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LION BREEDING.

BY DR. V. BALL, C.B., F.R.S., HONORARY SECRETARY ROYAL ZOOLOGICAL SOCIETY OF IRELAND.

THE breeding of lion cubs commenced in the gardens of the Royal Zoological Society of Ireland in the year 1857, and has been continued through an unbroken descent to the end of 1891, or for thirty-five years; from which, if we subtract the five years from 1874 to 1878, inclusive — when there was no breeding lioness in the gardens and no cubs were born — the actual period of breeding lasted only thirty years, during which the average number of births has been 5.3 per annum.

Parents of the Cubs.

MALES	No. of Cubs.	FEMALES	No. of Cubs.
Natal (1857–64)	42	Natalie (1857–9)	10
		Anonyma (1861–4)	20
		Old Girl (1862–73)	55
Sire unknown (1869)	3	Nellie (1869)	3
Old Charley (1866–74)	47	Biddy (1871)	4
		Victoria (1879–81)	7
		Zenobia (1879–83)	17
Young Charley ('79–84)	27		
		Queen (1884–91)	28
Paddy (1883–91)	31	Minnie (1884–6)	6
Romeo (1890–91)	9	Juliet (1890–91)	9
	159		159

Sexes of the Cubs.

Males	85	Females	73
Unknown	1	Forward	86
	86		159

Percentage of males to females 53.8 to 46.2, or a majority of 7.6 males out of every 100.

The Number of Cubs in a Litter.

Total number of litters, 43; number of cubs, 159; average number of cubs in each litter, 3.7.

Of litters of	6	cubs there were	2
" "	5	" "	8
" "	4	" "	17
" "	3	" "	9
" "	2	" "	5
" "	1	" "	2

Thus it will be seen that the average number of cubs in a litter approximates most nearly to 4.

Months in which the Cubs were Born.

January	6		July	5	
February	14		August	13	
March	3		September	27	50
April	22	40	October	23	
May	18		November	13	
June	9		December	6	
	72			87	
			Forward	72	
				159	

It is to be remarked that 90 out of the total of 159 were born in the four paired months, namely, April and May (40) and September and October (50). These amount to 56.6 per cent of the whole number, leaving only 43.4 per cent for the remaining eight months.

Disposal of the Cubs.

Died at, or shortly after, birth	30
" after some months or year	12
Retained for stock	8
Sold (yielding upwards of £4,000)	109
	159

THE PURIFICATION OF WATER BY CHEMICAL TREATMENT.[1]

BY WILLIS G. TUCKER, M.D.

PURE water does not exist in nature. It is an ideal substance to which the purest water that can be prepared by the chemist only approximates. From a chemical standpoint every foreign substance which water may contain is an impurity, but, hygienically considered, water is called impure only when it contains excessive amounts of mineral matter in solution or in suspension; when it contains organic matter of vegetable or animal origin, or the products of the decomposition of such matter in quantities exceeding certain generally accepted but rather arbitrarily assigned limits, or when it is shown to contain living organisms believed to be associated with or productive of diseases which water may communicate. All filth in food or drink is to be abhorred, but, none the less, distinction must be made between that which, containing or accompanying specific disease germs, may give rise to specific diseases, and that which is, while not unobjectionable, yet apparently incapable of materially affecting health. The chemist is as yet unable to distinguise disease-producing from relatively harmless impurities in water. He can recognize those constituents which indicate organic pollution; demonstrate the present existence of putrescent material, or show that such material has previously existed

[1] Read before the Medical Society of the County of Albany at a meeting held February 23, 1892. Reprinted from the Albany Medical Annals, April, 1892.

