sail through the air, like a balloon, or break up into small detachments, and enter open windows like a bat, as some silly persons believe, or argue as if they believed. Before it has travelled very far, it must necessarily be so diluted as to be innoxious.

(*) This is of course, on the supposition that there is no ventilation. In the Grotto del Cane at Naples there is always a stratum of carbonic acid at the bottom, because the gas is continually issuing from the ground, while, as it mingles with the air above, it is carried off by the general movement of the atmosphere.

GENERAL OBSERVATIONS

on the weather.

The climate of Rome, if I have described correctly the phenomena of the different months, cannot be regarded as suited to patients who suffer from diseases of the respiratory organs. Though the thermometer on the average is ten degrees higher in Rome than in London, the variations of temperature are as great in the former as in the latter city, and a change from a maximum of 65° to one of 50° or 45° — which is of frequent occurrence, in the course of 48 hours during the winter months — is felt as much at Rome as a change from 55° to 40 or 35° in London. The climate of Rome is described by Sir James Clark, who is quoted in Murray, as relaxing and oppressive, and no distinction is made between summer and winter (*). Sir J. Clark may have been a clever physician, but he evidently knew nothing of what he was writing about. He probably remained only a few months in Rome, and supplemented his own ignorance by the ignorance of the natives whom he consulted. That the air of Rome cannot be relaxing will be clear to any one who makes observations on its hygrometric condition and temperature. An

(*) Many persons talk as if they thought that the air of one place was composed of different gases from that of another, and was situated in a sort of well, over which the winds, from every quarter of the compass, might blow without removing, or diluting these gases. A few days ago a gentleman at Piali's, who

air is relaxing which is at once warm and moist, and hygrometric observations shew that these two conditions rarely coexist at Rome. During the winter season the Tramontana is the prevalent wind, and the Tramontana is both cold and dry. In fact, the fine bright days which are considered the great recommendation of Rome are due to this prevalence of Northerly winds; for the southerly winds always bring clouds and rain. The wet days, also, are usually cold, while hygrometric substances, like Nitrate of Ammonia, show that, even when rain is falling heavily, the lower stratum of air is often far from being saturated with moisture. A portion of this partially deliquescent salt, exposed to the air in an open saucer, has remained perfectly dry up to the present date, Nov. 27, since the middle of Oct^{r}, though heavy rain, producing nearly an inch and a half of water, fell on the day and night of the 17th. The reason of this is, that these cold rains generally come with a superficial current from the N, and, while the weathercocks all point from that quarter, the clouds may be seen sailing in an upper current from the S, and apparently at no great elevation. These superficial Northerly currents crossed by an upper current from

had, I suppose, been "doing" the galleries and churches of Rome, attributed his exhaustion to the relaxing effect of the air of Rome of which he had read in Murray. Yet a Tramontana wind was blowing at the time, which must have carried away, every quarter of an hour, the whole body of air incumbent over the city. If the relaxing quality of the air of a place is not due, as I have supposed, to heat and moisture combined, it must be owing to some peculiar gas; and what is the nature of this gas, whence does it proceed, and how does it hold its own against the winds from the sea or the mountains, which are continually tending to renew the air of the place.

the S, are, as I have said, called in Switzerland "la fausse Bise", or the "false Bise". It is during such weather that the great falls of snow on the Apennines take place; for the true Tramontana, extending to the upper regions of the atmosphere, is too dry to furnish much downfall, either in the form of rain or snow. It is only when the true scirocco, or SSE wind, blows, that the deliquescent salt of which I have spoken begins to melt, and indicates an approach to saturation in the atmosphere. These winds are both warm and moist, and the weather which they bring is certainly relaxing, for a day or two, until they terminate, as they always do, in rain, which cools the air, or is attended by a change of wind to the N. But such winds are comparatively rare, much rarer than the SW winds of England, which feel just as relaxing with a temperature of 55° in London as the scirocco with a temperature of 65° in Rome.

These observations apply to the winter season. The heat of summer is attributed by some, who do not make Meteorological observations, to the Scirocco wind. Bnt there is *no true Scirocco* during the fine weather of summer. The SW sea breeze is mistaken for it, and this, though it blows from the sea, is not a damp wind; the dew point being usually from 20° to 25° Fahr. below the maximum temperature. The heat of summer, though often extreme, is a dry heat, and has no relaxing effect upon the frame of those who do not take violent exercise.

The great advantage which Rome enjoys over England is the immunity from fogs. A thin fog sometimes occurs in the night and early morning; but it is always dispersed by the rays of the sun long before midday: Sometimes it rises and forms clouds, and if the barometer is falling, is considered a harbinger of rain.

I have noticed the temperature 93°, given in Murray as the highest in Rome, and declared it to be incorrect. As an average maximum it is too high, and as an extreme, it is too low. The highest *average* maximum given in any of the tables is 91° and the lowest 87°. The highest *extreme* is 107° the lowest 98.° The decimals are omitted.

The Geological and Meteorological conditions by which the health of the Campagna may be influenced being thus described, I will proceed to examine the various theories which attempt to explain the nature and extent of that influence. After which, I will consider how far the malaria of the Campagna, confined as it must be to certain spots either distant, or limited in extent, is likely to extend to Rome; and, how far, if it reaches that city, it is likely to be modified in its character before it arrives. Of these theories there are two, which, though they are opposed to every principle of Chemical and Mechanical science, are, nevertheless, very generally received, and serve, more than any others, to keep alive the belief in the noxious quality of the air of the neighbourhood of Rome, and, consequently, to a certain extent, of the city itself. The first theory is not, as far as I am aware, held by any medical man in the present day, but is very widely spread among the visitors to Rome. It is, that certain sulphureous emanations from the volcanic soil of the Campagna infect the atmosphere, and cause the fevers of the place. I have met with several who have imbibed this notion, and I have seen the same thing stated in old books upon Rome, which I read long ago, but whose title I forget.

Such a notion implies, of course, great ignorance both of Chemistry, and of the characteristics of malaria fevers. For, on the one hand, no sulphureous vapour could be

evolved in appreciable quantity from the volcanic tufa; on the other, no compound of sulphur could produce the peculiar symptoms of intermittent fevers. Sulphurous acid, and sulphuretted hydrogen, are the only vapours containing sulphur which can be generated by natnral causes, the former by the combustion of sulphur in active volcanoes, the other by the decomposition, in contact with water, of iron pyrites (or sulphuret of iron). Now, there are no combustions going on in the Campagna of Rome, and no fumaroles discharging sulphurous acid, as at Naples. Besides, sulphurous acid, though irrespirable, is said to have the effect of destroying marsh miasma, as chlorine destroys, by decomposing, sulphuretted hydrogen. Again, the tufa consists mainly of fragments of older rocks, limestone, mica, etc, intermixed with volcanic minerals, such as augite. The sulphurets form but a minute portion of the whole, and both they and the purely volcanic minerals decompose and disintegrate with extreme slowness; so that no appreciable quantity of sulphuretted hydrogen(*) could be generated in the manner supposed. Were it otherwise, each gas would betray its presence, the former by its irritating effect upon the trachea, the latter by its offensive smell; by which it may be recognised, if there is the merest trace of it in the air. We may assume, therefore, that, if the two gases exist at all, it must be in infinitesimal quantity. This theory, as I have said, is

(*) The sulphnretted hydrogen evolved by the water of the Lago Solfatara on the road to Tivoli is, doubtless, far greater in quantity than all that can be produced in the same time by the decomposition of the volcanic minerals of the Campagna. Yet, nobody fancies that the air is infected by the vapour from those lakes, any more than that of Harrogate by the sulphur baths

not generally maintained by medical men in the present day; but the other, which has been proposed to account for what is believed to be a fact by many — but which I am disposed to deny — namely, that the dry parts of the Campagna are as unhealthy as the wet during the heats of summer, has the support of many of the faculty, and among others, of Arnold the Historian (*). However dry the ground may appear, collections of water, it is said, exist at a shallow depth below the surface, which in hot weather exhale a damp vapour charged with the malarious principle. To this hypothesis two objections may be raised; 1st that the vapour from the water below will not rise to the surface in any appreciable quantity, and 2rd, that if it did, it could have no injurious effect upon the health. Water rises by capillary attraction through ordinary soil at a slow and continually decreasing rate, (**) and at a cer-

(*) " Abundant experience", says Arnold, "has proved that, when the surface of the ground is wet, the malaria poison is far less noxious than when all appearance of moisture on the surface is gone, and the damp makes its way into the atmosphere from a considerable depth under ground". The utter absurdity of this statement will be apparent, when it is considered that it is equivalent to asserting that aqueous vapour from the reservoirs of pure water in the bowels of the earth—in combination, I presume with a high temperature of the air — is capable of producing malarial fever. For the ground, by the supposition, being parched, there can be no rotting vegetation on the surface to furnish a noxious element to this tepid steam.

(**) In order to satisfy myself as to the height to which water would rise in common earth by capillary attraction, and its rate of rising, I filled a glass cylinder, open at both ends, with fine dry soil, and placed one end of it in a flat vessel of water. At the close of the 2nd day the water had risen 10 inches, and the rate was reduced to 1 $^1/_2$ inches in 24 hours. On the 12th day it had

tain point, its rise must be arrested by the increasing temperature as it approaches the surface; otherwise, the surface would be never dry. Again, the evaporation from the moistened earth below the surface, or from a reservoir supposed to exist at any depth, will proceed at an almost insensible rate. Every one may have remarked that the ink in a bottle left uncorked will not dry up for several months (*), though the same quantity, if poured into a shallow saucer, would evaporate in a few days. If this is the case with a bottle whose neck is, perhaps, half an inch in diameter, how slow must be the evaporation through the pores of the earth from the water below.

But let us assume for argument's sake that the watery vapour rises freely through the earth, and ascends from any depth. Since it proceeds from saturated strata, or reservoirs, beyond the influence of air and light, no animals or plants can exist to taint the water by their putrefaction or decay. The aqueous vapour, therefore, must necessarily be pure, and I have shown that "damp", the "bête noire" of Doctors, old women, and valetudinarians, cannot, in the form of aqueous vapour, or hygrometric moisture, produce any deleterious effect upon the human frame It is true , as I have observed , that a warm air, nearly saturated with moisture, may relax the system, and by indisposing to exertion, indirectly affect

risen 18 inches, and the rate was then about $^1/_8$ of an inch. How slow, then, must be the rise, when the earth is consolidated by its own weight, or by the treading of cattle.

(*) This is owing to the atmosphere of watery vapour, which fills the neck of the bottle, and by its elasticity presses upon the surface of the ink, and retards its evaporation. Every liquid has an atmosphere of its own vapour, which has a similar effect, when the air is prevented from sweeping freely over its surface.

the health; but it cannot induce any specific disease. During the expedition to Holland in the year 1809, the fever which decimated our troops was generally attributed to emanations from the water that existed below a surface which was apparently dry. But, when the water was reached by shallow wells, it was found to be pleasant to the taste, perfectly wholesome, and was drunk with impunity by all. Now, it is impossible that the vapour can contain any principle which is not found in the water itself. Distillation by a gentle heat, or distillation which is not destructive, like that of coal in the retort of a gas work, can produce no compound which does not exist ready formed in the fluid submitted to the process; though it may leave many behind; those substances, for instance, which, like the salt of the sea, are incapable of being volatilised by the heat applied (*).

Before I conclude this subject, I will make some observations upon a passage in Livy quoted by Arnold in

(*) Pliny the younger, in the description of his Laurentian villa to which I have before referred, confirms this view. He observes that, agreeable as the place was, it was deficient in running water. "But, it has," he says, "wells, or rather springs": "snnt enim in summo". "For they are on the surface". He then goes on to observe. "Omnino littoris illius mira natura: quocunque loco moveris humum, obvius et paratus humor occurrit, isque sincerus, et ne leviter quidem tanta maris vicinitate corruptus". "Strange, altogether, is the nature of that shore. In whatever spot you dig, water is met with close at hand, and a water not in the slightest degree brackish, in spite of the close neighbourhood of the sea". In a passage previously quoted, Pliny describes his villa as "even more pleasant in summer than in winter". It is evident, therefore, that the idea of the unhealthiness of subsoil water during the heats of July and Augnst never entered into his thoughts.

confirmation of the views of those who maintain that the parched and arid districts of the Campagna are as malarious as those which retain their moisture during the heats of summer. Livy introduces the Roman soldiers in winter quarters at Capua as plotting to seize upon the city, and expressing themselves in the following strain: "Cur autem potius Campani agrum Italiae uberrimum, dignam agro urbem, qui nec se nec sua tutari possint, quam victor exercitus haberet, qui suo sudore et sanguine inde Samnites depulisset? An aequum esse, dedititios suos illa fertilitate atque amoenitate perfrui, se militando fessos in pestilente atque arido circa urbem solo luctari?" "And why should the Campanians, a people who could defend neither themselves nor their property, possess the most fruitful territory of Italy, and a city worthy of the territory, rather than the victorious army, which by its blood and sweat had driven thence the Samnites? Was it just that their own subjects should have the entire enjoyment of that fertility and agreeableness, while they,exhausted by warfare, were struggling in the parched and pestilential soil around the city". Livy. VII. 38.

The words "in pestilenti atque arido circa urbem solo" are seized upon by Arnold and others, as evidence that the whole Campagna surrounding Rome, whatever its Physical character, was equally unhealthy. I have before observed that this description is inconsistent with what we read in the elder Pliny of the extensive suburbs radiating in every direction from the walls of the ancient city, as well as with the fact that the margin of the highways, and the banks of the Tiber and Anio, were lined with the villas of the rich and noble. But, independently of this, what rational person would seek in "Livy's pictured

page" for data on which to ground a scientific theory. Livy, like Gibbon and Macaulay, had the imagination of a poet, and was fond of working up the dry records of history into little dramas. He puts into the mouth of his speakers the language and sentiments most appropriate to their characters, and most suitable to the circumstances in which they are placed, and is no more responsible for those sentiments and language than an ordinary dramatist for the utterances of the fool, or villain, whom he introduces into a play. Besides, when people are out of temper with men or things, they are apt to fling opprobrious terms at the offending person or object, without troubling themselves about the appropriateness of the terms. The language, therefore, of a character in a drama, so far from representing the opinions of the author, may not even be intended to convey the conscientious convictions of the speaker himself. Yet, Arnold is silly enough to quote a portion of a speech supposed to be uttered by angry soldiers as expressing the opinion of Livy himself, 'The neighbourhood of Rome', he says, 'is characterised by Livy as a' "pestilential and parched soil". Such is the discrimination of one whom most persons would be disposed to receive as an authority. (*)

(*) I had almost forgotten to cite the case of the Val di Chiana as an additional illustration of the absurdity of the notion that subterranean water can render a place malarious, if the surface is perfectly dry. As the dead level of the ground did not admit of drainage, the land was raised by warping, until the surface was dry enough to be cultivated. It is evident, therefore, that at the depth of two or three feet the original marshy ground, saturated with water, must exist. Yet, as long as the surface is kept dry by attending to the canals, the district is perfectly healthy, with the exception, perhaps, of a narrow strip near the

Having disposed of these two fallacies, and shown that the malaria cannot, in any degree, be due to them, we may pursue the enquiry into the true cause of the liability of the Campagna of Rome to intermittent fevers, if indeed that liability be any thing but a delusion. When I first came to Rome, about 18 years ago, I had formed no opinion abont the so called malaria; but every thing which I have seen, and every thing which I have heard since that time, has convinced me that there is an enormous amount of exaggeration on the subject. The Italians of Central and Southern Italy are, from their temperament, slow to apply a remedy to an evil, however much they feel its pressure, and in order to excuse their indolence and want of energy, they magnify the evil, and expatiate with folded arms upon the difficulty of overcoming it. The Romans, in addition to the "dolce far niente" of their compatriots, are strongly tinctured with superstition, and love to consider themselves the victims of some great and mysterious power of Nature, or some ordinance of Providence, which it would be hopeless, and almost impious, to resist. There are barbarous nations which are said to worship the Devil, not because they love, or reverence the fiend, but because they are afraid of incurring his vengeance by any act which might appear to be derogatory to his Divinity, or to imply a doubt of his power. In like manner, the Romans, while they bewail the fate of their country, exposed, as they say, to such a

lakes of Chiusi. But, if the canals were allowed to silt up, and to saturate the surface with moisture, the whole region would revert, as in the middle ages, to its original state, that of an unproductive and pestilential marsh.

visitation, resent as impertinent. or almost profane, any doubts as to the reality, or the intensity of the visitation. Even Father Secchi, whose reputation as an Astronomer is European, and who is the author of many works on the Mechanical Sciences, uses language regarding the climate of Rome and the Campagna which subsequent experience, I trust, has induced him to modify. "If things proceed," he says, "at this rate, for some time longer, I do not hesitate to utter the melancholy prediction that Rome will become an oasis in a pestiferous desert, and end by becoming itself the prey of desolation". (*) This was written ten years ago, but I am not aware that the Demon of Malaria has made fresh conquests, or that there has been any approach to the realization of these dismal vaticinations. A similar apprehension was expressed by the engineer Giordano at the time of the occupation of Rome by the Italians. "The capital, he feared, would count many victims among the clever administrators who had already done such good service to Italy, as well as among the men of business who should come to settle at Rome". Dr Balestra, the author of an elaborate work upon the climate of Rome, and the Campagna, though he enlarges upon the unhealthiness of the latter, thinks that there was never any ground for these apprehensions, as far as Rome was concerned. "some years," he observes; "have passed away, and yet these victims of the Roman climate have been so few that there is no occasion to recall them."

