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## The Economics of Information and the Meaning of Speech

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## The Economics of Information and the Meaning of Speech

### Cover Page Footnote

Professor of Law and Philosophy, University of Florida. Kenneth Arrow, Amar Bhidé, Timothy Endicott, and Richard A. Posner provided helpful comments, suggestions, and criticisms. All opinions expressed in this article are mine alone.

## THE ECONOMICS OF INFORMATION AND THE MEANING OF SPEECH

Charles W. Collier<sup>+</sup>

*In common usage the communication of information is not sharply distinguished from the use of language or speech to make factual or propositional statements. So it should come as no surprise that one of the main legal justifications for protecting speech--that it underwrites a "marketplace of ideas" and thereby contributes to the search for truth--has strong parallels in the economic theory of information. "Indeed," as Kenneth Arrow writes, "the market system as a whole has frequently been considered as an organization for the allocation of resources; the typical argument for its superiority to authoritative central allocation has been the greater intake of information through having many participants."*

*As it turns out, however, the concept of information in the extensive literature on information theory, communications engineering, and mathematical statistics is ill-suited to serve as the conceptual underpinning for a marketplace of ideas. To make this argument, I analyze and discuss the scientific notion of information, especially in its capacity as a commodity that can be exchanged on a market; I then turn to the special constitutional and statutory protections for speech, especially those based or premised on a "marketplace of ideas"--the defining theory of protected speech.*

*As I conclude, the prospects for developing a marketplace of ideas within standard economic theory are decidedly gloomy. "The chief point made here," Arrow reminds us, "is the difficulty of creating a market for information if one should be desired for any reason." "The presumption that free markets will lead to an efficient allocation of resources is not valid in this case." Information theory cannot underwrite even a "marketplace of information," much less a marketplace of ideas.*

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<sup>+</sup> Professor of Law and Philosophy, University of Florida. Kenneth Arrow, Amar Bhidé, Timothy Endicott, and Richard A. Posner provided helpful comments, suggestions, and criticisms. All opinions expressed in this article are mine alone.

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Truth and understanding are not such wares as to be monopolized and traded in by tickets, and statutes, and standards. We must not think to make a staple commodity of all the knowledge in the land, to mark and license it like our broadcloth and our woolpacks . . . . Where there is much desire to learn, there of necessity will be much arguing, much writing, many opinions; for opinion in good men is but knowledge in the making.

—John Milton<sup>1</sup>

#### INTRODUCTION

In common usage the communication of information is not sharply distinguished from the use of language or speech to make factual or propositional statements. So, it should come as no surprise that one of the main legal justifications for protecting *speech*—that it underwrites a “marketplace of ideas” and thereby contributes to the search for truth—has strong parallels in the economic theory of information. “Indeed,” as Kenneth Arrow writes, “the market system as a whole has frequently been considered as an organization for the allocation of resources; the typical argument for its superiority to authoritative central allocation has been the greater *intake of information* through having many participants.”<sup>2</sup>

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1. JOHN MILTON, *Areopagitica: A Speech for the Liberty of Unlicensed Printing*, in THE OXFORD AUTHORS: JOHN MILTON 236, 257, 265 (Stephen Orgel & Jonathan Goldberg eds., Oxford Univ. Press 1990) (1644).

2. 4 KENNETH J. ARROW, *Information and Economic Behavior*, in COLLECTED PAPERS OF KENNETH J. ARROW 136, 146 (1984) (emphasis added).

As it turns out, however, the concept of information in the extensive literature on information theory, communications engineering, and mathematical statistics is ill-suited to serve as the conceptual underpinning for a marketplace of ideas. To make this argument, I analyze and discuss the scientific notion of *information*, especially in its capacity as a commodity that can be exchanged on a market. I then turn to the special constitutional and statutory protections for *speech*, especially those based or premised on a “marketplace of ideas”—the defining theory of protected speech.

One important implication of this discussion may be singled out. The analysis provides criteria for assessing emerging arguments to the effect that all communication of information—including valuable political information, provided secretly by agents of foreign governments and received secretly by federal election campaign officials (all in violation of federal election law)—should be protected by the First Amendment against prosecution.<sup>3</sup> Alan Dershowitz, for example, writes:

[T]here is something worrisome about the current frenzy of criminal investigations. To me they point to a frightening trend . . . : the criminalization of political differences . . . .

. . . .

Even if it were to turn out that the Trump campaign *collaborated*, *colluded* or *cooperated* with Russian agents, that alone would not be a crime . . . .<sup>4</sup>

In other words, that would merely be “politics,” (protected) free speech, and the (protected) free discussion of ideas. But Professor Dershowitz can reach this conclusion only by confusing *information* and *speech*. There is no “freedom of information” clause in the U.S. Constitution. All such arguments live or die by the terms of a “marketplace of ideas.”<sup>5</sup>

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3. See, e.g., 36 U.S.C. § 510; 52 U.S.C. § 30121 (discussing contributions and donations by foreign nationals). “A foreign national shall not, directly or indirectly, make a contribution or a donation of money or other thing of value, or expressly or impliedly promise to make a contribution or a donation, in connection with any Federal, State, or local election.” 11 C.F.R. § 110.20 (2021) (codifying that “[n]o person shall knowingly solicit, accept, or receive from a foreign national any contribution or donation prohibited” by this law). “A solicitation is an oral or written communication that, construed as reasonably understood in the context in which it is made, contains a clear message asking, requesting, or recommending that another person make a contribution, donation, transfer of funds, or otherwise provide anything of value.” 11 C.F.R. § 300.2 (2021).

4. Alan M. Dershowitz, Opinion, *When Politics Is Criminalized*, N.Y. TIMES, (Nov. 28, 2017), <https://www.nytimes.com/2017/11/28/opinion/politics-investigations-trump-russia.html> (emphasis added); see also ALAN M. DERSHOWITZ, TRUMPED UP: HOW CRIMINALIZATION OF POLITICAL DIFFERENCES ENDANGERS DEMOCRACY 138, 189–90 (2017).

5. See, e.g., Press Release, U.S. Dep’t of Just., Off. of Pub. Affs., Appointment of Spec. Couns. (May 17, 2017) (“Deputy Attorney General Rod J. Rosenstein today announced the appointment of former Department of Justice official and FBI Director Robert S. Mueller III to serve as Special Counsel to oversee the previously-confirmed FBI investigation of Russian government efforts to influence the 2016 presidential election and related matters.”).

My discussion is structured around three contrasts: (I) Cryptography and communication; (II) Information and speech; (III) Information vs. knowledge.

#### I. CRYPTOGRAPHY AND COMMUNICATION

Modern communication theory owes much to its origins in cryptography, in particular to the British decipherment of the German Enigma codes during World War II.<sup>6</sup> Claude Shannon famously asserts that the “semantic aspects of communication are irrelevant to the engineering problem”; but *meaning* often lies just beneath the surface (it could be the location of a German submarine, for example).<sup>7</sup> For Shannon, the “message” (the information) must be converted into a “signal” (for example, encoded in Morse code) and then sent over a channel (“the medium used to transmit the signal from transmitter to receiver”).<sup>8</sup> At the other end, the receiver performs the inverse operation: “reconstructing the message [the information] from the signal.”<sup>9</sup>

In oral speech, the information source is the brain, the transmitter is the voice mechanism producing the varying sound pressure (the signal) which is transmitted through the air (the channel) . . . . When I talk to you, my brain is the information source, yours the destination; my vocal system is the transmitter, and your ear . . . is the receiver.<sup>10</sup>

Shannon’s schematic diagram of “a general communication system” is strikingly similar to Ferdinand de Saussure’s famous “circuit of speech,” which originates in the brain of speaker *A* when a given concept triggers a corresponding sound pattern:

This is an entirely *psychological* phenomenon, followed in turn by a *physiological* process: the brain transmits to the organs of phonation an impulse corresponding to the pattern. Then sound waves are sent from *A*’s mouth to *B*’s ear: a purely *physical* process. Next, the circuit continues in *B* in the opposite order: from ear to brain, the physiological transmission of the sound pattern; in the brain, the psychological association of this pattern with the corresponding concept.<sup>11</sup>

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6. See, e.g., ANDREW HODGES, *ALAN TURING: THE ENIGMA* (1983); DAVID LEAVITT, *THE MAN WHO KNEW TOO MUCH* 156–90 (2006).

