

15/4/96/84.

(1) Number of pages 44
(2) Date of repair 10-12-1980
(3) Initials of the Referencer and 11-12-1980

TAMIL NADU ARCHIVES

GOVERNMENT OF TAMIL NADU

Revenue DEPARTMENT

G.O. No.	2706	Press.
B.P. No:		Mis.
Dated	12.5-1877	197 .

82

Not to be folded or roughly handled

REVENUE DEPARTMENT

No. 2400

From E. A. Schrotky Esq^{re}

Dated

1st May

1877.

FOR ORDERS.

I see no need
10/15/77

No 2400
Forwarding a Pamphlet
on Man, Plant & Soil

FOR ORDERS.

Rev
Miss 12-5-77 N 2706.

C. G. May 77. Recd 5/77.

3
MAN, PLANT AND SOIL,

AND

THEIR CORRELATIONS.

BY

EUGENE C. SCHROTTKY.

AGRICULTURAL AND ANALYTICAL CHEMIST,

AUTHOR OF

"THE PRINCIPLES OF RATIONAL AGRICULTURE APPLIED TO INDIA AND ITS
STAPLE PRODUCTS."

"THE REMOVAL AND UTILIZATION OF THE BOMBAY NIGHTSOIL."

"BOMBAY WATERS AND THE ALBUMINOID OF AMMONIA TEST."

CALCUTTA:

THACKER, SPINK & CO.

1877

All rights reserved.

MAN, PLANT AND SOIL,

AND

THEIR CORRELATIONS.

BY

EUGENE C. SCHROTTKY.

AGRICULTURAL AND ANALYTICAL CHEMIST,

AUTHOR OF

"THE PRINCIPLES OF RATIONAL AGRICULTURE APPLIED TO INDIA AND ITS
STAPLE PRODUCTS."

"THE REMOVAL AND UTILIZATION OF THE BOMBAY NIGHTSOIL."

"BOMBAY WATERS AND THE ALBUMINOID OF AMMONIA TEST."

CALCUTTA:

THACKER, SPINK & CO.

1877

All rights reserved.

5

Inscribed
TO
ADOLAR
IN REMEMBRANCE OF OLDEN TIMES.

c 9

Appendix. 37

MAN, PLANT AND SOIL, AND THEIR CORRELATIONS.

IN whatever light we regard man, whether from a psychical or from a physical point of view, whether we look upon him as the end-link of a chain of Darwinian evolutions, or as the specially created image of our Maker, whether we regard him in his highest god-like aims, as the philosopher who searches the realms of the universe and the depths of earth for evidence of the past and prognostications of the future, the philosopher who brings the laws of Nature, the laws of God, within the precincts of mathematical calculations and conclusions, or whether we regard him in his simplest occupations, as the hard-plodding son of the soil, typified by the ryot of Bengal, whose wants and aspirations reach not higher than for a cloth to cover his loins and for a dish of rice and curry to

feed himself and his family,—but, in whatever light we regard him, his first want is food, and his first resource plant and soil.

Man, as regarded from a chemical point of view, is an accumulation of organic compounds, consisting of oxygen and hydrogen, carbon and nitrogen, accompanied with small portions of mineral matter, all arranged in cellular systems round a framework of phosphate of lime and magnesia, and regulated in their arrangements and functions by that unfathomable principle which we call life. A constant tendency exists in these organic compounds, which are mostly of a highly complex nature, to resolve themselves into simpler forms, which are dissipated into the air or otherwise disposed of. A constant change is therefore going on, a constant waste of tissue takes place, and a constant want exists to replace what has been lost.

This want is supplied by food. If we were to attempt to feed man with the elements he is composed of, if we were to offer him oxygen and hydrogen, carbon and nitrogen, duly accompanied by his mineral requirements, in order to make up for the waste of his tissue, we should fail in the attempt. Man is not able to assimilate these substances in their simple forms; he requires for his food substances which approach in complexity and constitution those they are intended to replace. The albumen and fibrine of the human blood

require for their replenishment substances of similar constitution, which, indeed, we find in the gluten of bread and the caseine of milk. Hence man is limited as to the source of his food, and instinct and necessity has, in the first place, taught him to look for it among the products of the vegetable kingdom,—among the products of *plants*.

"Vegetables," says Liebig, "produce in their organism the blood of all animals; for the carnivora in consuming the blood and flesh of the gramivora, consume, strictly speaking, only the vegetable principles which have served for the nutrition of the latter.

