THE GROWTH OF MEANING AND THE LIMITS OF FORMALISM: IN SCIENCE, IN LAW[1]

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Abstract

A natural language is an organic living thing; and meanings change as words take on new, and shed old, connotations. Recent (post-Fregean) philosophy of language has paid little attention to the growth of meaning; radical philosophers like Feyerabend and Rorty have suggested that meaning-change undermines the pretensions of science to be a rational enterprise. Thinkers in the classical pragmatist tradition, however –Peirce in philosophy of science and, more implicitly, Holmes in legal theory– both recognized the significance of growth of meaning, and understood how it can contribute to the progress of science and to the adaptation of a legal system to changing circumstances. This paper develops these insights, and illustrates them by reference to (1) the growth of meaning of "DNA" from the identification of "nuclein" to the discovery of mtDNA almost a century later, and (2) the growth of meaning of "the establishment of religion" in the First Amendment to the U.S. Constitution from its ratification in 1791 to the present day. Arguing that the growth of meaning can indeed contribute to rationality, it also shows why narrowly formal models are inadequate both to science and to law.

KEY WORDS: Meaning; Logic; C. S. Peirce; Oliver Wendell Holmes; Science; Law.

Resumen

Un lenguaje natural es una cosa viviente orgánica, y los significados cambian a medida que las palabras adoptan nuevas connotaciones y abandonan viejas. La filosofía del lenguaje reciente (post-fregeana) ha prestado poca atención al desarrollo del significado; filósofos radicales, como Feyerabend y Rorty han sugerido que el cambio de significado socava las pretensiones de la ciencia de ser una empresa racional. Pensadores en la tradición pragmatista clásica, sin embargo –Peirce en la filosofía de la ciencia y, más implícitamente, Holmes en la teoría del Derecho– reconocieron la importancia del desarrollo del significado y comprendieron cómo éste puede contribuir al progreso de la ciencia y a la adaptabilidad de un sistema jurídico a las circunstancias cambiantes. Este trabajo desarrolla estas ideas, y las ilustra por medio de una referencia a (1) el desarrollo del significado de "ADN" desde la identificación de la "nucleína" hasta el descubrimiento del ADN mitocondrial casi un siglo más tarde, y (2) el desarrollo del significado de "el establecimiento de una religión" en la Primera Enmienda de la Constitución de los Estados Unidos desde su ratificación en 1791 hasta la actualidad. Argumentando que el desarrollo del significado puede contribuir mucho a la racionalidad, también muestra por qué los modelos estrechamente formales son inadecuados, tanto para la ciencia como para el Derecho.

PALABRAS CLAVE: Significado; Lógica; C. S. Peirce; Oliver Wendell Holmes; Ciencia; Derecho.

1. The Life of Language

A natural language is an organic, living thing.[2] Over the long haul a language may, like Latin, give birth to several different, new languages, and eventually fall into desuetude and die.[3] And all natural languages slowly –and sometimes not so slowly– shift, change, and adapt: borrowing words from other languages and from the specialized jargon of scientists, soldiers, sailors, lawyers, bureaucrats, etc.; turning once-live metaphors to new purposes or domesticating them as comfortable clichés; sporting new idioms, buzzwords, slang, and catchphrases.

Modern English is replete with now-dead sailing metaphors, like "taken aback" (disconcerted, startled), "three sheets to the wind" (reeling drunk), "not enough room to swing a cat" (cramped), and "scuttlebutt" (gossip);[4] it has borrowed a clutch of its scientific words, from "alkali" to "zenith," from the Arabic; and has inherited words like "pajamas" and "curry"[5] as a legacy of the era of British rule in India. Of late, it seems to have become acceptable to use "hopefully" not only to modify a verb, but also, like the German "*höffentlich*," to modify an entire sentence; and trade names like "Xerox" and "Google" have become verbs in almost everyone's vocabulary. In American English, over just a few decades "Watergate" (the name of the building at the center of the Nixon-era political scandal) gave birth to "travelgate" (the scandal over the White House travel office), "Hillarygate" (the scandal over Hillary Clinton's stock-market coup), and "zippergate" (the scandal over President Clinton and Monica Lewinsky).

[2] Two recent books, Crystal (2007) and Abley (2007), exploring regional (Crystal) and international (Abley) variations of English, illustrate the point.

[3] According to Barber (2007), half of the world's roughly 7,000 languages are dying. (According to Gomes (2007), however, there is a revival of Latin on the internet.)

[4] "Aback" means "in a position to catch the wind upon the forward surface of a square sail"; hence "taken aback" for being taken by surprise. "Sheet" refers to "a rope or chain that regulates the angle at which a sail is set in relation to the wind"; hence "three sheets to the wind" for "drunk." A cat-o'-nine-tails was the whip with which sailors were flogged for infractions of naval discipline (so-called because scars it left looked like scratches from a cat); hence "not enough room to swing a cat" for cramped quarters. The scuttlebutt was the cask of fresh water from which sailors drank; hence "scuttlebutt" for gossip – as, talk around the office water-cooler. (I rely here on a standard dictionary of American English, Merriam-Webster (1991, p. 43) ("aback," 1084 ("sheet"), 214 ("cat"), 1057 ("scuttlebutt").

[5] "Pajamas"derives from the Hindi, which derives in turn from the Persian, "pă" (leg) and "jăma" (garment). Merriam-Webster (1991, p. 847). Madhur Jaffrey conjectures that "curry" may derive from "kari," a Tamil word meaning "sauce" and also referring to a spice called kari leaf; or from "karhi," a North Indian dish made with spices and chickpea flour. Jaffrey (1978, pp.14-17).

And every year or so, it seems, I stumble on intriguing changes of meaning in some term of philosophical interest. A few years ago I learned that in eighteenth century English the word "pragmatist" meant simply a busy person; that by the late nineteenth century it had come to mean a busybody, someone who meddles officiously in other people's business; and that it only relatively recently acquired its current connotation of someone who goes by expediency rather than principle.[6] And the next year I learned that "integrity" derives from the Latin "*in*" and "*tangere*," meaning the untouched, the inviolate or pure; and that in English this word once connoted –as I am told its closest equivalents still do in Portuguese and, though by now only with respect to the Virgin Mary, in Spanish– virginity.[7]

My present topic, the growth of meaning –by which I mean not only words' acquiring new meaning, but also words' losing older connotations, as well as the coining of new terms or co-option of old ones to express new concepts and distinctions– is just one aspect of this much larger, enormously complex phenomenon of the evolution and development of languages.