7. C.E. SHANNON, *A Mathematical Theory of Communication*, 27 BELL SYS. TECHN. J. 379, 379 (1948).

8. *Id.* at 380–81.

9. *Id.* at 381.

10. Warren Weaver, *Some Recent Contributions to the Mathematical Theory of Communication*, in *THE MATHEMATICAL THEORY OF COMMUNICATION* 3, 7 (Bd. of Trs. of the Univ. of Ill. ed. 1998) (1949).

11. FERDINAND DE SAUSSURE, *COURSE IN GENERAL LINGUISTICS* 12 (Charles Bally & Albert Sechehaye eds., Roy Harris trans., Open Court Publ’g Co. 1986) (1916).

An idea is fixed in sound and “a sound becomes the sign of an idea”; meaning is simply the counterpart of a sound pattern (*image acoustique*).<sup>12</sup> In standard linguistic usage, the *sign* reflects an intention to communicate and thereby encompasses two distinct aspects: the signifier (*signifiant*), a material aspect (e.g., the burning of a flag); and the signified (*signifié*), a conceptual aspect (what the flag burning means).

The cryptographer, like the linguist, is normally trying to solve a semantic problem too: What does the “signal” mean; where, exactly, is that German submarine? In this context, it may be useful to distinguish:

*Level A.* How accurately can the symbols of communication be transmitted? (The technical problem.)

*Level B.* How precisely do the transmitted symbols convey the desired meaning? (The semantic problem.)<sup>13</sup>

Focusing mainly on Level A—at least initially—may not be entirely unreasonable. Think of a very professional and discreet telegraph operator, to whom you hand a “personal” telegram for transmission: “She pays no attention to the meaning, whether it be sad, or joyous, or embarrassing. But she must be prepared to deal with all that come to her desk . . . . [A] communication system ought to try to deal with all possible messages . . . .”<sup>14</sup>

It seems most natural to understand the *signal* in communication theory as a rudimentary *sign* in the standard linguistic sense. “[I]t is the signs we transmit, or physical signals; we do not transmit their ‘meaning’”; and this justifies the exacting mathematical, statistical study of communication.<sup>15</sup> But from a teleological point of view, conveying meaning is normally the whole *purpose* of signs or signals. It is, therefore, hard to conceive of any interest in a truly meaningless signal—keeping in mind that “[t]he concept of information applies not to the individual messages (as the concept of meaning would), but rather to the situation as a whole. . . .”<sup>16</sup>

#### *A. Technical Analysis of the Transmission of Information*

Communications engineers spent a lot of time in the 1920s trying to develop optimal channels and conditions for transmitting telegraph signals. Anticipating their conclusions, we may say that a defining measure of the information in a message is the number of possibilities from among which the message is selected. Consider by analogy a small mountain stream of such dimensions that only one fish—of whatever type—can pass through it every second. Now consider such a stream that is populated by only two types of fish: minnows and goldfish.

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12. *See id.* at 66–67, 111–12.

13. Weaver, *supra* note 10, at 4.

14. *Id.* at 27.

15. COLIN CHERRY, ON HUMAN COMMUNICATION 44 (M.I.T. Press 2d ed. 1966).

16. Weaver, *supra* note 10, at 9.

Think of the fish as representing messages or units (parts) of messages. Each different type of fish “stands for” something different. If someone were to release these fish in a sequence informed by, say, Morse code, a primitive message might be conveyed. (“[T]his our life . . . findes tongues in trees, books in the running brooks . . .”)<sup>17</sup>

Now imagine another stream—identical in every respect to the first—except that this second stream is populated by *four* types of fish: minnows, goldfish, trout, and catfish. How would we compare this second stream to the first—as to its “capacity for transmitting messages”? As for “efficiency,” the *rate* by which fish can pass through is the same: one fish per second. Again, the type of fish does not matter. So, if that is what is meant by “efficiency,” the two streams are equally efficient.

But an obvious difference to ponder would be the greater “range of possibilities” the second stream seems to present. One can imagine all sorts of combinations in a four-fish stream that would be quite cumbersome, if not impossible, to replicate in a two-fish stream. Extrapolating broadly, while a two-fish stream might need five or more fish to represent the letter “a” in Morse code, a twenty-six-fish stream could meanwhile be spelling out an entire five-letter word, like “*antic*.”<sup>18</sup>

It must have been considerations like these that led Harry Nyquist to formalize the relationship between these physical properties of a channel—in my example, the rate of transmitting fish (a constant) and the number of types of fish—and what he called “the rate of transmission of intelligence.”<sup>19</sup> Fish are not “intelligence”; in my analogy, they are arbitrary but convenient physical things used as symbolic building-blocks of messages. In Nyquist’s formulation, “the speed of transmission of intelligence” is “the number of *characters*, representing different letters, figures, etc., which can be transmitted in a given length of time, assuming that the circuit transmits a given number of *signal elements* per unit time.”<sup>20</sup> More formally, the speed of transmitting intelligence ( $W$ ) may be approximated as

$$W = k \log m,$$

where  $k$  is a given (constant) rate of sending “signal elements,” and  $m$  is the number of different *types* of signal elements (“current values”) employed.<sup>21</sup> “Current values” are the types of discrete signals a telegraph system can send; if, for example, a system can communicate only “On” or “Off,” then it has only

17. WILLIAM SHAKESPEARE, *AS YOU LIKE IT* act 2, sc. 1, ls. 15–16.

18. See H. Nyquist, *Certain Factors Affecting Telegraph Speed*, 3 BELL SYS. TECHN. J. 324, 325 (1924) (“For example, the letter *a* in ordinary land telegraphy will be said to be made up of five signal elements, the first constituting a dot, the second a space and the next three a dash.”).

19. See *id.* at 332–33.

20. *Id.* at 333 (emphasis added).

21. If  $b^x = y$ , then  $x$  is the logarithm of  $y$  to the base  $b$ ; for example,  $10^3 = 1000$ , so 3 is the logarithm of 1000 to base 10. In information theory, logarithms to the base 2 are most convenient and will be assumed throughout.

two current values. Signal elements are the physical constituents and manifestations of current values, which in turn make up meaningful characters and letters.

The logarithm of  $m$  ( $\log m$ ) is the power (exponent) to which a given base must be raised to equal  $m$ . Where a factor shows explosive, exponential increases, the *logarithm* of this growth—showing steady, proportional increases—may be more useful, as a slower, smoother approximation by “orders of magnitude” (a common metric in economics, statistics, and the natural sciences). So, for a given rate of sending signal elements, if the number of current values is increased, the rate of transmitting intelligence can be materially increased too. But, by implication, it seems that if one were willing to wait long enough, the same total amount of “intelligence” would eventually be received, regardless of the rate at which it could be transmitted.

Ralph Hartley elaborated significantly on Nyquist’s insights in the late 1920s, particularly in a paper entitled simply *Transmission of Information*.<sup>22</sup> But much of what Hartley says about *information* could also be said of a *language*.

Hartley asks us to consider a hand-operated telegraph system in which the sending operator has at her disposal three “current values” with which to transmit messages in code.<sup>23</sup> Suppose that instead of working from a pre-established text, the operator was to choose current values “in accordance with the results of a series of chance operations such as a ball rolling into one of three pockets.”<sup>24</sup>

We could transcribe the resulting sequence of symbols “equally well for a sequence representing a consciously chosen message” as for one sent in accordance with the above-described random selections.<sup>25</sup> “A trained operator, however, would say that the [random] sequence . . . was *not intelligible*.”<sup>26</sup>

This seems so obvious that asking “why?” borders on the naive. Yet Hartley’s answer is not entirely satisfactory either: “The reason for this,” he says, “is that only a limited number of the possible sequences have been *assigned meanings* common to [the receiving operator] and the sending operator.”<sup>27</sup>

And who “assigned” those meanings? “‘When *I* use a word,’ Humpty Dumpty said, in rather a scornful tone, ‘it means just what I choose it to mean—neither more nor less.’”<sup>28</sup>

But no one can choose what the words of a language mean—in the past, the present, or the future. No one can “assign” meanings to them. Language is the

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22. See, e.g., R.V.L. Hartley, *Transmission of Information*, 7 BELL SYS. TECH. J. 535 (1928).