The animal organism is a higher kind of vegetable, the development of which begins with those substances with the production of which the life of an ordinary vegetable ends.

The first substance capable of affording nutrition to animals, is the last product of the creative energy of vegetables."

Plants are, therefore, the immediate and chief source available to man for his bodily requirements.

The similarity of animal and vegetable life is very great, so far as its chemistry is concerned. Plants, as well as man, we find composed of organic compounds consisting of oxygen and hydrogen, carbon and nitrogen, with their accompaniment of mineral matter, arranged in cellular systems round a skeleton frame work, which, in the case of plants, consists of

silica and lime, regulated in their arrangements and functions by the principles of life.

The same constant change is taking place among their compounds, the same constant waste occurs. But the replacement of this waste, and the building up of additional compounds, is regulated by different principles. Man requires for his food substances in which the principles of life have been already active, while plants derive their food from such simple forms as carbonic acid, water and ammonia, the component elements of which they convert into most complex substances, such as gluten, vegetable albumen, and sugar.

In fact, vegetable life is eminently constructive, animal life destructive.

But there are other similarities existing between man and plant. The fire of life in man, if I may venture to express myself thus, is kept up by a constant combustion of organic compounds in the cellular system of the lungs; the oxygen of the air is the actor, carbonic acid the result. The fire of life in plants is kept up by a similar process taking place in the cellular system of the leaves, but here carbonic acid is the actor and oxygen the result, and a proper balance of these substances is therefore kept up in the atmosphere.

When life is extinct, man as well as plants are decomposed by the forces of Nature into those very simple forms which were employed by the plants

in building up their fabrics—air goes to air and ashes to ashes, and these substances are thus again rendered available for a new circuit, and we observe here one of those beautiful laws of nature which permit no waste and tend to keep everything within a never-ending circle of consumption and restitution.

The food of plants is twofold, organic and inorganic, and the sources from which they draw it are likewise twofold.

As mentioned before, plants are able to construct most complex compounds from such simple forms as carbonic acid, water and ammonia, and these three substances constitute, in fact, the three great suppliers of organic plant-food and are derived from rain and atmospheric air, the percentage of carbonic acid and ammonia in which is constantly kept up by animal respiration, by the results of animal and vegetable decomposition, and by the evolution of volcanoes. From these resources, always available, never diminishing, the plant builds up, on an average, 95 per cent. of its weight.

The inorganic or mineral food of plants consists chiefly of potash and soda, lime and magnesia, sulphuric and phosphoric acid, silica and iron, and is derived exclusively from the soil. Although these mineral substances form only, on an average, 5 per cent. of the weight of plants, yet their importance and their influence upon vegetable life cannot be over-estimated.

The inorganic food available to a plant is confined to within the radius of its roots, and in a state of nature the death of the plant and ensuing decomposition will restore to the soil the elements it abstracted, and thus the amount of available mineral food will never be diminished.

But if the hand of man intervenes, and removes the plant from the spot where it grew, the balance will be disturbed; for, that portion of the soil which the plant had abstracted is taken away with it, and as the soil is not moveable and interchangeable like the atmospheric air, Nature, in her ordinary operations, cannot restore to that part of the soil the inorganic plant-food which the hand of man has removed.

From man and plant a further step carries us to the soil.

Soil is the result of the gradual disintegration of the various rocks which compose the crust of this globe, the agent being climatic influences. We may regard it as composed of two parts,—the one comprising substances such as potash and soda, lime and magnesia, sulphuric and phosphoric acid, silica and iron, which serve as food for the plant, and which form about 10 per cent.; the other comprising sand and alumina, and other substances which do not serve as plant-food, but which are necessary to provide the physical qualities a soil must possess in order to be fit for the

support of vegetable life, and these form the larger part of the whole,—on the average, fully 90 per cent. The inorganic plant-food in the soil must be again divided into two parts,—the first comprising those components which exist in *physical combination* and are immediately available for the purposes of the plant, and the second, and far larger portion, comprising those minerals which are still in a state of *chemical combination*, unavailable, while thus; to the plant, but which may become available in time by the decomposing action of climatic influences.

Soil and air therefore nourish and support the plant, plant supports man, and the circle is complete when we go back to mother earth.

From soil to plant, from plant to man, and from man back again to the soil.

Looking back to the early days of our race, it followed as a natural consequence upon the rapid increase of mankind, that the food resources which Nature, unaided, provided, were very soon found not sufficient, and man took therefore to rearing artificially, if I may say so, those plants the products of which experience had taught him were most palatable and nutritious.

