REGENERATION: BIOLOGICAL, COMPUTATIONAL, THEOLOGICAL

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Academic cross-fertilisation is rare in an age of hyperspecialisation. This is sad, since genius has sometimes been related to the jumping of the gaps between or among fields that have typically been seen as having no meaningful relationship to each other. In this concise paper, we shall deal with the notion of regeneration in three domains that normally do not interact at all: zoology, computing, and dogmatics.

I. Biology: the Worms Turns

It is commonly known that if one cuts off a segment of a worm, the worm may be able to regenerate the lost portion of itself. Actually, the situation is a bit more complicated.

Distinguished zoologist G. E. Gates (1897-1987), a specialist in the morphology, physiology, taxonomy, and zoogeography of earthworms, devoted twenty years of his existence to the study of their regenerative possibilities. He tells us, sadly, that "little interest was shown" in his labours by his peers. He therefore published only a limited number of his findings, but these showed that it is at least theoretically possible in certain species of earthworms to grow two entire worms from a bisected specimen. Here are some of his results:[1]

Lumbricus terrestris Linnaeus, 1758 replacing anterior segments from as far back as 13/14 and 16/17 but tail regeneration was never found.

Eisenia fetida (Savigny, 1826) with head regeneration, in an anterior direction, possible at each intersegmental level back to and including 23/24, while tails were regenerated at any levels behind 20/21, i.e., two worms may grow from one.

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[1] G. E. Gates, *Burmese earthworms: An introduction to the systematics and biology of megadrile oligochaetes with special reference to Southeast Asia* (Transactions of the American Philosophical Society, 1972).

Criodrilus lacuum Hoffmeister, 1845 also has prodigious regenerative capacity with 'head' regeneration from as far back as 40/41.

Lampito mauritii Kinberg, 1867 with regeneration in anterior direction at all levels back to 25/26 and tail regeneration from 30/31; head regeneration was sometimes believed to be caused by internal amputation resulting from *Sarcophaga* sp. larval infestation.

Perionyx excavatus Perrier, 1872 readily regenerated lost parts of the body, in an anterior direction from as far back as 17/18, and in a posterior direction as far forward as 20/21.

It will be noted that the regeneration of worms entails two characteristics:

(1) The same regeneration is not possible for all worms; the degree of regeneration depends on the particular worm in question.
(2) The worm must suffer bisection for regeneration to take place.

II. Computing: Earthworm Algebra

A fairly esoteric, out-of-the-way mathematical notion parallels in many ways the zoological phenomenon of regeneration.[2] Suppose one takes a two-digit positive number (the length of the worm), multiplies it by 2, and then truncates it so as to continue with only its last two digits (segments). One does the same with that result, and the iteration proceeds until the number (the worm) regenerates itself, or regeneration proves impossible—a funeral service for the worm then becoming the appropriate action.

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[2] On this section of our paper, cf. Clifford A. Pickover, *Computers and the Imagination* (New York: St Martin's Press, 1991), pp. 237-39, and Donald E. Knuth, *The Art of Computer Programming,* Vol. 2 (2nd ed.; Boston: Addison-Wesley, 1981). (Not so incidentally: stay away from Knuth for theology. In his book, *Things a Computer Scientist Rarely Talks About* [CSLI Publications]. Knuth suggests that "infinity is not necessarily even one of God's attributes" [p. 172]! He continues: "But even [God's] ability to deal with finitely many numbers, on the order of Super K [= 10 ↑↑↑↑ 3], is much more than enough to inspire awe." Such are the theological pitfalls into which one can readily plummet when one analogises from mathematical expressions to the nature of the empirical universe--or God.) For instructions on running Pascal programs, see my website: http://www.jwm.christendom.co.uk (subsite: "Interactive Games"). In brief: using an Apple Mac with operating system 9x (or earlier OS), download a Pascal compiler from the net (we recommend THINK Pascal 4.5d4), copy the Earthworm program, and run it.