23. *Id.* at 536–37.

24. *Id.*

25. *Id.* at 537.

26. *Id.* at 538 (emphasis added).

27. *Id.* (emphasis added).

28. LEWIS CARROLL, *Humpty Dumpty*, in THROUGH THE LOOKING GLASS 148 (Frederick A. Stokes Co. 1905) (1871).

affair of everyone, hence the property of no one. To an extent unparalleled in other social institutions, everyone participates in language, which is why it is constantly being influenced by all. Only the community is able to establish a linguistic system—i.e., to institute values whose sole *raison d'être* lies in common usage and consent—and even it can do so only over time.<sup>29</sup>

Consider the transition in English from *thou* and its forms to *you*. For example, “[t]here is some unsuffusing thing beyond thee, thou clear spirit, to whom all thy eternity is but time . . . .”<sup>30</sup> Who made that “assignment”? And when, exactly, was it made? Hartley says he is trying merely to eliminate “psychological rather than physical considerations”; but in reality the factors he faces are imponderable social and historical forces, far beyond the control of anyone in particular.

Hartley’s larger project is to “estimat[e] the capacity of [a] physical system to transmit information . . . ignor[ing] the question of interpretation,” and thereby to “set up a definite quantitative measure of information . . . .”<sup>31</sup> Thinking back to the telegraph system where the sending operator had access to three current values, Hartley notes that two successive selections make nine different symbol sequences possible.<sup>32</sup> For example, 1\*, 2\*, or 3\* could each be followed by 1\*, 2\*, or 3\*. More generally, the number of current values (*s*) raised to the power

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29. FERDINAND DE SAUSSURE, *supra* note 11, at 71. Language always presents itself to the individual (and to the community at any given time) as an already-established system, articulated in a traditional fashion that transcends the will of the individual, even that of the community at any particular time. “At any given period, however far back in time we go, a language is always an inheritance from the past,” says Saussure. *Id.* “In fact, no society has ever known its language to be anything other than something inherited from previous generations, which it has no choice but to accept.” *Id.* at 72. Thus, the notion of a linguistic tradition is logically incompatible with deliberate assignment or human choice. Still, it is clear that languages do change, even if no one in particular is capable of changing them.

The only way to preserve the “purity” of a language, remarks Saussure, would be to remove it from circulation. If a speaking populace actually took up an artificial language like Esperanto, it too would immediately be out of the control of its inventors and would change like any other language; it would then be “impossible to turn the clock back.” *Id.* at 76. “Rules acquire and lose the status of traditions by growing, being practised, ceasing to be practised, and decaying; and rules brought into being or eliminated otherwise than by these slow, involuntary processes could not thereby acquire or lose the status of tradition.” H.L.A. HART, *THE CONCEPT OF LAW* 176 (2d ed. 1994).

The story, perhaps apocryphal, that the headmaster of a new English public school announced that, as from the beginning of the next term, it would be a tradition of the school that senior boys should wear a certain dress, depends for its comic effect wholly on the logical incompatibility of the notion of a tradition with that of deliberate enactment and choice.

*Id.*

30. HERMAN MELVILLE, *MOBY-DICK* 383 (Hershel Parker & Harrison Hayford eds., 2d ed. W. W. Norton & Co. 2002) (1851).

31. Hartley, *supra* note 22, at 538.

32. *Id.*

of the number of successive selections ( $n$ ) equals the number of possible sequences ( $sn$ ) for a system.<sup>33</sup>

This total number of possible sequences ( $sn$ ) “ignore[s],” as Hartley promised, “the question of interpretation”; unlike the work of a trained telegraph operator, “each selection [is] perfectly arbitrary . . . .”<sup>34</sup> But Hartley then sets out to prove, somewhat counterintuitively, that his result would be the same, “regardless of whether or not the primary symbols are grouped [as in letters or characters] for purposes of interpretation.”<sup>35</sup> Here Hartley is thinking of the various current values as “primary symbols” and the various sequences of these (which represent characters) as “secondary symbols.”<sup>36</sup>

The selection may then be made at the sending end among either primary or secondary symbols. Let the operator select a sequence of  $n_2$  characters each made up of a sequence of  $n_1$  primary selections.<sup>37</sup>

Now, if *characters* are thought of as the relevant units or building-blocks of messages, then they should have the same relationship to sequences of characters as current values have to sequences of current values. Think of current values *in themselves* as “unintelligible,” but when combined in certain sequences (as in, say, a code), as intelligible. The same process should be at work on a higher level when characters are combined into sequences of characters (e.g., words)—some intelligible, some not—depending on the code (or language). “We may think of the various current values as primary symbols and the various sequences of these which represent characters as secondary symbols. The selection may then be made at the sending end among either primary or secondary symbols.”<sup>38</sup>

Hartley discusses the Baudot telegraph system (two current values) “in which the operator selects letters or other characters each of which when transmitted consists of a sequence of symbols (usually five in number).”<sup>39</sup> Suppose the operator selects a sequence of three characters, each made up of a sequence of five primary selections (current values). At each such secondary selection, the operator has available as many different secondary symbols (characters) as there are different sequences that can result from making five selections from among the two primary symbols. For the Baudot System, this number of available secondary symbols =  $2^5 = 32$  characters.<sup>40</sup> So, the number of possible *sequences* of three characters (secondary symbols) that can result from the operator’s selecting three characters =  $32^3$ .

Take three random such secondary selections:

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33. *Id.*

34. *Id.*

35. *Id.* at 539.

36. *Id.* at 538-39.

37. *Id.* at 538.

38. *Id.*

39. *Id.*

40. *Id.*

1\* 1\* 1\* 1\* 2\*            1\* 1\* 1\* 2\* 2\*            1\* 1\* 2\* 2\* 2\*

If there were no mechanism for grouping the primary symbols into secondary symbols, we could have written:

1\* 1\* 1\* 1\* 2\* 1\* 1\* 1\* 2\* 2\* 1\* 1\* 2\* 2\* 2\*

With only two current values to work with, the number of possible *sequences* of fifteen current values =  $2^{15}$  (which also =  $32^3$ ). Thus, where  $s$  is the number of current values and  $n$  is the number of successive selections of current values, “the total number of possible sequences is  $sn$  regardless of whether or not the primary symbols are grouped [into secondary symbols] for purposes of interpretation . . . . This number  $sn$  [is] a measure of the information involved.”<sup>41</sup>

In this form,  $sn$  implies that the amount of information increases *exponentially* with each successive selection, which is counterintuitive though perhaps occasionally possible: “For example, the single word ‘yes’ or ‘no,’ when coming at the end of a protracted discussion, may have an extraordinarily great significance. However, such cases are the exception rather than the rule.”<sup>42</sup> Thus, Hartley instead derives “as our practical measure of information the logarithm of the number of possible symbol sequences”:

$$H = n \log s$$

$$= \log s^n,^{43}$$

where  $H$  is the amount of information associated with  $n$  selections, and  $s$  is the number of symbols available at each selection. In these terms “the information is proportional to the number of selections.”<sup>44</sup>

So, we see here a common theme among Nyquist, Hartley, and (later) Shannon: A defining measure of the information in a message is *the number of possibilities from among which the message is selected*. “The significant aspect,” observes Shannon, “is that the actual message is one *selected from a set* of possible messages.”<sup>45</sup> The larger this set of possible messages, the more information the actual, selected message (once deciphered) conveys.

### B. *The Origins of Information in Uncertainty*

Consider Paul Revere’s famous binary warning: “[o]ne if by land, two if by sea.” Likewise, legend has it that in 490 B.C. the Greek courier Pheidippides ran from Marathon to Athens and delivered one of two possible reports (“We were victorious!”) just before collapsing. Both messengers delivered important, meaningful “news”—but conveyed little new information.

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41. *Id.* at 539.

42. *Id.*

43. *Id.* at 540.

44. *Id.* at 539.