by the recognition of the products of its decay, but he can by no means assert with certainty that any given water will necessarily give rise to disease or will certainly prove to be wholesome. Waters containing putrescent organic matter of animal origin have been drunk without harmful results. Such cases are on record, and, on the other hand, waters which analysis has shown to be of fair chemical purity have unquestionably given rise to disease. Nevertheless the chemical analysis of drinking waters, despite the limitations and imperfections of our best processes, furnishes most valuable information, in no other way to be obtained, and I shall spend no time in a defense of this method of investigation. There are unmistakable signs of pollution which analysis may reveal, and such warnings should not go unheeded. If it be shown that a well receives the leachings of a privy-vault or cesspool, or that a running stream is contaminated by sewage, as yet unoxidized and possibly infectious, such water should be condemned, and neither chemist nor bacteriologist should be required to demonstrate its disease-producing power. Indeed this would be in most cases entirely impossible, such proof being seldom attainable.

Impurities in water exist in suspension or solution, and may be either inorganic or organic. Suspended matter may frequently be removed, wholly or partially, by mere sedimentation or by some simple process of filtration, but matter which is held in solution must be destroyed or removed in other ways. The boiling of water may produce a deposition of some of its earthy salts, a coagulation and precipitation of some of its organic matter, and a destruction of its microorganisms including disease germs if present; and while this method of purification is frequently serviceable as a household measure it is not adapted to use upon a large scale. By distillation a still further purification may be effected, but this is a still more costly process and can never come into general use. Within a few days I have examined a sample of distilled water prepared and sold in bottles for table use, in which, while the free ammonia was high, the albuminoid ammonia was very low; chlorine, nitrites, and nitrates absent, and total solids almost nil. Such water is as pure as can well be made on a commercial scale, but it is necessarily too expensive to be commonly used. Aeration has likewise been resorted to for the destruction by oxidation of organic matter, and is said to have been employed more than a century ago by Lind on the west coast of Africa. Considerable improvement has been effected in certain city supplies by pumping air into the mains or reservoirs or by discharging water in jets or fountains into basins so as freely to expose it to the air. Where waters are shown to be deficient in dissolved oxygen, especially in the case of impounded waters in which patches of green algæ appear upon the surface in warm weather, such treatment is often of the greatest value. It is an imitation of a natural process of purification, and the change effected is not to be regarded as purely chemical, being brought about by bacterial organisms, the nitrifying bacteria, which, under favorable conditions and in presence of free oxygen, convert nitrogenous organic matter into harmless inorganic forms.

The purification of polluted water by direct chemical treatment has been effected with more or less success in many ways, all practical methods involving the separation of precipitated matter either by sedimentation or filtration after treatment of the water. In other words, there is no chemical agent which, by simple addition to impure water, will render such water pure and wholesome. By chemical treatment we may precipitate lime and other earthy salts if present in undue quantity, coagulate and remove organic matter and bacteria, or promote the oxidation of such matter; and various processes accomplishing, more or less perfectly, these results, have, during recent years, been employed.

Clark's process, designed particularly for the softening of water owing its hardness to bi-carbonate of lime, consists in the addition of milk of lime, which results in the formation of an insoluble carbonate subsequently separated by sedimentation. Colored and turbid waters are clarified and organic matter and living organisms largely reduced by this treatment, as has been shown by Dr. Percy F. Frankland (*Chemical News*, Vol. LII., p. 40) and others, but if much organic matter is present the precipitation does not readily occur and filtration must be resorted to as in the Porter-Clark process. Other methods for softening water involve the use of caustic soda in addition to slaked lime, as in Howatson's process, and the use of tri-sodic phosphate, now a commercial article, by which means the salts producing permanent hardness are largely removed; and in the household carbonate of soda (washing soda) is employed for the same purpose, though its use is impracticable on a large scale on account of the expense.

