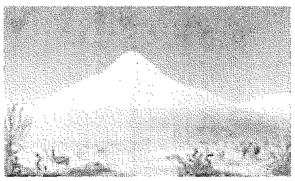
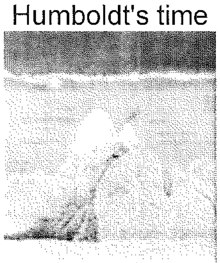
Meeting 15 • 25 February 2014
Week 8: Rocks & soil, weather & water (cont'd.); Stars & numbers

Version: **2/24/14**

pictures of the week



Mt. Chimborazo, illustration from Humboldt's time



Humboldt's iconic engraving of Mt. Chimborazo

thought-bite of the week:

"I reckoned that it was my duty in this book to record all the data obtained from reliable sources..., investigate the causes and relations, and establish fixed points in the rapid course of time..."

(Humboldt, "Personal Narrative", from *Jaguars and Electric Eels*, ed. & trans. Wilson, p. 19)

mini-text of the week (start):

"...we forgot that there might be dangers descending steep slopes covered with a smooth, slippery grass in the dark."

Humboldt, "Personal Narrative", from *Jaguars and Electric Eels*, ed. & trans. Wilson, pp. 17-18 (read more)

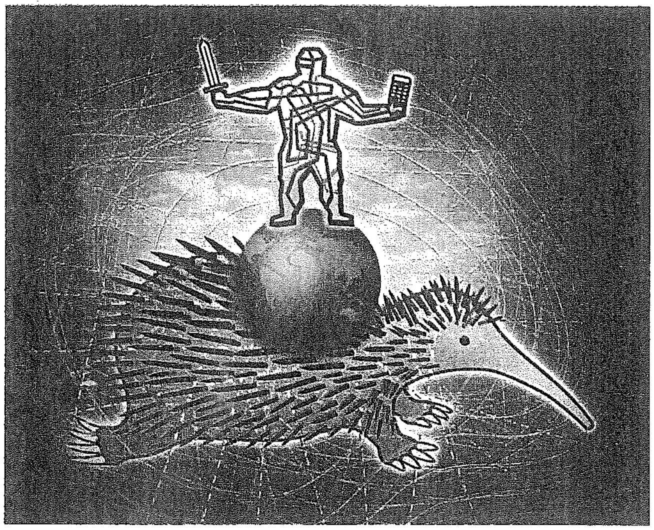
Topics for today (key to symbols)

• (05') Mini-text of the week: Who has gotten lost in the Big World Out There, perhaps on a steep place in a dark place? An example: the volcanic cliffs above Honolulu - not really lost, but kind of stranded
• (05') Thought-bite of the week: What KINDS of data are necessary for: a) detection and measurement of whatever climate change, environmental degradation, species loss may be occurring (did once occur), and how do we obtain that information? (more about this in a meeting or two); and for b) systematic / objective discussion of sustainable environmentalism?
• (10') Small-group discussion and reporting out to main group: Where in our COURSE (readings? discussions? handouts? own INQuiries?) have we already encountered the ORIGINS of sustainable environmentalism?
• (10') But why would / should / could anyone care / worry about the environment? What categories of thought are parts of the question? (tdjfodf, of course; but also fdpo, nfubqiztjdt / fuijdt / sfmjhjpo). What concepts must be there, and when - if they have not been around forever - did they become available? (tqfdjft - dsfbujpo & FYUJODUJPO; effq ujnf - vojwfstf, fnsui & "fwpmvujpo") The "Long-Beaked Echidna" - environmentalism and economics (*The Economist*, Feb. 22 2014, p. 66). If time: groups help edit an awful sentence in the article. Environmentalism v. Sustainable Environmentalism (John Muir, Gifford Pinchot [the person, the National Forest]); early stage v. later stage of modern environmentalism; preservation v. conservation). Recommended book: The Big Burn, by Timothy Egan
• (10') Species descriptions, with work samples. Important: Don't write as though you yourself were