45. SHANNON, *supra* note 7, at 379.

“[T]here is more choice, or uncertainty, when there are more possible events.”<sup>46</sup> Again, the perspective of the cryptographer is instructive: more “choice” for the encoder means more uncertainty for the decoder. We already know—to a probability of about .5—what Paul Revere or the Marathon runner will say. It is hard to be “surprised” either way—something that happens, on average, every other day can hardly be considered surprising. As a preliminary observation, then: *Information is inherently “surprising”* (the more surprising the better).

Shannon brings a strongly probabilistic approach to the study of information, which may be illustrated as follows. Suppose the weatherman announces one night: “There is a 50% chance of rain tomorrow in Centerville. Also, there is a one-in-a-million chance that a huge meteoroid now heading toward earth will make a direct hit on Centerville tomorrow, wiping out the entire town. That’s all for tonight, folks!” If, somehow, you could obtain definite information that it was, in fact, *not* going to rain tomorrow in Centerville, your friends planning a picnic would no doubt appreciate your having resolved that little uncertainty (which normally is resolved by waiting until tomorrow, when the rain itself [or lack thereof] will provide exactly the same information). Using just this sort of example, Shannon introduces a new term for units of information (“binary digits,” or *bits*), as a measure of the uncertainty the information resolves:<sup>47</sup>

Possible Outcomes	“Bits” of Information
2 = $2^1$	1
4 = $2^2$	2
8 = $2^3$	3
16 = $2^4$	4
32 = $2^5$	5
etc.	etc.

The one-in-a-million probability of the meteorite’s “direct hit” implicitly accounts for one million possible outcomes, only one of which involves a meteorite striking Centerville. On the “frequency” interpretation of probability, one could imagine the scenario for tomorrow playing out one million times, with 999,999 Happy Endings. Ruling out the meteorite involves ever so many more possibilities than ruling out rain for Centerville tomorrow; accordingly, it conveys proportionally more information.

More generally, as the extent of a “figure” approaches that of the “ground,” the figure becomes increasingly less significant and, in that sense, less important. But the opposite occurs when a relatively small, isolated figure emerges only from against a vast, undifferentiated background. In Merleau-Ponty’s examples (taken from actual studies), a tiny, pinpoint source of light, projected on a large

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46. *Id.* at 393.

47. The number of *bits* (the amount of information) is defined as the logarithm of the number of available choices.

screen in a darkened auditorium, clearly—and, in relation to its size, disproportionately—evokes the attention and interest of the subjects.<sup>48</sup> Thus, the “figure” is meaningful only *in relation to* the “ground.” Likewise, “[t]he information conveyed by signals is always relative; it depends upon the *difference* in the receiver’s doubt before and after their receipt.”<sup>49</sup>

By successive selections a sequence of symbols is brought to the listener’s attention. At each selection there are eliminated all of the other symbols which might have been chosen. As the selections proceed more and more possible symbol sequences are eliminated, and we say that the information becomes more precise. . . .

Inasmuch as the precision of the information depends upon what other symbol sequences might have been chosen it would seem reasonable to hope to find in the number of these sequences the desired quantitative measure of information.<sup>50</sup>

Generalizing, then, we may say that information theory utilizes a standard paradigm (common to *Gestalt* psychology and linguistic theory) of relational meaning, a standard “structure of meaning.”

## II. INFORMATION AND SPEECH

The problem with information is not its form; in this respect, flag burning, cross burning, and draft card burning (all of which have been viewed as legally protected “speech”)<sup>51</sup> are typically more rudimentary. The problem lies in its content. Information can tell us *how* to fight a war. But David Paul O’Brien (the draft card burner) tells us the war *should not* even be fought. Information does not comprise or encompass the kind of broad, normative knowledge, ideas, perspectives, and claims to truth that could speak to such issues. Arguments, ideas, and knowledge may be viewed, metaphorically, as “commodities”; but—to complete the metaphor—they should then be traded on an “intellectual market.”

### A. *The Semantic Problem(s)*

Here are some propositions about information that one would typically *not* associate with an intellectual marketplace: *Information* must not be confused with meaning. “[T]wo messages, one of which is heavily loaded with meaning and the other of which is pure nonsense, can be exactly equivalent . . . as regards information.”<sup>52</sup> This is perhaps the hardest idea to entertain. After all, in the

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48. See MAURICE MERLEAU-PONTY, *THE STRUCTURE OF BEHAVIOR* 7–10, 33–37 (Alden L. Fisher trans., 1963) (1942).

49. CHERRY, *supra* note 15, at 182.

50. Hartley, *supra* note 22, at 536.

51. See CHARLES W. COLLIER, *MEANING IN LAW: A THEORY OF SPEECH*, 119–20 (Oxford Univ. Press 2009).

52. Weaver, *supra* note 10, at 8.

previous section I just showed that information of any interest can be analyzed in the standard terms of relational meaning. But meaning is not of the essence in information; it is not the measure of information.

It is sometimes possible to tell—from its form alone—whether an argument is valid or invalid, without knowing exactly what it “means.” For example:

Slithy toves are more polite than borogoves.

Borogoves are more polite than beamish boys.

*Therefore*, slithy toves are more polite than beamish boys.

Or even:

All sinosklaves are really just rotundapères.

All rotundapères are really just skipnischweine.

*Therefore*, all sinosklaves are really just skipnischweine.

The form of these propositions is unobjectionable; we simply do not know what their content is. In that sense, we do not know what they mean.<sup>53</sup>

The opposite (actually, the reciprocal) of information is *redundancy*, not meaninglessness. In written English, for example (and apart from a few words of foreign origin), *u* is practically redundant after *q*. There is very little choice, little uncertainty, and thus little information conveyed when *u* is added to a preexisting *q*. “Information is a measure of one’s freedom of choice . . . [in selecting] a message.”<sup>54</sup> “The greater this freedom of choice, and hence the greater the information, the greater is the uncertainty that the message actually selected is some particular one. Thus greater freedom of choice, greater uncertainty, greater information go hand in hand.”<sup>55</sup> Where there is order, structure, and pattern, there is more meaning—but less information. “[F]rom the point of view of engineering,” writes Weaver, “a communication system must face the problem of handling any message that the source can produce.”<sup>56</sup> This is “the real reason that Level A analysis deals with a concept of information which characterizes the whole statistical nature of the information source, and is not concerned with the individual messages (and not at all directly concerned with the meaning of the individual messages).”<sup>57</sup>

In this sense, Daniel Bell’s suggestion that an “information theory of value” might play a role in the modern economy like that of the labor theory of value in classical economics, is not without merit.<sup>58</sup> Searching for information is like

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53. See JIMMY SONI & ROB GOODMAN, *A MIND AT PLAY* 35 (2017): “Shannon had learned . . . that any statement of logic could be captured in symbols and equations—and that these equations could be solved with a series of simple, math-like rules. You might prove a statement true or false without ever understanding what it *meant*.”

54. Weaver, *supra* note 10, at 9.

55. *Id.* at 18–19.

56. *Id.* at 14.

57. *Id.*

58. See Kenneth J. Arrow, *Information and the Organization of Industry*, in *MARKETS, INFORMATION, AND UNCERTAINTY* 19 (Graciela Chichilnisky ed., Cambridge Univ. Press 1999).

sifting through uncertainties. The more sifting required, the more valuable the eventual discovery. The *measure* of information is the amount of non-information that must be sifted aside to find the message—that veritable needle in the haystack. “Information content is then measured in terms of the *statistical rarity* of the signs.”<sup>59</sup> This is one reason that diamonds are more valuable than pebbles. Getting significant information is like solving a puzzle or figuring out a secret—it requires time, and it requires “labor.”

Now, I think, two rather broad definitional propositions may be put forward:

The measure of information is the *difficulty* of extracting its meaning.

The measure of speech is the *ease* of extracting its meaning.

As mentioned above, the *form* of meaning is essentially the same in both cases: relational meaning, common to structural linguistics and *Gestalt* psychology, in which the figure/ground distinction serves as a basic paradigm. It is, instead, the *content* of meaning, and the relative difficulty of extracting meaning, that differ so markedly.

Technical forces have combined to render the meaning of information ever more recondite, obscure, and difficult to decipher. The popular slogan, “information wants to be free”—however well intentioned—was never actually true. As will be shown in more detail below, information is especially amenable to being ensconced in secret formulae whose value consists largely in the fact that they are known only to their proprietary owners.

