

acid was accomplished very rapidly. By changing the ratio of water to soil from two to ten, Dyer found from seven to eighteen parts of phosphoric acid per million of dry soil. In Bulletin No. 22 the average for 147 analyses of a number of types of soil is 7.64 PO_4 , equivalent to 5.73 P_2O_5 , and for the Rothamsted soils from 10.5 to 19.6 PO_4 , equivalent to 7.9 to 11.7 P_2O_5 , figures entirely comparable with those obtained by Dyer. This question of the solubility of the phosphoric acid of the soil in water has been frequently discussed in the literature since the work of Knop, who used an unreliable method of analysis, and the very interesting replies of Schulze,* Heiden† and others. This early work has been described at length by Johnson‡ and is supposed to be familiar to every tyro in agricultural chemistry.

Analyst.	Parts P_2O_5 per Million of Soil.
Jarriges,	20
	trace
Grouven,	50
	15
	trace
Hoffmann,	50
	trace
	"
	"
Hellriegel,	10
	10
Küllenbergl,	5
Mixter,	1
Heiden,	57
	26 subsoil
	53
	19 subsoil
Eichhorn,	31
Schulze,	6
Ulbricht,	trace
	7
	trace
	3

The preceding figures obtained by several investigators using varying proportions of water and soil, digesting for widely varying lengths of time, from a few minutes to many days, using generally gravimetric methods of

recognized value, will show that the results presented in Bulletin No. 22 are in no way unusual, and that 'merest trace' is without significance until more specifically defined.

Several investigators besides Knop have reported only traces or no phosphoric acid in water extracts of soils, but generally because of the analytical difficulties in determining it rather than as statements of the actual amounts present.

The further reference in the 'Added Note' to Warrington's examination of drainage waters is irrelevant, since it has been perfectly well known since the time of Liebig that draining or leaching a soil does not remove the salts which may actually be in solution in the soil. Agricultural chemists are perfectly familiar with this fact through the classic papers of Liebig, Way and van Bemmelen, as well as others. Moreover, there are quite a large number of figures for drainage and lysimeter waters recorded in the literature which are much larger than that of Warrington, many of them being quoted by Johnson.*

Hilgard presented an address at the meeting in Washington, attacking Bulletin No. 22, and he also has anticipated publication of the proceedings.† Serious consideration can not be given to this paper, however, since the author claims a *non-sequitur* to the arguments of Bulletin 22, on general principles rather than specific instances. He devotes almost his entire effort to a personal attack on the present Chief of the Bureau of Soils, but incidentally expresses his displeasure with agricultural chemists of the country because they use the 'official method' of analyzing soils rather than the one which he proposed a number of years ago.

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WOODCOCK SURGERY.

In its desire to do nothing by halves, the American public is at present evincing an extraordinary fondness for 'nature books.' This would certainly be most commendable, were

* *Landwirthsch. Versuch-Stat.*, 6, 409, 1864.

† *Annal. der Landwirthsch.*, 45, 189, 1865.

‡ 'How Crops Feed,' pp. 309 et seq., 1890.

* *Loc. cit.*

† This journal, Vol. XVIII., p. 755, 1903, and *Los Angeles Herald*, Sunday, December 27, 1903.

there not evinced at the same time a lack of discrimination as deplorable as it is, in certain respects, inexcusable. We have, indeed, nature writers of every conceivable shade, from the ponderously accurate, scientific-because-incomprehensible, inartistic, biological specialist, through the whole gamut of good, bad and indifferent writers, to those who scruple not to take all manner of liberties with natural history facts in order to make an impression—and a fortune. And the public reads on with patient equanimity without distinguishing sound and critical observations on animal behavior from the drivel in which animals are humanized beyond all recognition.

Any endeavor to disturb such complacency will, perhaps, seem unkind, but it is clearly a duty which no serious student can shirk who has at heart the development of true animal psychology. In an admirable article published in the *Atlantic Monthly* for March, 1903, Mr. John Burroughs called attention to certain abominations in current nature books. He dwelt especially on the unwarrantable humanizing of animals which has become almost a mania with a certain class of writers. Mr. Burroughs's remarks, if anything, were too temperate, as events have shown. One would have supposed that his criticisms of Mr. William J. Long, for example, would have led that gentleman, before publishing further observations on animal behavior, to gain some idea of the value, or rather, lack of value, which serious students attach to anecdotes as evidences of rational endowment in animals. Instead of this, however, he publishes in a reputable and widely circulated journal (*The Outlook*, September 12, 1903) and republishes in book form with illustrations ('A Little Brother to the Bear, and Other Animal Studies') a series of anecdotes which for rank and impossible humanization of the animal can hardly be surpassed. Verily, *quem deus vult perdere prius dementat*.