Hence the origin of agriculture, *id est*, the rearing of plants for the food, for the necessities, as well as luxuries of mankind.

Agriculture occupied a far higher position among the ancients, than it does now, and its literature was more universally read and appreciated than it is in these days. Some of the most renowned of ancient authors have handed us down in their works extensive descriptions of ancient agriculture.

Theophrastus and Hesiod, Xenophon in his *Oeconomica*, Cato, Varro, and Columella in their *"De Rebus Rusticis,"* Virgil in his *Georgics*, all give evidence in what high estimation agriculture was then held. And we have only a small portion of what has been written.

Plinius laments over 40 Greek treatises on agriculture which were lost in his day, and Columella counts up fifty.

But not the Romans and Greeks only considered agriculture worthy to be practised and theorized by their greatest and wisest, but we have also records that such was the case in Asia.

The Persian kings used to examine personally the state of agriculture in their provinces, reward the laborious, and fine the neglectful, and even thought it not below their dignity to appear as simple farmers. "Ut intelligatis," says Cicero commenting upon this example, "nihil ei tam regale videri quam studium agricolendi."

An anecdote occurs to me, illustrating well how men in those days considered themselves bound to the soil which nourished them.

Attilius Regulus was in command of a victorious army in Africa, adding conquest to conquest, and the fora of Rome rung with the fame of his name. While thus engaged, news reached him that the bailiff of his estate, comprising about four acres, was dead, and that his slave had run away. He immediately wrote off to the Senate, enclosed a list of the agricultural tools at his estate, and threatened that, unless they took these into their special care and procured him another bailiff and another slave, he would give up the command of the army and come back to look after his estate.

And, I maintain, he was correct in his principle, for agriculture forms the basis of our life and the basis of human society, as at present constituted; it supplies the first and chief want of man,—his food, and without it there would be neither civilization nor an increasing population. Agriculture is the mainstay of all arts and manufactures, and it gives occupation to by far the greater portion of our race.

The permanent wealth of a country lies in its agriculture, in its acres of cultivated soil, and the cultivating population of all States are their chief support, and the chief payers of taxes.

But not alone in ancient times do we find agriculture honoured and practised by the leading members of communities; for can the English Nation not point proudly to its noble Lords who

are first and foremost in all agricultural movements and improvements? Is not the Squire of England and the "Gutsbesitzer" of Germany the representative of one of the most honoured and respected classes of men?

But the climax of their ambition is not to rack-rent their tenants and fill China jars with gold-mohurs—as I am told is the ambition of the zemindar of Bengal. Their ambition is to have their acres well-tilled and well-manured, to convert wastes into smiling corn-fields, and to have a contented and industrious tenantry—and their principles answer best and pay them best in the end—and the zemindar of Bengal would do well to imitate their example.

However, it is a sign of better times to come when Native Princes begin to understand this question rightly and do not hesitate to speak their mind. I quote an extract from an address which the first Prince of Travancore delivered at Trevandrum on the 26th of September 1874 :—

"It has seldom or never entered into the thoughts of the peasant, or of those who are much wealthier and better informed than he, to endeavour to make two blades of grass grow where only one does now, or to make that one blade twice as valuable as it now is. We have often heard people grumbling at the high prices at which rice, the staple food, and other articles are sold; and not

unfrequently they speak of the good bye-gone days when they could get four or five seers of rice for a fanam. The fact is, the population has been rapidly increasing, while the cultivation of the land has been, out of all proportion, lagging behind. Paddy is the chief produce of the land, and yet the home-grown paddy does not suffice to feed our people; and foreign paddy, worth several lakhs of rupees, is annually imported. Yet no attempt worth the name is made to increase the yield by manuring and other means. Instead of all this, we fold our hands and utter idle curses on the stars that innocently course the heavens, or inveigh against the Dewan for the time being! The fault is indeed to be laid at the door of our rich landlords and capitalists, and men who have received the benefits of education, rather than at that of the poor and ignorant peasantry. In industrial progress, as in everything else, it devolves on the well-to-do classes to take the lead."