A better slogan might be: “*Speech* wants to be free.” Jurists have gone to great lengths in finding various forms of expression to be protected. As Justice Gorsuch put it recently, “Americans can say pretty much anything they want for more or less any reason they want more or less anytime they want.”<sup>60</sup> Jurists have been especially creative in finding meaning in novel forms of “symbolic speech,” including flag burning, cross burning, draft card burning, nude dancing, wearing black armbands, and sleeping in public parks.<sup>61</sup> The “minimum requirements” for speech seem to be:

1. For the expression of an idea to count as *speech*, it must be “sufficiently imbued with elements of communication.”<sup>62</sup> This “entails at the very least a speaker and an audience.”<sup>63</sup>
2. “An intent to convey a particularized message” [must be] present.<sup>64</sup>

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59. CHERRY, *supra* note 15, at 180.

60. Adam Liptak, *Amid Protests at Trump Hotel, Neil Gorsuch Calls for Civility*, N.Y. TIMES (Sept. 28, 2017), <https://www.nytimes.com/2017/09/28/us/politics/neil-gorsuch-trump-hotel-protests.html>.

61. *See generally* COLLIER, *supra* note 51, at 89–150.

62. *See id.* at 91.

63. *Id.*

64. *Id.*

3. “[I]n the surrounding circumstances the likelihood [must be] great that the message would be understood by those who viewed it.”<sup>65</sup>

The *Spence* test contemplates that some forms of symbolic speech will be more obviously meaningful than others; and that some may have no discernible meaning at all. “We cannot accept the view,” remarks the Court in *United States v. O’Brien*, “that an apparently limitless variety of conduct can be labeled ‘speech’ whenever the person engaging in the conduct intends thereby to express an idea.”<sup>66</sup> Even when the “communicative element” in symbolic conduct such as O’Brien’s—burning his draft card on the steps of the South Boston Courthouse before a “sizable crowd”—is “sufficient to bring into play the First Amendment,” a lower than usual standard of protection against regulation (“intermediate scrutiny”) applies.<sup>67</sup> Whereas for speaking, writing, and other traditional uses of language, the usual, highest standard (“strict scrutiny”) applies.<sup>68</sup>

But why should speech receive any “special protection” against regulation at all? There have been two especially influential answers to this question—each with its own distinctive theory and distinguished proponents.

#### *B. The Role of Speech in the Political Process*

Consider the following, rather mundane situation arising under the Due Process clause of the Constitution. You need a new pair of eyeglasses. You go to your ophthalmologist (or optometrist) and get a new prescription for lenses, which you take to your optician.

But then, the very next day, you decide it would be handy to have *two* new sets of eyeglasses. If you live in Oklahoma, you are in a bit of a bind. *Per* state law, you must go back to your ophthalmologist (or optometrist) and get *another* prescription for the second set of eyeglasses. “What a waste,” you say!

But all perfectly legal, in Oklahoma:

The Oklahoma law may exact a needless, wasteful requirement in many cases. But it is for the legislature, not the courts, to balance the advantages and disadvantages of the new requirement . . . . [W]hen it is necessary to duplicate a lens, a written prescription may or may not be necessary. But the legislature might have concluded that one was needed often enough to require one in every case . . . . [T]he law need not be in every respect logically consistent with its aims to be constitutional. It is enough that there is an evil at hand for correction, and that it might be thought that the particular legislative measure was a rational way to correct it.<sup>69</sup>

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65. *See id.* at 91; *Spence v. Washington*, 418 U.S. 405, 410–11 (1974).

66. *United States v. O’Brien*, 391 U.S. 367, 376 (1968).

67. *Id.*

68. COLLIER, *supra* note 51, at 129–48.

69. *Williamson v. Lee Optical, Inc.*, 348 U.S. 483, 487–88 (1955).

This is *rationality review*, the “normal” standard of judicial review under the Constitution.<sup>70</sup>

Nevertheless, you might very well start wondering: “Who is behind this statute?” Could it be the ophthalmologist/optometrist “lobby”? If so, your recourse is clear: Vote out the rascals—those legislators beholden to the special interests of ophthalmologists and optometrists! Talk with your friends, send petitions around, organize rallies, march in marches, and above all, vote.

This is how the “political process” is supposed to work. And assuming it does work, if the Oklahoma law is really all that objectionable it will meet its doom through the normal workings of the political process. But now, suppose a law strikes at the heart of the political process itself—at *speech*, for example—not merely at eyeglass-prescription regulations. Here it is not simply a matter of recourse to the political process; here that process itself is targeted and threatened.

These considerations led Justice Stone in 1938 to articulate and theorize, for the very first time, a higher level of protection—heightened review—against legislative attacks on the political process itself.<sup>71</sup> Normally, he agreed, “regulatory legislation affecting ordinary commercial transactions is not to be pronounced unconstitutional unless in the light of the facts made known or generally assumed it is of such a character as to preclude the assumption that it rests upon some rational basis . . . .”<sup>72</sup> But Stone then pushed boldly into *terra incognita* by openly wondering:

[W]hether legislation which restricts those political processes which can ordinarily be expected to bring about repeal of undesirable legislation, is to be subjected to *more exacting judicial scrutiny* under the general prohibitions of the Fourteenth Amendment than are most other types of legislation. On restrictions upon the right to vote, see [Nixon v. Herndon; Nixon v. Condon]; on restraints upon the dissemination of information, see [Near v. Minnesota; Grosjean v. American Press Co.; Lovell v. Griffin]; on interferences with political organizations, see [Stromberg v. California; Fiske v. Kansas; Whitney v. California; Herndon v. Lowry]; and see Holmes, J., in [Gitlow v. New York]; as to prohibition of peaceable assembly, see [De Jonge v. Oregon].<sup>73</sup>

That is a pretty thorough canvassing of the elements of the political process; and it highlights the central role of speech. Indeed, there can be no political

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70. See James B. Thayer, *The Origin and Scope of the American Doctrine of Constitutional Law*, 7 HARV. L. REV. 129 (1893).

71. See *United States v. Carolene Prods. Co.*, 304 U.S. 144 (1938).

72. *Id.* at 152.

73. *Id.* at 152 n.4 (emphasis added) (citations omitted); see generally JOHN HART ELY, *DEMOCRACY AND DISTRUST: A THEORY OF JUDICIAL REVIEW* 105–34 (Harv. Univ. Press 1980).

process—as we know it—without freedom of speech. That in itself justifies “special protection” for speech in all its forms.

### C. *The Role of Speech in a “Marketplace of Ideas”*

Another approach to heightened review predates the Constitution and goes back at least as far as seventeenth century England, where authors needed the *imprimatur* of the Crown on anything published (licensing as prior restraint). One particularly aggrieved author was John Milton, who devoted a whole book to this sad state of affairs.

Some of his main arguments may be summarized as follows: (1) In order to do an intellectually respectable job of censoring (which entails understanding the works in question), the censors would have to be as brilliant and erudite as John Milton himself—hardly likely! (2) The very idea of censorship implies a low level of cultural and intellectual development, such that the populace has to be protected from “bad” ideas. But even biblical authorities read those bad books—with no apparent harm (“To the pure all things are pure”)—the better to understand and refute them. (3) Good ideas will drive out the bad, in a fair competition; far better to let them fight it out themselves:

And though all the winds of doctrine were let loose to play upon the earth, so truth be in the field, we do injuriously by licensing and prohibiting to misdoubt her strength. Let her and falsehood grapple; who ever knew truth put to the worse in a free and open encounter?<sup>74</sup>

About two centuries later another Englishman, John Stuart Mill, picked up the theme of a competition among ideas in his influential volume *On Liberty* (1859). Mill (like Milton and Descartes before him) was much consumed with the ideas of infallibility and absolute certainty; and they led him to some extreme (some would say puerile) expressions of opinion: “If all mankind minus one, were of one opinion, and only one person were of the contrary opinion, mankind would be no more justified in silencing that one person, than he, if he had the power, would be justified in silencing mankind.”<sup>75</sup>

Still, censorship does imply some form of infallibility. And the best—perhaps only—basis for certainty about our own ideas is that they have continually been put to the test of free and open discussion—“a standing invitation to the whole world to prove them unfounded.”<sup>76</sup>

There is the greatest difference between presuming an opinion to be true, because, with every opportunity for contesting it, it has not been refuted, and assuming its truth for the purpose of not permitting its refutation. Complete liberty of contradicting and disproving our opinion, is the very condition which justifies us in assuming its truth

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74. MILTON, *supra* note 1, at 269.