(*) Se le cose progrediscono di tal fatto, per alcun altro tempo, non dubito potervi far la trista profezia che Roma diventerà un'oasis in mezzo ad un pestifero deserto, e finirà ancor essa coll'essere preda della desolazione (sulle condizioni Igieniche del clima di Roma; Lettera del P. A. Secchi D. C. D. G.)

Thus it is that the Romans are content to magnify an evil, and exaggerate the difficulty of coping with it, while, instead of putting their shoulders to the wheel, they wait for Providence to aid them. A population of Englishmen, or Americans, would have made short work with the malaria. They would long ago have attacked the monster in his den, and found, perhaps, when they came to close quarters that it eluded their grasp, and showed itself, notwithstanding its possession of a "local habitation", and a world wide "name", to be, after all, an "airy nothing", a creature of hypochondriacal imaginations. Having said this much of the indolence and superstition to which the exaggerated notions of the Romans regarding their climate are in a great measure due, we will now confine ourselves to the conclusions which may be drawn from well ascertained facts examined by the light of science.

As facts accumulate, so does the difficulty increase of framing a theory which shall reconcile them all. So numerous are the cases where one, or other, of the three conditions considered necessary to the development of the malarious principle, namely, heat, moisture, and decaying vegetation, are wanting, and where, nevertheless, malarial fevers are said to be rife, that some have been driven to the conclusion that there is no such thing as Malaria, that is to say, no specific poison to which aguish fevers are due. (*) These fevers, they think, may in every case

(*) On the one hand Singapore is not reckoned unhealthy, though the climate is hot and moist, and though the place is in the immediate neighbourhood of salt marshes covered with a rank vegetation. On the other hand Hong Kong and Aden are, or were, considered malarious, though both places are dry, as well as hot, and the soil of one is a friable granite, and of the other

be explained by a chill, by over-heating, by over-exertion, or, in short, by any thing which interferes with the regular performance of the animal functions. In the report on the sanitary condition of the army in India it is observed that during twenty years from 1814 to 1833 the mortality from fevers among the Europeans in India was in direct proportion to their exposure to the weather, and the deficiency of the means which they possessed for protecting themselves from the influences of heat and cold, namely, 83 in 1000 among the noncommissioned officers and men; 38 in 1000 among the officers, and only 20 in 1000 among the civil service, during their first 20 years of service. (Report of Royal Commissioners on Sanitary state of Army in India L. XIX, XXI). If protection from weather counts for so much, why, it is argued, should it not count for every thing, and exposure be the sole cause of those fevers which cannot, like typhus and typhoid, be traced to the corruption of animal matter? To this it is objected

volcanic. But many places at their first settlement were thought to be unhealthy which afterwards proved not to be so. The first settlers are for a time insufficiently protected against the weather; they expose themselves recklessly to rain and the vicissitudes of heat and cold, and sanitary precautions are neglected for work which is considered of more immediate urgency. The consequence is, a certain amount of sickness, which is set down to the account of some noxious quality in the air. Man may even by his neglect render a place unhealthy which is naturally the reverse. Thus at Simla the sanatorium of India, a violent epidemic of cholera broke ont some time ago. This was afterwards clearly traced to defective drainage, by which the water supply was contaminated. We hear nothing now of the unhealthiness of Hong-kong; and Aden, I have no doubt, will be found to be no worse than any other place equally hot.

that chills, although they may occasion affections of the lungs, rheumatism etc, have no tendency to produce the peculiar symptoms of malarial fevers. It is certain, however, that over-exertion, or over-heating, or chills, will produce fevers; though it has never been clearly explained to what type they are to be referred, and a long array of facts are brought forward in support of the views of those who maintain that malarial fevers are not caused by any specific poison, whether chemical, or organic; such as would carry conviction to the minds of most persons, until they read the evidence which is marshalled on the other side. But, while "adhuc sub judice lis est," "while the case is yet before the judge," let us assume that either theory may be true, and take our measures accordingly, especially, as it is generally conceded that exposure, over-exertion etc. if they do not induce the disease, dispose the body to the reception of it,

Though a great deal which is plausible may be said for either theory, the preponderance of evidence is in favour of the production of aguish fevers by marshy ground under the influence of heat. Not only has marshy ground in every age and nation been regarded as a focus of disease, but the *same* place has been proved to be healthy, or the reverse, according as it was dry and cultivated, or allowed to revert to a state of Nature. A singular illustration of this is furnished by the Val di Chiana, where, within the historic period, we have evidence of three distinct alternations from unhealthy to healthy, and vice versa. In the time of the 2nd Punic war it appears that this was a highly cultivated district, which Hannibal, as he traversed it, laid waste with fire and sword, in order to cripple the resources of the Romans. (*) Yet in the age

(*) Livy XXII. 3.

of Dante it had returned to what was doubtless its condition in primeval times, that of a dreary and pestilential fen; to become again by the process of warping, and the engineering operations of Fossombrone, a healthy and productive region (*) in the present day. We thus trace three distinct changes in opposite directions within the period indicated, showing the great influence of drainage and cultivation on the salubrity of the air.

Of the fact that either moisture without heat, or heat without moisture, is insufficient to produce the conditions by which malaria is generated we have striking illustrations in the bogs of Ireland, and the Terai of India. The bogs of Ireland have always been a puzzle to those who believe that damp per se has a deleterious effect upon the human frame. Yet, the exemption from Malaria of Ireland, and other countries where bogs, properly so called, exist, may easily be explained. Bogs differ essentially from marshes, both in the positions they occupy and the kind of vegetation they support. They are found on the sides of mountains, or on plateaus of greater or less elevation, in countries where the climate is moist, and the summer temperature low. Their vegetation consists almost entirely of the "Sphagnum palustre." or bog moss, which has the property of continuing to grow from its extremity, whilst the parts that are buried beneath the surface undergo a slow change which converts them into peat. At the same time antiseptic compounds are for-

(*) Warping consists in enclosing a certain space of ground with mud walls, and admitting the streams, when they are charged with mud through an opening which is closed by a flood gate. When the water has deposited its mud it is drawn off again. In this manner several inches of soil are gained every year.

med which not only preserve the peat, but any foreign bodies which happen to be mixed with it. (*) The conservative influence of bogs is well known and every body has heard of the Irish oak, which buried for ages in the peat, has undergone no change except in colour. It is evident, therefore, that where there is no putrefaction or decay, no noxious substances can be disengaged. Marshes, on the other hand, are formed on the course of rivers, and at a lower level than bogs, which are fed more directly from the clouds; their vegetation is more varied and luxuriant, and more pernicious in its decay; though even marshes are comparatively innoxious in the cooler climates of the North.

The Terai is a strip of country running parallel, at a distance of about ten miles, to the last range of hills which forms part of the mountain system of the Himalayas. It is intersected by the great rivers which issue from the high central chain, into which, however, from the conformation of the ground, there seems to be no drainage. It is almost a dead level, and is covered partly with forests and partly with jungle. Though interspersed with shallow lakes, the greater part of it appears to be dry during both the cool and the hot season of the year. In this district there are three well defined seasons in regard to healthiness. During the cool season the Terai is perfectly healthy, and may be traversed in every direction without risk. It was at this time that a party was formed by the Prince of Wales and his suite, and the Prime Minister of Nepaul, Sir Jung Bahadoor, and his

(*) Peat has been found to contain Creosote, and not only the charcoal of peat, but the unburnt peat itself, when reduced to powder, has been found effective as a deodoriser and disinfectant.

attendants, for the purpose of shooting tigers, and other large game in the Terai. They camped out at night; yet none of the party, as far as I am aware, caught the jungle fever, or experienced any ill effects from the climate. During the hot and dry season, which commencing in the month of March continues until June, the Terai is still not unhealthy, if care be taken to avoid exposure to the sun, over-exertion, and chills which are the result of neglect of proper precautions, when the body is wet with profuse perspiration. But, during the third period, after the rains have commenced, the whole district, owing to the want of fall in the ground, becomes one great marsh, in which the jungle fever reigns supreme; no European, it is said, can abide within its limits, or even traverse it, without succumbing to the deadly quality of the air. Even the Hindoos fly with horror from the place. The only people who are proof against the poisonous atmosphere of the Terai are an aboriginal race, who drive their herds to feed upon the luxuriant vegetation which the rains call forth. In this, as in all similar accounts, there is probably a good deal of exaggeration. Lord Clyde, during the Indian mutiny, left a small force (*) in this malarious district, at the point where it borders upon Oude. Of this force Maun Sing, an Indian chief acting in concert with Lord Clyde, declared that not one fourth would return, and refused to allow his own men to enter the Terai. The predictions of Maun Sing were not, however, verified; for though cases of fever did occur, they were neither numerous nor fatal.

(*) Correspondence of Times March 19th 1876. The force consisted of the 7th Hussars, one battalion Rifle Brigade, and an Artillery detachment.

The case of the Terai, where the return of the cool weather brings the jungle fever to an end, shows that it is the fall of temperature accompanying the Autumnal rains in Italy which causes the disappearance of the malaria, and not the sweeping away of the germs of fever by those rains. (*) Heat and moisture combined are necessary to the development of the malarious principle, whatever that principle may be, and the rains of India come at a time when the power of the sun is the greatest, namely, in the months of June, July, and August, and supply the moisture which had been wanting to the heat, without essentially diminishing that heat. The rains of Italy, on the other hand, come at a time when the force of the sun's rays is so much reduced that the fall of temperature produced by a day, or two, of rain is never restored; consequently, the malaria is at an end, or is reduced to the smallest possible proportions.

It is needless to multiply instances of the noxious effects of marshes, when exposed to a burning sun, and of the great change which takes place in their healthiness by draining and cultivation. The Val di Chiana is in itself a host, and the Terai furnishes a crucial test of the theory that both heat and moisture acting upon dead vegetation, and promoting its decay, are required to produce the deleterious effects observed. It is not, however, from stagnant water, it is said, that the principle of disease arises, but from shallow pools in the act of drying up, while the vegetation which they sustained is rotting but

(*) That it is the fall of temperature which produces this effect appears, also, from what is stated to be a fact, that the early showers of July and August, which are of rare occurrence in ordinary years, rather intensify the malaria.

not yet dissiccated. (*) Thus the most unhealthy period in India is not when the inundations are at their height, but when they are subsiding, and leaving large expanses of slime exposed to a sun, which in Sept^r is equal in force to that of Italy in the beginning of August. It is this fact, or belief, that malaria does not proceed from stagnant water, if it exceed a certain depth, which has suggested, both in ancient and modern times, the idea of reclaiming the Pomptine marshes by digging ponds, or reservoirs, of several feet in depth, and raising the level of the remainder of the land by means of the soil thrown out. This was the method which Julius Cesar intended to apply (**), and which, supplemented by warping, modern engineers approve; for, owing to the dead level of the land, and its trifiing elevation above the sea, draining, in the ordinary sense, is out of the question.

If the fact be considered as established that malaria proceeds from marshy ground, and specially from ground in the act of drying, it remains to enquire what is the nature of the malarious principle, and how far it is likely to extend itself beyond the spots which give it birth; is it a gas, an inorganic substance, either solid or liquid, or are its effects produced by the germs of organised beings, vegetable, or animal, microscopic algae, or animalcules. The last is the theory which, though disputed by many scientific men, finds most favour in the present day; every fever being considered as a fermentation produced by some peculiar germ; whence the name of " zymotic "

(*) Thus the borders of the lake Fucinus were not unhealthy until the lake was drained. As the water shrank, the area left uncovered became a focus of fevers, which gradually diminished as the land became dry, and was brought into cultivation.

(**) Dion Cassius Lib. 44. 5.

or " fermentative ", given in all sanitary reports to this class of diseases. That malarial, or aguish fevers, are not produced by a gas may easily be shown. Light carburetted hydrogen, or marsh gas, is in itself perfectly innoxious, and is in fact identical in Chemical composition with the fire damp of mines, which may constitute one tenth part of the atmosphere, so as to form an explosive mixture, without making its presence sensible bv its effect upon the lungs. Carbonic acid gas is also evolved at the same time by the decomposition of the vegetable matter; but the latter effects thc breathing alone, and has no tendency to produce the symptoms of ague, or of any other description of fever. If other gases are generated, it is only in infinitesimal quantity. Besides, modern researches are thought to have shown that even the most noxious gases have in themselves no tendency to induce fever. The most deleterious of them, sulphuretted hydrogen, may strike down at once, by causing asphyxia, if it exist in a certain quantity, or in a state of greater dilution, it may produce various unpleasant symptoms, and depress the general health of those that habitually breathe it; but, unless the germs of some specific fever are present in the air, a gas, however poisonous, is believed by many to have no tendency to produce that fever. In reference to this new theory, Professor Tyndall observes, that drains and cesspools are not in the same bad odour as formerly; since in the year 1858, when the Thames was most offensive to the sense of smelling, and was shown by Chemical tests to be most highly charged with sulphuretted hydrogen, zymotic diseases, though apprehended as the consequence, were less plentiful than usual (*).

(*) Report of Mr Simon, quoted by Tyndall in his "Fragments of Science".

That the principle of malaria is not a liquid, or solid, is equally clear. Brocchi performed a series of experiments on a very large scale, outside the walls of Rome, near the church of San Lorenzo (*). Several globes of glass were filled with a frigorific mixture, by which the moisture of the atmosphere was condensed on the outside of the glass, and allowed to trickle into a vessel placed to receive it. Every precaution was taken to insure that no dust or foreign bodies floating in the atmosphere should become mixed with the water. In this manner two pounds of liquid were obtained. A portion of this water was then tested with various Chemical reagents; but nothing was discovered by this means. Other portions of the remainder were then evaporated to dryness, in order to see whether there was any sediment, or residuum, which might be the principle of Malaria. On one occasion, when the evaporation had proceeded pretty far, a turbidness was noticed, and a flocculent deposit observed. But this was found to be derived from the glass, a minute portion of which had been dissolved by the heat and moisture; for glass being a salt (a Silicate of Potash, or Soda) is soluble in a slight degree, especially when pounded. The trial being resumed in a vessel of a different material, the water was evaporated to dryness, without leaving any sediment. Combe, therefore, was mistaken, when he said in his "Principles of Physiology" that Brocchi had succeeded in obtaining a putrescent substance, in which the principle ef Malaria might reside; for Brocchi allows that his experiment had failed (**).

(*) Brocchi "Suolo di Roma".