"If our Government must provide for all the youths that receive education, our public offices will have to be extended miles, and public salaries to be increased by thousands of rupees, and after all to entertain a number of discontented, disobedient, and sometimes troublesome young men. The sooner the idea that Government employment is the *ultima thule* of education is scooped out of the heads of our youths, the better. Be assured that the wielding of a spade or the driving of a plough,

or the treading a watering lever, in one's own interest, is not a whit less honourable than scratching foolscap with goosequills, taken in itself. Remember that Cincinnatus, the Dictator, after saving Rome, and adding glory to its name, returned to plough his fields. Remember that Garibaldi, after liberating the same historical land from modern thralldom, went back to his island home to rear cabbages. I do not mean that those who are being educated should learn to shoulder a spade or drive a plough; but with their sharpened intelligence and ability to read, they can learn much that is practical and theoretical in the various industrial operations; and the knowledge so gained can be employed hand in hand with the capital which our yet undeveloped country must draw to itself."

Thus the first Prince of Travancore. But the little esteem in which the practice of agriculture is held in India, contrasts not only most unfavourably, when compared with the great regard in which it is held and the perfection with which it is practised in Europe, but it also does so when compared with other parts of Asia.

I could write at great length of Japan and more especially of China, where annually in the beginning of March a large agricultural *fête* is held, and the Emperor, accompanied by all the Princes of the Imperial family and by all the high officers of the State, proceeds to an appointed field, and laying aside his imperial robes turns up a furrow by his own

hand, "*ut intelligatis, nihil ei tam regale videri quam studium agricolendi*"; but I will not overtax the patience of my reader and return therefore to the more immediate subject of my treatise.

The operations of agriculture are universally known and will need no recapitulation, and I will only allude to the last act, crowning the efforts of the husbandman, I mean the harvest and the removal of the crops from the fields.

It follows from what I said before, that whatever a certain area may produce in straw and grain, the total weight will represent what the activity of the plant has collected of organic and inorganic compounds.

If we take the outturn of an acre of rice to be 800 lbs. of grain, and 4,000 lbs. of straw, we know, that about 95 per cent. of the total weight has been derived, as before explained, from sources, Nature is constantly renewing and which never diminish, while about 5 per cent. represent what the plant has withdrawn from the soil.

Now, I have endeavoured to demonstrate that Nature, in her ordinary operations, does and can do nothing to restore these 5 per cent. of mineral matter abstracted; it is a permanent loss, and as they represent, so to say, a portion of the essence of the soil, their continuous withdrawal will and must have a deteriorating effect upon the capabilities of a soil, be it ever so fertile, although perhaps

centuries may elapse before a permanent diminution in the outturn is perceptible, and therefore man must come to the rescue of Nature and restore what he has taken away.

To use a simile, which will be easily remembered, let us consider every pound of available inorganic plant-food present in the soil of an acre as equivalent to half an anna, and we will then have a certain sum represented by that acre, from which we draw in the course of a year in the shape of grain and straw say 100 annas, equal to 200 lbs. of inorganic plant-food; but in addition to this we get 4,600 lbs. which have been derived from a source which never diminishes, and which Nature without aid is constantly replenishing. Take the commercial value of the total produce now as equivalent to Rs. 35, deduct Rs. 15 for actual expenses connected with cultivation and taxes, we will have then a margin of Rs. 20 on the 100 annas withdrawn from the soil.

The conclusions are easily drawn, the soil is the capital with which the agriculturist operates in order to obtain the interest before mentioned, and this interest is drawn from an unfailing source which cannot become bankrupt, like Turkey or Egypt.

As long as the capital remains intact, the interest thereon will not diminish; but as sure as the earth turns round her axis, as sure will and must that interest, or, in other words, the agricultural outturn of a certain area diminish, if the balance of the fertilising substances in the soil is disturbed.

Before taking into consideration how far the maintenance of this capital is observed here in India, I must ask the reader to follow with me the crops removed from the fields to their destination. In they go, the laden carts, to hamlets and villages, from villages to towns, away whirl the railway waggons carrying the produce of the land to distant parts, away it goes in steamers and ships to distant lands; the produce of millions and millions of acres, all goes to serve one ultimate purpose, one ultimate object, namely to supply the necessities and luxuries of man, to supply his first and chief want—food.

From soil to plant, from plant to man.

It has been established that the body of an adult man does, on an average, not increase in weight, and that his food tends only to keep up and renew his ever-wasting tissues, and in the refuse of his food we find therefore all the inorganic substances which it contained before consumption.

It is to supply the food of man that the soil is tilled and made to yield milk and bread, and it is in the refuse of the food, man has consumed, that we have to look for those mineral substances which the plant has abstracted from the soil, and wherein they are again rendered available to accomplish another circle of nutrition, and it is man who must again restore them, for Nature cannot do so.