So far as I am aware at least, this topic hasn't attracted much attention in recent philosophy of language; though Donald Davidson came close to it when he strayed from the relatively well-behaved areas of natural languages into the outlaw realm of metaphors, puns, and malapropisms. This excursus, however, eventually led him to announce that he had abandoned, not only the Tarskian regimentation project, but also "the ordinary notion of a language" and "the boundary between knowing a language and knowing our way around the world generally"; and to conclude that "there is no such thing as a language, not if a language is anything like what many philosophers have supposed."[8] Indeed: unlike the rigorous but rigid formal languages on which Alfred Tarski focused, natural languages are extraordinarily rich and flexible –capable of their own kind of precision, different from but no less valuable than logical or mathematical precision, but shifting, diffuse, and sometimes elusive. And since they are undeniably languages, the "ordinary notion of a language" taken for granted by those "many philosophers" to whom Davidson alludes was hopelessly Procrustean.

[6] For details, see Haack (2005a, pp. 74-75).

[7] For details, see Haack (2006).

[8] On metaphor, see Davidson (1978); Haack (1995). On malapropisms, see Davidson (1986) (the quotation is from pp. 445-446); Hacking (1986).

Previously, the growth of meaning had drawn some attention from philosophers concerned about the rationale for the methods of linguistic philosophy. In "A Plea for Excuses" J. L. Austin wrote that while "[c]ertainly … ordinary language is not the last word" on philosophical questions, "it *is* the *first* word," because "our common stock of words embodies all the distinctions men have found worth drawing, and all the connexions they have found worth marking, in the lifetimes of many generations." In the introduction to *Individuals*, Peter Strawson argued that though "[u]p to a point, reliance upon a close examination of the actual use of words is the best, and indeed the only true way in philosophy," in metaphysics "the structure we seek … lies submerged"; and, while he allowed that "certainly concepts do change," he also insisted there is "a massive central core of human thinking which has no history."[9]

Strawson focuses on those core concepts he takes to be unchanging; and Austin doesn't say what the *next* word might be, after we have consulted the wisdom of earlier generations embodied in ordinary language. Nor do more recent analytic philosophers seem to have taken much interest in this challenge. Reading in the literature on the "Gettier paradoxes," however, I found William Rozeboom observing that (whatever folk wisdom may be implicit in it) ordinary language is simply not built for deep and subtle theoretical work, and that "we will have to go beyond its "simplistic presuppositions and coarse-grained uncritical categories."[10] Few seem to have paid attention.[11]

More recently, it seems to have been mostly radicals like Paul Feyerabend, who seemed to suggest that the "meaning-variance" of theoretical terms undermines the purported rationality of science,[12] and Richard Rorty, who looked forward to a literary or "poetic" post-Philosophical culture that abandons the project of representing the world accurately, and aspires only to devise ever-new "redescriptions,"[13] who have paid attention to meaning change.

I think the growth of meaning is much more significant than the recent philosophical mainstream acknowledges; but so far from being, as the radicals suppose, invariably a hindrance to rationality, it can contribute to the cognitive flexibility that rationality demands. So I am, as usual, distinctly out of line with current fashion –but, as so often, quite

[9] Austin (1956-1957) in Urmson and Warnock (1961) (the quotations are from pp.133 and 130 respectively). Strawson (1952, p. 9).

[10] Rozeboom (1967), in Pojman (1993, p. 183). The "Gettier paradoxes" are the supposed counter-examples to the definition of knowledge as justified true belief presented by Edmund Gettier in (1963).

close to some elements of the classical pragmatist tradition; for conceptual shifts and changes are a significant theme both in C. S. Peirce's philosophical writings and, albeit more implicitly, in Oliver Wendell Holmes's legal theory. Moreover, neither of them sees such shifts and changes as any threat to rationality; on the contrary, Peirce sees the growth of meaning of scientific concepts as essential to scientific inquiry, and Holmes sees the growth of meaning of legal concepts as part of the process by which the common law has advanced beyond its barbarous beginnings.

Writing in the late 1860s that as our knowledge grows, scientific concepts acquire new meaning and shed older connotations, the young Peirce observes that "[s]cience is continually gaining new conceptions." "How much more the word *electricity* means now than it did in the days of Franklin," he continues; "how much more the term *planet* means now than it did in the time [of] Hipparchus. These words have acquired information." "[M]en and words," he concludes, "reciprocally educate each other."[14] Almost twenty years later he returns to the theme, now writing not of natural-scientific but of social concepts: "[s]ymbols grow… A symbol, once in being, spreads among the peoples. In use and in experience, its

[11] In the Introduction to Haack (1993), suggesting that the Gettier paradoxes arose from the mismatch between the categorical concept of knowledge and the gradational concept of epistemological justification, I urged that we focus instead on trying to understand the determinants of degree of justification, i.e., of evidential quality; not, however, because I had read Rozeboom's paper, which I discovered only recently – in fact, only after I had already written much of the present paper. (A paper on the Gettier paradoxes, Haack (1983), hitherto unpublished, is included in the second, expanded edition of this book.)

[12] Feyerabend (1975), chapter 17, argues that "[t]e content classes of certain theories are incommensurable in the sense that none of the usual logical relations… hold between them" (see the "Analytical Index," p.15). (I say "*seemed* to suggest" because part of Feyerabend's point may have been that philosophers of science have construed rationality too narrowly.)

[13] See e.g. Rorty (1982), p.xlii ("The urge to make philosophy into Philosophy is to make it the search for some final vocabulary which can somehow be known in advance …"; p.xliii ("[Pragmatism] sees philosophy as one genre of literature … . Physics is a way of trying to cope with various bits of the universe; ethics is a matter of trying to cope with other bits"); and p. 92 ("Philosophy is best seen as a kind of writing"). See also Rorty (1988) and Rorty (1989).

