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OBSERVATIONS ON THE TEAS OF COMMERCE.

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IN my previous communication to the Society on this subject, in February, 1844 (Memoirs and Proceedings of the Chemical Society, ii. 73), I endeavored to show that there exist two distinct kinds of green tea, known in commerce as *glazed* and *unglazed*; that the former is colored by the Chinese with a mixture of Prussian blue and gypsum, to which a yellow vegetable coloring matter is sometimes added, while the latter are merely dusted with a small quantity of gypsum; that in the specimen of the so-called Canton gunpowder, this glazing or facing is carried to the maximum. I also mentioned, that I had never met with a sample of green tea in which the blue tint was given by means of indigo. Since the publication of that paper, I have been in communication with several parties of great experience in this subject, from whom I have received much additional information, which, with several experimental points of interest that have come under my own immediate observation, will form the subject of the present paper.

The first point to which I wish to call the attention of the Society is, the question of the blue coloring matter used by the Chinese for coloring the green teas being Prussian blue, because some doubts have been thrown on this subject from various quarters. Mr. Bruce thus states (Report on the Manufacture of Teas, &c., by C. A. Bruce, Aug. 16, 1839):—"The Chinese call the former (the indigo) *youngtin*, the latter (the sulphate of lime) *acco*." Now I am favored with the opinion of Mr. J. Reeves on this point, whose knowledge and experience render him most competent to decide in such a case; he believes that indigo is *never* employed for coloring used on tea, that the term *youngtin*, as used by Mr. Bruce, should be *yong-teen*, *foreign blue*, the name given by the Chinese to Prussian blue, in contradistinction to *Too-teen*, *native blue* or *indigo*; this, I think, is very conclusive evidence, and shows that Mr. Bruce's statement was erroneous.

In another quarter a surmise has also been published on this same point. Mr. Fortune, in his entertaining work (Three Years' Wanderings in the Northern Provinces of China, by Robert Fortune) on China, says, speaking of the ingredients used in dyeing the northern green teas for the foreign market, page 201:—"There is a vegetable dye, obtained

from *Isatis Indigotica*, much used in the northern districts, and called Tein-ching, and it is not unlikely that it may be the substance which is employed ;" again, at page 307—" I am very much inclined to believe that this (the Tein-ching) is the dye used to color the green teas which are manufactured in the north of China, for the English and American markets." This question, however, I think is now satisfactorily settled, and the experimental evidence I had adduced of the material being Prussian blue of a darker or paler tint, placed beyond a doubt by a positive demonstration ; for Mr. Fortune has forwarded from the north of China for the Industrial Exhibition, specimens of these materials, which from their appearance, there can be no hesitation in stating, are fibrous gypsum (calcined), turmeric root and Prussian blue ; the latter of a bright pale tint, most likely from admixture with alumina or porcelain-clay, which admixture may account for the alumina and silica found as stated in my previous paper, and the presence of which was then attributed possibly to the employment of kaolin or agalmatolite.

Mr. J. R. Reeves, in a letter to my friend Mr. Thompson, dated July 1, 1844, commenting on my paper, says :—" Mr. Warrington's experiments have led him to correct results as to the substances used, which I know to be Prussian blue, gypsum (fibrous), and turmeric ; the second being sulphate of lime ; and the last, the 'yellow, or orange-colored vegetable substance,' which Mr. W. does not otherwise name. That the coloring is not intended as an adulteration, I feel quite sure. It is given to suit the capricious taste of the foreign buyers, *who judge of an article used as a drink by the eye instead of the palate*. You well know how little the London dealers, even now, like the yellowish appearance of uncolored green tea. The Americans, a few years since, carried the dislike even farther than the English, and therefore the Chinese merchant had scarcely any chance of selling his tea unless he gave it a 'face' that would suit *their fancy*. The small quantity of the coloring matter used, must preclude the idea of adulteration as a matter of profit." Mr. J. Reeves states, " that in the East India Company's time, gypsum and Prussian blue were sometimes used upon hyson teas, Tien Hing using the first on his pale, bright hyson ; Lum Hing, the latter on his dark, bright leaf ; but these were only in minute quantities, just sufficient to produce an uniform face."

It is still a question of interest, which I before alluded to, whether the gypsum in its *calcined* state is not used for the absorption of the last portions of moisture, and allowing the tea the better to withstand the damp of the sea voyage. Through the kindness of Dr. Royle, I have received, since my last communication, a sample of green tea from the Kemaon district, in the Himalayas, which is quite free from any facing, as are also the green teas of Java, a large number of which I have had the opportunity of examining, and which are exceedingly clean and genuine in their appearance and character.