(**) Balestra tells us (L'Hygiène dans la Ville de Rome) that he preserved for seven years a phial of condensed dew from the

There remains, therefore, the germ theory, which I have mentioned as that adopted by many medical men in the present day. These germs are supposed to be the reproductive cells of a species of "alga", and correspond to the seeds of Phanerogamous plants. When the conditions are favourable, they germinate, and are developed into a minute Cryptogamous plant, which in its turn gives birth to an abundant crop of germs. In certain years, according to this theory, these germs appear in clouds, like flights of locusts, and, if they encounter the conditions which are favourable to their growth, they are developed, and occasion epidemic and contagious diseases, the latter of which are thought to be explicable only on the supposition of such germs. If sanitary precautions have deprived them of the soil in which to grow, their presence will be comparatively harmless. On the other hand, the conditions essential to their development may exist in the form of an atmosphere tainted by gaseous impurities, and yet, if the germs are not present, no evil may ensue. Such is the theory of germs, on which I pretend to offer no opinion. I have stated it, I think, clearly, and " valeat quantum"; let it be taken for what it is worth.

marshes of Ostia, through which were diffused minute bodies, which he conceived to be the sporules of the "alga" producing the malarial fever. He does not say whether these germs were visible to the naked eye, but only that after such a lapse of time the microscope could detect no alteration in their structnre. If the minute organisms observed by Balestra were really the germs of the malarial alga, and not the sporules of some other Cryptogamous plant, there must be few or none of them in the air of Rome; otherwise the pound of condensed atmospheric vapour evaporated to dryness by Brocchi must have left some residuum.

I have no thought of attempting an exhaustive treatise upon the subject of Malaria. My object is to indicate generally the causes to which the imputed insalubrity of the Campagna may be attributed, and then to show that this insalubrity, even if it were as great as is represented, must be confined to certain areas, either small in extent, or at a considerable distance from Rome, and cannot, consequently, extend to the populous quarters of the city. For this purpose, I have tried to show that heat and moisture combined are essential to the production of the fevers called intermittent, as far, at least, as those fevers depend upon causes beyond our control, and that the dry parts of the Campagna, which constitute nine tenths of the whole, cannot, on any scientific principle, be unhealthy during the heats of summer (*). As illustrations of this view I have adduced the Val di Chiana, and the Terai of India, already described as the strip of country where the last ridge parallel to the Himalayas sinks into the plains. In the case of the Val di Chiana, an unhealthy fen has twice within the historic period been dried by artificial means, and twice has become, not only productive but healthy. Once it was allowed to revert to its primeval state, and once it was known only as a fever breeding marsh (**). The Terai, again, which is said to be so deadly

(*) Even the modern Romans appear to concede this principle, when they declare that the short and partial rains of July and August only aggravate the Malaria, while ths copious rains of late Sept^{r} and early Oct^{r} disperse it, by lowering the temperature. If this be a fact, the explanation of it is simple enough. The dead vegetation, which, previously, had been desiccated and harmless, begins to rot, under the combined influence of heat and moisture, and generates unwholesome vapours.

(**) Such was its condition in the time of Dante, who describes

during the rains, is not unhealthy in the dry season, whether hot or cold. I have observed, also, in relation to the Val di Chiana, that its healthiness is dependent on the dryness of its *surface*, since, from the mode on which it was reclaimed, water must necessarily be found at the original level of the marsh, which would be reached at a depth not exceeding two feet or a yard. A similar observation may be made with regard to the Terai, where, from the absence of all slope towards the streams which traverse it, water must necessarily be met with at a very moderate depth. The argument that subterranean water cannot render a place unhealthy, provided the surface be dry, may be clinched by the case of Pliny maritime villa, which he describes as "pleasant in winter, but pleasanter still in summer," though water, he tells us, was found, wherever the ground was turned.

From these three cases the conclusion appears to me to be irresistible that a soil which is so dry on the surface that the dead vegetation is desiccated cannot be unhealthy at any season of the year (*). Yet, there are fanatical worshippers of the Goddess Febris, who are always trying to do her honour by extending the limits of her domain. These persons contend that even those parts of the Campagna which are parched up by a July sun, and exhibit the appearance of a brick field may be malarious for the reason before assigned. Having shown the absur-

it as a pest house," and compares it to one of the compartments of his Purgatory.

(*) The theory of germs is thought to reconcile the two cases of marshy land and arid soils. But how can these germs originate, or if conveyed by the wind, how can they vegetate, under such altered conditions! Why, also, should one dry soil be malarious, and another perfectly healthy?

dity of this notion, I will say no more about it, but assume such dried up portions of the Campagna to be perfectly healthy in themselves, though individuals, and especially large bodies of men have been attacked with fevers in such situations, from causes unconnected with the quality of the air or soil (°). There will remain therefore, as the foci of disease, the Pomptine marshes, and those of Ostia. which are the only ones of any considerable extent. The nearest part of the former is more than 30 miles from Rome, and is too distant to produce any effect upon the air within the walls, and even the latter, which is 12 or 13 miles from the city can scarcely be thought to transmit any large amount of malaria. The site of the lake of Gabii, which was one of the centres of disease, is now cultivated and healthy, and though there may be some patches of marshy ground in the little valleys which traverse the undulating plateau which stretches N. from Rome to Tuscany, it is impossible to conceive that these can vitiate the circuit within the walls. In fact, the North is the most healthy of the winds, and the season is most healthy when that wind prevails.

Our conclusions, however, will be affected by the theory of malaria which we adopt. If malaria be owing to some subtle emanation of the nature of a gas, it must, in travelling a long distance, be so far diluted by the law of the diffusion of gases which I have explained as to be perfectly harmless. If we adopt the theory of germs, it may be argued that, though the germs will be more widely scattered the further the distance they have to travel, each germ is complete in itself, and may sow

(°) Such cases will he considered in a subsequent section.

the seeds of disease; but again, the theory supposes that these germs vegetate only when they meet with a suitable soil, that is to say, an impure atmosphere, and this soil is usually conceded to be a gas, which, by the law that I have referred to before, cannot accompany the germs, but must exist at the place to which the germs are transferred.

From what I have said it is clear that, though malarious fevers may arise from other causes, they usually have their source in marshy districts during the hotter season of the year. It is equally clear from the illustrations I have given that, when the surface is thoroughly dried by artificial means, or, as in the case of the Terai, by the intense heat of the sun, these marshy districts invariably cease to be unhealthy. Yet, strange to say. those who maintain that aguish fevers do not proceed from any specific poison, are able to bring forward a host of cases where individuals, but specially large bodies of men, have been attacked with fevers of the malarial type, in dry soils, arid plains, and elevated and rocky positions. Of these cases I will select a few from

Dr Oldham's work: "What is Malaria"? in which he has collected a large number of cases, chiefly those reported by physicians who had practised in India. These cases, if they do not carry conviction to the mind of the reader, will show at least the extreme difficulty of arriving at a satisfactory conclusion as to the origin of malarial fevers.

"In the valley of the Guadiana", says Dr Fergusson, "the army was almost destroyed by remittent fevers, the country being so dry for want of rain that the river was only a chain of pools. At the town of Corea in Estremadura on the banks of the Alagon, a very pure and limpid stream, our troops experienced similar results". "Yet there was not an aquatic weed" adds the writer, "nor a speck, nor a line of marsh to be seen within miles of the town".

Dr Moore remarks of the sandy deserts of Rajpootana: "There are no floods, or heavy rains to deposit organic matter on the surface. There is little, or no, organic matter mixed with the sand. Water is some 200 feet from the surface, and the under stratum is a layer of sandstone. Yet the dwellers in these regions are martyrs to the so called malarious diseases".

"The large military station of Kamptee,(*) which enjoys the evil repute of being the hottest place in India, is," as our author observes, "one of the most unhealthy. Yet the station, as well as the neighbourhood, is remarkably free from all the supposed sources of Malaria. The ground is undulating, elevated, and open. There is no marsh. The

(*) "What is Malaria"? By C. F. Oldham. M. R. C. S. L. etc. etc. 1871.

(*) Kamptee is in the vicinity of Nagpore, on the table land of Central India.

banks of the small river which runs past the station are either perfectly bare of trees, or cultivated with the dry grain crops of the country. The bed of the river is rocky and sandy. The jungles, which have been accused of causing the Malaria, are at a distance of 15, to twenty miles, from the station, and during a great part of the year, the wind blows from the opposite direction. (*)"

The so-called "hill fevers" of India may well, says Oldham, be a puzzle to those who associate Malaria with low and marshy districts. It has been observed that low ranges of hills, not exceeding 2 or 3000 feet in height, as well as certain well defined belts on the slopes of higher mountains, are often highly malarious. It is unnecessary to specify the sites. About the fact there is no dispute, and an explanation of the phenomenon will be attempted hereafter.

Finally, as an illustration of the fact that a sudden change of climate from hot to cold may induce fevers having all the characters of Malaria, Amand observes, (**) "that many soldiers, after campaigning in Africa, where they have enjoyed good health, on returning to France in the cold season, will be seized with an attack of intermittent fever, to which, till then, they had been strangers. The same fact was not rare among the military surgeons who passed rapidly from the ambulances of Algeria to the hospitality of Strasburg, Metz, or Lisle" (L'Algeria médicale, quoted by Oldham).

It was to explain these cases, and reconcile them with the generally accepted theory of Malaria, that the existence of subterranean water was assumed. But in one

(*) See Oldham p. 78.
(**) Quoted by Oldham.

of the instances mentioned water was found only at an enormous depth, and in the others its existence could only have been a surmise. Besides, I have shown that, in all the instances with which I am acquainted, a marsh has ceased to be unhealthy, when the surface was dried by raising the level, even when, owing to the conformation of the ground, the subsoil water could not be drained away. It is absurd, therefore, to suppose, that, when the surface is dried by artificial means a marsh becomes healthy, and yet, when the ground is naturally arid, it can, all other conditions remaining the same, be unhealthy.

Enough may seem to have been said on this subject; but the account given by Dion Cassius of the partial reclaiming of the Pomptine marshes, in the time of Julius Cæsar and Augustus, is so remarkable in itself, and affords such a confirmation of my views, that I cannot refrain from quoting his words. When the senate were showering distinctions and privileges upon Julius Cæsar towards the close of his career, it was proposed, among other schemes, "to reclaim in his honour the Pomptine marshes." The expression used by Dion Cassius is: τά τε ἕλη ὁι τὰ Ηομπτῖνα χῶσαι, "To raise, in compliment to him, the level of the Pomptine marshes". As χῶσαι means "to heap up earth", the soil for that purpose was probably obtained from any hillocks which might have existed in the marshes, or by digging reservoirs several feet in depth. In Lib. 45, 9, the same historian relates "that Antony, in order to ingratiate himself with the people, and draw them over from the party of Octavius to his own, brought in, through Lucius Antonius his brother, the tribune, a measure for granting large allotments of land, both in other places, and in the Pomptine marshes, which had now

their level raised, and were capable of being cultivated," (*)

It is remarkable that there is no allusion in this passage to the malaria of the marshes, or to their increased healthiness as the consequence of the operation of raising the surface, but only to their greater capability of cultivation. It is evident that the ancients made light of what is such a bugbear to the moderns, and, perhaps, when we consider the influence of mind over matter, their scepticism contributed to their security. It may also be observed incidentally that, according to the foolish theory of Arnold, which he doubtless adopted from others, the malignity of the Demon of the marsh ought to have been increased by the trouble to which he was put in having to force his way through two or three feet additional of soil. (See page 75-Note),

But, if the existence of subterranean water is in many cases a gratuitous supposition, and if, where it exists, it can supply no noxious element to the air, what, it may be asked, is the cause of the fevers which are said to haunt those sites in India and in Spain which have nothing in common with the wet and low lying districts where the head quarters of ague are usually to be found, sites where the soil is parched and the position elevated, and where, as in India, the disease breaks out not in the hottest months, but after the rains have set in, or the scorching heat is replaced by chilly winds descending from mountain

(*) Ὁρῶν οὖν ὁ Ἀντώνιος τὸν Καίσαρα αὐξανόμενον ἐπιχείρησε δελεάσαι τὸ πλῆθος εἴ πως ἐκείνουτε αὐτοὺς ἀποσπάσειε καὶ ἑαυτῷ προσποιήσειε, καὶ, χώραν ἄλληντε πολλὴν καὶ τὴν ἐν τοῖς ἕλεσι τοῖς Ηομπτίνοις, ὡς κεχωσμένοις ἤδη καὶ γεωργεῖσθαι δυναμένοις, κληρουχηθῆναι διὰ Λουκίου Ἀντωνίου ἀδελφοῦ δημαρχοῦντος ἐσηγήσατο. L. 45. 9.

gorges? All who have written on the subject have tried to refer these fevers to one simple cause. The votaries of miasma assume that miasma may arise, in some occult manner, from every soil and rock upon the earth; even from disintegrating granite, as at Hong-Kong; though it is impossible to conceive how a substance which has been subjected to the heat of the central fires could retain any organic matter in its interstices. Such organic matter must not only have been carbonised, but volatilised, long before the molten granite cooled into a rock. The upholder of the germ theory takes for granted that these germs must be present, wherever he hears of Malaria, forgetting that the lower the organization of a plant, the more peculiar are the conditions under which it is able to germinate. Thus we never see lichens on walls protected from the rain, and this is implied in the popular name given to them of "weather stains". (*) Lastly, those who, like Oldham,

(*) In Paris a peculiar species of edible fungus is said to be raised by preparing a compost of certain earths and manures, in fixed proportions. No spawn is required; for the sporules appear to be always floating in the air ready to take advantage of the only soil in which they are able to grow. Many decaying substances have their own peculiar moulds, and those who make a special study of the Botany of Cryptogamous plants occasionally detect, in unusual positions, species never before described. The sporules of these may have been floating in the air, or diffused through liquid or solid substances, awaiting for years, perhaps for ages, the conditions under which alone they can germinate. The difficulty of explaining how the lower forms of animal and vegetable life could spring up invariably under certain conditions of soil, moisture, and temperature, led to the belief in spontaneous generation, once almost universal, and still held by a few in the present day. The reader may perhaps recollect the controversy on this subject carried on in the pages of the Times between Dr Bastian and Pro-

explain every thing by a chill, fail entirely when they come to apply their theory to the fevers engendered in marshy districts. The truth is, no single hypothesis will afford an explanation of all cases of malarious fevers: so various are the circumstances under which they arise. In fact, when we consider how much the laws of matter are modified by the vital principle, and how much the vital principle itself is controlled by the action of the mind, (*)

fessor Tyndall, who holds the only rational theory of "Omne animal ex ovo". The Doctor got many severe throws in the struggle, but rose undaunted, shook himself, and renewed the contest. Finally, the victory rested, as I conceive, with the Professor. The controversy, I believe, related to the appearance of Bacteria, and other animalculae, in water where sufficient pains had not been taken to exclude their spores or germs; but the arguments for, and against, spontaneous generation are equally applicable to the vegetable creation. It would seem that the more peculiar the conditions under which a Cryptogamous plant can vegetate the more widely diffused are its germs, and, as it appears from the experiments of Professor Tyndall that certain germs are omnipresent, it follows conversely that they can be developed only under conditions which rarely occur; otherwise, the developed plant would be found in every situation and on every substance. If, therefore, the germs of the Malarial alga are capable of vegetating under the most opposite conditions, they must form an extraordinary exception to the general law of Cryptogamous plants, and every soil on the face of the earth would be impregnated with them, and become malarious.