Such methods as these, however, are primarily intended for purifying water for laundry use, manufacturing purposes, and making steam. They are more important from a technical than from a sanitary standpoint, and we pass from these to speak of those processes in which the main object is the removal of constituents believed to be harmful to health. Before doing so, however, a few words concerning filtration may not be out of place, the more especially as either sedimentation or filtration is generally necessarily connected with every process intended for the purification of water. Filtration which is a mere straining, as for example, continuous filtration through sand or animal charcoal, may clarify a water without otherwise improving it in any respect, and if, after a time, the filter becomes foul, the water may be polluted rather than improved. I regard with disfavor most of the old-fashioned filtering appliances, which not only gave a false sense of security, but often served as breeding places for the growth of living organisms. A house filter which is not easily cleansed is an abomination, being generally allowed to take care of itself and in time becoming a source of real danger. A few years ago a case of no little interest was reported in the *Chemical News* (Vol. LII., p. 70). Two samples of water were analyzed for a family in which one member was ill with typhoid fever. One of the samples was from the house supply direct, and the other was the same water filtered through a portable charcoal filter of the common type. This latter sample yielded a much larger amount of albuminoid ammonia than the former, decolorized five times as much permanganate of potassium, and was in every respect objectionable. On inquiry it was learned that the filter had been in use for more than a year, and that in the place where the owner had formerly resided he had found the water so bad that he had made use of it to filter that which he used for his bath. A few years ago when typhoid fever prevailed in Providence, R.I., and seemed not to be fairly attributable to the city water-supply, Dr. T. M. Prudden examined several of the filters used in private houses and found the typhoid bacillus in no less than three of them (*New York Medical Journal*, Vol. L., p. 14). Filters giving such results, it need scarcely be said, are a constant menace to health, but those which allow of easy cleaning by reversed currents of water are free from most of the objections attending the use of the older forms. Five years ago I analyzed some samples of Albany water, filtered through a well-known filter manufactured in this city (the Blessing Duplex Filter), and found that a sample of water obtained by washing the filter after a day's use, yielded of albuminoid ammonia, 0.1850 parts per 100,000, showing that the filter had retained a large amount of organic matter. Water which had passed through the sand of the filter only, yielded 0.0023, and that which had passed through both the sand and charcoal yielded but 0.0014 parts per 100,000. This latter quantity is about one-tenth that ordinarily found in our city water, and this is certainly a very good showing. Two years since I analyzed water which had been drawn from our upper service, both before and after filtration through the same filtering apparatus, and found the free ammonia reduced to a fifth, the albuminoid ammonia to a fourth, and the oxygen absorbed to two-thirds of the amounts originally present, by filtration; while a sample of water from the lower city service had its free ammonia reduced to a fifth, albuminoid to a tenth, and oxygen absorbed to a twelfth, indicating a vast improvement in a water at that time in singularly bad condition. These results I believe to be largely due to the efficient action of the animal charcoal, which in this device acts, not as a strainer or filtering medium proper, but as an oxidizing agent, provision being made for its constant aeration. In many filtering appliances animal charcoal is a fruitful source of trouble and danger, but if the real filtration is accomplished by other material and the coal is subjected to frequent aeration and renewed when necessary, it is a most valuable agent for effecting the oxidation of organic matter. I purpose soon to make some experiments with a view to determining how long animal charcoal retains its activity in such filters, though it is very certain that, with proper treatment, it will continue to operate satisfactorily for a long time.