On Black and Green Teas.—Although the preparation of green and black tea from the respective plants, the *Thea Viridis* and the *Thea Bohea*, has been warmly advocated by many botanists, yet it is now, I believe, pretty generally admitted by all parties, that both green and

black teas can be and are made, indiscriminately, from the same parcel of leaves, taken from the same species of plant. It is also well known to all persons, that the infusions from these teas have marked differences of color and of flavor, and that the effects produced on some constitutions by green tea, such as nervous irritability, sleeplessness, &c., are very distinct from those of black tea. Their characteristic physical differences are too well known to require any comment, but they have peculiar chemical properties to which we shall have occasion to allude more particularly presently, and which have always been attributed by chemists to the effect of high heat in the process of manufacture.

The question presents itself then—from whence do these distinguishing peculiarities arise, and to what are they to be attributed? From observations made in other directions, in the course of the routine work of the establishment to which I am attached, I had formed in my own mind certain conclusions on this subject. I allude to the exsiccation of medicinal herbs; these are for the most part nitrogenous plants, as the *Atropa belladonna*, the *Hyoscyamus niger*, the *Conium maculatum*, and others. The plants are brought to us by the growers or collectors from the country, tied up in bundles, and when they arrive fresh and cool they dry of a good *bright green* color; but, on the contrary, it is found that if they are delayed in their transit, or remain in a confined state for too long a period, they become heated, from a species of spontaneous fermentation, and when loosened and spread open emit vapors, and are sensibly warm to the hand; when such plants are dried, the whole of the *green color* is found to have been destroyed, and a *red-brown* and sometimes a *blackish-brown result* is obtained. I had also noticed that a clear infusion of such leaves evaporated carefully to dryness was not *all* redissolved by *water*, but left a quantity of *brown oxidized extractive matter*, to which the denomination *apotheme* has been applied by some chemists; a similar result is obtained by the evaporation of an infusion of black tea. The same action takes place by the exposure of the infusions of many vegetable substances to the oxidizing influence of the atmosphere; they become darkened on the surface, and this gradually spreads through the solution, and on evaporation the same *oxidized extractive matter* will remain insoluble in water. Again, I had found that the green teas, when wetted and re-dried, with exposure to the air, were nearly as dark in color as the ordinary black teas. From these observations, therefore, I was induced to believe that the peculiar characters and chemical differences which distinguish black tea from green, were to be attributed to a species of heating or fermentation, accompanied with oxidation by exposure to the air, and not to its being submitted to a higher temperature in the process of drying, as had been generally concluded. My opinion was partly confirmed by ascertaining from parties conversant with the Chinese manufacture, that the leaves for the black teas were always allowed to remain exposed to the air in mass, for some time before they were roasted. Mr. Ball, in his valuable work (*An Account of the Cultivation and Manufacture of Tea in China*, by Samuel Ball, Esq.) on the manufacture of tea, has described in detail the whole routine of these interesting processes, fully confirming my pre-

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conceived opinions, and of which I cannot do better than give you a summary. Some of the facts, I believe, had been published in Batavia in 1844, by Mr. Jacobson (*Handboek v. d. Kult. en Fabrik v. Thee*), in the Dutch language. In the preface to his work, Mr. Ball says :—“It will be seen by dates incidentally adverted to, that the facts and most of the materials of this work, were established and collected thirty years ago.” “These facts, as well as other materials, were derived from conversation with growers and manipulators from the tea districts ; from written documents furnished by Chinese ; from published works in the same language diligently sought out ; and also from correspondence with a Spanish missionary long resident in the province of Fokim. These were all put into their present form full twenty years ago, and were read to one or two friends during my residence in China.”—“They were not, however, so arranged, with any view to immediate publication.”—“They were thus disposed, as the best mode of recording and keeping together the facts and materials I had collected.”—“But it was not till the year 1844, when I received Mr. Jacobson’s Handbook on the cultivation of tea in Java, that I found my own views so far confirmed, and my information such as to justify me in bringing my labors to a close.”