75. John Stuart Mill, *On Liberty*, in *ON LIBERTY IN FOCUS* 37 (John Gray & G.W. Smith eds., Routledge 1991) (1859).

76. *Id.* at 41.

for purposes of action; and on no other terms can a being with human faculties have any rational assurance of being right.<sup>77</sup>

It was left to Oliver Wendell Holmes, Jr., intellectual heir to Milton, Mill, and many others,<sup>78</sup> to pull together their disparate thoughts about a competition of ideas into a coherent and compelling vision:

Persecution for the expression of opinions seems to me perfectly logical. If you have no doubt of your premises or your power and want a certain result with all your heart you naturally express your wishes in law and sweep away all opposition . . . . But when men have realized that time has upset many fighting faiths, they may come to believe even more than they believe the very foundations of their own conduct that the ultimate good desired is better reached by free trade in ideas—that the best test of truth is the power of the thought to get itself accepted in the competition of the market, and that truth is the only ground upon which their wishes safely can be carried out. That at any rate is the theory of our Constitution.<sup>79</sup>

With that, we plunge into a foundational economic metaphor. It opens a window onto a strange new world, where ideas are like things actually exchanged for one another. Individuals “trade” in those ideas; in a sense, the ideas “compete” among themselves too—they have a certain independent, irrepressible *power*. All this takes place in a free, public “market.” And that market puts a better price or value on those ideas than any alternative means—better, for example, than the best estimates of those individual traders themselves. “[T]he power of the thought to get itself accepted in the competition of the market” is “the best test of truth.”<sup>80</sup>

“[T]he theory of our Constitution” tells us we might be wrong.<sup>81</sup> The theory is at once skeptical and relativizing. What seems clear to us today might be unclear tomorrow. Even our “fighting faiths” might be unveiled as faith in false gods. There is a higher standard of truth (“the only ground upon which [our] wishes safely can be carried out”), but we do not—individually—possess it.<sup>82</sup>

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77. *Id.* at 39; *see also id.* at 55 (emphasis added):

Nor is it enough that he should hear the arguments of adversaries from his own teachers . . . . He must be able to hear them from persons who actually believe them; who defend them in earnest, and do their very utmost for them. He must know them in their most plausible and persuasive form; *he must feel the whole force of the difficulty* which the true view of the subject has to encounter and dispose of . . . .

78. *See, e.g.,* Thomas C. Grey, *Holmes and Legal Pragmatism*, 41 STAN. L. REV. 787 (1989); STANFORD UNIV. PRESS, *THE LEGACY OF OLIVER WENDELL HOLMES, JR.* (Robert W. Gordon ed., 1992).

79. *Abrams v. United States*, 250 U.S. 616, 630 (1919) (Holmes, J., dissenting).

80. *Id.*

81. *Id.*

82. *Id.*

Truth resides in the judgment of the market—the long-term, considered judgment.

Milton and Mill may have foreshadowed this vision, but a wrestling match (or a “free and open discussion”) is not a marketplace. The specific *economic implications* are new with Holmes’s *Abrams* dissent. Thus understood, the idea of a “marketplace of ideas,” as facilitating the search for truth, has become the leading philosophical basis for free speech and the leading source of special or heightened legal (constitutional) protection for speech.

### III. COMMUNICATION THEORIES AND SOME DEFINING CHARACTERISTICS OF SPEECH

It often seems in informal usage that *communication* and *speech* or *language* are, if not exactly synonymous, more or less the same thing—different labels for two sides of the same coin. Consider the following passages from a leading text on semantics:

“To say that language serves as an instrument of communication is to utter a truism. Indeed, it is difficult to imagine any satisfactory definition of the term ‘language’ that did not incorporate some reference to the notion of communication.”<sup>83</sup> “[T]he structure of language is determined by the communicative functions that it is called upon to perform.”<sup>84</sup> “Furthermore . . . there is an intrinsic connexion between meaning and communication, such that it is impossible to account for the former except in terms of the latter.”<sup>85</sup>

#### A. *A Model of Communication*

To bring these issues into somewhat sharper focus, the linguist John Lyons proposes the following “model”:

[Communication is] the intentional transmission of [factual or propositional] information by means of some established signalling-system . . . .<sup>86</sup>

The restriction to “factual or propositional information” ensures that a communicative signal “is intended by the sender to make the receiver aware of something of which he was not previously aware.”<sup>87</sup> This, in turn, involves the possibility of choice or selection on the part of the sender. “If the sender cannot but behave in a certain way (i.e. if he cannot choose between alternative kinds of behaviour), then he obviously cannot communicate anything by behaving in

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83. 1 JOHN LYONS, SEMANTICS 32 (1977).

84. *Id.* at 40.

85. *Id.* at 32.

86. *Id.*

87. *See id.* at 32–33.

that way . . . . [M]eaning, or meaningfulness, implies choice.”<sup>88</sup> A second implication is “that successful communication depends, not only upon the receiver’s reception of the signal . . . [as] intended for him rather than for another, but also upon his recognition of the sender’s communicative intention . . . .”<sup>89</sup> It is not enough to “receive” the information; it must be “received as intended,” so to speak.

As thus elaborated, nothing in this model of communication stands out as inconsistent with the legal (*Spence*) test for *speech*, introduced above:

1. For “the expression of an idea” to count as *speech*, it must be “sufficiently imbued with elements of communication,” which entails at the very least a speaker and an audience.<sup>90</sup>
2. “An intent to convey a particularized message [must be] present . . . .”<sup>91</sup>
3. “[I]n the surrounding circumstances the likelihood [must be] great that the message would be understood by those who viewed it.”<sup>92</sup>

Indeed, the *Spence* Court freely helps itself to an everyday notion of *communication* in elaborating the legal requirements of *speech*. This “everyday notion,” however, is not the concept of communication involved in the quantification of information by the statistical theory of communication, or information theory.

Consider the sentences “*He took a book*” and “*He took a look*.” As spoken utterances, these sentences might well generate some acoustical confusion, or uncertainty, as to which one was actually uttered on a given occasion.

Any physical properties of the signals which enable the receiver to identify a particular sound as *b* rather than *l* (or any other potentially occurrent sound), and consequently to identify a particular form as *book* rather than *look* (or any other potentially occurrent form), may be described as signal-information . . . .<sup>93</sup>

Signal-information resolves uncertainty as to what the *signal* is; semantic information resolves uncertainty as to what the *message* is (what the signal means). It is the latter—semantic information—that was at issue in the above discussion of communication in the everyday sense. “When we say that a signal is informative we imply that it conveys some semantic information to the receiver (that it tells him something).”<sup>94</sup> But it is signal-information, and its quantification, that are at issue in the statistical theory of communication.

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88. *Id.* at 33.

89. *Id.* at 34.

90. *Spence v. Washington*, 418 U.S. 405, 409–11 (1974).

91. *Id.* at 410–11.

92. *Id.* at 411.

93. LYONS, *supra* note 83, at 41.

94. *Id.*

Signal-information and semantic information correspond roughly to Weaver's *Level A* and *Level B*, described above.

Thus, we need a new model—a model for the communication of signal-information:

Let us begin by supposing that there is a fixed and finite set of potential messages any one of which X may wish to send to Y. Let us further suppose that each message can be encoded by means of one and only one signal. Y knows that X is about to send him a signal, but he does not know which one of the inventory of signals it is to be. We will now define signal-information content, as a function of Y's expectancy, interpreting 'expectancy' in terms of probability of occurrence.<sup>95</sup>

Our interpretation and application of this model are subject to the theorem (articulated above by Hartley and Shannon) that signal-information content is inversely proportional to the expectancy of the receiver—that is, to its probability of occurrence.