(10') Species descriptions, with work samples. Important: Don't write as though you yourself were the audience, as though you were writing a biology paper, or even as though I were the ultimate audience. Picture a distinct category of learner and work from there. Hallmarks / gauges of strong species descriptions / group projects: 1) Is it about you or about sustainable environmentalism and AvH? 2) Will your audience learn ABOUT or learn TO, or both? 3) Could a teacher use your activity a) as is; b) by adding something to it? 4) Does it contribute balance to a larger effort (or is it just another take on the penguin / squid)? 5) Could you confidently present it publicly? Example: PSU Student Research Symposium
• (15') Speaking of species: what it's like to read Darwin's big book. Close comparison of the final beautiful paragraph in two editions. The immensely complicated issue of evolution, religion, politics, and eugenics, with an example from a biology textbook required in one American state (Hunter).
• (05') Group projects: concept of Big IDEA for Major Project, rather than finished, packaged product (though Big Ideas still have to be presented in effective packages). Reasons: a) never enough time; b) there wiu=ll be later Humboldt SINQs, and of course there is the larger Humboldt Project, and maybe some time even a Humboldt Capstone. This course's group projects could be handed off (anonymously) to your successors for further development. Into the projects we'll integrate the species descriptions and the foundation for learning materials of use to Humboldt-named schools, or just about any school. You learn best when you have to teach what you've learned. To be an educated, committed citizen is both to learn and to teach. H + NFL/NBA/MLB More examples - "Humboldt and Indigenous Cultures / Peoples /'Races'"; "Humboldt - You've Read the Novel, Now Go to the Play / See the Movie"; "Humboldt-Themed Student-Created Businesses (coffee, chocolate, Humboldt-branded articles made from Humboldt-related materials)
• (10') Examples of lesson plans that can guide species descriptions and some group projects: 1) see handout for previous meeting; b) here is "ThirteenEd Online", about lesson plans (example: math). For the Bigger Picture about principles, stakeholders, etc., see PSU/Oregon "STEM+German" grant-funded project.
• (05') If time: grants, jobs, résumé lines through PSU Institute for Sustainable Solutions; grants and conferences elsewhere; see earlier handouts for examples of internships. More soon about documenting your skills / achievements and the larger topic of employability.
• (0') Coffee / snack after class Thrusday? Lunch / Coffee Friday noonish?
• On the horizon: Soon: A last quantification activity: precise measurement of altitude / distance (demo, then do in groups). Thought questions: Are all angles and degrees created equal? Why use a barometer to measure altitude when the theodolites and trig tables are there? Margins for error in Humboldt's time and our own: latitude, longitude, altitude, temperature; news flash: PSU Building World's Biggest Barometer!! Soon: topographical mapping and iso-dimensions Looking further ahead (projects, etc.): presentation (continuation) about educational standards and their parts in the course: 1) Improving your learnign by helping others to learn - This is preparation for assignments about species description and group projects. looking ahead: presentation of project ideas (just the ideas, not finished projects) at meeting #16 Later: the iconic graphic of Chimborazo, and similar uses of graphics in delivering data and concepts; Upcoming: presentation about society back then (and any time before 1800 or so), to help understand how H related to people of other classes / races (teaser: When was it that someone's ears first popped with a change in altitude?) advice about "educated citizen" reading, with a short sample http://www.literature.org/authors/darwin-charles/the-origin-of-species/chapter-14.html

Free exchange | Valuing the long-beaked echidna

Setting a price on nature is a useful exercise, up to a point



ZAGLOSSUS ATTENBOROUGHI, a species of long-beaked echidna named after the British naturalist Sir David Attenborough, lives in the Cyclops Mountains in the Indonesian province of Papua. It has many unusual attributes, both social and physical. It is a solitary creature: it meets its own kind only once a year, to mate. The male has a four-headed penis; the offspring (known as a puggle) hatches from an egg and lives in its mother's pouch until its growing spines make it an uncongenial companion. It is greatly valued by locals—not, unfortunately, for its evolutionary quirks, but as a snack traditionally shared when tribal rivalries have been set aside. From its point of view, peace breaks out inconveniently often among the tribespeople of the Cyclops Mountains, and its grasp on existence is consequently tenuous. On the basis of reported sightings by locals and a few observations of the holes it makes when nosing around for earthworms, it is reckoned still to be around, but nobody is quite sure.