Here is a standard Pascal program (developed by the author) to achieve computational worm regeneration:

```
program Earthworm (INPUT, OUTPUT);

var
 x, a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t: INTEGER;

begin

WRITELN('Give a two-digit whole number as a starting value representing the
worm's length; note that to regenerate this must be a number that is a
multiple of 4 or of 20.');

{Odd numbers will never return; even numbers other than multiples of 4 or 20
will loop indefinitely--but try them to see our response!}

WRITELN;

READ(x);

a := (2 * x) mod 100;

{This truncates the starting value to its last two digits--in effect cutting
the worm so as to leave only its last two segments.}
{In standard Pascal, the mod division operator achieves the truncation by
lopping off all but the remainder; consider it the knife that severs the
worm!}

WRITELN;

WRITELN(a);

b := (2 * a) mod 100;
WRITELN(b);

c := (2 * b) mod 100;
WRITELN(c);

d := (2 * c) mod 100;
WRITELN(d);

{At this point, the worm represented by a starting value equal to a multiple
of 20 has regenerated, so the program must stop. Otherwise, if the worm's
length is a multiple of 4, the program must continue to the 20th iteration for
regeneration to be achieved.}

if d <> x then
 begin
```

```
e := (2 * d) mod 100;
WRITELN(e);

f := (2 * e) mod 100;
WRITELN(f);

g := (2 * f) mod 100;
WRITELN(g);

h := (2 * g) mod 100;
WRITELN(h);

i := (2 * h) mod 100;
WRITELN(i);

j := (2 * i) mod 100;
WRITELN(j);

k := (2 * j) mod 100;
WRITELN(k);

l := (2 * k) mod 100;
WRITELN(l);

m := (2 * l) mod 100;
WRITELN(m);

n := (2 * m) mod 100;
WRITELN(n);

o := (2 * n) mod 100;
WRITELN(o);

p := (2 * o) mod 100;
WRITELN(p);

q := (2 * p) mod 100;
WRITELN(q);

r := (2 * q) mod 100;
WRITELN(r);

s := (2 * r) mod 100;
WRITELN(s);

t := (2 * s) mod 100;
WRITELN(t);

{The following series of statements prevents an infinite loop when an odd
number--or an even number not a multiple of 4 or 20--is initially entered.}
```

```
    if t <> x then
     begin

      WRITELN;

      WRITE('No regeneration is possible for this poor worm!  Only worms with
    an even number of segments constituting a multiple of 4 or 20 will
    regenerate.');

     end;

   end;

  end.
```

* * * * * * * *

Let us run this program with a worm of 80 segments (a multiple of 20), 16 segments (a multiple of 4), 17 segments (an odd number of segments), and 46 segments (an even number of segments, but not a multiple of either 4 or 20):

Give a two-digit whole number as a starting value representing the worm's length; note that to regenerate this must be a number that is a multiple of 4 or of 20.

80

60

20

40

80

Give a two-digit whole number as a starting value representing the worm's length; note that to regenerate this must be a number that is a multiple of 4 or of 20.

16

32

64

28

56

12

24

48

96

92

84

68

36

72

44

88

76

52

4

8

16

Give a two-digit whole number as a starting value representing the worm’s length; note that to regenerate this must be a number that is a multiple of 4 or of 20.

17

34

68

36

72

44

88

76

52

4

8

16

32

64

28

56

12

24

48

96

92

No regeneration is possible for this poor worm! Only worms with an even number of segments constituting a multiple of 4 or 20 will regenerate.

Give a two-digit whole number as a starting value representing the worm's length; note that to regenerate this must be a number that is a multiple of 4 or of 20.

46

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36

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44

88

76

52

4

8

16

32

64

28

56

12

24

48

96

No regeneration is possible for this poor worm! Only worms with an even number of segments constituting a multiple of 4 or 20 will regenerate.

Fascinatingly, if the starting number (the worm's length) is a multiple of 20, it will *always* regenerate in 4 iterations, and if it is a multiple of 4, regeneration will *always* occur in 20 iterations. In no other cases will regeneration occur.

It follows that—in parallel with zoological worm regeneration—mathematical-computational regeneration operates with two characteristics:

(1) The same regeneration is not possible for all worms; the degree of regeneration depends on the particular worm in question.

(2) The worm must suffer bisection for regeneration to take place.

III. Theology: Regeneration Potentially Available for All

The word "regeneration" has etymological roots similar to those of the expression "being born again." Theologically, regeneration connects with baptism: Jesus teaches, "Except one is born of water and of the Spirit, he cannot enter the kingdom of God. . . . You must be born again" (John 3: 5-7), and the Apostle Peter declares, "Baptism now saves us" (I Peter 3:21).