(*) This subject has been treated at great length by Dr Carpenter in his work entitled "Mental Physiology." See Chap XIX of that work, headed "Influence of Mental States on the Organic Functions" pages 683, 684, 685. The points most strongly insisted upon by Dr Carpenter are, that the constant direction of the thoughts to any part diseased, or supposed to be diseased, will have the effect of causing a flow of blood to that part, and of aggravating in one case, and perhaps inducing in the other, the dreaded disease; on the other hand, that *the confident expectation of a cure,*

we cannot expect to reduce the derangements of the animal economy to principles as simple as the perturbations of the planetary bodies, where the most complicated movements may be resolved into the attraction of gravitation combined with the original velocity of projection, If to chills we add over-heating, and over-exertion, we may find in the first and last hypothesis, the origin of every kind of fever which is not contagious, and may take our measures accordingly, though we may be still in the dark as to the precise mode of action on the system. The theory of germs, which is nothing but a speculation as to the mode of action, is beset with peculiar difficulties in the case of malarial fevers. "As a moist atmosphere " observes Oldham, "is essential to the existence of these vegetations, it is impossible that they can live in hot, dry, and parched countries, amid barren rocks, and sandy deserts, where malaria, nevertheless, is very prevalent. If malarious fevers be produced by similar organisms, what becomes of the spores produced during a case of ague? They must leave the patient, or he could not recover. They do not infect the atmosphere, or the clothes of the patient, or the disease

whether by pretended physical, or supernatural means, is the most potent agent in bringing it about, The most melancholy feature in the plague at Athens, as described by Thucydides, was the despair which seized upon all that were attacked, and which, by preventing them from making an effort to resist the disease, rendered recovery almost impossible, while greater faith in the resources of the healing art has certainly contributed to lessen the mortality by the same disease in modern days. The curative influence attributed to change of air is, no doubt, due, not to any difference in the constitution of the atmosphere, but to change of scene, and to the novelty and interest of the objects which divert the mind from dwelling on its bodily sensations.

would spread through them. They do not establish themselves on the bodies of the attendants, or they would be attacked by the same disease."

"If, after reproducing itself to such a marvellous extent within the body, the whole mass of vegetation—plant and germ—parent and offspring—suddenly ceases to exist, what puts an end to its life, and what becomes of the debris?"

But, whether the theory of germs be true or false, it is of no practical importance. That marshy ground, during the hotter season of the year, is a focus of disease appears to be established by overwhelming evidence, and it is a matter of no importance to those attacked whether the noxious influence is exerted through the medium of germs, or of some subtle emanation which has hitherto eluded the researches of Chemists. On the other hand, that fevers, having all the characters of malarial fever, often break out among those who are stationed on dry, rocky, and elevated sites, rests upon evidence almost equally conclusive; for the cases which I have adduced might, if space permitted, or the patience of the reader allowed, have been multiplied tenfold.

Assuming, therefore, the fact, we will try to explain the cause of the fevers, which originate under conditions so different from those of which we have treated hitherto. The first thing to be observed in the cases I shall proceed to cite is, the extraordinary variations of temperature in these unhealthy spots. If we are to believe Oldham, the thermometer at Kamptee during the *cool* season ranges from 36° to 110° in the shade, and hoar frost is occasionally formed. (*) The consequence is, a large percentage

(*) Kamptee being within the tropics the power of the sun is great, even during what is called the cool season in Bengal, and

of sickness among the white soldiers exposed on sentry duty, as well as among the native population. The next thing to be noticed is the almost complete immunity from fever enjoyed by those who possess the means of protecting themselves from the weather.

According to Annesley, quoted by Oldham, in the hilly district of Sirgoojah, the range of the thermometer during the rainy season is upwards of 70° in 24 hours, and a similar variation of temperature is probably the reason of the fevers with which the natives, woodcutters and others, are attacked in the Sâl forests on the plateau of Amarkuntuk 3000 feet above the sea. At the same time European officers with good tents, bedding, and clothing, find the climate refreshing and invigorating. The native servants, also, of the officer who was the informant of Oldham, being well protected from cold, escaped fever.

"In central Africa fevers," says Livingstone, "are very prevalent in July, corresponding to our Jan^{y}. At an elevation of 4000 feet temperature varies from 94 and 96° to 42° and 52°. The Balonda (a Negro tribe) at this season, never leave their fires until 8 or 10 in the morning"

At Dalhousie, the highest portion of which is at an altitude of 7800 feet, intermittent fevers are common, and remittents not unknown. Both are prevalent during wet seasons among the native servants, and other natives from

the upper Provinces of India. It is situated, as I have said, on the table land of Central India, and table lands, if of considerable extent, are at least as hot during the day as the plains little elevated above the sea, while at night they are colder according to their elevation. Hence the extraordinary variation of temperature above stated is the more easy to be conceived.

the plains, who are very sensitive to the cold, and seldom sufficiently protected from its effects, being thinly clad and often very badly lodged. The warmly dressed, and well housed white population, suffer but little from these fevers.

I will conclude with one of the most remarkable of the cases adduced by Oldham in support of his views, that of the chokee, or station for palanquin bearers, on the Dalhousie road, in the ascent to the Himalaya mountains. The site of the station was once a narrow ridge of clay slate 5000 feet above tho sea, on either side of which was a sheer descent of 600 or 700 feet to the rocky beds of two mountain torrents. No situation could be conceived more free from all those conditions on which marsh fever is supposed to depend. Yet, out of 30 or 40 men stationed there scarcely one escaped fever. "I have frequently," says Oldham, "found more than a dozen men at once prostrated by intermittent fever, and most of the others suffering from the effects of the disease." The cause of these fevers was discovered to be the icy blasts which at night swept down a mountain gorge, that opened upon the station, from the snow clad Himalayas, which rose beyond; for other villages near the Chokee in more sheltered situations were perfectly healthy. "The station was removed", adds Oldham, "and with the best results." (*)

(*) Bangalore, the British station in Mysore, is 3000 feet above the sea, and remarkably free from all supposed sources of Malaria. But, though it is one of the healthiest stations in India for the white soldier, the native troops from the low countries are particularly liable to fever, especially on their first arrival. How can this be explained, except by the greater susceptibility of the latter to cold, and consequent liability to chills? It is a fact, also, deserving of notice, as pointing in the same direction, that several stations, whose

From the illustrations which I have given of the malaria which haunts the marsh, and from the evidence which I have quoted of the fevers which attack the sojourners in dry and elevated sites, it is plain that aguish, or intermittent fevers, may be due to two causes perfectly distinct; some influence, yet unexplained, of marshy ground, at certain seasons of the year; or chills produced by exposure to the weather in those whose hèat generating power has been weakened by long residence in the warmer climate of the plains. To these we may add overheating, and the fevers induced by it, called ardent fevers, upon which intermittent fevers so often supervene that some writers have assigned to the former diseases a malarious origin. No human ingenuity, in the present state of our knowledge, can reconcile the two cases of the miasma arising from

uncouth names it is not necessary to repeat, have been successively abandoned, reoccupied, and again abandoned, under the impression that they had become unhealthy, or the reverse. Yet the Chemical qualities of the soil, and the Geological conformation of the ground, could not have altered in the interval; but the weather might have varied greatly, and the diseases resulting from exposure to it might, at one time, have been intensified, and at another. have appeared in a milder form. A still more remarkable case is that of Sir Samuel and Lady Baker who, on board their comfortable boat, with plenty of good, dry, clothing, and shelter from the weather, passed through the swamps of the White Nile in safety, though their native boatmen, from being constantly wet, suffered severely from fever, and the people of the country are described as fever stricken wretches. Afterwards, when exposed to constant rain, without change of clothing, with indifferent shelter, and suffering from hunger and fatigue, these adventurous travellers nearly lost their lives from fever, on a tableland some 4000 feet above the sea (Quoted from Oldham page 148) See also page 137. Report of Royal Commission I. XIX. 21, already quoted. page 83 of this work.

marshy ground, and the fevers originating in dry and elevated sites. Consequently, the believers in marsh miasma as the sole cause of ague are driven to make various gratuitous assumptions, when they try to account for the malaria of arid plains and hilly localities, assumptions which, even if they were correct, would fail, as I have shown, to establish their point. On the other hand, those who would refer every ailment to a chill break down completely, when they come to apply their theory to the fever of the marsh. Thus, to produce the required chill, Oldham calls in the aid of that factotum "damp," (*) the

(*) The vulgar notion of the deleterious effects of damp is evidently an unwarrantable conclusion from the fact that water applied to the skin produces a powerful sensation of cold, so that wet feet and wet clothes may be the source of various and fatal diseases. But, if the power of aqueous vapour to carry off heat bore any relation to the cold produced by the evaporation of water, the other constituents of the atmosphere, Oxygen and Nitrogen gases, ought to be colder still. Oxygen and Nitrogen gases have never been liquified, like carbonic acid, and, consequently, Oxygen aud Nitrogen must be substances of extreme volatility. If, therefore, solid carbonic acid "burns frore", to use the expression of Milton, and a small piece of it placed upon the hand disorganises the tissues, and produces a little sore, like a fragment of red hot charcoal, how intense must be the cold produced by the evaporation of Oxygen and Nitrogen. Oxygen and Nitrogen gases ought, therefore, if the assumption of which I have spoken be correct, to absorb more heat than aqueous vapour, and a large mixture of the latter ought to make the air feel warmer. As a matter of fact, the specific heat of aqueous vapour is a trifle greater than that of atmospheric air, in the ratio of 29 to 23 (Fownes' Chemistry pages 57. 58). But this slight difference in the power of absorbing heat is more than counterbalanced by the effect of hygrometric moisture in lessening the insensible perspiration by which the animal heat is carried off, in impeding radiation on clear nights, and in giving out latent heat,

servant of all work to those who are content to father every notion which is current among the vulgar. Yet there is nothing in the Chemistry of the atmosphere more certain than that the drier the air the greater the diurnal variations of temperature, so that the air over a marsh must be cooler during a summer's day, owing to the evaporation from the humid ground, and warmer at night owing to the impediment which the stratum of watery vapour near the ground offers to radiation into space. Oldham, in fact, though his reasoning on most other subjects is sound, appears, like the rest of the world, to have a very confused notion of the nature of "damp," and the phenomenon of dew. In one place, he attributes the comparative healthiness of certain warm and humid sites to their equable temperature, and explains the equability of the temperature, by the large quantity of moisture with which the air is loaded. In another, he speaks of damp, and copious dews, as intensifying the cold of other sites, which have the reputation of being malarious; the truth being, that the hygrometric moisture in the air serves to regulate the fall of temperature, while the dew, whether copious or not, is the consequence, not the cause, of the cold produced by terrestrial radiation.

To the theory of chills the objection has been raised that cold may occasion catarrh, bronchitis, rheumatism,

when precipitation takes place. A person, therefore, exposed to the night air on a clear night will be less likely to get a chill, if the atmosphere is moist, than if it is dry. In all my reasonings I may repeat what I have said before, that by damp, or moisture, I understand the invisible elastic vapour dissolved in the air, like white sugar in water, and not visible mist or fog, though the chilling effect of a mist is greatly exaggerated, and though the mist itself is the consequence, not the cause, of the cold which attends it.

and similar complaints, but has no tendency to produce intermittent fevers. If, however, we are to believe the concurrent testimony of the physicians who have practised in India, as well as the evidence of travellers, like Livingstone, and Sir Samuel Baker, fevers having all the characteristics of malarial fevers, even to the enlargement of the spleen, may be the consequence of exposure to the weather in warm climates, at seasons, and in localities, where the variations of temperature are great and sudden. Similar fevers may supervene upon complaints produced more directly by the cold, or may be, as we have observed, the result of overheating: for, as Dr Henderson, quoted by J. R. Martin, observes, (*) "where the line is to drawn between apoplexy, (heat fever) and remittent fever, it is difficult to say". Dr Mackinnon, also, well remarks; "In fact, we may be assured, that under what head a particular case of fever is entered often depends upon arbitrary, and preconceived opinions." (**)

From a review of the evidence on either side it is plain that the Malaria of the Pomptine and Ostian marshes, and the fever which attacks the dwellers in the dry and elevated parts of the Campagna, must be placed in two distinct categories, and explained on two different principles. Some law connecting the two cases may be hereafter discovered; bnt at present no glimpse of such a law can be discerned; so that the upholders of miasma, being unable to explain, are tempted to ignore, the facts which militate against the popular theory. I have said that the Malaria of the marshes, though greatly exaggerated, is undoubtedly a reality; but, as they are at too great a

(*) Quoted by Oldham.
(**) Quoted by same.

distance to produce any sensible effect upon the health of Rome, we may leave them in abeyance, and proceed to enquire how far the cases of fever which occur in the parts of the Campagna contiguous to Rome may be due to the mode of life of the inhabitants, to Meteorological conditions to which they alone are exposed, or to the indiscretions of individuals.

In most of the cases which I have extracted from the work of Oldham, the fevers are clearly traceable to chills produced by great variations of temperature, and by exposure to wet and cold. In the plains of Estremadura the same causes were probably in operation, in conjunction with over-heating and over-exertion, and the disease so produced in our army was, perhaps, aggravated by neglect of sanitary precautions. Armies in the field always suffer more from sickness than from the sword or bullets of the enemy, and this sickness is almost always set down to the account of the climate. Thus many spots acquire the character of being malarious simply because they have been the theatre of war, which always brings unwholesome influences in its train.

The principles to be gathered from these cases I will now apply to ihe explanation of the fevers which attack the poorer classes in the drier parts of the Campagna, which constitute as I have observed, nine tenths of the whole.

The mode of life of the agricultural labourers in the Campagna, as described by Balestra, goes far to explain the sickness and mortality among them during the summer months. Of these labourers not more than 3000 are permanent residents in the Ager Romanus. The rest, amounting at times to 25,000, are a migratory population, who have left their homes in Central and Southern Italy, to reap the harvest, or prepare the ground for the reception of the grain; and some of them have descended from the pure and bracing air of the Sabine mountains. All day long they work under a burning sun without nourishment sufficient to sustain their strength, and at night they are often unable to obtain the shelter of a roof. Every one, says Balestra, knows how badly fed these labourers are, even when their food has been furnished by the

farmers — Mercanti di Campagna — but they are still worse off, when it has been supplied by the *Caporali*, or mercenary headmen, who make a disgraceful profit out of these poor people. At harvest time, the food of the country people who gather in the crops consists of nothing but bread, onions, a little bacon, or cheese, and water mixed with vinegar to quench their thirst. Very rarely are they allowed a tumbler of bad wine mixed with water. We have here a kind of food, insufficient in quantity, inferior in quality, and not possessing that proportion of the nitrogenous or albuminous principle which is necessary to maintain the bodily vigour, and repair the loss of muscular tissue sustained during the extraordinary labours of harvest, and the subsequent tillage of the land, Then, every evening, after having undergone such immoderate fatigue under a broiling sun, the labourers do not always succeed in finding a place of shelter in the cottages few in number, and scattered as they are, which deserve rather the name of huts, and often do not possess benches to lie upon, The greater part, not having even such beds as these, and being obliged to be ready at daybreak to resume their work, lie down in the midst of the fields, on the bare ground, under the vault of heaven, covered only with the light and ragged clothes in which they have worked during the day (1) "Many of these unhappy men," Balestra

(1) The variations of temperature are much greater in the country than in towns. If we are to believe one Davy quoted by Oldham, while the diurnal variation at Valetta was only 4° Fahr, it amounted to 20 Fahr in the country, in the months of Aug. and Sept. 1833. The diurnal variation at Rome in July and August, as observed by me, is about 25°, when the weather is clear and calm. If we

goes on to "say, are attacked with severe complaints, especially pernicious fevers, and many succumb to them.' These are the persons who fill the hospitals, swell the death rate, and gain for Rome the reputation of being an extremely unhealthy city. In the statistical tables drawn up at the Capitol of late years the patients from the country are distinguished from the patients of the town, and thus one source of error is removed. (1) Dr. Balestra, whose work is written to show that all intermittent

suppose the variation to be even 5° greater in the open Campagna, or 30°, we have *one* reason why the badly fed labourers, sleeping without sufficient covering under the canopy of heaven should get a chill. Balestra observes that the variation of temperature is greater in Florence, and other places where intermittent fevers do not prevail. But at Florence there is no class of men living under the same conditions as the agricultural labourer of the Ager Romanus, who, if he were well fed, and well covered at night, might, I believe, sleep with impunity, and, perhaps, with benefit, under the summer sky.