Although a careful dissection of this whole article, entitled 'Animal Surgery,' would yield no little instruction and some amusement, it will suffice to quote only one of the author's anecdotes with a brief commentary:

"Twenty years ago, while sitting quietly by a

brook at the edge of the woods in Bridgewater, Mass., a woodcock fluttered out into the open, and made his way to a spot on the bank where a light streak of clay showed clearly from where I was watching. It was the early hunting season, when gunners were abroad in the land, and my first impression was that this was a wounded bird that had made a long flight after being shot at, and that had now come out to the stream to drink or to bathe his wound, as birds often do. Whether this were so or not is a matter of guesswork; but the bird was acting strangely in broad daylight, and I crept nearer, till I could see him plainly on the other side of the little stream, though he was still too far away for me to be absolutely sure of what all his motions meant.

"At first he took soft clay in his bill from the edge of the water and seemed to be smearing it on one leg near the knee. Then he fluttered away on one foot for a distance and seemed to be pulling tiny roots and fibers of grass, which he worked into the clay that he had already smeared on his leg. Again he took more clay and plastered it over the fibers, putting on more and more till I could plainly see the enlargement; he worked away with strange, silent intentness for fully fifteen minutes, while I watched and wondered, scarce believing my eyes. Then he stood perfectly still for a full hour under an overhanging sod, where the eye could with difficulty find him, his only motion meanwhile being an occasional rubbing and smoothing of the clay bandage with his bill, until it hardened enough to suit him, whereupon he fluttered away from the brook and disappeared in the thick woods.

"I had my own explanation of the incredible action—namely, that the woodcock had a broken leg, and had deliberately put it into a clay cast to hold the broken bones in place until they should knit together again; but, naturally, I kept my own counsel, knowing that no one would believe in the theory. For years I questioned gunners closely, and found two who said that they had killed woodcock whose legs had at one time been broken and had healed again. As far as they could remember, the leg had in each case healed perfectly straight instead of twisting to one side,

as a chicken's leg does when broken and allowed to knit of itself. I examined hundreds of woodcock in the markets in different localities, and found one whose leg had at one time been broken by a shot and then had healed perfectly. There were plain signs of dried mud at the break; but that was also true of the other leg near the foot, which only indicated that the bird had been feeding in soft places.

"All this proved nothing to an outsider, and I kept silence as to what I had seen until last winter, twenty years afterwards, when the confirmation came unexpectedly. I had been speaking of animals before the Contemporary Club of Bridgeport, when a gentleman, a lawyer well known all over the state, came to me and told me eagerly of a curious find he had made the previous autumn. He was gunning one day with a friend, when they shot a woodcock, which on being brought in by the dog was found to have a lump of hard clay on one of its legs. Curious to know what it meant, he chipped the clay off with his pen-knife and found a broken bone, which was then almost healed and as straight as ever. A few weeks later the bird, had he lived, would undoubtedly have taken off the cast himself, by first soaking it in water, and there would have been nothing to indicate anything unusual about him."

Mr. Long virtually claims that a woodcock not only has an understanding of the theory of casts as adapted to fractured limbs, but is able to apply this knowledge in practice. The bird is represented as knowing the qualities of clay and mud, their lack of cohesion unless mixed with fibrous substances, their tendency to harden on exposure to the air, and to disintegrate in water. Inasmuch as woodcocks have for generations been living and feeding in muddy places, we could, perhaps, although not without some abuse of the imagination, suppose the bird to possess this knowledge. But the mental horizon of Mr. Long's woodcock is not bounded by the qualities of mud. He is familiar with the theories of bone formation and regeneration—in a word, with osteogenesis, which, by the way, is never clearly grasped by some of our university juniors. This woodcock has never been hampered by

a college training, has never been required to study sections of decalcified bone—has, in fact, never seen a bone, at least to recognize it as corresponding to a part of his own anatomical structure, and yet he divines the functions of the periosteum and the necessity for proper 'setting' of the bony tissue. This wonderful knowledge can not, be the result either of experience or of instinct, for it would be as absurd to claim that the same woodcock is continually breaking his legs and has learned to profit by such accidents, as to maintain that woodcocks for innumerable generations past have all broken their legs with sufficient frequency and regularity to lead to the development of such an exalted surgical instinct. We are inclined to believe that while the woodcock was waiting for the cast to harden on his leg, his versatile mind was revolving the problem whether even his human observer, Mr. William J. Long, would be capable of attaining to such *a priori* knowledge of the surgery of fractures without ever having seen such a thing as a bone or a cast.