Of the chemical agents which have been employed in water purification, the most important are metallic iron, solutions of iron salts, generally the chloride, permanganate of potassium, and alum. Spongy iron, obtained by the reduction of hematite-ore at a temperature of a little below that of fusion, thereby rendering the metal porous or spongy in form, was first made use of by Bischof, whose process was patented in England in 1871, though Dr. Medlock had secured a patent in 1857 for a process of purification based upon the use of metallic iron plates, and Spencer in 1867 introduced a material which he called magnetic carbide, in which the active agent was iron. The carbonic acid in the water, acting upon the iron in one or the other of these forms, produces a ferrous carbonate, which, by oxidation, yields hydrated ferric oxide, and this is believed to effect the oxidation of organic matter and serve as a coagulant as well, producing a flocculent precipitate, which is subsequently separated by sedimentation or filtration through sand. Such methods have been employed with more or less success in various European cities, but Anderson's process, which has been successfully used at Antwerp, Ostend, Paris, and Vienna, has generally replaced other methods of purification by iron. In this process the water is forced through revolving purifiers consisting of iron cylinders revolving on hollow trunnions which serve for inlet and outlet pipes. On the inner surface of the cylinders are curved ledges running lengthwise, which scoop up and shower down through the water fine cast-iron borings as it flows through the cylinder, so that every portion of the water is brought into contact with the iron, which is kept constantly bright and clean by attrition. The water issuing from the purifiers is exposed to the air, by allowing it to flow through a trough, to secure the precipitation of the ferric hydrate, and by filtration through sand this precipitate is subsequently removed. It is claimed for this process that the organic matter is altered in form and largely destroyed, the albuminoid ammonia being reduced to from one-half to one-fourth, and micro-organisms largely destroyed or removed. At Antwerp 2,000,000 gallons daily are thus treated, and Professor Edward Frankland has shown that this water is completely sterilized and nearly all its organic matter removed. The cost, previous to the introduction of settling reservoirs before filtration, has been $4 per million gallons. In a paper read before the Franklin Institute in 1890 by Easton Devonshire, C.E., it is estimated that the cost of working expenses, with an output of 5,000,000 gallons per diem or over, should not exceed $2 per million.

Ferric chloride has been employed in Holland for removing clayey matter and organic impurities from the water of the Maas, which supplies Rotterdam. Carbonate of iron is formed and decomposed with separation of ferric hydrate which coagulates and removes the organic matter, but such treatment is attended with many difficulties and is not likely to come into general use. The same may be said of the employment of permanganate of potassium, which oxidizes organic matter and by its decomposition yields manganic hydrate which precipitates much of the suspended matter present in the water. Such processes may be successful, here and there, on a small scale, but they cannot as yet be practically or economically employed in the purification of large supplies.

The only other purifying agent of which we need speak is alum. It is said to have been used for centuries in China and India, but particular attention was first directed to its use by Jennet in 1865. Most waters contain more or less bicarbonate of lime in solution, and the alum acting upon this constituent yields sulphate of lime, carbonic acid gas, and aluminic hydrate, as shown in the following equation:

$$K_2Al_2\ (SO_4)_4 + 3\ H_2\ Ca\ (CO_3)_2 = 3\ Ca\ SO_4 + K_2\ SO_4 + 6\ CO_2 + Al_2\ (HO)_6.$$

As the aluminic hydrate forms and deposits it not only entangles and carries down finely-divided, suspended, mineral matter but coagulates and removes much of the dissolved organic matter as well. By this means peaty and other colored waters are decolorized; turbid waters containing finely divided clay are clarified and bacteria removed. Professor A. R. Leeds, in an experiment performed upon the water used at Mt. Holly, N. J., found that alum, added in the proportion of half a grain to the gallon, produced the following effect: "On standing the peaty matter was entirely precipitated in reddish-yellow flakes and the water above became perfectly colorless and clear. On pipetting off some of this supernatant fluid I found that instead of containing 8,100 colonies of bacteria per cubic centimeter, as it did before precipitation with alum, it contained only 80 colonies. On filtering some of this supernatant water through a double thickness of sterilized filter paper into a sterilized tube I found no bacteria in the filtered water. In other words the water had been rendered, by the addition of an amount of alum so minute as to be inappreciable to taste and almost to chemical tests, as sterile as if it had been subjected to prolonged boiling." (*Journal American Chemical Society*, ix., p. 154.)

Austen and Wilber made a valuable report to the State Geologist of New Jersey in 1885, on the "Purification of Drinking Water by Alum." They found that 1.2 grains per gallon was sufficient for the complete precipitation and clarification of the New Brunswick city water, if sufficient time was allowed for settling. Such an amount is imperceptible to the taste and can exert no physiological action. If more alum is used less time is required for sedimentation, and *vice versa*. More than two grains to the gallon was seldom required. They showed likewise that waters which will not yield clear filtrates on account of their containing finely divided clayey matters, even when filtered through the finest filter-paper, were immediately coagulated and precipitated by 1.16 grains of alum to the gallon, so that they could be filtered immediately after adding the alum, yielding brilliantly clear filtrates, and, in their opinion, no more than twice this quantity, or about two grains per gallon at most, need ever be employed.