As though *Zaglossus attenboroughi* did not have enough to contend with in the Cyclops Mountains, it also has problems with the discipline of economics. Over the past few years, economists have been making concerted efforts to value the natural world, and have made some headway. But they struggle to make sense of Sir David's long-beaked echidna—and quite a lot of other evolutionarily interesting species too.

Humanity's servants

Adam Smith spotted that economics has problems valuing nature. "Nothing is more useful than water: but it will purchase scarce anything; scarce anything can be had in exchange for it. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it," he wrote. In Smith's time, failing to value nature's bounty had little consequence, but since then mankind's activities have put some priceless (in both senses) resources—fresh water, clean air, a stable climate, healthy oceans—at risk, so the argument for taking them into account in designing policy has grown. At the same time, economics has tightened its grip on policy-making, so factors that are to shape policy need numbers.

Bowing to the primacy of economics, the Millennium Ecosystem Assessment, a huge global study of the state of the planet published in 2005, pushed the idea that nature provided "ecosystem services" to people as a way of persuading humanity that it trashed nature at its peril. That led to the establishment of The Economics of Ecosystems and Biodiversity, an initiative designed to put numbers on, and publicise, the economic benefits of biodiversity. Other country-level schemes were also established around the world, of which Britain's is perhaps the most advanced. Some of the people involved in Britain's effort have also contributed essays to a new book* which provides a useful guide to the methods, uses and pitfalls of valuing biodiversity.

Nature has two sorts of value—use value and non-use value. The first includes water, which can be drunk; bees, which pollinate crops; bacteria, which fertilise soil; and so on. The second applies to things whose continued existence people value even though they are not necessarily going to use them—not just natural phenomena, but also man-made marvels such as Afghanistan's Bamiyan Buddhas, whose destruction by the Taliban was mourned around the planet.

Establishing the value of these goods is tricky, but there are ways of going about it. First, if an ecosystem service has an output—such as pollinated crops—then it is often possible to work out the value of the input. On that basis, a study by academics at Cornell University estimated that bees and other insects contributed $29 billion to the American economy in 2010. Second, if market prices are affected by nature, a value can be derived from them. Thus an apartment in New York with a view of Central Park is worth considerably more than one without such a view. Third, people's behaviour—for instance the costs that they are prepared to bear to visit a national park—reveals the value that they place on unpriced goods. Finally—and this last method applies principally to non-use value—people can be asked whether and how much they prize aspects of nature.

Some of the numbers derived from these methods are distinctly dodgy, but conservationists argue, fairly reasonably, that it is better to have mediocre estimates than none at all. They lend force to environmentalists' arguments and can usefully be fed into cost-benefit analyses. Governments thinking of planting forests or creating nature reserves, for instance, can put sensible numbers on the value people attribute to them, and thus work out whether the land in question would be better used for agricultural or recreational purposes.

Yet, as the story of *Zaglossus attenboroughi* suggests, these methods have their limits. Beyond its snack value, it is not useful to humanity. It produces nothing. There are no goods whose market price it affects. Nobody visits it. And it would not do well in surveys asking people whether they valued it: the outcome of such exercises is always a big vote for African elephants, lions, and the other "charismatic" beasts that people like to look at (and that are, mostly, not endangered).

Zaglossus attenboroughi is not charismatic; but, as a creature clinging on to one of the most distant and thinly-populated branches of the tree of life, it is of great scientific interest. Perhaps, after all, it does have a use: to remind people that although putting numbers on nature is worthwhile, economics cannot quite capture the value of all the creatures sharing this planet. ■

*Nature in the Balance: The Economics of Biodiversity. Edited by Dieter Helm and Cameron Hepburn. Oxford University Press

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Busy Sentence

Give your pooch something to bark about E1

SPORTS

Blazers quiet as trade deadline comes and goes D1

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IVE.COM FRIDAY, FEBRUARY 21, 2014

Court tosses area land plan

The way that urban/rural reserves are designated is rejected, in a ruling hailed by conservationists

Reaction: Local governments, groups have very different takes on the court's ruling | **A6**

By Christian Gaston
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The Oregon Court of Appeals on Thursday opened the door for the Legislature to take charge over charting the Portland area's growth in coming decades.

In a 126-page decision, the court scrapped a plan in which the Metro regional government and metro-area counties agreed to designate parcels of land as urban or rural reserves. The reserves process, created by the Legislature in 2007, has been locked in litigation since Metro and Portland-area counties adopted their plan in 2010.