[14] Peirce, in Hartshorne *et al*. (1931-58), 7.587. The editors write that the material on "Consciousness and Language" in which this appears is probably the manuscript for Peirce's Lowell Institute Lectures for 1866-67 (lectures some of which, I note, Holmes attended. See Wiener (1949), p. 75 in the 1972 edition.) Recently, of course, the word "planet" took a notable new turn when an international congress of astronomers voted to demote Pluto to the status of "dwarf planet." See Chang (2006).

meaning grows. … Such words as *force*, *law*, *wealth*, *marriage*, bear for us a very different meaning than they bore to our barbarous ancestors."[15]

In Peirce, stress on the growth of meaning is closely connected with the Pragmatic Maxim, which he articulated as early as 1878, in "How to Make Our Ideas Clear"[16] (though he was not yet ready to use the word "pragmatism" in print, fearing that its new, philosophical sense would be confused with its then-ordinary meaning, "officious meddling").[17] The Maxim ties pragmatic meaning –according to Peirce the third and highest grade of clearness– to the experiential consequences of a concept's truly applying to something. In his later, more realist formulation, the Maxim says in effect that the pragmatic meaning of a word is given by a list of subjunctive conditionals, along the lines of "if you were to do A_1, experiential consequence E_1 would result," "if you were to do A_2, experiential consequence E_2 would result," …, and so on. I say, "and so on," because it is clear that Peirce intends the list to be open-ended, to shift and change as our knowledge grows, as "men and words reciprocally educate each other."

The Pragmatic Maxim had two purposes –one critical, the other constructive: to show that certain disputes in traditional or as Peirce says, "ontological" metaphysics are (pragmatically) meaningless;[18] and to explain the (pragmatic) meaning of "hard" or "intellectual" concepts generally. Peirce relies on the Maxim when he argues that the dispute between Catholics and Protestants over the doctrine of transubstantiation

[15] Peirce, in Hartshorne, *et al*. (1931-58) 2.302 (c.1895). Recently, of course, "marriage" also took a notable new turn with efforts, successful in some jurisdictions, to legalize same-sex marriages. In the U.S., Massachusetts has legalized same-sex marriages, and a few other states have "limited relationship recognition laws." In May 2008 the California Supreme Court ruled that "the right to marry," as characterized in the California Constitution, "guarantees same-sex couples the same substantive … rights as opposite-sex couples." *In Re. Marriage Cases*, 43 Cal. Rptr. 757, 829 (2008). In November 2008, however, Proposition 8, amending the California Constitution to ban gay marriage, was passed. Wildermuth (2008). See <http://www.nolo.com> for details of the legal state of play across the states in the U.S.; <http://www.lambdalegal.org> is also a useful source. Campbell D. Barrett (2006) includes information about the law in European countries and elsewhere.

[16] Peirce, in Hartshorne *et al*., eds. (1931-58), 5.388-410 (1878).

[17] The section headings "The Pragmatic Maxim" and "Applications of the Pragmatic Maxim" in "How to Make Our Ideas Clear" (note 16 above) are not Peirce's, but were added by the editors of the *Collected Papers*.

[18] Not, however, like the later Verification Principle, to show that metaphysics is wholly misconceived. See Peirce, in Hartshorne, et al., eds. (1931-58), 5.423 (1905); see also Haack (2007). (Peirce's use of "ontological" in this context is potentially misleading; it should not be taken to imply that he thinks ontological questions, in general, illegitimate –far from it.)

is pragmatically meaningless, and when he explains such philosophical concepts as truth and reality.[19] Most to my purpose here, in a striking passage of 1902 he applies this "precept which is more serviceable than a definition" to clarify the pragmatic meaning of "lithium" (the name of a chemical element first identified in 1818): "if you search among minerals that are vitreous, translucent, grey or white, very hard, brittle, and insoluble, for one which imparts a crimson tinge to an unluminous flame, this mineral being triturated [*sic*] with lime or witherite rats-bane, and then fused, can be partly dissolved in muriatic acid, … ,"[20] etc., etc. –his list of conditionals goes on for most of a paragraph– this is lithium. (By now, the list would be even longer, as lithium has been found to have many and various properties useful in industry, medicine, etc.)[21]

But my argument here will depend, not on the viability of the Pragmatic Maxim, but on the difference between having a merely verbal understanding of a scientific concept and having a seriously knowledgeable grasp of what it involves, to which Peirce's distinction of three grades of clarity draws our attention. And my argument will not be completely general, but will focus specifically on the vocabularies of science and of the law. Both scientific and legal concepts grow, though in rather different ways and for rather different reasons; and this partly explains why exclusively formal, syntactic approaches in philosophy of science and philosophy of law are inadequate. So far from undermining the aspiration of the sciences to find out something of how the world is, however, the growth of meaning can contribute to progress towards this goal; and, so far from revealing that legal decisions are always arbitrary and capricious, the growth of meaning can help the law adapt in a rational way to changing social circumstances.

2. The Growth of Meaning and the Progress of Science

"Rational" and its cognates are slippery and ambiguous, to say the least;[22] so I should explain that my talk of "the rationality of science" is

[19] Peirce, in Hartshorne *et al*., eds. (1931-58), 5.405-10 (1878).

[20] Peirce, in Hartshorne, *et al*., eds. (1931-58), 2.330 (c.1902). I note that Peirce was trained as a chemist, and for much of his life was a working scientist.

[21] "Pour lithium in molten glass and it comes out lighter and stronger. Add lithium to concrete and it hardens faster. Lithium kills algae, scrubs carbon dioxide from the air in spaceships and puts the juice into wristwatch batteries." Miller (1994) (the quotation is from A.1) Lithium is also used in the treatment of manic depression.