There may be other more pressing, there may be more interesting, there may be more congenial questions concerning mankind, individually and socially, but there is none, I say absolutely none, of so great importance.

Upon the proper restoration of the capital, withdrawn from the soil by the operations of agriculture, depends the welfare and ultimate existence of nations, for we cannot squander Nature's resources without experiencing severe retribution.

But how neglectful have we not been in the past?

A few lines cut by me some years ago from the English "*Times*" express better, than I could do, what every thoughtful man should feel on the subject; they run as follows:—

"The great sewage question slumbers. Who is to awaken it? Five hundred thousand tons of it flow daily into the Thames at an enormous annual cost for pumping, machinery, &c. Even our great and powerful Metropolitan Board of Works, which expended £4,000,000 to carry it into the Thames, seem afraid now to deal with it and are perplexed, for it is poisoning our water and choking the noble stream. Who are most interested in it? Surely it must be our landowners first, then our farmers, and ultimately the British people, whose stomachs would be better and cheaper filled than at present, were it utilised. But it is so 'big' a job that every

one seems to shirk it. The railways were a 'big' job—£500,000,000! but that has been done. Are people aware of the value of town sewage and what it costs to produce it? The population of London and its vicinity are nearly 4,000,000, and they consume the annual average produce of more than 20,000 acres daily; or 7,300,000 acres annually. As I look with admiration and wonder at the almost flying trains of railway cars laden with cattle, sheep and pigs and other comestibles, I cannot help saying to myself, 'there they go, right down into the sewers.' Similar thoughts pass through my mind as I observe the unloading of fleets of enormous ships and barges laden with corn, eggs, butter, cheese, and other eatables and drinkables. . . . Under the Sanitary Acts the corporate bodies of our towns and cities are perplexed by this question of sewage, and immense sums have been almost fruitlessly expended. *It is quite clear that into the country and on to the land it must ultimately go, so we had better make up our minds to this and see how it can best be done.* In conclusion, it is quite clear and indisputable that the vast waste of human refuse is impoverishing our country to a great extent by diminishing and exhausting the productive powers of the soil. All countries that do this must eventually suffer the extreme penalties of want and poverty, and must also depend, as we do now to a great extent, on foreign nations for our daily bread."

Now the Chinese and Japanese have without the aid of science solved this question. Both nations practise agriculture upon the principle, that *without continuous manuring, there can be no continuous harvest, no continuous production.*

They argue as follows :—"a small portion of what I take away from the soil is replaced by Nature, (meaning rain and atmospheric air); the remainder I must restore."

What can be more simple and still so correct?

I quote from Dr. Moran's report to the Minister of Agriculture at Berlin on Japanese husbandry; while speaking of a Japanese town and of the utilisation of the refuse of human food, he says :—

"It is sent every night and morning in its natural form into the country around, to return after a time in the shape of beans or turnips. Thousands of boats may be seen early every morning laden with high heaps of buckets full of the precious stuff, which are carried from the canals in the cities to the country. These boats come and go with the regularity of the post.

"In the evening long lines of coolies are seen on the road, who, having carried the produce of the country to the town in the morning, return each with two buckets of manure.

"Caravans of pack horses, which have often brought manufactured articles (silk, oil, lacquered

goods, etc.) a distance of 200 to 300 miles from the interior to the capital, are also returned with buckets or baskets of manure."

Thus in Japanese agriculture we have before us the representation of a perfect circulation of the forces of Nature; no link in the chain is lost:

"From soil to plant, from plant to man, and from man back again to the soil."

And now let us consider what is done in India in order to maintain this chain complete. You have followed me patiently through all the links of the chain, from soil to plant and from plant to man, but here we must stop, Indian agriculture has lost the connecting link, the chain is broken, and we see everywhere a painful waste of that portion of our food which ought to go back to the soil.

But no, here it goes into the sea, there into the river, it lies about in heaps around villages to create pestilence and diseases, and to be washed away into nullah and river by each succeeding monsoon. And, with a few honourable exceptions, whenever necessity compels corporations and municipalities to consider what to do with this essence of our food, the anxiety displayed, "how to get most easily rid of it" is most painful to observe; it does not seem to occur to them that their only and chief anxiety should be, "how to make the best use of it."