Rep. Brian Clem, D-Salem, last week floated a legislative fix to bring parties together on a plan to clear lawsuits, protect land in the disputed Helvetia area, and free parcels near Hillsboro and Beaverton for development. Metro President Tom Hughes reacted angrily, calling Clem's proposal a backdoor power grab by special interests that would destroy years of work that cost millions of dollars.

The court, however, made clear that Metro's plan, which is aimed at charting the area's growth through 2060, is unacceptable. Washington County used "pseudo factors," it said, to determine which parcels should be considered urban and designated for eventual development and which should be left as rural reserves. The court also found fault with some urban reserves in the Stafford area of Clackamas County and with some rural reserves in Multnomah County.

The ruling disappointed local government leaders.

"As a result of today's ruling," Washington County Chairman Andy Duyck said in a news release, "our region faces renewed uncertainty just as the state's economy has started to recover. We will need to work with our community partners and consider our next steps carefully."

The court didn't eliminate the reserves process, and it left a path for Clackamas and Multnomah coun-

*See **Land use**, A6*

this tendency to become striped most strongly displayed in hybrids from between several of the most distinct species. Now observe the case of the several breeds of pigeons: they are descended from a pigeon (including two or three sub-species or geographical races) of a bluish colour, with certain bars and other marks; and when any breed assumes by simple variation a bluish tint, these bars and other marks invariably reappear; but without any other change of form or character. When the oldest and truest breeds of various colours are crossed, we see a strong tendency for the blue tint and bars and marks to reappear in the mongrels. I have stated that the most probable hypothesis to account for the reappearance of very ancient characters, is—that there is a *tendency* in the young of each successive generation to produce the long-lost character, and that this tendency, from unknown causes, sometimes prevails. And we have just seen that in several species of the horse-genus the stripes are either plainer or appear more commonly in the young than in the old. Call the breeds of pigeons, some of which have bred true for centuries, species; and how exactly parallel is the case with that of the species of the horse-genus! For myself, I venture confidently to look back thousands on thousands of generations, and I see an animal striped like a zebra, but perhaps otherwise very differently constructed, the common parent of our domestic horse (whether or not it be descended from one or more wild stocks) of the ass, the hemionus, quagga, and zebra.

He who believes that each equine species was independently created will, I presume, assert that each species has been created with a tendency to vary, both under nature and under domestication, in this particular manner, so as often to become striped like the other species of the genus; and that

each has been created with a strong tendency, when crossed with species inhabiting distant quarters of the world, to produce hybrids resembling in their stripes, not their own parents, but other species of the genus. To admit this view is, as it seems to me, to reject a real for an unreal, or at least for an unknown, cause. It makes the works of God a mere mockery and deception; I would almost as soon believe that the old and ignorant cosmogonists, that fossil shells had never lived, but had been created in stone so as to mock the shells living on the sea-shore.

Summary.—Our ignorance of the laws of variation is profound. Not in one case out of a hundred can we pretend to assign any reason why this or that part has varied. But whenever we have the means of instituting a comparison, the same laws appear to have acted in producing the lesser differences between varieties of the same species, and the greater differences between species of the same genus. Changed conditions generally induce mere fluctuating variability, but sometimes they cause direct and definite effects; and these may become strongly marked in the course of time, though we have not sufficient evidence on this head. Habit in producing constitutional peculiarities and use in strengthening and disuse in weakening and diminishing organs, appear in many cases to have been potent in their effects. Homologous parts tend to vary in the same manner, and homologous parts tend to cohere. Modifications in hard parts and in external parts sometimes affect softer and internal parts. When one part is largely developed, perhaps it tends to draw nourishment from the adjoining parts; and every part of the structure which can be saved without detriment will be saved. Changes of structure at an early age may effect parts subsequently developed; and many cases of corwe bear in mind how small the number of all living forms must be in comparison with those which have become extinct, the difficulty ceases to be very great in believing that natural selection may have converted the simple apparatus of an optic nerve, coated with pigment and invested by transparent membrane, into an optical instrument as perfect as is possessed by any member of the Articulate Class.