Information is imparted—something is “informative” —*only where there is doubt or uncertainty*, i.e., alternatives or choice, selection, or discrimination.<sup>96</sup> We may approach this idea most usefully from the extremes. When the occurrence of a signal is totally predictable (i.e., when it has a probability of 1), it conveys no signal-information at all. In standard English (as mentioned previously), *u* immediately following *q* is totally predictable and carries no more signal-information than if it had been omitted. Here, we might say, “expectancy” turns into certainty, not probability. On the other hand, an initial *j* is never followed by *b, c, d, f, g, j, k, l, q, r, t, v, w, x, or z*. Here, uncertainty turns into impossibility (i.e., a probability of 0), which is no probability either. Only in the middle range—where something is possible but not inevitable—do we have true probability. And here signal-information connects up somewhat with semantic information, in the sense that meaning implies the possibility of choice or selection, i.e., uncertainty.

This more technically accurate model of communication and information, it must be said, *does* conflict—in fundamental ways—with the legal, constitutional definition of *speech*, as enunciated in *Spence* and other leading cases. This conflict and incompatibility may perhaps best be illustrated by the role of information theory in one of natural science's greatest triumphs.

### *B. Decoding the Human Genome*

Friedrich Miescher discovered the nucleic acids in 1869, a crucial step in the history of genetics.<sup>97</sup> In the course of his career, Miescher tried to conceptualize the process of hereditary transmission through sexual reproduction, for which he

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95. *Id.* at 42.

96. *Cf.* CHERRY, *supra* note 15, at 170–71.

97. *See generally* HANS BLUMENBERG, *DIE LESBARKEIT DER WELT* 372–409 (2d ed. 1983).

proposed a number of models—some physical or mechanical (corresponding roughly to Weaver’s Level A), and others that might be described as “semiological” (tracing the transmission of meaningful signs, as in Weaver’s Level B).<sup>98</sup>

One of Miescher’s most charming models of the former sort views the egg as a complicated machine that comes to a complete standstill, for lack of a single, seemingly minor screw. At the last minute, the sperm provides the crucial screw, which fits perfectly in just the right place and sets the entire, elaborate machinery successfully in motion.<sup>99</sup> “Nothing more needs to be done . . . . The pure simplicity of this explanation has to count for something.”<sup>100</sup>

Toward the end of his life, while engaged in his favorite subject—plant biology—Miescher introduced another suggestive genetic model (this one of the semiological sort).<sup>101</sup> He notes that large, organic molecules offer “colossal” possibilities for the relative spatial arrangements of carbon atoms, such that “all the richness and all the diversity of genetic inheritance can be expressed just as well here, as the words and concepts of all languages in the 24-30 letters of the alphabet.”<sup>102</sup> It is unnecessary to have “an apothecary’s cabinet of countless chemical elements” to account for the transmission of all the corresponding genetic traits.<sup>103</sup> Protoplasm and nucleus “originate not from countless chemical compounds but from a very few individual elements, though these themselves may have a very complicated chemical structure.”<sup>104</sup>

Combination and recombination of a relatively small number of elements: later Schrödinger compares this to the use of Morse code, with only dots and dashes at its command and yet the ability to express all the words of a language. In retrospect, it is hard to miss Miescher’s prescient suggestion of a “genetic code.” But missed it was—by all of his contemporaries and even by his highly erudite admirer and centennial celebrant, Erwin Chargaff, who belatedly suggested a related model: “If, from the very beginning, the nucleic acids had been thought of as *a text* . . . then, within thirty years, this brief aphorism could have been turned into a grand epic.”<sup>105</sup> As it was, however, the spectral, shimmering image of the “double helix” still lay eight long decades away, in a dim and doubtful future.

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98. *See id.*

99. FRIEDRICH MIESCHER, Brief xxviii (2. Mai 1872), in 1 DIE HISTOCHEMISCHEN UND PHYSIOLOGISCHEN ARBEITEN 70–73 (Leipzig, F.C.W. Vogel 1897) (author translation).

100. *Id.*

101. FRIEDRICH MIESCHER, Brief lxxv (Dec. 17, 1892), in 1 DIE HISTOCHEMISCHEN UND PHYSIOLOGISCHEN ARBEITEN 116–17 (Leipzig, F.C.W. Vogel 1897) (author translation).

102. *Id.*

103. *Id.* at 117 (author translation).

104. *Id.* (author translation).

105. Alexander von Erwin Chargaff Muralt, *Vorwort zu einer Grammatik der Biologie*, 26 EXPERIENTIA 810, 812 (1970) (Ger.) (author translation).

By 1944 the gene was generally acknowledged to be a large molecule, on account of its relative permanence in the face of heat.<sup>106</sup> “We believe a gene—or perhaps the whole chromosome fibre,” writes Erwin Schrödinger, “to be an aperiodic solid.”<sup>107</sup>

[I]n the vitally important processes of cell division . . . the chromosomes . . . contain *in some kind of code-script* the entire pattern of the individual’s future development and of its functioning in the mature state. . . .

In calling the structure of the chromosome fibres a code-script we mean that the all-penetrating mind, once conceived by Laplace, to which every causal connection lay immediately open, could tell from their structure whether the egg would develop, under suitable conditions, into a black cock or into a speckled hen.<sup>108</sup>

Schrödinger’s lectures, though intended for a general audience, were quite influential in the scientific community, including Crick and Watson. They sent him a reprint of their *bahnbrechend* article in *Nature* (1953), with the inscription: “[I]t looks as though your term ‘aperiodic crystal’ is going to be a very apt one.”<sup>109</sup>

In 1962, the Nobel Prize in Physiology or Medicine was awarded jointly to Francis Crick, James Watson, and Maurice Wilkins “for their discoveries concerning the molecular structure of nucleic acids and its significance for *information transfer in living material*.”<sup>110</sup> To complete this collection of models, one should perhaps include a rough approximation of the current state of the theory (as concerns information transfer):

In one of your cells, a strand of your DNA contains the instructions to build a protein (source); the instructions are encoded in a strand of messenger RNA (transmitter); the messenger RNA carries the code to your cell’s sites of protein synthesis (channel); one of the “letters” in the RNA code is randomly switched in a “point mutation” (noise); each three-“letter” code is translated into an amino acid, protein’s building block (receiver); the amino acids are bound into a protein chain, and the DNA’s instructions have been carried out (destination).<sup>111</sup>

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106. ERWIN SCHRÖDINGER, *WHAT IS LIFE? THE PHYSICAL ASPECT OF THE LIVING CELL* 61 (Cambridge Univ. Press 1945).

107. *Id.*

108. *Id.* at 21 (emphasis added).

109. See Joachim Pietzsch, *Perspectives: What is Life?*, THE NOBEL PRIZE, <http://www.nobelprize.org/prizes/medicine/1962/perspectives/> (last visited Oct. 6, 2021).

110. *Nobel Prize Outreach, The Nobel Prize in Physiology or Medicine 1962*, <http://www.nobelprize.org/prizes/medicine/1962/summary> (last visited Oct. 6, 2021) (emphasis added).

111. SONI & GOODMAN, *supra* note 53, at 139–40; see also Francis Crick et al., *Award Ceremony Speech, The Nobel Prize in Physiology or Medicine 1962*, THE NOBEL PRIZE,

All of these latter paradigms may be considered “semiological models,” in the sense that they concern (formally at least) the transmission of signs or messages. All of these semiological models make use of information theory in its formal, technical sense. Yet none of them are remotely compatible with the legal doctrine of constitutionally protected *speech*.

### C. An Intention-Based Theory of Speech

As mentioned above, *Spence* and other leading cases—in setting out the minimum legal elements of “speech”—explicitly invoke an everyday notion of *communication* and its associated implications of a “speaker” and an “audience”—all of whom are understood to be human beings or, in constitutional usage, “persons.”<sup>112</sup> *Who* is the “speaker” of the genetic code; *who* formulated and articulated it with the intention of communicating it? Nature? God? Bringing them within the jurisdiction of the federal courts is not going to be easy.