Take Calcutta, for instance, which has solved

let us hope to the entire satisfaction of all concerned, the question of "how to get most easily rid of it." If we take its population as 700,000, and calculate the amount of food consumed, and compute its value, we will find that it amounts to little less than $2\frac{1}{2}$ crores of rupees annually, and that at least 800,000 acres are necessary to produce it.

We know now, that in the refuse of human food we find all the mineral constituents withdrawn from the soil, and it follows therefore that a conscientious restoration of the refuse of food, now annually consumed in Calcutta and wantonly wasted, would enable the country to raise again products worth $2\frac{1}{2}$ crores of rupees, without any further call upon the resources of the soil.

It is only when we go into figures, that we can understand what a waste of national wealth is going on.

As the question may be put to me "how to utilise this refuse of our food," my answer is—"do, as has been done in China and Japan for centuries past."

The ryot of India has therefore been living on the capital, represented by the soil, in addition to the interest thereon, and that the natural consequence of this, namely a gradual deterioration and diminishment in the outturn per same area, has taken place, must be apparent to the most superficial observer. I have given in one of my publications the statistics

of this decline, but it will be consistent with the subject of this treatise to allude to them here.

The "Ayeen Akbary" contains a set of tables showing the average produce of food-stuffs and other agricultural products throughout the whole of India, which, dating from the middle of the seventeenth century, were drawn up in the Emperor Akbar's reign by order of his great minister, Tudar Muhl, and were based upon the records of nineteen years' careful observation of the season. (The natural philosophers of that age regarded 19 years as a solar cycle, in which the seasons were supposed to run through all their variations, but we have now learnt from Dr. Hunter [of Madras] and from Mr. Blanford, that this cycle consists really of eleven years.) These statistical tables appear to have been prepared with extreme care, and their reliability is uncontested—a statement which unfortunately cannot be always made in favour of the agricultural statistics which are now being collected. According to these tables, the average produce of rice in India amounted in the middle of the seventeenth century to 1,338 lbs. per acre, of wheat 1,155 lbs. per acre, of cotton (unpicked) 670 lbs. per acre, equal to about 223 lbs. picked. If we search the statistics of the nineteenth century, and especially those of this decade, we find the average yield of rice to be 800 to 900 lbs. per acre, of wheat 660 lbs. per acre, of cotton (picked) 52 lbs. per acre: and I ask now, have we not reason to stand aghast at the fact, thus

revealed, that the soil of India is rapidly approaching exhaustion?

For thousands of years the soil of India has nourished millions of people; but for thousands of years the soil has annually been deprived of a portion of its plant-food, of inorganic elements which are indispensable to the growth and development of our crops—while the restoration of these essential elements of plant-food has during this untold period either been nil, or of a very inadequate character. Can we, therefore, be surprised at the tale the above figures tell?

The gradual decrease is still more apparent if we follow the outturn of cotton, 223 lbs. per acre of picked cotton was the produce of the soil in the middle of the seventeenth century. No reliable information regarding this staple seems to be available from that time until the present century; but I would ask you to refer to Colonel Monier Williams' memoir, in which, speaking of the Broach zillah and its black soil, he states that it produced in his time (1828) 128 lbs. of cotton per acre.

Much later (1844) we learn from Dr. Burn, who had charge of the Broach experimental farm, that under the most careful cultivation, only 83 lbs. of cotton were obtained from one acre; in the last decade the average produce was 67 lbs. per acre, and now a still lower average of 52 lbs. has been reached.

Mr. Rivett-Carnac, sometime ago Cotton Commissioner, when reporting upon the cotton cultivation of Ahmedabad, says that he is "at a loss to account for the continuous yearly decrease" of this staple. But this decrease, I maintain, can easily be accounted for, if we consider the natural laws, the rational principles of agriculture, which demand a conscientious restoration to the soil of those elements of plant-food which have been taken away from it; and if the yearly outturn is not to be diminished, we must act in harmony with those laws, otherwise we shall follow the example of the foolish husbandman, in expecting to reap where we have not sown.

If we further compare the yield of the so-called fertile soil of India, with the results of European agriculture, the consequences of a neglectful practice will be still more apparent.

Of wheat, 1,500 lbs. per acre is the average in Europe, 660 lbs. the average of India. Of rice, 2,500 lbs. is the yield per acre in Italy, 2,000 lbs. in America, while the average of India is 900 lbs.