He who will go thus far, ought not to hesitate to go one step further, if he finds on finishing this volume that large bodies of facts, otherwise inexplicable, can be explained by the theory of modification through natural selection; he ought to admit that a structure even as perfect as an eagle's eye might thus be formed, although in this case he does not know the transitional states. It has been objected that in order to modify the eye and still preserve it as a perfect instrument, many changes would have to be effected simultaneously, which, it is assumed, could not be done through natural selection; but as I have attempted to show in my work on the variation of domestic animals, it is not necessary to suppose that the modifications were all simultaneous, if they were extremely slight and gradual. Different kinds of modification would, also, serve for the same general purpose: as Mr. Wallace has remarked, "if a lens has too short or too long a focus, it may be amended either by an alteration of curvature, or an alteration of density; if the curvature be irregular, and the rays do not converge to a point, then any increased regularity of curvature will be an improvement. So the contraction of the iris and the muscular movements of the eye are neither of them essential to vision, but only improvements which might have been added and perfected at any stage of the construction of the instrument." Within the highest division of the animal kingdom,

namely, the Vertebrata, we can start from an eye so simple, that it consists, as in the lancelet, of a little sack of transparent skin, furnished with a nerve and lined with pigment, but destitute of any other apparatus. In fishes and reptiles, as Owen has remarked, the range of gradations of dioptric structures is very great." It is a significant fact that even in man, according to the high authority of Virchow, the beautiful crystalline lens is formed in the embryo by an accumulation of epidermic cells, lying in a sack-like fold of the skin; and the vitreous body is formed from embryonic sub-cutaneous tissue. To arrive, however, at a just conclusion regarding the formation of the eye, with all its marvellous yet not absolutely perfect characters, it is indispensable that the reason should conquer the imagination; but I have felt the difficulty far too keenly to be surprised at others hesitating to extend the principle of natural selection to so startling a length.

It is scarcely possible to avoid comparing the eye with a telescope. We know that this instrument has been perfected by the long-continued efforts of the highest human intellects; and we naturally infer that the eye has been formed by a somewhat analogous process. But may not this inference be presumptuous? Have we any right to assume that the Creator works by intellectual powers like those of man? If we must compare the eye to an optical instrument, we ought in imagination to take a thick layer of transparent tissue, with spaces filled with fluid, and with a nerve sensitive to light beneath, and then suppose every part of this layer to be continually changing slowly in density, so as to separate into layers of different densities and thicknesses, placed at different distances from each other, and with the surfaces of each layer slowly changing in form. Further we must suppose that there is a power, represented by natural selection or the survival of the fittest, always intently watching each slight alteration in the transparent layers; and carefully preserving each which, under varied circumstances, in any way or in any degree, tends to produce a distincter image. We must suppose each new state of the instrument to be multiplied by the million; each to be preserved until a better one is produced, and then the old ones to be all destroyed. In living bodies, variation will cause the slight alterations, generation will multiply them almost infinitely, and natural selection will pick out with unerring skill each improvement. Let this process go on for millions of years; and during each year on millions of individuals of many kinds; and may we not believe that a living optical instrument might thus be formed as superior to one of glass, as the works of the Creator are to those of man?

Modes of Transition

If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down. But I can find out no such case. No doubt many organs exist of which we do not know the transitional grades, more especially if we look to much-isolated species, round which, according to the theory, there has been much extinction. Or again, if we take an organ common to all the members of a class, for in this latter case the organ must have been originally formed at a remote period, since which all the many members of the class have been developed; and in order to discover the early transitional grades through which the organ has passed, we should have to look to very ancient ancestral forms, long since become extinct.

We should be extremely cautious in concluding that an organ could not have been formed by transitional gradations of some kind. Numerous cases could be given amongst the lower animals of the same organ performing at the same time wholly distinct functions; thus in the larva of the dragon-fly and in the fish Cobites the alimentary canal respires, digests, and excretes. In the Hydra, the animal may be turned inside out, and the exterior surface will then digest and the stomach respire. In such cases natural selection might specialise, if any advantage were thus gained, the whole or part of an organ, which had previously performed two functions, for one function alone, and thus by insensible steps greatly change its nature. Many plants are known which regularly produce at the same time differently constructed flowers; and if such plants were to produce one kind alone, a great change would be effected with comparative suddenness in the character of the species. It is, however, probable that the two sorts of flowers borne by the same plant were originally differentiated by finely graduated steps, which may still be followed in some few cases.