The processes peculiar to the preparation of black tea, are styled *Leang-Ching*, *To-Ching* and *Oc-Ching*, and these all consist in carefully-watched and regulated processes of *spontaneous heating* or *slow fermentation* of the leaves until a certain degree of fragrance is developed. The leaves are said to *wither* and *give*, and become soft and placid. The utmost care, practical skill and experience are required in the properly conducting these operations, and as soon as the proper point is arrived at, the leaves are to be immediately removed to the *Kuo* or roasting-pan. After being roasted and rolled two or three times, they are then to be dried, and this is effected in the *Poey-long*, which consists of a cylinder of basket-work, open at both ends, and covered on the outside with paper ; it is about $2\frac{1}{2}$ feet in height, and $1\frac{1}{2}$ in diameter, which diameter is diminished in the centre like an ordinary dice-box to one foot and a quarter. This stands over and round a small charcoal fire, and is supplied with cross-bars about fourteen inches above the fire, on which an open sieve containing the tea is placed ; and a small aperture about an inch and a half in diameter is made in the centre of the tea with the hand, so that an ascending current of air and the products of the combustion pass through and over the tea contained in the sieve. A circular flat bamboo tray is placed partially over the mouth of this cylinder, and most probably serves to regulate the rapidity of the ascending current, prevent the admission of the cold air to the leaves, and at the same time allow a sufficient outlet for the generated watery vapors and the products of combustion. At the commencement of this operation, the moist leaves are still green and retain their vegetable appearance ; after the drying has continued about half an hour, the leaves are turned, and again submitted to the heat for another half hour ; they are then taken out, rubbed and twisted, and after sifting away the small dust, again returned to the sieve and drying tube. This operation of sifting

is very necessary, to remove any of the small tea or dust which might otherwise fall through the meshes of the sieve on to the fire, and the products of their combustion would deteriorate and spoil the flavor of the tea. The leaves have now begun to assume their black color; the fire is diminished or deadened by ashes; and the operation of rolling, twisting and sifting is repeated once or twice until they have become quite black in color, well twisted, and perfectly dry and crisp. They are then picked, winnowed, and placed in large quantities over a very slow fire for about two hours, the cylinder being closed.

Now, that this black color is not owing to fire is evident; for in cases mentioned by Mr. Ball, where the leaves have been dried in the sun, the same color is obtained; and on the other side, if roasted first, without the process of fermentation or *withering*, and then finished in the Poey-long, a kind of green tea is produced.

In the operations for the manufacture of green tea, on the contrary, the freshly-picked leaves are roasted in the Kuo at once, without delay, at a high temperature; rolled and roasted again and again, assisted sometimes with a fanning operation to drive off the moisture; and always with brisk agitation until the drying is completed.

The marked differences in the mode of manufacture of black and green tea, will, I consider, after what has been stated, fully account for all the variation of physical and chemical properties to which I have before alluded.

Adulteration and Sophistication of Teas.—Since writing my former paper, several teas have come under my notice which must be classed under this head. The first I shall mention is a sophistication which has been carried on in this country to some extent, and consists in giving the appearance of green tea to an imported black tea. The material used as the bodies for this process of manufacture is a tea called scented caper; it is a small, closely-rolled black tea, about the size of small *gunpowder*, and when colored is vended under this latter denomination, the difference in price between the scented caper and this fictitious *gunpowder* being about 1s. per pound, a margin sufficient to induce the fraud. This manufacture has been carried on, I understand, at Manchester, and was kept as secret as possible; and it was only after considerable trouble that some of my friends succeeded in obtaining two different specimens for me, that could be fully depended on, as originating in this manufactory. It appears that it is generally mixed with other tea, so as to deceive the parties testing it. How this manufactory was conducted I am not prepared to say:—but some preparation of *copper* must have been employed, as the presence of that metal is readily detected in the specimens I received. I believe, however, that this sophistication has ceased.

I have now to call your attention to another adulteration of the most flagrant kind. Two samples of tea, a black and a green, were lately put into my hands by a merchant for examination, the results of which he has allowed me to make public. The black tea was styled *scented caper*; the green, *gunpowder*; and I understand they are usually imported into this country in small chests called catty packages. The ap-