Of cotton, the average yield in America is 200 lbs. per acre, in Egypt 300 to 400 lbs.; in India it is only 52 lbs. The farmer of Europe and America lives comparatively in opulence; the ryot of India vegetates in squalid poverty, his implements are of the rudest possible description, and his cattle pitiable specimens of a gradual degeneration. Starved

is the soil, starved are the cattle, starved are the ryots who cultivate the soil—the soil itself craves for its proper sustenance, and men and cattle crave for it likewise.

And now you will ask what can be done to improve this state of things? Can we root out the present system of agriculture, and establish it on a different basis? Can we force corporations and municipalities to give back to the land what has been taken from it? I fear we cannot, the custom established through centuries lasts longer than the conviction of an hour, and it is so easy to say "*laissez aller, par après nous c'est le deluge.*" But neither would violent changes be beneficial or lasting. The best improvements are effected step by step, and it is thus only that we can hope for any success in improving agriculture.

But one of the first steps to attain that end will be agricultural education, to spread, by word and deed, among the agricultural masses a knowledge of the rational principles, on which alone agriculture can be carried on successfully and without injury to the fertility of the soil.

Let this knowledge be ever so elementary, it will be one step forward, and when this step is taken, I am certain we shall move on; and though we shall be all dead and gone before the work is completed, a commencement must be made some time or other, and what can be done to-day, why defer it till the

morrow? Once the work is commenced, once the ball is set rolling, link will be added to link until the chain is complete:

From soil to plant, from plant to man, and from man back to the soil.

APPENDIX.

The following extracts may serve to contribute additional weight to the facts and arguments set forth in the foregoing treatise.

In a letter to the *Indian Agriculturist*, Mr. Wedderburn, after doing me the honour to allude to some contributions of mine on the present small returns of Indian agriculture, says as follows:—

"The remedy, no doubt, is to return to the soil all that has been taken out of it, but has that remedy ever been in practice in former centuries in India? If so, the practice among so conservative a people would have continued till now; and with a powerful sun, undeteriorated soil, and irrigation, we should have heavier crops than in more temperate climates. It would be desirable to know that such statistics of former outturns are reliable as averages, not as exceptional crops.

If the higher orders of natives could be got to take an interest in agriculture, it would lead to one of the most marked improvements the country could witness. As it is, only the ordinary ryot cultivates the ground: landed proprietors let it out to farmers, sharing the produce, and take no personal interest in its cultivation, and, as a rule, there is no more obstinate follower of old customs than the cultivator of the soil.

He has not sufficient manure for his field; the cattle manure from the denudation of forests is too often made into fuel,—but whether as inhabitant of a village, or of a detached homestead, he defiles the outskirts of the village, or his house, with night-soil, which, if carefully preserved and applied to his fields, would give back, in great measure, what was taken from them.

Experiments made in this direction by the municipality of which I am President, have clearly shown how the ground can be continuously cultivated with rotation crops without any diminution

Appendix.

31

the land, and in no long period double its produce. An
like the Rao of Kutch should see to this. But

Appendix.

29

of its fertility by simply applying the night-soil of a town mixed with the ashes of vegetable rubbish. Plantains, bearing in nine months, have been succeeded by tobacco, a four months' crop: after that wheat, then cholera; the climate is too hot for root crop, but the soil for several years has never been for a week without a crop. So soon as one is harvested another is planted with of course the assistance of the night-soil and ashes manure; the country tobacco has developed into nearly double the ordinary sized leaf, one has attained thirty-two inches by fifteen, and the leaf has improved in fineness, and make better than ordinary cigars, selling at eleven rupees per thousand. The soil is little better than *kunkur*, or nodular lime stone, which, when solid, is dug up for road repair and the void replaced by the sweepings of the town drains. It effervesces with acid, so does not require lime, and has a good deal of nitrate in its composition, having been the site of an old district jail. Cocoanuts have been brought to flower in four years by this method of cultivation. I have heard that Mahomedans have less scruple than Hindoos in employing the manurial wealth of their villages, instead of allowing it to accumulate and poison the air and water supply, and aggravate the ravages of cholera; but until Europeans take up the cultivation of land in the plains, and show what wealth is wasted, and opportunities of improvement neglected, it is hopeless to expect anything of the native cultivator. The consequences of the existing, and probably for ages continuous, state of things are not realized till the poison of the air and water produce their natural effects; and cholera, small-pox and fever prevail over the land, not to mention the evil effects, when cattle and pigs are the sole scavengers, whose milk and meat are deteriorated if not poisoned by such diet. One of the greatest improvements a municipality can effect is, to show how the economical disposal of the refuse of a town can be made the requisition of the fertility of the soil of the country.