[22] See Haack (1995), in Haack (1998, pp. 142 ff.)

not meant to suggest that there is a special Scientific Method, a mode (or modes) of inference or procedure (or procedures) of inquiry used by all scientists and only by scientists, and explaining the successes of the sciences. Rather –over centuries of work, and using a vast array of constantly evolving instruments of observation, techniques of experimental control, models, metaphors, mathematical and statistical procedures, computer programs, etc., etc.– the sciences have gradually refined and amplified the underlying methods, procedures, and modes of inference on which all serious empirical inquirers rely. Nor is my talk of the rationality of science meant to suggest that, at every step, science always or inevitably advances. The progress of science is ragged and uneven: science as a whole, or this or that part of science, may advance astonishingly quickly, or move ahead only glacially slowly, or stagnate, or even regress. Science is a human enterprise and, like all human enterprises, thoroughly imperfect. Nevertheless, it is a rational enterprise insofar as it aspires to discover (some of) the truth about the world and, at its best, goes about that task in such a way that it can, and sometimes does, succeed.

For much of the mid- to late-twentieth century, many in mainstream philosophy of science seem to have taken for granted that what makes science rational must be explicable exclusively in narrowly logical, i.e., formal, syntactically characterizable, terms. The many and various deductivist, inductivist, confirmationist, probabilist, Bayesian, decision-theoretical, etc., etc., philosophies of science of this era testify to the power of this idea; as does the fact that critics who, seeing that these logical models failed, promptly jumped to the conclusion that science is *not* really a rational enterprise, but a kind of intellectual confidence trick. Nevertheless, the idea was mistaken. Elsewhere, I have argued this at length;[23] here, I will simply note that Nelson Goodman's "grue" paradox[24] already pointed pretty unmistakably to this conclusion. "All emeralds are green" has exactly the same *form* as "All emeralds are grue"; so if the first is supported [25] by our evidence thus far, but the second is not, the reason for this difference must lie in the *content* of the two claims. Carl Hempel recognized this as long ago as 1964, when he wrote in his "Postscript on

[23] See Haack (2003), chapter 2 for a summary history of formal models of science; and chapter 7, for my argument that irrationalist critics of science share the assumption that rationality must be explicable in formal-logical terms.

[24] Goodman (1954).

[25] Goodman would say "confirmed"; but see Haack (2003, pp. 73-77), where I distinguish supportiveness, warrant, justification, and confirmation.

Confirmation" that "the search for purely syntactical criteria of … confirmation presupposes that the hypotheses in question are formulated in terms that permit projection; and *such terms cannot be singled out by syntactical means alone*."[26]

Though Goodman's paradox points to a true and important conclusion, his own proposed solution, that only predicates currently entrenched in the scientific vocabulary are projectible, would impose a profound conceptual conservativism on the sciences. And this, I believe, leads in exactly the wrong direction. Degree of supportiveness of evidence depends on increment of explanatory integration; i.e., briefly and roughly, whether and to what degree evidence supports a claim depends on whether and how much the addition of the evidence to the claim improves the explanatory integration of the whole account –or, more roughly yet, on how well the claim and the evidence fit together in a explanatory story. And explanation is not a purely logical concept. The covering-law model of explanation[27] oversimplified; but it oversimplified a genuine insight: that explanation is always, overtly or covertly, general. Explanation is possible only where there are real kinds and laws; and so it requires classification of things into real kinds, and a vocabulary that corresponds to those kinds.[28]

This vocabulary-dependence is one reason why science cannot be understood in exclusively formal-logical terms –not that logic has no role, but it is at most part of the story.[29] It also suggests why scientists constantly shift and adjust the language of their field, introducing new terminology and/or subtly adapting the meaning of older terms: they are working towards a vocabulary that better aligns with the real kinds of thing or stuff.[30] (Of course, these efforts may be more, or less, successful; like the progress of science generally, the development of good scientific terminology is a ragged, uneven process.)

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[26] Hempel (1964), in Hempel (1965, p. 51) (italics mine). Many years later, Hempel would conclude that Kuhn had been right all along – that truth has no role to play in an understanding of the scientific enterprise. See Hempel (1990).

[27] Hempel (1945).

[28] I this paragraph, I have drawn on Haack (2003, pp 66-67, 84-86 and 129-135). I don't mean to suggest – as W. V. Quine seems to – that the solution to the "grue" paradox is simply that "grue" is not a natural-kind term; neither, after all, is "green." See Quine (1969). Rather, the problem lies in the false assumption that the only evidence we have that all emeralds are green is that all so-far observed emeralds have been green.

[29] See also Haack (2005b) for my views on the limits of formal methods in philosophy.

[30] Haack (2003, chapter 5).

Some examples from the history of cellular biology illustrate the point. The word "protein," referring to complex combinations of amino acids containing carbon, hydrogen, nitrogen, oxygen, usually sulfur, and sometimes other elements, derives from the Greek "*protos*," meaning "first"; and entered the scientific vocabulary around 1844. As etymology suggests, proteins were long assumed to be of prime biological importance.

In 1869 Friedrich Miescher discovered a hitherto-unknown substance, not a protein, in the nuclei of pus cells; he called it "nuclein." (He thought its chief function was to store phosphorous.) In 1889 Richard Altmann purified nuclein of proteins, and suggested a new name for this newly-purified stuff, "nucleic acid"[31] –presumably because it was found in the nucleus and, because of the many phosphate groups it contained, was acidic. The idea that nucleic acid was somehow involved in heredity also dates from the late nineteenth century, when Miescher found that the sperm of salmon, Albert Kossel that the sperm of herring, and Albert P. Mathews that the sperm of sea urchins all contained a salt of "nucleinic" acid.[32] This "nucleic" or "nucleinic acid" was the stuff we now know as "DNA."

In 1922 Hermann Staudinger proposed the concept of a macromolecule, a very long molecule held together by bivalent bonds and compactly folded in the cell. This new concept was so controversial that, when Staudinger presented it at a conference of the Zurich Chemical Society, several distinguished members of the audience tried to persuade him it was a really bad idea –until by the end of the meeting he was so frustrated that he was reduced to bellowing, "*Hier stehe ich, ich kann nicht anders*."[33] Eventually, however, the concept was found to be indispensable; and now, of course, we know that DNA is a molecule of this type.

The "deoxyribo" part of what we now call "deoxyribonucleic acid" or "DNA" indicates that the stuff contains ribose sugars ("ribo"), but with one of the hydroxyl groups replaced by a hydrogen ("deoxy"). For a while, this stuff was also called "deoxypentose nucleic acid" –the term Maurice Wilkins *et al*. used in the paper of theirs published in *Nature* in 1953 alongside James Watson's and Francis Crick's more famous paper.[34] The abbreviation "DNA" dates from 1944;[35] since then, scientists have come

[31] Levene and Bass (1931, chapter VIII). Portugal and Cohen (1977, chapter 1).