Again, two distinct organs, or the same organ under two very different forms, may simultaneously perform in the same individual the same function, and this is an extremely important means of transition: to give one instance,—there are fish with gills or branchiæ that breathe the air dissolved in the water, at the same time that they breathe free air in their swimbladders, this latter organ being divided by highly vascular partitions and having a ductus pneumaticus for the supply of air. To give another instance from the vegetable kingdom: plants climb by three distinct means, by spirally twining, by clasping a support with their sensitive tendrils, and by the emission of aërial rootlets; these three means are

Such are the facts, though they did not need confirmation by me, in regard to the wonderful instinct of making slaves. Let it be observed what a contrast the instinctive habits of F. sanguinea present with those of the continental F. rufescens. The latter does not build its own nest, does not determine its own migrations, does not collect food for itself or its young, and cannot even feed itself: it is absolutely dependent on its numerous slaves. Formica sanguinea, on the other hand, possesses much fewer slaves, and in the early part of the summer extremely few: the masters determine when and where a new nest shall be formed, and when they migrate, the masters carry the slaves. Both in Switzerland and England the slaves seem to have the exclusive care of the larvæ, and the masters alone go on slave-making expeditions. In Switzerland the slaves and masters work together, making and bringing materials for the nest; both, but chiefly the slaves, tend, and milk, as it may be called their aphides; and thus both collect food for the community. In England the masters alone usually leave the nest to collect building materials and food for themselves, their slaves and larvæ. So that the masters in this country receive much less service from their slaves than they do in Switzerland.

By what steps the instinct of F. sanguinea originated I will not pretend to conjecture. But as ants which are not slave-makers will, as I have seen, carry off the pupæ of other species, if scattered near their nests, it is possible that such pupæ originally stored as food might become developed; and the foreign ants thus unintentionally reared would then follow their proper instincts, and do what work they could. If their presence proved useful to the species which had seized them—if it were more advantageous to this species to capture workers than to procreate them—the habit of collecting

pupæ, originally for food, might by natural selection be strengthened and rendered permanent for the very different purpose of raising slaves. When the instinct was once acquired, if carried out to a much less extent even than in our British F. sanguinea, which, as we have seen, is less aided by its slaves than the same species in Switzerland, natural selection might increase and modify the instinct—always supposing each modification to be of use to the species—until an ant was formed as abjectly dependent on its slaves as is the Formica rufescens.

Cell-making instinct of the Hive-Bee.—I will not here enter on minute details on this subject, but will merely give an outline of the conclusions at which I have arrived. He must be a dull man who can examine the exquisite structure of a comb, so beautifully adapted to its end, without enthusiastic admiration. We hear from mathematicians that bees have practically solved a recondite problem, and have made their cells of the proper shape to hold the greatest possible amount of honey, with the least possible consumption of precious wax in their construction. It has been remarked that a skilful workman with fitting tools and measures, would find it very difficult to make cells of wax of the true form, though this is effected by a crowd of bees working in a dark hive. Granting whatever instincts you please, it seems at first quite inconceivable how they can make all the necessary angles and planes, or even perceive when they are correctly made. But the difficulty is not nearly so great as it at first appears: all this beautiful work can be shown, I think, to follow from a few simple instincts.