The normative pattern in the historic church is, therefore, infant baptism with confirmation of one's faith in Christ on reaching an age of accountability.[3] In the case of an unbeliever who does not resist the

[3] The justification of infant baptism proceeds as follows:
1) Our Lord's final (and therefore exceedingly important) command to the church was to "go baptise all nations" (Matt. 28:19). One becomes a member/citizen of a nation on birth. Therefore the command includes children.
2) "Without faith it is impossible to please God" (Hebrews 11:6), and faith is the gift of God (Ephesians 2:8-9). That gift of faith is provided through the word of God, which is available to adults by hearing it (Romans 10:13-17). But children before the age of accountability obviously cannot receive the word by hearing, since they are too young to understand it. Therefore, another means is also provided: water baptism--one is saved

Holy Spirit, conversion normally occurs when baptism takes place; however, the reborn individual, though he need never be rebaptized or "re-regenerated," is not thereby exempted from later conversion experiences. Because of the constant presence of the "old man" in the Christian life, Luther considered conversion (a turning back to the God of baptism) as a proper daily activity on the part of the believer.[4]

The 17th-century dogmaticians were correct, therefore, in distinguishing between conversion in the case of the unregenerate person on the one hand, and conversion in the case of the regenerate but lapsed individual on the other. For example, Leonard Hutter (1563-1616), professor of theology at Wittenberg, asserts that in the conversion of infidels a change occurs "from unregenerate to regenerate, from unbelievers to believers. But the condition of the lapsed in the Church is such that, although seduced by the devil, they have become subject to divine wrath and eternal damnation, nevertheless they have not yet altogether fallen from the covenant itself and from the right of adoption of the sons of God, so far as God is concerned; nor do they absolutely fall away from that, unless they persevere to the end in sin."[5] They are in the same position as the prodigal son: though in his self-centredness he departs from his Father's house and squanders his gifts, the lights in the Father's house continue to burn and he may always return if he will repent and "come to himself," saying "I have sinned against heaven and before thee" (Luke 15: 11-32).

"through the washing of water by the word" (Ephesiana 5:26).
3) "Baptism saves" (1 Peter 3:21). This does not mean, however, that one cannot subsequently fall away, since God's grace is resistible (Acts 7:51, 1 Thessalonians 5:19, Hebrews 6:4-6). Once the child reaches the age of accountability--that age of course varying from person to person--he/she must "confirm" by personal acceptance what was received in baptism--through entering into a conscious personal relationship with Christ. (Thus the place of Confirmation in the public life of the church.)
4) We do not know the state of unbaptised infants who die before reaching the age of accountability--though we know that God is love and does not want anyone to perish (1 Timothy 2:4). But we *do* know that baptised infants are saved--so a Christian parent will surely want that gift of grace for his/her child.
(See Uuras Saarnivaara , *Scriptural Baptism: A Dialog Between John Bapstead and Martin Childfont* (Eugene, OR: Wipf & Stock, 2003).

[4] "Let everyone esteem his baptism as a daily dress in which he is to walk constantly, that he may ever be found in the faith and its fruits, that he suppress the old man and grow up in the new. . . If any one fall away from it, let him again come into it. . . . If therefore we have once in baptism obtained forgiveness of sin, it will remain every day, as long as we live, that is, as long as we carry the old man about our neck" (*Large Catechism*). Cf. Montgomery, "The Place of Conversion in the Life of the Christian," *Global Journal of Classical Theology,* 2/3 (August, 2001): http://phc.edu/gj_jwm_conversion.php

[5] *Loci communes theologici* (1619), quoted in Schmid, *Doctrinal Theology*, trans. Hay and Jacobs (5th ed.; Philadelphia: United Lutheran Publishing House, 1899), p. 473.

Theological regeneration, then, differs considerably from both biological and computational regenerations. It does not require scission (since it applies to the whole person) and it is not limited in its effects to only certain classes of people:

(1) *The same regeneration is possible for every person, since Christ died for all; regeneration is not a matter of degree, and the particular characteristics of the person are irrelevant for its efficacy—regeneration depending, as it does, solely on one's willingness to acknowledge one's selfcentredness and to trust in Christ alone for forgiveness and salvation.*[6]

(2) *The person need suffer no truncation for regeneration to take place; indeed, true wholeness arrives only through such regeneration: "If anyone is in Christ, he is a new creature: old things are passed away; behold, all things are become new" (II Corinthians 5: 17).*

The appropriate connection between natural and supernatural regeneration discussed in this paper was classically made by hymn writer Isaac Watts:

Alas! and did my Savior bleed

And did my Sovereign die?

Would He devote that sacred head

For such a worm as I?

[6] And the faith itself is the product not of human ability, since every member of our fallen race is "dead in trespasses and sins" (Ephesians 2:1; cf. Rom. 3:23), but is entirely the product of divine grace—the gift of God, "not of works, lest any person should boast" (Ephesians 2: 8-9).