[32] Taylor, ed., (1965, p. 153).

[33] [Here I stand, I can do no other]. Olby (1974, pp. 6-10), quoting (p. 7) Frey-Wyssling (1964, p. 5).

[34] Watson and Crick (1953); Wilkins, Stokes, and Wilson (1953).

[35] Merriam-Webster (1991, p. 370).

to distinguish A-DNA, B-DNA (the less ordered, paracrystalline form, with a higher water content), and Z-DNA (in which the helices have a left-handed twist).[36]

After the discovery of the structure of DNA, what had formerly been called "pentose nucleic acid" became known as "ribonucleic acid" or "RNA": introduced in 1948, the term refers to various nucleic acids containing ribose and uracil as structural components, and associated with the control of cellular activities. Earlier, scientists had called DNA "true nucleinic acid," and RNA "pseudo-nucleinic acid"; for RNA was known to be found in the cytoplasm, while nucleinic acid, as the name suggests, was still taken to be in the nucleus only.

"Ribosome," referring to the RNA-rich cytoplasmic granules that are sites of protein synthesis, was introduced around 1958; "messenger RNA," for an RNA that carries the code for a particular protein from the nuclear DNA to a ribosome and acts as a template for the formation of that protein, and "transfer RNA" for a relatively small RNA that transfers a particular amino acid to a growing polypeptide chain, were introduced in 1961.

In the 1960s scientists showed that mitochondria[37] –organelles in the cell that convert glucose and other food molecules to the fuel that drives it, now known to have had their origin as bacteria– have their own DNA, "mitochondrial DNA," or "mtDNA." Until 1962, attention focused on the mtDNA in simple organisms like yeast; between 1963 and 1968, animal mtDNA was discovered. By 1980, scientists were able to identify genes on mtDNA, and to understand the processes of replication and mutation, transcription, etc.[38] (And by now, if you Google "mitochondrial DNA," you will find dozens of articles on the use of mtDNA identification techniques in physical anthropology, genealogical research, in forensic science, and so forth.)

This history, abbreviated as it is, suggests something of the processes by which scientists adjust and readjust their terminology and shift and adapt the meanings of existing words to work out a vocabulary that better represents real kinds of stuff. The word "protein" has lost any suggestion of prime importance; it has ceased to be analytic that nucleic acids are found exclusively in the nuclei of cells; the old word "nuclein" has eventually been replaced, in several steps, by "DNA"; and "DNA" itself has acquired new, complex connotations, and produced new, elaborate

[36] Crick (1988, p. 75).

[37] According to the Oxford English Dictionary online, the word "mitochondrion" was first introduced in 1901, superseding the earlier term "*Nebenkern*."

[38] Mounolou and Lacroute (2005).

terminological offspring; and so on. The dictionary definition of "DNA" confirms that, by a kind of sedimentation of knowledge into its meaning, this term has indeed "acquired information," as Peirce puts it, "in use and experience":

> **DNA** … (deoxyribonucleic acid): any of various nucleic acids that are localized esp. in cell nuclei, are the molecular basis of heredity in many organisms, and are constructed of a double helix, held together by hydrogen bonds between purine and pyridamine bases, which project inward from two chains containing alternate links of deoxyribose and phosphate.[39]

Some might object that this conflates the meaning of "DNA" with what is known about DNA, and that to take it at face value as simply giving the meaning of the term is to misrepresent important biological discoveries –that DNA is the genetic material, that it has this double-helical structure, etc.– as merely analytic truths. Of course I don't deny that these were major biological discoveries; nor that, at the time they were made, it was not part of the meaning of "DNA" that it is the genetic material, that it is a double helix, etc. Nevertheless, the objection misfires. For my thesis is in part that meaning grows as our knowledge grows, and that growth of meaning can aid the growth of knowledge; and this implies both that the supposed distinction between "the meaning of 'X'" and "our presumed knowledge of X" is an artificial one, and that "analytic" is best understood as elliptical for "analytic given the meaning of the words *at time t*.[40] (This last thought should not be shocking: "a simple truth is silly sooth" makes no sense in modern English; but it was analytic in Shakespeare's day, when "silly" meant "simple" and "sooth" –as in "soothsayer"– meant "truth.")

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It is a familiar fact that mastery of a language comes in degrees. Some people are bilingual; some are fluent in two or several languages; some have a reading knowledge of a language that they cannot speak, or

[39] Merriam-Webster (1991, p. 370).

[40] Perhaps I need to add that the fact that the meanings of scientific terms changes over time does not imply, as Feyerabend suggested, that supposedly rival theories are never really incompatible; that would require a stronger premise: that no sentence in one theory has the same meaning as any sentence in the other. See Haack (1987, pp. 291-295).

cannot speak well; many might be best described as able to "get by" in a language or languages other than their own. A few people are masters of their native language; more have some degree of verbal skill, agility, flexibility, and rhythm; and some are only barely articulate, or not even that. Moreover, specialists –from cellular biologists and string theorists to cooks and composers, map-makers and mechanics, gardeners and grammarians, etc., etc.– have a deeper understanding of the relevant specialized sub-vocabularies of the language than the rest of us either have or need. In every language there will be a complex combination of core vocabulary familiar to virtually every competent speaker, and specialized vocabularies well-understood by practitioners of this or that trade or art or field of study, etc., understood less fully but up to a point by some outsiders, and perhaps entirely opaque to some native speakers. Not everyone who uses the term "DNA" –not even everyone who uses it correctly for all everyday purposes– knows even that small part of the scientific story built into Webster's definition; and of course many lay people at best half-understand the term.