I was led to investigate this subject by Mr. Waterhouse, who has shown that the form of the cell stands in close relation to the presence of adjoining cells; and the following view may, perhaps, be considered only as a modification of this theory. Let us look to the great principle of gradation, and see whether Nature does not reveal to us her method of work. At one end of a short series we have humble-bees, which use their old cocoons to hold honey, sometimes adding to them short tubes of wax, and likewise making separate and very irregular rounded cells of wax. At the other end of the series we have the cells of the hive-bee, placed in a double layer; each cell, as is well known, is an hexagonal prism, with the basal edges of its six sides bevelled so as to join an inverted pyramid, of three rhombs. These rhombs have certain angles, and the three which form the pyramidal base of a single cell on one side of the comb enter into the composition of the bases of three adjoining cells on the opposite side. In the series between the extreme perfection of the cells of the hive-bee and the simplicity of those of the humble-bee we have the cells of the Mexican Melipona domestica, carefully described and figured by Pierre Huber. The Melipona itself is intermediate in structure between the hive and humble bee, but more nearly related to the latter: it forms a nearly regular waxen comb of cylindrical cells, in which the young are hatched, and, in addition, some large cells of wax for holding honey. These latter cells are nearly spherical and of nearly equal sizes, and are aggregated into an irregular mass. But the important point to notice is, that these cells are always made at that degree of nearness to each other that they would have intersected or broken into each other if the spheres had been completed; but this is never permitted, the bees building perfectly flat walls of wax between the spheres which thus tend to intersect. Hence each cell consists of an outer spherical portion, and of two, three, or more flat surfaces, according as the cell adjoins two, three, or more other cells. When one cell rests on three other cells, which, from the spheres being nearly of the same size, is very frequently and necessarily the case, the three flat surfaces are united into a pyramid; and this pyramid, as Huber has remarked, is manifestly a cross imitation of the three-sided pyramidal base of the cell of the hive-bee. As in the cells of the hive-bee, so here, the three plane surfaces in any one cell necessarily enter into the construction of three adjoining cells. It is obvious that the Melipona saves wax, and what is more important, labour, by this manner of building; for the flat walls between the adjoining cells are not double, but are of the same thickness as the outer spherical portions, and yet each flat portion forms a part of two cells.

Reflecting on this case, it occurred to me that if the Melipona had made its spheres at some given distance from each other, and had made them of equal sizes and had arranged them symmetrically in a double layer, the resulting structure would have been as perfect as the comb of the hive-bee. Accordingly I wrote to Professor Miller of Cambridge, and this geometer has kindly read over the following statement, drawn up from his information, and tells me that it is strictly correct:—

If a number of equal squares be described with their centres placed in two parallel layers; with the centre of each sphere at the distance of radius x $\sqrt{2}$, or radius x 1.41421 (or at some lesser distance), from the centres of the six surrounding spheres in the same layer; and at the same distance from the centres of the adjoining spheres in the other and parallel layer; then, if planes of intersection between the several spheres in both layers be formed, there will result a double layer of hexagonal prisms united together by pyramidal bases formed of three rhombs; and the rhombs and the sides notwithstanding that Leibnitz formerly accused Newton of introducing "occult qualities and miracles into philosophy."

I see no good reason why the views given in this volume should shock the religious feelings of any one. It is satisfactory, as showing how transient such impressions are, to remember that the greatest discovery ever made by man, namely, the law of the attraction of gravity, was also attacked by Leibnitz, "as subversive of natural, and inferentially of revealed, religion." A celebrated author and divine has written to me that "he has gradually learnt to see that it is just as noble a conception of the Deity to believe that He created a few original forms capable of self-development into other and needful forms, as to believe that He required a fresh act of creation to supply the voids caused by the action of His laws."

Why, it may be asked, until recently did nearly all the most eminent living naturalists and geologists disbelieve in the mutability of species? It cannot be asserted that organic beings in a state of nature are subject to no variation; it cannot be proved that the amount of variation in the course of long ages is a limited quality; no clear distinction has been, or can be, drawn between species and well-marked varieties. It cannot be maintained that species when intercrossed are invariably sterile, and varieties invariably fertile; or that sterility is a special endowment and sign of creation. The belief that species were immutable productions was almost unavoidable as long as the history of the world was thought to be of short duration; and now that we have acquired some idea of the lapse of time, we are too apt to assume, without proof, that the geological record is so perfect that it would have afforded us plain evidence of the mutation of species, if they had undergone mutation.

But the chief cause of our natural unwillingness to admit that one species has given birth to clear and distinct species, is that we are always slow in admitting great changes of which we do not see the steps. The difficulty is the same as that felt by so many geologists, when Lyell first insisted that long lines of inland cliffs had been formed, and great valleys excavated, by the agencies which we see still at work. The mind cannot possibly grasp the full meaning of the term of even a million years; it cannot add up and perceive the full effects of many slight variations, accumulated during an almost infinite number of generations.