(1) The harvest, beginning in the middle of June, is usually over before the middle of July, and this is not considered the most unhealthy time of the year. But then commences what is called the "rinquartatura," or ploughing the land, and preparing it for the reception of the seed. This work which lasts to the commencement of Sept^{r} is pronounced by de Tournon, "Etudes statistiques sur Rome", quoted by Balestra, to be the most pernicious, and most murderous of any. "I will not venture," he observes, "to say how many labourers, overcome with fatigue, living so miserable a life, and exposed to the heat of the Dogstar, are overtaken by severe and mortal diseases, especially after the sudden variations of temperature which characterise the Autumn have commenced, and the first showers of the season have begun to fall. At this time the great hospitals overflow with these wretched, veritable slaves of the soil, who quitting every year the pure air of their native land, come to encounter an inglorious death upon a terrible field of battle."

fevers are due to the germs of a peculiar alga, which has its origin and development in marshy and humid districts during the heats of summer, appears to be unconscious that by his recital of the unhealthy life led by the agricultural labourers he is weakening his own case. For, if his account be correct, why, it may be asked, should we look beyond the want of nourishing food, and the exposure at night without sufficient covering after a day of toil, for an explanation of the fevers with which these labourers are attacked. Dr. Balestra, and others who hold the same views, may perhaps reply that the germs are the proximate cause of the fevers, and that the unhealthy influences which he describes merely dispose the body to receive them into the system. But the prevalence of malarious fevers in India, in spots where there can be no suspicion of marsh miasma, or of the presence of the germs supposed to be generated in marshy ground, shows that, where certain Meteorological conditions exist, exposure to them without protection may be sufficient to produce fevers having all the characters of the intermittent fever of the marsh. On the other hand, protection against them will, as has been observed, afford *absolute immunity* from attack. These fevers, to which so many of the agricultural labourers in the drier parts of the Campagna fall victims, are the exact counterparts of those from which the thinly clad and badly housed Hindoos suffer when removed to the arid and elevated sites which I have described, and both have a common origin in the derangement of the animal functions by heat, cold, or excessive toil. Unfortunately, in the case of the Campagna, we have no evidence of the exemption from Malaria whioh would, I believe, be enjoyed by persons in

confortable circumstances, because few, or none, of the Italian gentry, or the richer foreigners, spend the summer in villas in the open country. One singular case, however, is mentioned by Balestra of a rich English family settled in the Campagna — in what part he does not say — who preserved their health by sleeping during the day, and passing the night awake. On this case it may be observed that, as the body is said to be more susceptible of the malarious influence during sleep, the air of the day could not have been very noxious, when this family could sleep in it with impunity; on the other hand, as the malarious principle is said to be more highly concentrated at night, the air of the night could not have been very deleterious, when it could have been breathed without any ill effect by simply keeping awake.

As we have scarcely an instance of a family which can command all the indulgences of life spending the summer in the wilder parts of the Campagna, so we have none of large bodies of men well fed, well clad, and sheltered at night, passing the most unhealthy months outside the walls of Rome. It is, therefore, impossible to prove, what I believe would be the result, that labourers, or soldiers, under the favourable conditions supposed, would retain their health. The case of the French army which conducted the siege of Rome in 1859 is often cited by those who hold with me that nothing but good food, protection against the weather, and the avoidance of whatever may overtask the bodily powers, is required *in the dry and undulating* Campagna, to afford absolute security against fever. The men were housed at night in tents were of course well fed and clothed, and enjoyed excellent health throughout the siege. But the Malaria

— mongers might take exception to this case, because the siege was over, and the army had entered Rome, by the 30 June, whereas the unhealthy season is not considered to commence before the month of July, and embraces July, August, and the early part of Sept.r The case, however, is good, as far as it goes, and may be set off against that of the labourers who gather in the harvest in the month of June. If, moreover, the health of the French army is nothing to the point, we may find evidence, of the nature we require, in the exemption from fevers in India enjoyed by the civil servants of the government, as compared with the soldiers and noncommissioned officers of the army. the cases being only 20 in a 1000 among the former against 83 among the latter, (see page 83).

Supplying, therefore, the evidence which is wanting in the case of the Campagna by what occurs in other parts of the world, where the sites are similar, we may assume that, with the exception of certain spots of limited extent, which may be avoided by those who believe in their unhealthiness, the belt of country for many miles beyond Rome cannot be malarious in the proper sense of the word, and cannot, consequently, infect the air of the city. The fevers which attack the country people and others within this belt must be due to causes which are under the entire control of man, and which may by certain precautions be rendered completely innoxious. These precautions, we will now proceed to consider.

Of those recommended by the Italian Doctors few are of any value. One or two may be dictated by common sense; but the greater part are at once vexatious and useless, or are opposed to every sound sanitary principle. Of some the efficiency may be doubted, though it cannot be disproved.

Thus Brocchi maintains that the exemption of the ancient Romans from Malaria was owing to the woollen garments which they wore, and that the moderns should go forth to do battle with the Demon of the marsh incased in no other armour than a flannel shirt and drawers. To me it seems that, as long as the mouth is open to inhale the marsh miasma, or the germs of the supposed Malarial alga, it matters little that the absorption of the latter by the skin is somewhat checked by the flannel, assuming that the flannel has the effect supposed. It is more likely that the woollen tunic of the Romans acted, as it would act in the present day, by absorbing the perspiration, and preventing the chill which arises from allowing it to cool upon the skin.

Balestra's book is full of minute and vexations precautions, so that one is reminded of the verse of Juvenal

"Et propter vitam vivendi perdere causas,"

and tempted to ask, whether life would be worth purchasing at a cost of trouble and anxiety which would destroy the inducements for living. Balestra's only concern is to exclude the germs of Malaria, and he cares not whether, along with these germs, he excludes the vital air of heaven. As Brocchi is all for flannel, so Balestra is all for avoiding exposure to the wind, and hermetically closing the chamber against the admission of fresh air.

Of the precautions which are usually recommended to visitors by the physicians of this place I will select two, which are pre-eminent by their absurdity, and by the ignorance which they display of the Chemistry of

Nature, and treat them somewhat in detail. The first is, not to be abroad after sunset, the hour following which is supposed to be the most unhealthy in the twenty four, At that hour the Demon of Malaria is supposed to be making his rounds, and it is only after he has retired from his beat that any body ought to venture abroad. People are strongly advised, also, to retire before that time from the grounds of the Borghese, and other villas, where there are plantations of trees. Have those who adopt these notions, and transmit them to others, ever troubled themselves to enquire what new forces can be called into action by the setting of the sun, or how existing forces can be intensified by the mere disappearance of that luminary? It is a popular belief, disseminated by ignorant teachers, that there is a sudden fall of temperature at sunset. If the persons who hold this belief chose to watch the thermometer for several days in succession, during any season of the year, they would find that the temperature, instead of falling rapidly, sinks very slowly after sunset, until ten or half past ten, when the land wind springs up, and the Mercury begins again to descend. The fall of temperature, which in calm and clear weather often amounts to 25° in 24 hours, takes place almost exclusively between 3 P. M. and sunset, and betveen 9, or 10 P. M. and sunrise. Thus the two hours after sunset are those when the temperature, instead of falling rapidly, is most nearly stationary; and these two hours are in summer the most sultry of any, because the sea breeze has died awa , while the land wind from the Apennines has not yet sprung up.

It is untrue, also, that the dew, which is supposed in some unaccountable manner to exert a noxious influence

on the human frame, does not *begin* "to fall" until the disappearance of the sun. Wells tells us that he has frequently felt the grass moist in dry weather several hours before sunset, though he has never known dew to be present in such quantity upon grass as to exhibit visible drops before the sun was very near the horizon. (1). It is equally untrue that the formation of dew *proceeds with greatest rapidity* during the hour or two immediately following sunset. On the contrary, since the precipitation of dew depends on the fall of temperature, and the fall of temperature is slowest during the time of which we are speaking, the "fall" of dew ought also to proceed at a slower rate. But, whether the formation of dew be slow or rapid, none of it can be deposited, as I have shown (pages 67, 68), upon the exposed parts of the body, or on *thin* clothing. To dread a chill, therefore, from walking on a dry road, or footpath, because the grass is drenched with dew, is as absurd as it would be for A to apprehend catching cold because a bucket of water had been emptied over B.

It thus appears that the Meteorological conditions which are generally considered to be disposing causes of Malaria (2) are feebler and more equable during the hours of evening twilight. Consequently, there is no ground for the popular belief in the peculiar unhealthiness of the hour immediately following sunset, a belief so wide of

(1) Wells on Dew. Ed. Casella. page 6.

(2) Some persons suppose that the dew, besides giving a chill, attracts the spores of the Malarial alga. But, since the dew, as I have explained, is confined to the surface of the bodies on which it is precipitated, the greater the number of spores attracted by it the fewer must remain in the air,

the truth that it can be accounted for only by the tendency of the human mind to erroneous conclusions, or, as Bacon somewhat coarsely expresses it, by "the love of the lie. (1)

As for those who think that certain villas are malarious, owing to the *presence* of trees, I leave them to settle accounts with those who maintain that the unhealthiness of the Campagna is due to their *absence*.

Leaving, then, this tissue of absurdities and contradictions, I will proceed to consider the most preposterous of all the notions current at Rome, namely, that the exclusion of fresh air at night is conducive to health, or preventive of disease.

On the practice of closing the windows at night

There is nothing on which Italian Physicians insist more strongly than on closing the windows of the bedrooms at night, even in the hottest weather. Yet this is a practice as much opposed to common sense as to the principles of scientific hygiène, That there is no danger in sleeping with the windows open my own experience shows. Every night during the hottest months of eight

(1) The believers in this fallacy talk as if a floodgate was opened at sunset letting loose the Malarious Vapour; but assuming this absurdity to be true, when once it is liberated why should the vapour disappear, or diminish in intensely, at the expiration of an hour or two.

and a half summers, that is to say about 800 times, I have slept with my windows as wide open as they could be thrown, and never caught the fever, or experienced any other inconvenience from so doing. Indeed, I consider that the cool and pure morning air has been the means of preserving my health during the scorching heat of July and August,

The notion that there is something unwholesome in the night air is nothing but a form of the superstition which associates every thing fearful, and every thing evil, with darkness, and with the colour black. Ghosts were thought to roam abroad at night, and to vanish at the crowing of the cock. On Walpurgis eve the witches were believed to hold their orgies; the devil is painted black, and, in the middle ages, a black cat was thought to be the form which some of his imps assumed. In like manner, some noxious influence is believed to pervade the atmosphere during the hours of darkness. Yet the mere absence of the sun can produce no change, except in the temperature and relative humidity of the air. As well might we expect that closing the shutters during the day, and putting out the fire, would alter the constitution of the air within a room. " Why," says Waterton, " should man be so terrified at the admission of night air into any of his apartments. The cow and the horse sleep safely on the cold damp ground, and the roebuck lies down to rest in the heather on the dewy mountain's top. I myself can sleep all night long bareheaded under the full moon's watery beams, without any fear of danger." (1) But,

(1) Waterton's essays 2nd series. Chap. on Fresh Air. R, Rawlinson, C. B., the civil Engineer, in a letter addressed to the

while the night air is really innoxious, the air of a bed room shut up for seven or eight hours must become vitiated by the breath of even one or two persons, and by the emanations from their skins. And the vitiation is greater if the weather be hot, because there is not even that imperfect ventilation which is produced by the cold air forcing itself in through every cranny in the doors and windows. "There are," says Prof. Williams, "few mephitic gases more foul than those which are excreted from the animal body itself." (1) Yet these foul gases the Doctors recommend us to breathe in preference to the pure air of heaven. I have instanced the case of the Black Hole of Calcutta, where many of the 26 who escaped suffocation died of Typhus, not caught by contagion from others, but induced by the poisonous air which they had been compelled to inhale. This, it may be objected, is an extreme case; but, though the air of a shut up bed room may not be so vitiated as to produce Typhus in a night, it must, by depressing the vital energies, predispose the body to that, and to other fevers.

But it is necessary, the Italian physicians would say, to exclude the malaria with which the night air is charged. To this it may be replied that in the same degree in

Times in, I believe, the Aug. of 1872, makes this remark, in reference to the subject we are discussing. "Night air is the only air which can be had at night; but it need not be feared. Any outside fresh air is better than lung and skin tainted inside air." "Oh si sic omnia"! In this there is sound sense; but in a letter addressed to the Times of the 20th May 1876, on the health of Rome he starts with an assumption which I shall have occasion hereafter to controvert.

(1) Principles of Medicine. 2nd vol, p. 44 Lond. 1848.

which we exclude the principle of malaria, we enclose the more dangerous principle of Typhus. If it be observed that the animal emanations in a bed room occupied by only one or two persons are too diluted to affect the health, the same may be said of the air which has travelled all the way from the marshes of Ostia — for the Pomptine marshes from their distance are out of the question.

Finally, for the very reason that the marshes themselves are more dangerous during the night, places at a moderate distance must be less so. The exhalations from the marsh, or the germs, or whatever constitutes malaria, are during the day carried up by heated currents, and diffused laterally; whereas at night, when these currents cease, they subside to the ground and brood over the surface of the marsh. Even, if the germs were attracted by the dew, as some suppose, no dew could ever be deposited in a room, even if every side of it were open to the air. The explanation of this I have already given (page 67 article Dew)

The apprehension of catching cold by leaving the windows open is as groundless as the fear of catching the fever; for the temperature during two and a half months, including the last week in June, and the first in September rarely sinks as low as 60° in the open air at night, and usually ranges between 65° and 70°; while in a room, even with the windows wide open all night, the thermometer just before sunrise will be found no lower than between 70° and 75°. This difference is owing to the radiation from the heated walls. Such a temperature can never give cold, if the sleeper has the slightest covering, and is felt only as an agreeable coolness.

In contrast to these silly precautions, one of which assumes as a fact the very reverse of the truth, while the other would exclude the more harmless by including the more dangerous principle, as if a man were to shut up the tiger in an Indian compound in order to shut out the wolf, or the jackal, I will quote the sensible observations of Dr. Livingstone, the conclusion from many years experience of the effect upon the human constitution of soil, moisture, temperature, and elevation, under a tropical sun. "The best preventives against fveer," he observes, "are plenty of interesting work to do, abundance of wholesome food to eat, and to be well housed, and well clothed." (1) Of these conditions the firstnamed is perhaps the most conducive to health, and will enable us to bear up against many physical privations, and often sustain a feeble constitution. The reverse of this may be seen in the class of persons called "valetudinarians," who being without occupation, pursuit, or interest in life, are continually fancying themselves ailing, and constantly applying to the Doctor, whose advice to them ought to be comprised in the pithy sentence, "live upon sixpence a day, and earn it."

As a conclusion from all which I have said, it appears that, while the Malaria of the Pomptine and Ostian marshes is enormously exaggerated, (2) that of the

(1) Expedition to the Zambesi III. 72.