A. WEDDERBURN, C. S.,
President, Municipal Commission of Coimbatore.

P. S.—It is not improbable that if the night-soil and ashes conservancy were adopted in European towns, instead of the water system, which overdilutes the sewerage and makes it unprofitable, except for sandy meadows in Edinburgh, there would be less occasion for the expensive manures, such as guano, now imported, and of which there must be but a limited supply. Such conservancy would no doubt be more expensive than that of water, but the expense might be recouped by the sale of a valuable manure, and health improved by the non-pollution of rivers and wells."

And the following supplies further facts:—

"TO THE EDITOR OF THE TIMES OF INDIA.

SIR,—The condition of the soil in India is now attracting some attention, and not an hour too soon is the subject raised. Mr. R. H. Elliott declares that "the people are living on the capital of the soil because of the difficulty of manuring and irrigating it sufficiently." Mr. Schrottky has demonstrated, in his recent lectures, that Mr. Elliott's statement is founded on fact; and he has unanswerably shown that the land is becoming rapidly exhausted, and that the increasing population will at no distant date be unable to obtain adequate sustenance from the produce of the country.

In one State on this side of India the food question would seem to be pressing with some urgency—I refer to Kutch. In the last published Report on its Administration—a most able document drawn up by Mr. Motiram Dalputram, the late Dewan—it is stated that Kutch is a "Province where the utmost efforts of the agricultural population are exhausted in forcing the means of human sustenance from a reluctant soil, both on account of its sterility and the failure of rains." Here the agriculturists themselves are becoming "exhausted" in their efforts to force the soil to yield them sustenance; but though no human efforts will ensure them a due and seasonable fall of rain, yet human exertions can lay on their fields substances that will promptly restore the ferti-

lity of the land, and in no long period double its produce. An enlightened ruler like the Rao of Kutch should see to this. But what a miserable example of helplessness we enlightened English surely must exhibit in the eyes of all, when our professional and highly-paid engineers have no other plan for the disposal of invaluable products—for the want of which the land is starving—than to cast it all into the sea, thus betraying a culpable ignorance of its value and a barrenness of resource in mechanical invention.

M.



Rev. 240477

BY THE SAME AUTHOR.

THE
PRINCIPLES OF RATIONAL AGRICULTURE
APPLIED TO
INDIA AND ITS STAPLE PRODUCTS
Rs. 7-8.

... We beg to direct the earnest attention of our readers to, and study of, a book that has been recently published. It is one so comprehensive in its scope, so full and clear in exposition and treatment, that they (Planters and Zemindars) need not fear being able to understand it. Though written, as the name of the author would imply, by a foreigner, it is simplicity itself in statement, reasoning, and conclusion; and to any who approaches the subject with an intelligent appreciation of the great questions involved, it is intensely interesting. *—Indian Daily News, August 2nd, 1876.*

... All honour to the author of the able and exhaustive work before us. ... He writes learnedly of Agriculture as a science, and of the principles by which the science is governed. ... A highly useful work. *—Delhi Gazette, July 26th, 1876.*

FEW of the books published in India have been looked forward to with greater interest, and no one, when the volume is in his hands, will be disappointed in his expectations for the whole subject is handled with a master hand. *—Times of India, July 27th, 1876.*

... We do not bestow on this work more praise than it merits. *—Bombay Gazette, July 27th, 1876.*

THACKER, SPINK & CO.,
CALCUTTA.

Ms. B. 12.5.77 v. 2706.

From

J. Schroffley Esq.

To

The Ch. Secretary to the Govt. of Madras

Post, No 35 Chauringhee
Calcutta 1st Nov

Sir

I have the honour to forward by samst a copy of my pamphlet on "Man, Plant & Soil & its Correlations," published

Towards the end of the Pamphlet I have taken some question of more an ordinary interest & which cannot be in diff. to the Administration of so essentially an agricultural country, and I have no doubt they will receive due consideration. If your opinion is of sufficient interest, I shall be glad to receive orders for a few copies for Government distribution. The

one pr copy

2

I have the honour to be
your most obedt servant
Engel Schrotky

✓

10. 12. 1877

12. May 77.

Handwritten in
man, Reut
soll

M. Schrotky with
informant test for

Mr No 2706

dated 1877

From
E. Schrotky

No 240

Handwritten in
a copy of 10
on man, man
soll and their
relations

For Mr