Although I am fully convinced of the truth of the views given in this volume under the form of an abstract, I by no means expect to convince experienced naturalists whose minds are stocked with a multitude of facts all viewed, during a long course of years, from a point of view directly opposite to mine. It is so easy to hide our ignorance under such expressions as the "plan of creation," "unity of design," &c., and to think that we give an explanation when we only re-state a fact. Any one whose disposition leads him to attach more weight to unexplained difficulties than to the explanation of a certain number of facts will certainly reject the theory. A few naturalists, endowed with much flexibility of mind, and who have already begun to doubt the immutability of species, may be influenced by this volume; but I look with confidence to the future,—to young and rising naturalists, who will be able to view both sides of the question with impartiality. Whoever is led to believe that species are mutable will do good service by conscientiously expressing his conviction; for thus only can the load of prejudice by which this subject is overwhelmed be removed.

Several eminent naturalists have of late published their beings are grouped, shows that the greater number of species in each genus, and all the species in many genera, have left no descendants, but have become utterly extinct. We can so far take a prophetic glance into futurity as to foretell that it will be the common and widely-spread species, belonging to the larger and dominant groups within each class, which will ultimately prevail and procreate new and dominant species. As all the living forms of life are the lineal descendants of those which lived long before the Cambrian epoch, we may feel certain that the ordinary succession by generation has never once been broken, and that no cataclysm has desolated the whole world. Hence we may look with some confidence to a secure future of great length. And as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection.

It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with Reproduction; Inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the conditions of life, and from use and disuse: a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less-improved forms. Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There

is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved.

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1860 + later

1859 ed

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Civic Biology

From Wikipedia, the free encyclopedia

author George William Hunter

A Civic Biology: Presented in Problems (usually referred to as just *Civic Biology*) was a biology textbook

Excerpts

Evolution of Man. -- Undoubtedly there once lived upon the earth races of men who were much lower in their mental organization than the present inhabitants. If we follow the early history of man upon the earth, we find that at first he must have been little better than one of the lower animals. He was a nomad, wandering from place to place, feeding upon whatever living things he could kill with his hands. Gradually he must have learned to use weapons, and thus kill his prey, first using rough stone implements for this purpose. As man became more civilized, implements of bronze and of iron were used. About this time the subjugation and domestication of animals began to take place. Man then began to cultivate the fields, and to have a fixed place of abode other than a cave. The beginnings of civilization were long ago, but even to-day the earth is not entirely civilized.

The Races of Man. -- At the present time there exist upon the earth five races or varieties of man, each very different from the other in instincts, social customs, and, to an extent, in structure. These are the Ethiopian or negro type, originating in Africa; the Malay or brown race, from the islands of the Pacific; The American Indian; the Mongolian or yellow race, including the natives of China, Japan, and the Eskimos; and finally, the highest type of all, the caucasians, represented by the civilized white inhabitants of Europe and America. ...

Improvement of Man. -- If the stock of domesticated animals can be improved, it is not unfair to ask if the health and vigor of the future generations of men and women on the earth might not be improved by applying to them the laws of selection. This improvement of the future race has a number of factors in which we as individuals may play a part. These are personal hygiene, selection of healthy mates, and the betterment of the environment.

Eugenics. -- When people marry there are certain things that the individual as well as the race should demand. The most important of these is freedom from germ diseases which might be handed down to the offspring. Tuberculosis, syphilis, that dread disease which cripples and kills hundreds of thousands of innocent children, epilepsy, and feeble-mindedness are handicaps which it is not only unfair but criminal to hand down to posterity. The science of being well born is called eugenics. ...

Parasitism and its Cost to Society. -- Hundreds of families such as those described above exist today, spreading disease, immorality, and crime to all parts of this country. The cost to society of such families is very severe. Just as certain animals or plants become parasitic on other plants or animals, these families have become parasitic on society. They not only do harm to others by corrupting, stealing, or spreading disease, but they are actually protected and cared for by the state out of public money. Largely for them the poorhouse and the asylum exist. They take from society, but they give nothing in return. They are true parasites.

The Remedy. -- If such people were lower animals, we would probably kill them off to prevent them from spreading. Humanity will not allow this, but we do have the remedy of separating the sexes in asylums or other places and in various ways preventing intermarriage and the possibilities of perpetuating such a low and degenerate race. Remedies of this sort have been tried successfully in Europe and are now meeting with some success in this country.