In January, 1889, a sample of peaty water from Athol, Mass., having a decided yellowish-brown color, was submitted to me for examination. Difficulty had been experienced in clarifying this water by filtration, and I made some experiments to determine the action of alum upon it. Our city supply was at that time yellowish in color and slightly turbid, and this was also tested. It was found that, in both cases, the addition of alum in the proportion of 2.3 grains per gallon gave rise at the end of twenty-four hours to a yellowish flocculent deposit, undergoing no further change on standing for four days, the water becoming clear and almost perfectly colorless. The waters were tested again by adding the alum, shaking in a flask, and immediately filtering through paper. The city water became transparent and perfectly colorless, and the peaty water retained but a very faint, almost imperceptible yellowish tint. The peaty water yielded originally 0.0225 parts of albuminoid ammonia per 100,000, but after the addition of alum, agitation and filtration, it yielded but 0.0060 parts, or about one-fourth as much, showing how great an improvement had been effected.

For household use, on a small scale, water can be easily clarified and purified by placing a layer of clean cotton, two or three inches deep, at the bottom of a glass percolator, such as is used by druggists, and pouring the water to be filtered, to which solution of alum has been added, into the percolator and allowing it to drip through into a clean vessel placed to receive it. The alum solution is conveniently made by dissolving half an ounce of alum in a quart of water, and of this solution a scant teaspoonful should be added to each gallon of water to be filtered. Alum is now used in a number of filtering and purifying systems which have of late years been brought prominently before the public by their inventors or the companies controlling them.

If now it be asked, do such processes as these which we have described, admit of practical and economical application to the purification of large volumes of polluted water for the supply of our great cities, I fear that an unqualified affirmative answer can hardly be given. In American cities the consumption of water is much greater than in European towns. The "Encyclopedia Brittanica" states that "the consumption varies greatly in different [English] towns, ranging from about twelve to fifty gallons per head per day," and that "an ample supply for domestic use and general requirements is from 20 to 25 gallons per head daily." With us a hundred gallons is frequently supplied. Albany wants 15,000,000 gallons, with a population of less than 100,000. Philadelphia and St. Louis consume 70 gallons; New York, 80; Boston, 90; Chicago, 115; and Detroit, 150; while Glasgow, Dublin, and Edinburgh consume but 50; London, 40; Birmingham, Leeds, and Liverpool about 30; and Manchester and Sheffield still less. On the continent it is about the same. Paris uses about 50 gallons; Hamburg and Dresden 60, and Leipsic but 23. In American cities the waste of water is enormous and to purify one gallon for drinking and household uses and nine gallons for flushing water-closets, watering streets and extinguishing fires must ever be a wasteful process, to say the least. Many towns in this country are now using water purified by artificial means, with apparent satisfaction; but I do not think that the time has come when it can be said that such purification is practicable in all cases. Certain methods, like the Anderson process, give excellent results under favorable conditions, but competent engineers have not recommended them for American cities. Sedimentation, coagulation, filtration, aeration, all these have passed the experimental stage and are in a sense practical, but that processes involving so much manipulation can be advantageously employed in treating the enormous volumes of water required by large cities, especially where pumping is also necessary, is not as yet demonstrated. As regards filtration alone, it may be said that in our climate the filter-beds, which give satisfactory results in many parts of Europe, cannot generally be employed to advantage, and that this method of filtration has been by no means uniformly successful even in Europe. In a recent report Dr. Theobald Smith has called attention to the fact that in the Berlin epidemic of typhoid in 1889, "the distribution of the disease was identical with that of the filtered river water," the filter beds being worked with great rapidity to make up for a deficiency in the water-supply, and the filtered water containing at times 4,000 bacteria per cubic centimeter. In discussing this case he says: "These facts go far to prove that polluted water, when immediately delivered for consumption even after filtration, is not wholly safe. They likewise make prominent the fact, that, while filtration largely rids a given water of its bacteria, it is a process requiring the utmost care, the most constant attention, not only on the part of the engineer, but also of the chemist and bacteriologist. We are furthermore convinced," he adds, "by these experiments that surface water which shows very little, if any, pollution, and which is stored before use, is safer than filtered water which before filtration is being manifestly contaminated with sewage." As regards methods of rapid filtration under pressure, combining chemical treatment of the water, generally by alum, as well, various systems are in use in this country, controlled by individuals or companies employing a variety of patented devices. Granting that the results in some cases seem to be excellent, I think the time has not yet come when they can be unhesitatingly recommended for the purification, in all cases, of large city supplies. I know of no city with a population of one hundred thousand that is using such a process to-day. That numerous infectious diseases are conveyed by water admits of no dispute. In my opinion it is vastly better to purify our sewage before discharging it into the streams which supply us with water, or keep it out of them if practicable altogether, than to attempt to purify the water which it pollutes. Chemical treatment and filtration may be practicable and efficient in certain cases, but I believe that the statement by the Rivers Pollution Commission of England, more than twenty years ago, in their sixth report, is as true now as it was then: "Nothing short of the abandonment of the inexpressibly nasty habit of mixing human excrement with our drinking water can confer upon us immunity from the propagation of epidemics through the medium of potable water." The cities of this country may eventually be driven to methods of artificial purification of their water supplies, but it cannot be said that the conditions necessitating such action generally exist as yet. In most cases the safer and more economical course will be found to be either the securing of an unpolluted water, if such be available, or the protection from pollution of existing sources of supply.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