(2) In the semi-poetical romance of the "Improvisatore" is a very sensational description of the Campagna during the summer months. The Scirocco wind is represented as blowing throughout that time, the air as stagnant, except at sunset and sunrise, and a sulphureous vapour as drawn in at every breath. All these details I have shown to be incorrect, and the subsequent mention of Nov.r

drier parts of the Campagna has no existence at all in the proper sense of the term. The Romans were not, as Brocchi absurdly assumes, rendered Malaria-proof by their woollen garments; for there were places, such as the Tuscan Maremma, which were reckoned highly dangerous even by them. The absence, therefore, of all allusion to the fever of the Pomptine marshes by Horace, and by Dion Cassius, and to the Malaria of the sea coast by Pliny, if it does not prove that these places were perfectly healthy, shows at least an amount of indifference on the subject inconsistent with the notion that they could have been as deadly as they are represented to be in modern times. Now, their physical character was the same then, as in the present day, and even the strip of country along the coast, which Pliny describes as pleasant in winter, but pleasanter still in summer "haec jucunditas ejus hyeme, major æstate," did not owe its healthiness to the cultivation of dry crops, but consisted of woods and

as the pleasantest month in the year proves that the author knew nothing about the Climate of Rome and the Campagna, and, therefore, drew upon his imagination for his facts. Oct.r is allowed by all who reside at Rome, or visit it early in the season, to combine every thing which can render it agreeable to excursionists in the country. The heat never rises to excess, the trees retain their foliage, and the pastures, refreshed by frequent rains, are as green as in England or Ireland. On the other hand, cold rains, and high winds occasionally occur in Nov.r and the trees have begun to shed their leaves. Yet Hare, in his "Walks near Rome" has transferred this description to the pages of his work, as if it were an extract from some scientific treatise It is thus that the popular errors which exist regarding Natural objects, and Natural phenomena are implanted, or caused to strike deeper root, in the mind of the ignorant and unreflecting.

pastures ranged over by herds of well fed kine. Its appearance in summer must have resembled that of the Pomptine marshes at the same season, the scenery of which is as beautiful as its air is said to be deadly. These marshes are not, as many persons suppose, a dreary fen, nor is the greater part of them covered with water, or in a sodden state. On the contrary, while the rest of the Campagna is parched with heat, the Pomptine marshes present the appearance of an English Park. Pastures of emerald green, interspersed with clumps of trees, and pieces of water fringed with bushes, the whole backed by the Volscian mountains rising to the height of 4000 feet, form pictures which artists, who venture into those regions of ill repute, occasionally transfer to their canvass

Since, then, the sea coast of Latium, now reckoned so pestilential, could be described by Pliny as such a delightful residence, (1) though the qualities of the soil had not been essentially modified by the hands of man, and the natural features of the country could have undergone no change, we may suspect a large amount of exaggeration in the popular account of its unhealthiness at the present day. The notion of its unhealthiness once formed, the indolence of the Italian character, which disposes it to seek an excuse for its inactivity in the difficulty of coping with an evil, and perhaps, the effect of imagination in rendering the body more susceptible of

(1) Nor was Pliny's a solitary villa: for he describes (Ep. 2. 17.) the whole coast as lined with buildings, sometimes close together, and sometimes apart, so as to present the appearance of a continuous town. This coast, therefore, now so silent and deserted, must have resembled the bay of Naples between that city and Vesuvius.

an attack of fever in a spot reputed to be malarious, would tend to magnify and perpetuate it. A similar observation may be made with regard to the Pomptine marshes, whose Malaria is ignored by Horace and Dion Cassius, and which are partially covered with corn, though mainly grazed with cattle in the present day.

But, if there is reason to suspect exaggeration in the description which is given of the Malaria of the marshes themselves, still more reason is there to doubt whether they have any appreciable influence on the climate of Rome. The notion that the Malarious vapour can advance like a fog bank, or a cloud wafted by the wind, and travel for long distances confined within definite limits, and that, consequently, its progress can be arrested by plantations of trees and by walls, is inconsistent with the law of the diffusion of gases, which I have before explained (pages 68, 69); for mist consists of minute particles of water, and, therefore, does not follow the law of elastic fluids, whereas, as far as we can infer from the experiments of Brocchi who, it will be recollected, obtained nothing tangible, or visible, from his experiments on the air outside the walls of Rome, the Malaria must be a vapour, though of extreme tenuity, and possess all the properties of a vapour, permeating the air, as water permeates sand, and losing by dilution all its peculiar properties before it has travelled very far.

I have thus shown, as far as it can be shown by the evidence at our command, that, while the air of the marshes must have lost nearly all its noxious quality before it arrives at Rome, the air of the drier parts of the Campagna can possess no noxious quality at all, and that the fevers which are so rife at certain seasons of the year

may be explained by the mode of life of those who are attacked by them. I will now proceed to consider fevers of another type than aguish, or intermittent fevers.

Fevers other than Malarious; or Contagious fevers

I have dwelt thus long on Malarial fevers, and tried to show how various are the causes to which they may be due, and how feeble must be those causes in the city of Rome, and its immediate neighbourhood, because by ignorant people fevers of every description, endemic, or epidemic, contagious, or noncontagious, including those which are due to the most opposite conditions of soil and temperature, are thought to have their permanent abode in Rome. By these persons the same unhealthy influences which induce intermittent fever are believed to be capable of generating fevers of every possible type. That such a notion exists in the mind of many appears from the expression "Roman fever." By this must be meant any fever occasioned by the unhealthy atmosphere of Rome; for to use the phrase in the sense of a fever peculiar to Rome would be as absurd as to talk of Roman circles, Roman squares, or Roman equilateral triangles.

These irrational notions are fostered by letters equally irrational, which appear occasionally in the Times. Mechanical engineers who understand nothing about Chemistry, and quasi — Literary men, who understand no science at all, after a residence of a few weeks at Rome,

fancy themselves qualified to write about the Climate, and address letters to the papers, couched in language which must be unintelligible to the old women whom it is intended to influence; but which, for that very reason, must convey to their minds the impression of some great but mysterious danger lurking in the air. These letters, while they frighten the ignorant and the cowardly, serve only to betray to the well informed the stupidity, or, may be, the malignity of the writers. Horace, in one of his satires introduces Damasippus as bantering him for not writing, and telling him that, if he can produce nothing by cudgelling his brains, it is to no purpose that he gives vent to his vexation by cudgelling the walls of his apartment (1). Something similar to what Horace is playfully accused of doing is constantly done by the wiseacres of whom I am speaking. Not the recognised correspondent of the Times (2) alone, but every visitor who is disgusted with the usages of the place, or has had a difference with his tradesman or his landlord, vents his spleen by an onslaught on the Climate, addressed to the sympathetic journal whose dislike to Rome amounts to a Monomania.

Of the letters which have appeared within the last year I will select two conspicuous for the fallacies they involve, or the ignorance they display. R. Rawlinson. C. B, from whom better things might have been expected, after his sensible observations on the subject of night air, commences his letter, May 20th 1876 in the following strain.

(1) Culpantur frustra calami, immeritusque laborat
Iratis natus paries dis atque poetis. Sat. II. 3.

(2) This has nô reference to the present correspondent, who agrees with me that the notion of the unhealthiness of Rome is a vulgar prejudice.

"A few words of warning to persons in Rome, and to persons intending to visit Rome, may be of service. *The city is a site which bears the saturation of ages of human occupation*". Never was so much ignorance concentrated in a single sentence. The sentence means, if it means any thing, that Rome is built upon a site, the soil of which is saturated with the organic matter that has been accumulating during centuries of human occupation. In this statement there are two false assumptions, one expressed, the other implied. It is assumed that the quantity of organic matter in the soil of a city must go on increasing indefinitely; it is implied that the number of those that have lived within the walls of Rome during the last nineteen hundred, or two thousand years, greatly exceeds the number of those that have been born and died, in the same space of time, within an equal area of the cities of London or Paris. For, otherwise, why should the refuse matter with which the soil is presumed to be saturated, the "Kochen middens", the sewage, and the corpses of the dead, be more abundant in Rome than in the capitals of England, or of France. With the latter assumption I will deal the first. We have no means of estimating the total number of the inhabitants of Rome during the last twenty centuries; but, when we consider how much the population of the city declined during the middle ages, and that, at one time, it was reduced to 17,000; if, on the other hand, we call to mind how much the population of London and of Paris has increased since the time of the Roman Empire, we shall see that there is no sure ground for supposing that more persons have dwelt on equal spaces during the time specified in the one city than in either of the two others. But, while the people

of Rome were probably not more numerous, the organic matter deposited in the soil was certainly less abundant. In the time of the Republic it was not the custom to bury within the walls any but distinguished men, or poor persons who could not afford the expense of a tomb in the Appian way; of which latter the cemetery — afterwards converted into a garden by Maecenas — was on the Esquiline hill. When cremation was introduced, there were, of course, no noxious effluvia from burial grounds. Even in modern times there was nothing in Rome corresponding to our churchyards in the city of London, whose confined area was crowded with the corpses of a populous parish. To the advantage enjoyed in this respect by Rome we may add the copious supply of water, by which the drains can be flushed, and the heavy rains, amounting sometimes to several inches in a day, by which the refuse on the surface is washed away.

As I have thus shown that no more organic matter could have been deposited in the soil of Rome than in that of London, or of Paris, and that in all probability the quantity was considerably less, it would seem to follow that there could have been no accumulation of such matter from age to age; otherwise, every great city in the world would, in course of time, become, not only as unhealthy as Rome is said to be, but absolutely uninhabitable. Since, however, it appears from the letter to which I have referred that there are persons so ignorant as not to know the provision which Nature has made for rendering animal and vegetable matter innoxious, and preventing its increase, I will enter into some details.

When animal matter is thrown upon the surface we all know how quickly it disappears. Flies and ants, and,

in warm climates, scavenger birds and quadrupeds, give an account of it in a very short space of time. When it is buried in the earth it begins to undergo a change, which proceeds with greater or less rapidity, according to the nature of the soil. If the soil be abnormally dry, it may be desiccated, and remain for ages without further change. Thus in certain dry localities in warmer climates bodies have been reduced to the state of mummies, and thus have been preserved for unknown periods of time. In soil of abnormal wetness, or in water, a body, or any animal matter, may be apparently converted into a fatty substance, (Margaric acid), which undergoes little, or no, alteration in the air, and may even be made into candles. (*) In soil of medium humidity decomposition soon commences, and in a space of time, which varies from two to three years, according to the quality of the wood of which a coffin is made, and the freedom with which the air gains access, the softer portions of a body disappear. (**) In leaden coffins the resolution of a body into its elements takes place with extreme slowness, but is completed, nevertheless, in from 50 to 100 years; from which it appears, that the air can find admission, and the gases generated within a leaden coffin can escape, through the pores of the metal. This appears further from the fact, that out of 22,000 leaden coffins examined externally by Mr Walter Lewis, who was directed by the General Board of Health in 1849 and 1850 to visit the vaults of the principal churches of London, none were burst, and only 20 were found to have

(*) The muscular tissue decays, leaving the fatty matter.

(**) Curiosities of Science. Page 97 2nd series. Abridged from Lancet 1851.

been bulged. (*) Mr Lewis also examined the contents of nearly 100 coffins, and found the included air to consist of Nitrogen, Carbonic acid, a little sulphuretted Hydrogen, and in some cases a considerable quantity of Ammonia, all holding in suspension animal matter in a very minute state of division. It is to this animal matter, which acts as a putrid ferment, rather than to any poisonous quality in the gases generated that the deleterious effects of a decaying body are due.

It is clear from this that there can be no putrescent matter of an earlier date than 100 years, and very little that is older than 2 or 3. No saturation of the ground, therefore, is possible, unless the animal, or vegetable matter, is continually being deposited in a very limited space. Yet Rawlinson talks as if the remains of Pantolabus the buffoon, and Nomentanus, the spendthrift, the wretched paupers of whom Horace speaks, (**) might still be tainting the air, or ready to give out unwholesome fumes, when the ground was opened. Experience, on the contrary, shows that, over nearly the whole of Rome, the organic matter deposited at any time in the soil, must have been resolved into its elements, or have formed innoxious compounds.(***) During the hottest months of last

(*) Curiosities of Science. Page 237. 1st series.

(**) Hoc miserae plebi stabat commune sepulcrum,
Pantolabo scurrae, Nomentanoque nepoti. Sat. I. 8.

(***) Ulmin, or Humus, a Carbonaceous compound, is the residuum of the fermentation of vegetable matter. It undergoes little, or no, change, when exposed to the air, and can furnish to it no appreciable quantity of noxious gas. Humus, it may be observed, is not a definite Chemical compound, and, therefore, cannot be expressed by any Chemical formula

summer (July and August) 1876, the Corso was opened throughout its entire length, for the purpose of repairing the gas pipes; but there was nothing unusual in the appearance of the soil, and no unpleasant smell could be perceived, except that arising from the escape of gas. I made many enquiries, but could not learn that the health of the people living in the Corso had been affected, or that there had been any outbreak of fever among the workmen employed.

The other letter was from Arthur Arnold. An article, the joint composition of Mr. W. W. Story, and Dr Lauchlan Aitken had been inserted in the Times of June 10th 1876, ridiculing the exaggerated notions, and absurd apprehensions regarding the climate of Rome. To this article in a day or two there appeared an answer, in a highly indignant tone, as if the writer thought it a great piece of impertinence to doubt a fact so well established as the pestilential character of the place. In the article by Mr Story and Dr Aitken, among other arguments against the unhealthiness of Rome, reference is made to the "healthy aspect of the Roman population". Here Mr Arthur Arnold thought he discerned an opening for an attack. His language is somewhat obscure, as might have been expected, when he purposed to regard the subject from an unsavoury point of view; but his reasoning appears to be this. The ordinary Roman sacrifices to Cloacina in the open air, and his health, therefore, is not affected by the incense from his offerings to the Goddess, like that of the richer native, or foreigner, who performs the same rites under the roof of the house in which he lives.

The only remark I shall make on this letter will be that it contains an unconscious admission that the air of the city is not impure until it is tainted by those who

have departed from the more primitive practice to which he refers.

Into the question of the domestic arrangements at hotels, and the machinery for excluding sewer gases from the houses, I will not enter, because this belongs to the Mechanics, not to the Chemistry, of the question. It was of the Climate as the result of Natural causes that I purposed to treat; for the unhealthy influences which are the work of man, whether confined to single houses, or extending over wide districts occupied by manufactories, do not constitute the Climate of a place.

I have selected these two letters as specimens of a larger number. In both the same animus may be discerned; but the former required to be answered at greater length; because the fallacy which it contains was calculated to deter numbers from visiting Rome. "Omne ignotum pro magnifico" said the Caledonian chieftain in Tacitus; "omne obscurum pro terribili," may the old women of the masculine gender exclaim, when they read the dark warnings contained in the paragraph which I have quoted from R. Rawlinson. C. B.

I have thus traced the prevailing belief in the unhealthiness of Rome to four principal sources, which leave but a small residuum of truth; namely, vindictiveness, selfishness, ignorance, and timidity; the vindictiveness of a leading journal, the selfishness of Hotel-keepers, and professional men, who have an interest in keeping visitors away, the timidity of many, and the ignorance of nearly all. Of the effect produced ignorance is responsible for the larger share, and the fallacies begotten of ignorance are legion; so that it would be impossible to expose them all. But one of which I heard only a few months ago is so super-

latively ridiculous that I will relate it here for the amusement of my readers. It is believed, I am told, by many that, if a hole be dug in the Campagna, and a person hold his nose over it for a few minutes, he will catch the Roman fever. The absurdity of this will appear from what I have said before, that water is purified, instead of being tainted, by filtering through the soil, and consequently, there can be no reservoirs of putrid water in the bowels of the earth.

To do battle with all the Protean forms of error would be an endless task; but I have encountered, I hope with success, the fallacies which are most popular with the common herd. Going back to the time of the Romans, I have directed attention to the fact that Horace and Dion Cassius make no mention of the Malaria of the Pomptine marshes, on an occasion when it would have been natural to allude to it, and that Pliny the younger ignores the unhealthiness of the seacoast between Antium and the Tiber, though on no rational principle can the change presumed to have taken place be explained. The conclusion, therefore, is that an enormous amount of exaggeration must exist regarding these places in the present day.

Coming to modern times, I have explained that there can be no sulphureous emanations from the volcanic tufa, and that, of the only two compounds of sulphur which could be generated by natural causes, one in the minutest quantity would betray its presence by its peculiar odour, the other by its irritating effect on the Trachea. Besides, the latter is supposed to have the effect of destroying the Malarious principle.

I have then proceeded to shew that Malarious fevers may be due to two causes perfectly distinct; to some subtle

emanation from marshy ground, or, in dry and elevated sites, to certain Meteorological conditions, against which proper precautions have not been taken. They may be owing also to any thing, which overtasks the bodily powers, or interferes with the healthy performance of the animal functions. Of this I have given illustrations, which, though only a few out of scores that might have been adduced, appear to me to be conclusive on the question.

With regard to the Malaria of the marsh I have, I hope, made it clear that the three conditions of heat, moisture, and decaying vegetation must concur to produce the intermittent fever which is traceable to that particular source. Thus, in Ireland we have extensive tracts called bogs, which are always sodden with moisture, but which, nevertheless, are perfectly healthy, because the summer temperature is low.

Again, in every part of the world, we have large collections of water, which, however hot the climate, do not render the air unhealthy, if the shores are not marshy, and the water sufficiently deep. In fact, it has been proposed in modern, as in ancient times, to reclaim the Pomptine marshes by digging reservoirs of a certain depth, and raising the level of the remainder of the marsh by the soil thrown out. Here we have in summer two of the conditions required to generate malaria, heat, and watery exhalations from the reservoirs; but the third, decaying vegetation, is wanting; for it is only when a marsh is in the act of drying up, or when the water is so shallow that the air can penetrate to the bottom, that unhealthy vapours appear to be evolved. Accordingly, Father Secchi, who has such strong convictions on the subject of Malaria, approves this plan.