Peirce's three grades of clarity can be seen as located along a continuum of degrees of depth of understanding: from being able to use a word more or less correctly (the first grade of clarity), to being able to give a verbal definition (the second grade), to being able to work with the terms in the course of inquiry, to employ them deftly and adapt them as needed (the third grade). So the idea Hilary Putnam calls "division of linguistic labor" [41] has a significant place in the picture I am sketching. Perhaps unlike Putnam, however, I think of this division of labor gradualistically, because understanding comes in degrees; and dynamically, because both specialists' and lay people's understanding of specialized scientific (etc.) terminology changes over time. And in other respects my picture is very different from Putnam's.

Shifts and changes in the vocabulary of the natural sciences contribute to progress as they achieve a closer fit with the real kinds of thing or stuff in the world. Reference certainly matters. But since my theme is that the meanings of scientific terms grow and shift with the growth of knowledge, I presuppose that they *have* meanings; and so, obviously, resist the assimilation of kind terms to rigid designators. This doesn't mean, however, that I think of kind terms as disguised definite descriptions; rather, I see them as first and foremost common nouns. Neither an assimilation of kind terms to rigid designators nor an assimilation to definite descriptions meshes well with the history recounted here.

[41] The idea is presented in Putnam (1973).

Nor, though I accept a kind of realism about kinds, do I assume that every general term in our language corresponds to a real kind in the world; *which* kinds are real is something to be discovered, not something that can simply be read off our (or scientists') current vocabulary. Now, however, I am waxing metaphysical; just when it is time to turn, as advertised, to my second topic: the growth of meaning in the language of the law.

3. The Growth of Meaning and the Adaptation of Legal Systems

A legal system is not, as a scientific discipline is, primarily engaged in inquiry into some aspect of the world;[42] its core business is finding ways to settle the disputes that inevitably arise in human communities. Rather than growing, like scientific concepts, as part of a process of adapting language to correspond to real kinds of thing and stuff in the world, legal categories shift and adapt in the search for livable resolutions of disputes in ever-changing social circumstances. And Holmes's allusions to the growth of meaning in the law are much less explicit than Peirce's reflections on the growth of meaning of scientific concepts. Nevertheless, the ideas Holmes articulates in *The Common Law* and in "The Path of the Law" are undeniably apropos.

At the very beginning of *The Common Law*, Holmes explains that to accomplish his task of "present[ing] a general view of the Common Law," "other tools are needed besides logic." "The life of the law has not been logic; it has been experience," he continues; "the felt necessities of the time, the prevalent moral and political theories, intuitions of public policy, avowed or unconscious, even the prejudices which judges share with their fellow-men," are much more relevant than the rules of the syllogism. As the law evolves, "old form receives new content, and in time even the form modifies itself to fit the meaning it has received."[43]

Now we see how an idea that features prominently in the early pages of "The Path of the Law" bears on my theme. "If you want to know the law and nothing else," Holmes writes, you should think of what courts would decide were a question to come before them.[44] There is an obvious

[42] Which is not, of course, to deny that legal proceedings normally *involve* inquiry, both factual and legal.

[43] Holmes (1881), in Novick (1993, pp.115 and 119).

[44] Holmes (1897), in Novick (1993, p. 391).

parallel with the Pragmatic Maxim;[45] and, by focusing attention on the law as partly constituted by judicial decisions,[46] the prediction idea contributes to Holmes's understanding of the evolution of legal concepts. The crucial point is that judges are not simply cranking out algorithms: all legal provisions and precedents will leave some room for interpretation; and no formal-logical apparatus, however powerful,[47] could tell us how best to interpret or extrapolate these provisions and precedents so as to handle the new kinds of dispute that arise in new, unforeseen and perhaps unforeseeable circumstances.

When courts have to decide whether the right to privacy guaranteed by the U.S. constitution extends to a public telephone booth[48] or a department-store dressing room,[49] or how rules governing the formation of contracts are to be applied when agreements are made electronically,[50] or rules governing copyright in an age of electronic file-sharing,[51] etc., etc., they aren't simply figuring out the logical consequences of existing law; they are extrapolating its meaning. And as the legal system adapts to changing circumstances, changing moral sensibilities, and changing understandings of the world and our place in it, initially thin, schematic legal concepts take on new meaning and shed older connotations; in law, as in science, "men and words reciprocally educate each other." (There is no guarantee, of course, that this gradual adaptation and evolution of legal concepts will always or inevitably be successful in its purpose, any more than there is that the gradual adaptation and evolution of scientific concepts will always or inevitably be successful in its, very different, purpose.)

[45] Indeed, Max Fisch once suggested that Holmes's "prediction theory" might have inspired Peirce's Pragmatic Maxim, rather than the other way round. See Fisch (1942).

[46] It should be said, however, that while the idea of law-as-prediction sounds reasonably plausible if you think of an attorney advising a client what the legal consequences of a proposed course of action would be, it is much less plausible if you think, instead, of a judge deciding how existing law should be applied in these new circumstances. See also Haack (2005a, pp. 86-87).

[47] I say, "however powerful" because, as his references to "the syllogism" indicate, Holmes was not aware of the revolutionary advances in formal logic that had been made by Frege and Peirce just before the publication of *The Common Law*. See Haack (2007).

[48] In *Katz v. United States*, 389 U.S. 347 (1952) the U.S. Supreme Court ruled that the right to privacy extends to a public telephone both.

[49] In *State of Ohio v. McDaniel*, 44 Ohio App. 2d 163, 337 N.E.2d 173 (1975) the U.S. Supreme Court ruled that the defendant had reasonable expectation of privacy in a department store dressing room.

[50] See Watnick (2006), Norwood (2005-6).

[51] See Litman (2001); Ginsburg, Litman, and Kevin (2004; 4th edition 2007).