American Weeds.

PROFESSOR BYRON D. HALSTED of the New Jersey Experiment Station has recently presented to the agricultural public a list of "American Weeds,"— mostly phanerogams, — which contains no less than 751 varieties and species, exclusive of noxious fungi. Well may the long-suffering farmer turn up the whites of his eyes at this formidable list. A closer examination, however, shows us among the "weeds" all our cultivated clovers, medics, vetches, and many of our best agricultural grasses. The criterion used by the New Jersey botanist in deciding what to admit and what to exclude from his catalogue is not apparent, and no word of explanation is vouchsafed.

In the vegetable kingdom, if not in the United States Republic, it is true that "it is self-evident that all plants are born free and equal." The distinguishing of plants as weeds and not weeds is purely human and artificial. The popular idea of a weed seems to be a repulsive, or hurtful, wild plant. But few persons give exactly the same definition. I have been at some trouble to secure the definitions of a number of intelligent persons, and give below a few samples: —

"A plant where you don't want it." — *Director Experiment Station.*

"A noxious or useless plant." — *Curator of Museum.*

"A plant out of place." — *Chemist.*

"A troublesome plant." — *Chemist.*

"An obnoxious plant of many species not fit for food or medicinal purposes." — *Clerk.*

"A plant not edible, so far as known, nor medicinal, or otherwise serviceable to man, and which always thrives where not wanted."—*Inspector of Fertilizers.*

"A plant for which we have no use so far as we know."—*Meteorologist.*

"(1) Underbrush or bushes; (2) a useless or troublesome plant." —*Webster.*

My own definition: Any plant which from its situation or inherent properties is hurtful to human interests; a vegetable malefactor.

By the usage of the English language the name "weed" is connotative and implies in a plant a bad and hurtful quality. Used metaphorically or analogically it is always a term of opprobrium.