Lastly, I have shown that heat alone can never render a place malarious, if the soil be dry, even if we make the gratuitous assumption of subterranean water, because the vapour from such water must necessarily be pure, and, as by the supposition the soil is dry, the vegetation, must either be growing, or desiccated, in neither of which cases can it generate malarious vapour.

From a review of the whole evidence it is clear, on the one hand, that the fevers which attack the agricultural population of the drier parts of the Campagna are not due to any emanation from the ground, but to a mode of life enforced by poverty, or, in some cases, to the neglect of proper precautions, when the body is overheated. To suppose, therefore, that such fevers can extend to Rome is as absurd as to imagine that the diseases produced at Kew, by the poverty of A, or the indiscretion of B, can affect the health of C who lives in Belgravia, or Mayfair. On the other hand, it is difficult to conceive how the marsh miasma, from the morasses of Ostia, diluted as it must be by the law of the diffusion of gases, can taint in any sensible degree, the air of Rome. It is true, if we adopt the theory of germs, that, though the *number* of these germs may be reduced, the *vitality* of each cannot be weakened by travelling long distances. But I have pointed out *one* objection to this theory, that Malarial fevers are *not* contagious; and it is absurd to suppose that a germ, or two, from the marshes of Ostia can produce intermittent fever in one living in Rome, and yet that the innumerable germs generated during the progress of the fever should not infect those who wait upon the patient, and through them, spread the contagion far and wide. Why, also, is it that the Val di Chiana, and other places

reclaimed in a similar manner, have become healthy, as well as productive? The germs could not be destroyed by heaping a foot, or two, of soil upon them, and some of them would escape every time the soil was moved, even if they did not find their way through the pores of the earth. Besides, on the immediate shores of the Lake of Chiusi, which are still marshy, these germs might continue to propagate themselves. The fact, also, that places within a short distance of marshy ground may be perfectly healthy in summer appears to me to be conclusive against the theory of germs Thus the alluvial valley of the Rhone at Villeneuve is considered malarious in summer, while Veytaux, a short walk from it, is reckoned a healthy site.

To sum up, therefore, the evidence and the arguments on either side, if I have succeeded in showing that no malarious principle can be generated in the drier parts of the Campagna lying N, E, and SE of Rome — since the three conditions necessary to its development never coexist — it follows that *no* malarious influence can be conveyed to Rome when the wind blows from those quarters. On the other hand, if the miasma which undoubtedly arises in a greater or less degree from the marshes of Ostia be a vapour, it must, by the law which I have repeatedly stated, be too diluted to produce any sensible effect when it reaches the city. If we suppose the malarious principle to reside in germs, a few may possibly arrive in Rome. But to this theory I have stated what appear to me to be unanswerable objections. I will say no more about it, therefore, but leave the reader to form his own conclusions as to the probability of its truth.

With regard to diseases of another type there is no

reason to suppose that contagious fevers, though occasionally epidemic in Rome, as in other capitals of Europe, are in any way engendered by the soil or climate of the place. To establish this conclusion, I have examined the letter of R. Rawlinson. C. B, that which assumes the accumulation through successive ages of putrescent matter in the soil of Rome, and implies from this the constant presence of fevers of a typhoid character, in addition to the Malaria supposed to be endemic in the town and neighbonrhood. In my strictures upon this letter I have, I trust, made it clear te the reader that the assumption in the opening paragraph is opposed to the principles of Chemical science, and that, therefore, the inference based upon it must fall to the ground. It would be useless labour to quote and controvert any more of the articles which appear on the same subject in the daily Papers. "Ex uno disce omnes". Let the ignorance of one be a specimen of the ignorance of the rest, and let none imagine that the letters of a Civil Engineer, or a Littérateur, on the subject of climate carry any weight with them, unless the Civil Engineer or Littérateur possess a knowledge of Chemistry and Meteorology, which is rarely the case in England (*).

(*) In England science is every day becoming more professional, and the study of it by those who make it a profession more confined to a single branch. Yet the sciences touch and overlap each other in so many points that it impossible to acquire a thorough knowledge of one without understanding, at least, the general principles of several others. Our Engineers are among the first in Europe in the mechanical, or constructive, part of their profession, that which deals with bridges, tunnels, and embankments; but a knowledge of Chemistry is not expected from them; and, if we are to judge from the letters which appeared some time ago in the

Statistics of Malarial and other Fevers

Basing my reasoning on the principles of Atmospheric Chemistry, and the mechanical properties of the gases, I have tried to show 1st; that no malarious principle can be generated except in the marshes of Ostia, and a few spots of limited extent immediately outside the walls of

Times, they may be unacquainted with the laws by which water in motion is governed. Among the general public, science is less diffused than it was 50 years ago, and its diffusion appears to be inversely proportional to its progress. The stream flows in a channel which is always deepening, and its volume, therefore, is continually augmenting; but it does not overflow and fertilise the land. No two Sciences have made such progress within the period stated as Chemistry and Geography; yet, few but those who study the former professionally possess a knowledge of its most elementary principles; while the latter, though taught every where, is learnt nowhere, and the ignorance of it is universal and profound. Even our rulers seem to have no idea of the distance between two points and of the physical obstacles which may intervene. Did Lord Derby, when he obtained an assurance from the Russians that our interests in India would not be affected by their plans for carrying on the war, imagine that a body of troops could be detached from the army in Armenia, make a dash at the Persian gulf, and fortify a post there, before the English knew what they were about? How the Russians must smile at onr ignorance. Let not, therefore, any person, however eminent in a single branch of knowledge, be considered as entitled to speak with authority on the question we are discussing, unless he has given his attention to those Sciences which have a bearing upon it, and with these sciences scarcely any, as I have observed, are acquainted, except those who study them professionally. Certainly in the two cases on which I have commented we may with reason exclaim "ne sutor ultra crepidam".

Rome, (*) and 2nd, that such malarious principle must be too diluted when it arrives in the quarters inhabited by foreigners, and Italians in comfortable circumstances, to affect in any appreciable degree the purity of the air. With regard to the alarm which has lately been raised about typhoid, and other infectious fevers, I have reviewed one of the letters which pander to that alarm, and shown the utter absurdity of supposing that there can be a greater accumulation of organic matter in the soil of Rome than in that of London or Paris, or any other great city, and, consequently, any greater liability to those fevers which are supposed to have their origin in the fermentation of putrescent animal matter.

But, the question, it may be objected, is not to be decided by reasoning from theoretical principles, but by the evidence of facts and figures; for to use the language expressing the popular sentiment on scientific matters "there is no arguing against facts". In deference to this sentiment I am ready to meet the Malaria-mongers on the ground which they select, though to me it is far more satisfactory to prove from well established scientific principles that a thing cannot, than to show by an array of facts and figures that it does not exist; for the so called facts are often nothing but inferences which may be disputed (**), and figures may be manipulated so as to establish any

(*) These are San Paolo fuori le Mura, and the banks of the Maranna (Aqua Crabra), which have, I know not with what truth, acquired the character of being malarious.

(**) Thus it is a fact that one or more persons fell sick, or died in a given place. That the place is unhealthy is merely an inference from the fact, an inference which may be denied by those who know the circumstances under which the deaths occurred.

conclusion we desire. Yet, as even this kind of evidence, imperfect as it is, sustains the view for which I am contending, that Rome is as healthy as any Capital of Europe, with the exception, perhaps, of London, (1) I will give, first the Statistics of Balestra, and then the death rate for the city, extracted from the Bulletins which are issued weekly by the Statistical department of the Italian government. Balestra declares (2) that the death rate for Rome does not exceed 22.06 (3), while that of Florence is 30,05 and that of Naples 32.0 If these figures were correct, they would at once decide the question of the relative healthiness of Rome and the other two cities; for, even if Florence enjoys, as it is said, an immunity from intermittent fevers, it is a matter of no consequence to a visitor whether he dies of that disease, or of some complaint induced by the greater severity of the winter, or the inferior quality of the water. Balestra, however, does not give us his authority for attributing so high a death rate to Florence, and, as Florence, for what reason I know not, is omitted in the list of towns whose death rates are given in the Bulletins of the Italian government, I will lay no stress on the high figure quoted by Balestra, but, leaving the healthiness of Florence in

(1) The bills of mortality for London include Highgate, Hampstead, and other elevated and airy districts, where the soil is dry, and the houses scattered, and consequently give a lower death rate than the more crowded city of Rome.

(2) L' Hygiène dans la ville de Rome par le D.r Balestra page 27.

(3) This does not agree with the average I have deduced from the statistical tables of the government.

abeyance, proceed to consider the lessons we are taught by the statistical tables to which I have referred.

In quoting the figures of these tables, I shall confine myself to four of the cities whose death rates are compared with that of Rome, namely, Naples, London, Paris and Vienna; for my purpose will be answered, if it can be shown that Rome is decidedly more healthy than three of the towns enumerated, and little less so than London, a large portion of which enjoys exceptional advantages.

It is only since 1876 that these tables have been kept in their present form, so as distinguish the sick in the hospitals who are resident in Rome, from those who are attacked in the Campagna and brought into Rome to be cured, and it is only since October 1876 that I have been able to procure an unbroken series of them. But the returns of even 52 consecutive weeks will enable us to form a conjecture as to the comparative healthiness of Rome and of the cities which I have selected, and any one who wishes to know how far the conclusions arrived at from the figures of these 52 weeks are borne out by the subsequent returns may, on application at the Capitol, procure the Bulletins gratis, and be supplied with them weekly at his lodgings (1).

(1) By the death rate is meant the number of deaths in a thousand of the population, during any given week, multiplied by the number of weeks in a year. Thus, in the week ending July 28th 1877, the deaths per thousand of the town population of Rome were 0.51, or about one in two thousand, and 0.51 multiplied by 52 gives 26.3. The death rate, therefore, for any given week, represents the number of persons out of every thousand that *would* die in a year, if the mortality for that week remained constant.

DEATH RATE

of Rome

and of four principal cities

from week ending 8th Oct.r 1876

to week ending 29th Sept. 1877

1876	Rome	Naples	London	Paris	Vienna
Week end.g 8th Oct.r	23. 2		18. 4	22. 9	24. 0
15th	18. 6		17. 9	22. 1	27. 0
22nd	18. 0		18. 8	22. 9	25. 3
29th	24. 3		18. 3	21. 6	24. 0
5th Nov.r	30. 1		21. 0	22. 8	23. 9
12th	28. 9		21. 0	23. 6	26. 5
19th	27. 6		24. 4	30. 5	25. 7
26th	26. 5		28. 2	31. 1	29. 9
3rd Dec.r	25. 6		25. 5	27. 2	26. 2
10th	16. 4		23. 3	29. 1	27. 5
17th	21. 7		21. 6	26. 4	24. 5
24th	28. 1		21. 6	24. 5	25. 6
31st	27. 0		21. 8	25. 6	29. 8
1877					
Week end.g 6th Jan.y	20. 8	38. 3	14. 3	26. 7	28. 4
13th	20. 8	32. 1	20. 1	26. 5	27. 2
20th	27. 1	38. 3	22. 0	26. 9	28. 9
27th	29. 2	38. 4	21. 0	27. 8	27. 4
3rd Feb.y	27. 1	43. 2	22. 6	29. 7	25. 2
10th	28. 6	43. 2	22. 2	29. 7	26. 7
17th	25. 2	43. 8	21. 6	26. 6	25. 1
24th	23. 1	37. 1	22. 1	——	28. 1
3rd Mar.	31. 1	36. 4	22. 6	29. 0	26. 9
10th	27. 3	36. 4	22. 6	29. 1	26. 9
17th	36. 2	44. 1	26. 3	28. 1	29. 5
24th	29. 9	40. 0	26. 6	29. 6	30. 0
31th	24. 6	——	30. 3	36. 7	30. 8
7th Apr.	30. 9	——	30. 3	31. 9	40. 7
14th	19. 6	30. 0	28. 4	32. 9	32. 2

1877	Rome	Naples	London	Paris	Vienna
Week ends 21st Apr.	21.1	——	25.3	29.6	34.9
28th	23.1	30.1	22.6	28.8	33.5
5th May	17.1	30.7	23.0	29.4	36.7
12th	20.8	30.3	22.0	27.7	32.7
19th	20.7	26 7	23.8	29.5	31.1
26th	21.3	29.1	——	——	34.3
2nd June	21.8	29.8	20.6	28.0	31.9
9th	19.2	28.1	21.3	26.0	35.8
16th	22.0	26.2	21.1	24.5	27.7
23rd	22.4	29.1	19.4	25.8	32.0
30th	22.4	31.6	18.8	24.9	29.8
7th July	25.7	——	19.2	22.3	23.9
14th	23.9	29.0	19.5	23.0	28.6
21th	24.1	28.4	21.4	21.9	30.6
28th	26.3	28.3	21.2	23.2	25.8
4th Aug.	22.2	26.2	21.1	23.0	25.6
11th	20.2	27.7	21.3	21.8	23.9
18th	19.9	24.8	19.1	23.7	22.3
25th	21.8	22.2	19.3	20.6	22.3
1st Sept.	25.6	——	18.6	24.9	23.4
8th	20 7	——	18.6	24.9	26.4
15th	20.3	——	17.4	23.4	20.4
22nd	19.7	20.1	18.6	21.1	21.4
29th	17.0	23.9	17.4	20.1	22.5

If the weekly averages for Rome, London, Paris, and Vienna be added together, we get the numbers 1236.8, 1106.1, 1309.6, and 1460.8. If these numbers be divided by 52 the number of weeks in the case of Rome and Vienna, where the returns are complete, and by 51 and 50 in the case of London and Paris, where the returns for one and two weeks respectively are wanting, we get the figures 23.8, 21.7, 26.2, 28.0, which represent the average death rate for the four cities of Rome, London, Paris and Vienna, during a period of 12 months. It would be

useless to go through the same process for Naples, not only because the returns for that city are incomplete, but because it is sufficient to run the eye down the column to see how greatly the death rate exceeds that of Rome (1).

We will now compare the number of deaths weekly at Rome from the two forms of Zymotic disease, namely Malarial and Typhoid fevers, which are thought to be most prevalent in the city, with that of the deaths from diseases of the respiratory organs, and the results obtained will doubtless surprise those who are possessed with the notion that fever is responsible for the great majority of the deaths at Rome.

(1) This does not agree with the low death rate given by Balestra, but is sufficiently favourable in comparison with that of Naples, Paris and Vienna.