Now, what are the proofs furnished by Mr. Long? First, reminiscences of 'twenty years ago.' A recent apology by Ginn and Company for the existence of Mr. Long's works informs us that the gentleman was born in 1867. He was, therefore, a lad of sixteen when he met that surgical genius among woodcocks. Granting that he was a most unusual and precocious observer, are we to suppose that twenty years can elapse in any human life without distorting and exaggerating the impressions of adolescence? Observe the wavering, nebulous language of the anecdote. The bird was 'acting strangely,' but there was absolutely no proof that his leg was broken. That such was the case is pure 'guesswork' on Mr. Long's part. He 'could see him plainly on the other side of a little stream,' but he was too far away for him to be 'absolutely sure of what all his motions meant.' He 'seemed' to be smearing clay on his leg; he 'seemed' to be pulling tiny roots,' etc. Then the language suddenly becomes positive as the unwarrantable inference crystallizes into definite form in the brain of the observer. We can not sufficiently deplore the fact that this *rara avis*

with a vengeance was permitted to disappear 'in the thick woods,' after adjusting and hardening his clay cast. Could the creature have been captured, we venture to affirm that he would have been eligible to a chair of surgery in one of our leading medical schools, and a phenomenally rapid progress of the science would have been insured.

Mr. Long does not rely entirely on the hazy reminiscences of his boyhood. A brace of reminiscing 'gunners' is introduced and another surgical genius among woodcocks, who, though deeply versed in osteogenesis, must have been singularly ignorant of such comparatively simple mechanisms as firearms or he could hardly have come to such an ignominious end as hanging in a market. This bird, unfortunately, had mud on both legs, though only one of them had been injured. It is surprising that Mr. Long supplies so obvious an explanation of the presence of mud on the sound leg. As he seems to set considerable store by this woodcock anecdote, we suggest that in future editions of his work he discard so commonplace an explanation and adopt one more in harmony with the remainder of his story. Thus he might state that the fracture occurred while the bird was sojourning in a country of unusual geological formation. He was unacquainted with the physical qualities of the mud in that particular region, so that before making the cast for his fracture he made an experimental cast for his sound leg in order to test the cohesive properties of the substance.

The heavy artillery of Mr. Long's proof is the concluding reminiscence of a lawyer 'known all over' the vast state of Connecticut. Again, from a dead bird, which in this instance he has not even seen, he not only infers what the living bird had done, but he indulges in some vaticination as to what the bird 'undoubtedly' would have done had he escaped death or, in other words, evolved from his inner consciousness as clear a knowledge of firearms and explosives as of fractures and casts. Since an ounce of prophylaxis is worth at least a pound of cure, it is rather surprising that the wise woodcocks should spend so much time making casts for their broken limbs in-

stead of keeping out of the reach of gunners.

In last analysis the whole fanciful anecdote is seen to be built on the finding of mud on the legs of a couple of dead woodcocks. In both cases the mud had accumulated at a healed fracture, not at all an unlikely occurrence in mud-frequenting birds. In the whole passage one looks in vain for a particle of authentic proof that the woodcock possesses any chirurgical knowledge or skill whatsoever. Before publishing his article, Mr. Long should have consulted his legal acquaintance on the evidential value of boyhood reminiscences and the tales of sportsmen. He seems really to put implicit confidence in all sorts of hunting and fishing yarns, even when they fall from the lips of lawyers known all over the state of Connecticut. The careful reader of the paper can see between the lines the sly, mirthful twinkle in the eyes of some of these old gunners to whom Mr. Long seems to be continually running for confirmation and amplification of his vagaries.

The passage above quoted is a fair sample of not a little of the literature that is being recommended by teachers and publishers as collateral reading for the pupils of the 'nature study' classes of our schools. Such reading is fondly supposed to afford both instruction and entertainment. That it furnishes instruction can be flatly denied, for it lacks truth, the first requisite of instructive reading. It is bad even as fiction. Amusement it undoubtedly furnishes—more, in fact, than the authors contemplate, since it not only titillates the fancy of the boys and girls, but adds to the gayety of comparative psychologists. Those who are attacking the fads of our educational system will find plenty of work awaiting them as soon as they turn their attention to the excrescences of 'nature study.'

WILLIAM MORTON WHEELER.

SPECIAL ARTICLES.

RHYTHMS OF CO₂ PRODUCTION DURING CLEAVAGE.

THE wonderful sequence of morphological changes in indirect cell division is a subject of perennial interest to biologists. The visible changes are generally recognized to be the