The perspective taken here is very close to some ideas developed by Edward Levi in his 1949 *Introduction to Legal Reasoning* –like Rozeboom's paper on the Gettier paradoxes, an oasis of good sense in a sometimes dispiriting field. "The law forum is the most explicit demonstration of the mechanism required for a moving classification system," Levi writes; "new situations arise [and] people's wants change. The categories used in the legal process must be left ambiguous … to permit the infusion of new ideas." He is quite clear, moreover, that while this means that legal decisions are not always certain and unchanging, nor formally derivable from legislation or precedent, it doesn't mean that they are arbitrary and capricious, either.[52]

Holmes illustrates how legal concepts shift and change, describing older conceptions of who or what could be held legally liable for an injury or death. At one time, an animal or even an inanimate thing might be punished: *Exodus* prescribes that "if an ox gore a man or woman, that they die; then the ox shall surely be stoned…"; Plutarch tells us that "a dog that had bitten a man was to be delivered bound up to a log four cubits long"; Plato's *Laws* provided that "[i]f a slave killed a man, he was to be given up to the relatives of the deceased," while "if a beast killed a man it was to be slain and cast beyond the borders," and an inanimate thing that killed a man was also to be cast out; as late as the second century AD some courts "still sat in judgment on inanimate things…". And even much later, an animal or inanimate thing that caused injury or death would be legally forfeited: in the time of Edward I, "If a man fell from a tree, the tree was deodand [forfeited]. If he drowned in a well, the well was to be filled up"; and a book from the reign of Henry VIII reports that when a man killed another with a sword, the sword was forfeited.[53] Closer to our time, Levi provides a splendid history of the evolving legal concept of an inherently dangerous object.[54] The legal concept of causation –which seems gradually to have grown to accommodate not only lengthy casual chains, but also complex congeries of interacting contributory factors, and even circumstances where defendants' actions made evidence of causation, in the more ordinary sense, unavailable– would also provide a good illustration.[55]

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[52] Levi (1949, pp. 4-5); the quotation is from p.4. Not so incidentally, perhaps, Levi cites two classical pragmatist philosophers, John Dewey and George Herbert Mead.

[53] Holmes (1881), in Novick (1993, pp. 118 and 127).

[54] Levi (1949, pp. 9-27). The problem arose in cases concerning the liability of a seller of an article which causes injury to someone who, further down the line, bought it from someone else.

[55] Some of this story is told in Porat and Stein (2001).

But here I will illustrate by sketching some highlights of the story of the Establishment Clause of the First Amendment to the U.S. Constitution, which provides that "Congress shall make no law respecting the establishment of religion." Devised for a new nation of which virtually all citizens were Christian, but of rival sects –and many of whom had come to America to escape religious persecution– the Establishment Clause was intended, at a minimum, to preclude the establishment of a national church, i.e., a church that would be an arm of the government as the Church of England was (and remains) in England,[56] and had been in Virginia until shortly before the First Amendment was ratified in 1791. By now, however, the question of the relation of church and state has become a many-headed hydra; and the meaning of the Establishment Clause has been stretched and adapted to cope with the disputes that arise in these new circumstances. ("Originalists" regard these adaptations as false to the principle that the Constitution means only what its framers specifically intended it to mean; but Thomas Jefferson, we know, was far-sighted enough anticipate that the Constitution would need to be flexible, to handle circumstances that would change in ways that could not be foreseen.)[57]

The first application of the Establishment Clause to the states came, long after its ratification, in 1947. While in the very young nation of 1791 most children had been educated, so far as they were educated, either by their families or in church schools, by 1947 a system of public schools had been in place for decades; and the dispute in *Everson* was over school buses. Mr. Everson challenged the constitutionality of a New Jersey statute that authorized reimbursing parents for their children's bus fare to school, regardless of whether the children attended a public or a parochial school; this violated the Establishment Clause, he argued, by forcing taxpayers to support schools teaching the Catholic faith. Writing for the majority of the U.S. Supreme Court, Justice Black explained that the Establishment Clause "means at least this":

[56] "Remains" in a more than somewhat etiolated form, however.

[57] Thomas Jefferson wrote: "I am certainly not an advocate for frequent and untried changes in laws and constitutions. … But I know also, that laws and institutions must go hand in hand with the progress of the human mind. As … new discoveries are made, new truths disclosed, and manners and opinions change with the change of circumstances, institutions must change also, and keep pace with the times. We might as well require a man to wear still the coat which fitted him as a boy, as civilized society to remain ever under the regimen of their barbarous ancestors." Jefferson (1816).

> Neither a state nor the Federal Government can set up a church. Neither can pass laws which aid one religion, aid all religions, or prefer one religion over another. Neither can force or influence a person to go to or remain away from church against his will or force him to profess belief or disbelief in any religion. No person can be punished for entertaining or professing religious beliefs, for church attendance or non-attendance. No tax..., large or small, can be levied to support any religious activities or institutions...[58]

For a first case, this was extraordinarily difficult (and had the reimbursement gone to the schools rather than the parents, the upshot might have been different). Ruling for the defendants, however, Justice Black argued that, since it simply extended state benefits to all citizens regardless of their religious beliefs, the New Jersey statute was constitutional; it was a close call, but this statute fell on the right side of the line.[59]

Now, sixty years after *Everson*, the United States is significantly different from the United States of 1947; and over the intervening decades the phrase "the establishment of religion" has gradually come to encompass more and more. By now, the Establishment Clause has been taken to preclude, *inter alia*, requiring public schools to begin each day with a Bible reading;[60] forbidding the teaching of evolution in schools or universities;[61] providing for the reimbursement of non-public schools for salaries, books, etc., for secular purposes;[62] requiring that any public-school textbook that offers an account of the origin of man should say explicitly that it is a theory, not a fact;[63] putting a copy of the Ten Commandments on the wall of a public-school classroom;[64] mandating equal time in public-school biology classes for evolution and creation science;[65] allowing schools and churches to determine whether liquor licences should be granted to businesses within 50 yards of their premises;[66] modifying a statute to mandate a minute of silence for "meditation or prayer" in the public-school day;[67] forbidding the

[58] *Everson v. Board of Education of Ewing Tp.*, 330 U.S. 1 (1947), 15.
[59] *Everson* (note 58 above), 16.
[60] *School District of Abington Twp. v. Schemp*, 374 U.S. 203 (1963).
[61] *Epperson v. Arkansas*, 373 U.S. 47 (1968).
[62] *Lemon v. Kurtzman*, 403 U.S. 602 (1971).
[63] *Daniel v. Waters*, 515 F.2d 485 (6th Cir. 1978).
[64] *Stone v. Graham*, 440 U.S. 39 (1980).
[65] *McLean v. Arkansas*, F29 F. Supp. 1255 (1982).
[66] *Larkin v.Grendel's Den*, 459 U.S. 116 (1982).
[67] *Wallace v. Jaffree*, 472 U.S. 38 (1985) (the modification was the addition of the words "or prayer").