Deaths from diseases

ZYMOTIC AND PULMONARY

1876		Zymotic	Pulm.y
Week end.s	8th Oct.r	17	24
—	15th	10	32
—	22nd	5	28
—	29th	14	42
—	5th Nov.r	9	26
—	12th	13	64
—	19th	11	63
—	26th	17	58
—	3rd Dec.r	13	59
—	10th	7	36
—	17th	7	31
—	24th	14	45
—	31st	12	41
1877	6th Jan.y	0	34
—	13th	5	32
—	20th	9	47
—	27th	2	62
—	3rd Feb.y	3	49
—	10th	3	57
—	17th	8	61
—	24th	7	54
—	3nd Mar.	10	59
—	10th	5	43
—	17th	8	77
—	24th	10	63
—	31st	5	52

1877		Zymotic	Pulm.y
Week end.s	7th Apr.	10	45
—	14th	4	36
—	21st	5	40
—	28th	4	42
—	5th May	6	32
—	12th	5	40
—	19th	3	35
—	26th	7	42
—	2nd June	10	44
—	9th	6	37
—	16th	8	36
—	23rd	6	34
—	30th	7	33
—	7th July	7	28
—	14th	9	25
—	21th	8	20
—	28th	9	28
—	4th Aug.	13	28
—	11th	11	21
—	18th	10	24
—	25th	15	29
—	1st Sept.	18	24
—	8th	16	24
—	15th	12	24
—	22nd	9	19
—	29th	3	27

With regard to this table it is to be observed that until 6th Jan.y 1877 the returns from the City and Campagna are not distinguished and, therefore, in comparison with those of that year, will be somewhat higher than they ought to be. But the ratio of the Zymotic to the Pulmonary diseases, and the general conclusions to be drawn from the tables will not thereby be greatly affected. The Pulmonary diseases include Bronchitis, Pleurisy, and Pul-

monary Consumption, but the Zymotic are confined to Malarial ard Typhoid fevers; because Scarlattina, Small Pox, and others, are not usually associated with any peculiarity in the soil or climate of Rome, and appear only occasionally as Epidemics, and not more frequently than in any other large town of Europe. The deaths from the two forms of fever specified amount to 445 in the course of the 52 weeks, while those from diseases of the lungs reach the large figure 2056 of which 1298 are due to the acute forms of the disease (Bronchitis and Pleurisy) and 758 to Pulmonary consumption. Returns for subsequent years may modify the results obtained, but not, I believe, in any important degree. Of the 445 deaths from the two forms of zymotic disease to which I have confined myself, 159 are attributable to Typhoid or Enteric fever. The returns of the Registrar General of England for 1870, the only ones I have had an opportunity of examining, show that the deaths in London from Typhoid fever amounted in that year to 2008. As the population of London was then about 3.200,000 and the present population of Rome is in round numbers 280,000, or to that of London in 1870 as 1 to 11.5, the deaths from Enteric fever, *all conditions being the same,* ought in the two cities to be in that ratio. Dividing 2008 by 11.5 we get nearly 175, as the corresponding number of the deaths at Rome from the same disease. The actual number, as we have seen, was 159, which is 10 per cent less. I am not aware that the health of London was below the average in 1870; though the condition of Rome in 1876 was certainly unfavorable for comparison, as the deaths in the city during the last three months of 1876 are mixed up with those from the Campagna; so inappreciable is the

effect of the mass of corruption on which certain wiseacres assume Rome to be built.

These conclusions will prepare us for what Balestra observes, that: "The Physical constitution of the Romans does not exhibit any external trace of Malaria, but is in general robust, well developed," and, as Lancini remarks, "if not equal to that of the Romans of antiquity, certainly superior to that of many large districts of the Peninsula."

In the report of the Minister of War Mezzocapo on the condition of the Army, it is stated, that there are fewer rejections for malformation of the body, or for weak health, among the conscripts from Rome and its vicinity than among those from other parts of Italy. To this we may add, that the Roman women are a remarkably handsome race, very superior in personal appearance to those of Florence, the healthiness of whose city used to be contrasted by the Times with the pestilential character of the climate of Rome. The only drawback to their good looks is the etiolation produced by their sedentary life, and by the foolish practice of sitting in darkened rooms, even when their apartments face the north. Thus, while the female peasantry of the Campagna are imbrowned by the sun, the women of the upper and middle classes of Rome are distinguished by the paleness of their complexions.

Conclusion.

I will now conclude by briefly recapitulating the topics on which I have enlarged. I thought it necessary to preface my work with an explanation of the origin of the dislike of the Times to Rome, because the belief

in the unhealthiness of that city is in a large measure due to the articles in that paper, whose opinions are accepted by many as if they were dictated by absolute wisdom. It is true that the Times, except on one occasion, Oct — 75, has been silent on the subject, for the last 7 or 8 years; but its persistent attacks, on the healthiness of Rome during the previous 8 or 9 had so thoroughly inoculated the public mind with the notion of the pestiferous character of the place that the effect created could not be removed by simply discontinuing those attacks. It was essential, therefore, to my purpose to invalidate the authority of the Times on the question of Climate, and by telling the story of its correspondent, which is known to few besides myself, to render innoxious the ill feeling it has displayed.

Eliminating, therefore, such extraneous influences as the vindictiveness of a Newspaper, and the selfishness of Hotel-keepers and Professional men in those cities which are the rivals of Rome, I commenced with the question of the Climate of Rome in Ancient times, and the notions current among the Moderns regarding the healthiness of the city, each of which I examined in their turn: I remarked that both Horace and Dion Cassius ignored the Malaria of the Pomptine marshes (1), and that the strip

(1) I make no account of what the Poets say. Their province is to move the feelings by striking contrasts and vivid images, and they often introduce an epithet, like that of " pestifera " in the verse of Silius Italicus,

Et quos pestifera Pomptini uligine campi VIII 381.

because it fits with the metre. No doubt these marshes were less healthy than the drier parts of Latium. Yet, as the poet describes them as sending their contingent to the war, he could not have believed them to be altogether deadly to human life.

*

of seacoast between Porto D'Anzio and the Tiber, in which no one would venture to live in the present day, is declared by Pliny the younger to be agreeable at all times, but especially agreeable in the summer time. The change in the climate, cannot, as I observed, be explained by cultivation, because the land, as Pliny tells us, was grazed by numerous herds, and, if grazing could render a soil healthy, the Pomptine marshes ought not to be malarious in the present day.

Coming to modern times, I showed the fallacy of two popular notions, that emanations from the volcanic soil of the Campagna, or from subterranean water, infect the air. I next explained that malarial fevers, or fevers indistinguishable from them, may proceed from two distinct sources, from any thing which interferes with the healthy performance of the animal functions — of which I gave numerous illustrations — or from marshy ground where the three conditions of heat, moisture, and decaying vegetation coexist. In the first case, common sense tells us that the diseases engendered by exposure, privation, or overexertion in the Campagna must be confined to the individuals affected, and cannot extend to Rome; in the latter, the law of the diffusion of gases would render the malarious principle, if it were a gas, inappreciable at Rome, and why it should not reside in germs, I have given, I think, sufficient reason.

I then examined, and, I hope, confuted, the fallacies of those who from ignorance, mischievousness, or malignity, write letters calculated to alarm the visitors to Rome, by leading them to suppose that the modern city is built over a mass of corruption, which has been accumulating since Romulus first settled on the Palatine Hill.

Finally, I have shown by the statistics of 1877 that the death rate of Rome is less than that of Naples, or of the capitals Paris and Vienna, neither of which has the reputation of being unhealthy, and that the deaths from fever during every month of the year, even July and August, when malaria is said to prevail, are fewer than those from Pulmonary diseases. The result may indeed be modified by the returns of 1878, but only, if I may judge from the statistics of preceding years, to a trifling extent.

The reader may now be left to judge of the soundness of my arguments, and to compare them with the reasoning which satisfies the public mind, and appears conclusive to ordinary understandings. With a specimen of this reasoning I will bring the present treatise to a close. A traveller quits England in perfect health, and after a longer or shorter stay in Rome, he is perhaps attacked with fever. Under these circumstances the fever is not unfairly set down to the account of the climate. Another, after spending months in Rome, and enjoying excellent health, is laid up with fever two or three weeks after his return. In this case also Rome must bear the blame. The seeds of the fever, it is assumed, were sown at Rome, and the fever was going through the process of incubation, or hatching, in the interval between the departure from the city and the seizure of the patient. Thus: "Heads I win, and tails you lose" are the terms on which the votary of malaria is allowed to argue the question of climate, and the simpleton public does not perceive that in every contingency he must establish his point.

Influence of Trees on climate.

Though I purposed to confine myself to the climate within, and immediately without, the walls of Rome, yet, as trees influence indirectly, if not directly, the healthiness of a place, and they can be grown in many situations, it may be expected that something should be said about their influence upon climate, and the improvement which is likely to take place by planting not only the Campagna, but also certain places within the walls, or a short distance beyond them. The evidence as to the effect of trees upon the atmosphere is somewhat conflicting, and their mode of action may be explained in different ways. Some suppose that they act by straining, as it were, the air, as it passes through them. But, if we reject the theory of germs, a portion of which may be conceived to be arrested by the trees, they can purify the air only by absorbing malarious vapour. Now, the only gases which are absorbed by the leaves of plants, and furnish nutriment to them, are carbonic acid, ammonia, and watery vapour, in none of which does the principle of malaria reside. As to the effect attributed to them by many, of arresting the progress of the malarious vapour, I believe this to be purely imaginary. Assuming the principle of malaria to be a vapour, it must, by the law to which gases are subject, diffuse itself in every direction, and pass over the tallest trees, as well as through their interstices. Thus carbonic acid, though heavier than air, has been detected even on the summit of Mont Blanc. It is true that, just as more carbonic acid is found on the floor of the Grotto del Cane than in the air above, so the malarious vapour must be denser a few

feet above the marsh than at greater elevations; but, as soon as the vapour is conveyed beyond the limits of the marsh, it must extend itself in every direction, and the excess near the earth must bear a continually diminishing ratio to the quantity in the air at any height above it. Balestra tells us that Supino, in the province of Frosinone, which had previously from its healthiness been the resort of invalids from tho adjoining districts, became unhealthy immediately after the cutting down of a belt of trees which grew to the South of it. Now, any one who looks at the map will see that the lofty ridge of the Volscian mountains intervenes between Supino and the Pomptine marshes. It is absurd, therefore, to suppose that the vapour which had passed over the summits of those mountains would be arrested by the lower barrier of a belt of wood.

Again, we are called upon to believe that the cutting down of a wood to the North of Cisterna had the effect of rendering the place less unhealthy, because the wood stopped and concentrated the malaria from the sea. " Credat Judæus, non ego. "

To plant the Campagna would, no doubt, be desirable. Trees adorn the landscape, they are a source of profit, and they equalise to a certain extent the diurnal temperature, as well as the temperature of the year, by shielding the earth from the rays of the sun during the day, and impeding the escape of heat by radiation on calm and cloudless nights. By maintaining a moister atmosphere beneath them, they tend also to increase this effect; for, as I have before shown, moisture in the air impedes radiation, both to and from the earth. It is principally in this way that trees promote the health of the districts where they grow. The shelter which they afford enables many to

escape the effect of continuous exposure to the sun during the day, and allows travellers, or the peasantry, when compelled to pass the night in the open air, to avoid a chill by sleeping beneath their shade. The Hindoos, therefore, instead of considering woods malarious, always, when on a journey, select a clump of trees under which to spend the night.

Having said this much about trees in general, I will now proceed to consider what has been said of the Eucalyptus, about which an immense deal of nonsense has been talked, (1) though it undoubtedly possesses some of the pro-

(1) Thus, it has been said of one species, the Eucalyptus globulus, that, though it requires a great deal of water and draws up so much by its roots as to be able to dry the wettest ground, yet, when planted in a district of Algeria on which rain had not fallen for seventeen years, it grew with great rapidity, attained in a few years a great elevation, and induced frequent rainfalls; so as totally to alter the character of the climate. This notion that trees attract the clouds and condense them into rain, can be explained on no Mechanical, or Scientific principle, and rests only on evidence such as would connect Tenterden steeple with Goodwin sands. Because, when a country is cleared of wood, the volume of water in the rivers is diminished, and the smaller streams dry up, superficial reasoners fancy that the rainfall must be lessened; where as it is only wasted. I have treated the subject of forests elsewhere at some length, and shown that they act, not by increasing, but by economising, the rain, and that all the results which have been observed to follow the destruction of forests may be explained on this supposition. When a country is denuded of wood, the rays of the sun beat upon it, the wind sweeps over it, and the surface is quickly dried. The water which thus disappears is so much abstracted from the growing crops. Few persons are aware how much is lost by evaporation. It has been calculated, that the water exhaled as vapour by the Nile, between the point where it receives its last tributary the Atbara and the sea, would feed a river as large as the Rhine at Coblentz.

perties attributed to it. The Eucalyptus, so called from the peculiar structure of its flower, (1) is found almost exclusively in Australia, though one species "Eucalyptus persicifolia" is a native of the Cape of Good Hope, and another "Eucalyptus resinifera" has been naturalised in India, where a gum called "Kino" is prepared from it. In Australia it is called the stringy-bark tree, from the manner in which the outer bark peels off in strips, and also the gum tree, from the gum-resin which all, or most of the species, exude. Though it grows very fast, and is said in six or seven years to attain the same dimensions as the oak in twenty, its wood is extremely hard, and so dense that, when freshly cut down, it will sink in water. But, when seasoned and the sap replaced by air, it will float. It is therefore, a very profitable tree to grow, though its sombre foliage detracts from its beauty in a landscape.

But, it is with the antimiasmatic properties attributed to this tree that we have to deal. It is said to absorb by its roots, and evaporate by its leaves, such a quantity of water as to be capable of draining a marsh. The gum which it exudes, the dried and powdered leaves, and the extract from them, are said to contain an alkaloid resembling quinine, while the balsamic emanations from its foliage pervade the air, and are believed to nentralise the malarious principle. The neighbourhood of S^{t}. Paul's without the walls has always had the reputation of being unhealthy, and the monks of the Trois Fontaines were in the habit of quitting it during the heats of summer. Now that the

(1) From εὖ, well, and καλύπτω to cover, because the flower is at first covered by a little lid, which falls off, when the flower is more fully developed.

Eucalyptus has been extensively planted around the convent, the fevers are believed to be becoming less frequent, though it is not pretended that thay have altogether ceased. Part of the effect may be due to the trees, and part I suspect, is owing to the belief in their efficacy. I have before spoken of the influence of the imagination upon the functions of the body, and it a remarkable illustration of this view that those who disbelieve in the malaria are the very persons who escape it. Thus, all those who have come to Rome with the intention of settling there, or are in the habit of passing the summer in the place, have, as far as I know, enjoyed excellent health. I may instance, among others, M^r^ Hooker the Banker, M^r^ Rogers the Sculptor, M^r^ Arthur Strutt, and M^r^ Shakespere Wood, the last two of whom have brought up healthy families. To these I may add myself, who have spent eleven summers in Rome, and never had a touch of the fever (1). Scepticism is, I believe, a better specific against fever than quinine; but the scepticism must be unhesitating and entire, like the disbelief in witchcraft, and the influence of the planets upon the destinies of men; otherwise, if any doubt should exist, despondency may ensue, and despondency will weaken the power of bearing up against the supposed disease.

(1) Nor are these a few who have survived out of a larger number that have succumbed to the influence of the climate; for the English residents at Rome have never been many, and the few that have died since I have been here have fallen victims to pulmonary and other complaints, which had no connexion with malarious fever.

Corrigenda and Addenda

In page 41 the temperature of July 1841 is said to have risen to 107. But there is reason to suspect that the first table I have given of observations from 1828 to 1860 is incorrect, and that the maximum temperatures are all too high, owing probably to the exposure of the thermometer in some small area, where the temperature was raised by the heat reflected from walls on which the sun had been shining many hours of the day.

In page 46 it is stated that the Abbé Longuerue visited Rome towards the close of the last century. It should have been towards the beginning,

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Snow is a phenomenon of such rare occurrence at Rome that, when writing the article "General observations on the weather," it escaped my recollection. I may observe, therefore, that during a residence of fifteen winters at Rome, I have seen snow not more than five times, and then only in March, the month in which, as I have observed, the greatest variations of temperature occur.

In every case it began to melt immediately, and in a few hours it had disappeared.

As a further illustration of the ignorance displayed by the Times on all matters connected with science I give the following extract from a leading article in that

Journal of Oct.r 17th 1877. Speculating upon the causes of the late explosion in the colliery near Wigan the writer observes, " The storm of Sunday was already brewing. The pressure of the atmosphere, as shown by the sudden fall of the Barometer, had greatly *increased* from what it had been just before. The result of this may probably have been to keep down the fire-damp within the mine, and prevent it from passing off as quickly as it would otherwise have done. With a store of explosive material thus collected, and waiting only for a flame to kindle it, the chances of an accident were more than usually great, and the accident, if it did occur, would be more than ordinarily terrible." It is evident that the author of the article does not understand the principle of the Barometer. I had always imagined that a fall of the Barometer indicated *diminished* pressure, and that the true explanation of the fact that explosions usually occur with a low Barometer was, that the diminished pressure allowed the gas to escape from the fissures and cavities in the coal, where it had previously been retained by the superior elasticity of the atmosphere air; such, however, is the ignorance of science in the present day, in spite of the facilities afforded for acquiring it, that none are found to detect these errors.