pearance of these teas is remarkable ; they are *apparently* exceedingly closely rolled, and very heavy ; the reasons for which will be clearly demonstrated. They possess a very fragrant odor. The black tea is in compact granules, like shot of varying size, and presenting a fine glossy lustre of a *very black* hue. The green is also granular and compact, presenting a bright pale-bluish aspect, with a shade of green, and so highly glazed and faced, that the facing rises in clouds of dust when it is agitated or poured from one vessel to another ; it even coats the vessels or paper on which it may be poured. On examining these samples, in the manner described in my former paper, to remove this facing, I was struck by the tenacity with which it adhered to the surface, and which I had never remarked in any previous sample, requiring to be soaked for some time in the water before it could be detached ; with this precaution, however, the greater part of the facing material was removed. It proved, in the case of the sample of green tea, to be a pale Prussian blue, a yellow vegetable color, which we now know to be turmeric, and a very large proportion of sulphate of lime. The facing from the sample of black tea was *perfectly black* in color, and on examination was found to consist of earthly graphite or black lead. It was observed that during the prolonged soaking operation, to which these teas had been submitted, there was no tendency exhibited in either case to unroll or expand, for a reason which will be presently obvious. One of the samples was therefore treated with hot water, without, however, any portion of a leaf being rendered apparent. It increased in size slightly, was disintegrated, and then it was found that a large quantity of sand and dirt had subsided ; this was separated by decantation, and collected ; it was found to amount to 1.5 grains from 10 grains of the sample, or 15 in the 100 parts. It was evident, however, that much of the lighter particles must have been lost in the process of decantation ; a weighed quantity of the sample was therefore carefully calcined, until the ash was quite white, and the whole of the carbonaceous matter burnt off ; it yielded a result equivalent to 37.5 on the 100 parts. During this operation, also, no expansion or uncurling of the leaf, as is generally to be observed when heat is applied to a genuine tea, was seen ; in fact, it was quite evident that there was *no leaf to uncurl*, the whole of the tea being in the form of dust. The question next presented itself as to how these materials had been held together, and this was readily solved ; for, on examining the infusion resulting from the original soaking of the sample, abundant evidence of gum was exhibited.

The sample of green tea was of a precisely similar kind to the black ; it yielded 4.55 grains of ash, &c., from 10 grains of the specimen, or 45.5 per cent. A specimen of Java gunpowder yielded 5 per cent. of ash ; so that we have in this sample 40.5 per cent. of dirt and sand over and above the weight of ash yielded by the incineration of a genuine tea.

Thus we have then in these samples a mixture of tea dust with dirt and sand, agglutinated into a mass with a gummy matter, most probably manufactured from rice-flour, then formed into granules of the desired size, and lastly dried and colored, according to the kind required

by the manufacturer, either with black lead, if for black tea ; or with Prussian blue, gypsum, or turmeric, if intended for green.

Since examining these two samples, I have obtained through a friend another specimen of green tea, having a very different appearance ; that is, better manufactured, or rather, I should say, more likely to deceive the customer, from its being made to imitate an *unglazed tea*. It is of a yellowish-green color, scented and granulated as the former samples, and not much dusted ; it yielded 34 per cent. of ash, sand and dirt.

On inquiry, I have learned that about 750,000 lbs. weight of these teas have been imported into this country within the last eighteen months, their introduction being quite of modern origin ; and I understand that attempts have been made to get them passed through the Customs as *manufactured goods*, and not as teas ; a title which they certainly richly merit, although it must be evident, from a moment's consideration, that the revenue would doubtless be defrauded, inasmuch as the consumer would have to buy them as teas from the dealer. It is to be feared, however, that a market for them is found elsewhere. The Chinese, it appears, will not sell them except as teas, and have the candor to specify them as *lie* teas ; and if they are mixed with other teas of low quality, the Chinese merchant gives a certificate, stating the proportion of the *lie tea* present with the genuine leaf. This manufacture and mixing is evidently practised to meet the price of the English merchant. In the case of the above samples, the black is called by the Chinese, *lie flower caper* ; the green, *lie gunpowder* ; the average value is from 8d. to 1s. per lb. The brokers have adopted the curious term *gum and dust*, as applied to these *lie* teas or their mixtures, a cognomen which at first I had some difficulty in understanding, from the rapid manner in which the two first words were run together.

I will subjoin the results obtained from the careful incineration of a variety of teas, as they may be interesting, for the purpose of comparison, and illustrate the point I have mentioned as to these spurious teas being mixed with genuine ones.

Gunpowder tea, made in Java, gave 5.0 grains of ash in the 100 parts ;	
Gunpowder, during the East India Company's Charter,	5.0
Kemaon hyson,	6.5
Assam hyson,	6.0
Lie gunpowder, No. 1,	45.5
" " No. 2,	34.0
Scented caper,	5.5
Lie flower caper,	37.5
Mixtures containing these lie teas, No. 1,	22.5
" " " No. 2,	11.0

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ON THE RECIPROCAL AGENCIES OF MIND AND MATTER.

[Continued from page 369.]

IN taking into consideration the leading characteristics and powerful agency of that gift of God which constitutes the supremacy of man over the rest of animated nature, *The Human Mind*, I began by attempting to