teaching of evolution in public schools unless creation science is also taught;[68] a Christmas display of a crèche surrounded by potted poinsettias on the staircase in a courthouse;[69] a non-sectarian prayer at a high-school graduation ceremony;[70] a school district deliberately drawn to follow the boundaries of a religious enclave;[71] an evolution disclaimer to be read before public-school biology classes;[72] and a one-minute statement to be read before ninth-grade biology class to the effect that there are "gaps" in the theory of evolution, and that students might want to consult the Intelligent Design text, *Of Pandas and People*, which the Dover, PA School Board had made available.[73]

In a scathing dissent in *Lee*, in which a "non-sectarian" prayer at a high-school graduation ceremony was ruled unconstitutional in part on the grounds that graduating students would feel "coerced" to attend, Justice Scalia complained that the majority of his colleagues on the Supreme Court seemed to have transmuted the traditional understanding of "coercion," referring to compulsion by force of law and threat of legal penalty, into a flimsy amateur-psychological *ersatz*.[74] In his no less scathing dissent in *Kyrias Joel*, in which the boundaries of a school district had been delineated so as to encompass just the members of a small, strict Jewish sect, he complained that the majority seemed to imagine that "the Powers that Be, up in Albany, have conspired to effect an establishment of Satmar Hasidim"; and that they were calling "establishment" what would more properly be described as toleration.[75] Whether these cases were wisely decided or, as Justice Scalia believed, unwisely, he was certainly right about one thing: the legal meaning of "the establishment of religion" has grown significantly.

Equally certainly, its meaning has grown at least in part in response to the fact that, as Levi put it, "[n]ew situations arise and people's wants change." This is brought out particularly clearly by Justice O'Connor's "endorsement test," first articulated in her concurrence in a 1984 case in which a Christmas display in a public park –including a crèche along with a plastic Santa Claus, plastic reindeer, giant candy canes, and a talking wishing well– was held *not* to violate the Establishment Clause.[76] In

[68] *Edwards v. Aguillard*, 482 U.S. 578 (1987).
[69] *County of Allegheny v. American Civil Liberties Union*, 492 U.S. 573 (1989).
[70] *Lee v. Weisman*, 505 U.S. 577 (1992).
[71] *Board of Education of Kyrias Joel v. Grumet*, 512 U.S. 687 (1994).
[72] *Freiler v. Tangipahoa Board of Ed.*, 185 F.3d 337 (1999).
[73] *Kitzmiller v. Dover Board of Ed.*, 400 F.Supp.2d 707 (2005).
[74] *Lee v. Weisman* (note 70 above), 631-46; the discussion of "coercion" is on 640-41.
[75] *Kyrias Joel* (note 71 above), 732. Albany is the capital of the state of New York.
[76] *Lynch v. Donnelly*, 4675 U.S. 668 (1984).

determining whether a government practice violates this clause, she wrote, courts should ask whether the practice conveys to a reasonable observer that the government endorses one religion over others, or endorses religion in general over non-religion, and so makes a person's religious beliefs, or lack of them, relevant to his standing in the polis, his status as a citizen.[77]

Whether or not the endorsement test is wise or practicable, it clearly represents an effort to come to terms with the fact that, though it remains a country of strong religious feeling, the U.S. is no longer a uniformly Christian nation; among its citizens are devotees of virtually every religion you can think of,[78] not to mention plenty of evangelical atheists. The possibility that Anglicanism or Methodism or etc., might be legally established as a national church (or even that Mormonism might be legally established as a state church in Utah) seems remote; the danger to be averted now is, rather, that atheists or Catholics or Jews or Unitarians or Anabaptists or Jehovah's Witnesses or Seventh-Day Adventists or Christian Scientists or Muslims or Hindus or practitioners of Santería or of one or another Native American religion or … etc., etc., be treated as less than full citizens. And this is the very idea that, extrapolating the meaning of "establishment" to cover *any* kind of government endorsement of religion, Justice O'Connor tried to articulate.

Some who would prefer more ample government accommodation of religion think the courts have gone too far; some who would prefer a more throughly secular government think they haven't gone far enough. But it is no part of my argument that the present legal meaning of "establishment of religion" is ideal, or that courts' reasoning on this matter is always cogent; far from it. It *is* part of my argument, however, that the gradual, untidy, sometimes jerky evolution of the meaning of the Establishment Clause –now in the direction of more government accommodation of religion, now in the direction of less government entanglement with religion– is one way our legal system has adapted as it tries to cope with the needs and demands of an ever-changing society; and that this process of ongoing adaptation is not necessarily an impediment, but can be a contribution, to rationality.

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[77] I am paraphrasing Justice O'Connor's amplification of the rationale for her "endorsement test" in her concurrence in *Allegheny v. ACLU* (note 69 above), in which Justice Blackmun adopted her test in his ruling for the Court.

[78] 20 years ago, in 1987, there were estimated to be 1,347 religious organizations in the U.S. *Edwards v. Aguillard* (note 78 above), 608 n.6 (Justice Powell, concurring). For updated information, see Pew Forum on Religious and Public Life (2008).

Do these arguments extend to the language of the social sciences, or of civil-law systems? What about the language of philosophy? (How exactly does Peirce's acknowledgment of the epistemological importance of the growth of meaning bear on his insistence on the need for philosophy to develop a precise, "scientific" vocabulary governed by the principles of his "ethics of terminology"?)[79] Does meaning grow through the whole of language or, as Strawson suggested, primarily in the sub-vocabularies of this or that specialized field? What can be said about what kinds of growth of meaning change are beneficial, and what neutral, or damaging? How radically would the approach suggested here oblige us to modify the conception of language that has dominated philosophy since Frege? All good questions; but they will have to wait for another occasion.[80]

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[79] See Hartshorne *et al.*, eds. (1931-58), 2.219-26 (1903), where Peirce offers his "ethics of Terminology"; 5.413-4 (1905), where he introduces "pragmaticism"; and 5.502 (c.1905), where he discusses the meanings of "is." See also Haack (2009).

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