If we were dealing with individual plants as courts of justice deal with persons, each particular plant might he properly described as a weed or not weed according to the circumstances of each case. But here we are dealing not with individuals but with species and varieties, and can take note only of the general character of the groups. If we have planted a bed of pansies, and there springs up among the pansies a red clover plant, this particular plant is hurtful to us, and therefore is treated as a weed, but we are not therefore justified in writing the species *Trifolium protense* in a list of weeds. The general character, — the qualities for which the clover genus generally and this species especially are noted, are good and beneficial to mankind. It was only by chance or the carelessness of some one that this clover plant got into our flower-bed. "The plant out of place" definition of a weed can refer only to a particular plant. It cannot be applied to a species, for a plant of any species is liable to be occasionally misplaced.

We must maintain then that the inclusion in a list of weeds of such plants as the clovers, medics, vetches, and agricultural grasses is unjustifiable and wrong.

A large number of Professor Halsted's "weeds" are mere "wildlings of nature" for which we have as yet found no important use. But justice requires that in the case of plants as well as persons every one shall be held innocent until proven guilty of wrong.

Both from an æsthetic and from a practical standpoint it is true that most of these so-called weed plants are more useful than hurtful. They clothe and beautify waste places. Many of these wild plants furnish food and nectar for honey bees, and all aid more or less in conserving the fertility of the soil, prevent washing etc. It is as unjust to stigmatize such plants as "weeds" as it would be to call all savage tribes criminals.

Professor Halsted omits wholly and without comment noxious fungi from his list of weeds. Yet these are our very worst and most dangerous weeds. In number they far outrun all the phanerogamic species.

To justify its inclusion in a list of "American weeds" a plant must not only possess a positively noxious character, but must also be sufficiently obnoxious or wide spread to give it a national reputation.

If we exclude from Professor Halsted's list all obscure and non-noxious species we shall have left about 150 *species* of weed-plants worthy to be called "American Weeds."

GERALD MCCARTHY.

N. C. Experiment Station, July 5.

Some Remarks on Professor Cyrus Thomas's Brief Study of the Palenque Tablet.

IN *Science*, No. 488, Professor Cyrus Thomas stated that "the particular manner of reckoning the days of the month"— or more precisely, the exact designation of a date by the sign of the day and the position it holds in the number of twenty days (*uinal*) that people are in the habit of calling a Maya month — as it is found not only "in some of the series of the Dresden Codex," but throughout the whole of it, is also found on the Palenque tablet. This statement undoubtedly is a correct one. But Professor Thomas, following Professor Förstemann, asserts that the "peculiarity of this method is that the day of the month is counted not from the first of the given month, but from the last of the preceding month; thus the fifteenth day of *Pop*, beginning the count with the first, will, according to this method, be numbered 16." If it were really so, this method of reckoning the days of the month would be a very curious one, and hardly to be understood. Professor Förstemann based this assertion on the supposition that the calendar system of the Dresden Codex is the same as that which prevailed in Yucatan at the time of Bishop Landa's writing. In vol. xxiii. of the *Zeitschrift für Ethnologie*, published by the Berlin Anthropological Society, in a paper entitled "Zur mexikanischen Chronologie, mit besonderer Berücksichtigung des zaposekischen Kalenders," I have shown that the priests who wrote down the Dresden Codex did not begin their years with the days *kan, muluc, ix, cauac*, as in Landa's time, but with the days *been, e'tznab, akbal, lamat*, exactly corresponding to the *acatl, tecpatl, call, tocbtl* (cane, flint, house, rabbit), the signs used by the Mexicans to designate their respective years. Beginning the years in this manner, the day 4 *ahau* 8 *cumku* is really the eighth day of the month *cumku* in the *been*, or "cane," years. The day 9 *kan* 12 *kayab* is really the twelfth day of the month *kayab* in the same *been*, or "cane," years; and thus with all the other dates throughout the whole Dresden Codex.

The evidence derived from the fact that the same method of numbering the days of the month, that is to say, the same method of beginning the years, is also found in the Palenque tablet, leads — I agree with Professor Thomas — to the inference "that there were intimate relations between the people of this city and those where the Dresden Codex was written, and that there is no very great difference in the ages of the two documents." On the other