Likewise, with the “audience.” Judge Posner reminds us that:

[t]here is a sense in which everything we do consciously and much of what we do unconsciously is expressive—is the visible counterpart to (or “expression” of) some “inner” mental state, often an emotion such as anger or fear or joy . . . . But the expression that is relevant to freedom of speech . . . is the expression of a thought, sensation, or emotion *to another person*. This is a narrower concept of expression than the first but it is of course enormously broad, encompassing . . . the whole field of human communication, verbal and nonverbal.<sup>113</sup>

So, we run into another fundamental problem with respect to speech: *To whom* is the “genetic code” addressed? To the “messenger” RNA? To Laplace’s “all-penetrating mind”? They, too, will be difficult to bring within the jurisdiction of the federal courts. There is, in short, no plausible scenario in which

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<https://www.nobelprize.org/prizes/medicine/1962/ceremony-speech/> (last visited Oct. 6, 2021) (emphasis added):

The deoxyribonucleic acid molecule can . . . be looked upon as two interwoven spiral staircases, forming one staircase. The outside of this staircase consists of the phosphate and sugar molecules. The steps are formed by the paired bases. If it were possible to stain each base separately, that is each half-step, and if it were also possible for a person to climb this staircase, this person would get an impression of a tremendous variety. Soon he would discover, however, that red always was coupled to blue, and black to white. Also, he would notice that the steps sometimes had black to the right, and white to the left, or the reverse, and that the same variation was true also for the red-blue steps. The climber, who in molecules of human deoxyribonucleic acid had to ascend millions of steps, would see an endless variation in the sequence of red-blue, blue-red, black-white, and white-black steps. He would ask, what is the meaning of this, and he would realize that *the staircase contained a kind of message, the genetic code*.

112. See generally COLLIER, *supra* note 51, at 89–128.

113. *Miller v. Civil City of South Bend*, 904 F.2d 1081, 1092 (7th Cir. 1990) (Posner, J., concurring).

“*information transfer in living material*” could satisfy the legal, constitutional requirements of *speech*.<sup>114</sup> “Mother Nature does not communicate to us with signs or language.”<sup>115</sup>

Another distinguishing characteristic of speech—as opposed to information—is that, with speech, an audience recognizes a speaker’s expressive intentions. It is not enough to receive potentially informative material or come across something that could be used as a linguistic “sign.”

Consider the following example suggested by Paul Grice:

Those spots didn’t mean anything to me, but to the doctor they meant measles.<sup>116</sup>

Here we would have to say that the doctor and the patient—despite their different “understandings”—received exactly the same *information*. But we are *not* entitled to say, “what was meant by those spots was that he had measles” (indirect discourse). Nor, adds Grice, can a restatement of the example “be found in which the verb ‘mean’ is followed by a sentence or phrase in inverted commas. Thus ‘Those spots meant measles’ cannot be reformulated as ‘Those spots meant ‘measles’” or as ‘Those spots meant ‘he has measles.’”<sup>117</sup> The point of these restrictions is that, in the example, we have no speaker, no speaking, and thus no basis to formulate or reformulate what any speaker *meant*. We have only spots—informative, perhaps, but (strictly speaking) meaningless. To the doctor, the spots meant measles, but not because the spots themselves said that or told that to the doctor. It can only be presumed that the doctor had his own ways of attributing meaning to the spots. For all we know, he could have consulted a medical handbook on *The Meaning of Spots*. Now, *that book* would be “speech”—though not by the spots themselves, of course.

Suppose I discover that my friend Billy Bob Bartley has murdered someone. So, I take one of his trademark red handkerchiefs (with its distinctive “BBB” monogram) and place it in some bushes at the crime scene. When the police find the handkerchief, does it *mean* “Billy Bob is the murderer” or “Billy Bob is your suspect”? No—not any more than those spots meant “measles” or “he has measles.”

But now suppose the police detectives are so hapless that, after three days, they still have not discovered the planted handkerchief. So, I stride dramatically over to the crime scene, pull aside the bushes with a flourish, and unmistakably reveal to the assembled inspectors the incriminating handkerchief, which they eagerly examine. Now, does the handkerchief, or my revealing it that way, *mean* something? This is perhaps a closer case; but I think Grice is right to emphasize (in a similar example) that the detectives’ recognition of my intention to

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114. *Nobel Prize Outreach*, *The Nobel Prize in Physiology or Medicine 1962*, <http://www.nobelprize.org/prizes/medicine/1962/summary> (last visited Oct. 6, 2021).

115. CHERRY, *supra* note 15, at 217.

116. H.P. Grice, *Meaning*, 66 *PHILOSOPHICAL REV.* 377, 377 (1957).

117. *Id.*

implicate Billy Bob is “(more or less) irrelevant to the production of this effect by the [handkerchief].”<sup>118</sup>

But suppose, finally, instead of planting evidence I assemble the police inspectors in my studio, where on a large canvas I start drawing an elaborate picture of Billy Bob in the act of committing the murder. As my drawing gradually unfolds before their eyes, the detectives must gradually realize that I am trying to “tell” them something; and more specifically that I am, in effect, “saying” something, like “Billy Bob committed the murder” and “Here is how he did it—see?” Here, the recognition of my intention to implicate Billy Bob is *not* “(more or less) irrelevant to the production of this effect by the [picture].”<sup>119</sup>

[I]t will make a difference to the effect of my picture [on the police detectives] whether or not [they take] me to be intending to inform [them] (make [them] believe something) about [Billy Bob], and not to be just doodling or trying to produce a work of art.<sup>120</sup>

. . . Clearly we must at least add that, for [me to have meant] . . . anything, not merely must it have been “uttered” with the intention of inducing a certain belief but also the utterer must have intended an “audience” to recognize the intention behind the utterance.<sup>121</sup>

Those spots, that incriminating handkerchief the police discovered (even if I pointed them to it), or even my completed drawing (if the authorities came across it when I was away)—those are all just so much evidence or information, from which inductions, deductions, and “educated guesses” can be made. But that is not how *speech* works. If I frown spontaneously at something in displeasure (without knowing you are observing me), you may rightfully consider that expression a “natural sign” of my displeasure. But if (knowing you are observing me) I frown *deliberately* to express my displeasure—to all appearances, in exactly the same way—and thereby convey my displeasure to you: What is the difference?

If the audience does not realize I am frowning deliberately (to convey my displeasure), then, even if the audience concludes I am displeased, I will not have succeeded in *conveying* my displeasure. Again, my intentions will have been “(more or less) irrelevant to the production of this effect by the [frown].”<sup>122</sup> I will have inadvertently succeeded only in providing *information* from which—as from “natural signs”—informed conclusions may be drawn. But in meaningful *speech*, my intention—that you recognize my expression as intended to convey a message—must play a role in inducing your belief: You believe what I express, at least in part, *because* you recognize that I expressed it with

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118. *Id.* at 383.

119. *Id.*

120. *Id.*

121. *Id.* at 382.

122. *Id.* at 383.

the intention that you believe it. My speech to you is thus a “meeting of minds” in the sense that my expressive intentions are (intentionally) revealed to you.

#### IV. INFORMATION VS. KNOWLEDGE

“The development of language reflects back upon thought; for with language thoughts may become organized, new thoughts evolved.”<sup>123</sup> Isolated propositions, however true, gain greatly in significance and usefulness by being integrated into a coherent and unified *body of knowledge*. This brings us to another set of statements about information that it would be very odd and strange to assert of knowledge:

[I]nformation in communication theory relates not so much to what you *do* say, as to what you *could* say . . . . The concept of information applies not to the individual messages (as the concept of meaning would), but rather to the situation as a whole . . . [to] the amount of freedom of choice we have in constructing messages.<sup>124</sup>

With assertions constrained by *requirements of objectivity*, by contrast, we would normally say that we have *no* “freedom of choice in constructing messages” (beyond irrelevant stylistic variations); the objects of knowledge rigorously constrain and determine our meaningful descriptions and analyses of them. Or, viewed the other way around, it is the *objects* of knowledge that are constrained by the conditions that make it possible for us to experience them.

On the assumption that objects—as experienced—are conditioned in every respect by the nature and limits of our cognition, we should be able to have some knowledge of objects *a priori*. . . . For experience is itself a form of cognition that involves understanding; and understanding has rules that I must presuppose as being in me *a priori*, before objects are even experienced. These rules are expressed *a priori* in concepts, to which all objects of experience must therefore conform and with which they must agree.<sup>125</sup>

Here, the point is not to avoid redundancy but to avoid saying something false. Less freedom of choice, less uncertainty, and *more* knowledge go hand in hand. Modern philosophy emerges with Descartes’ hard-won epistemological standpoint, from which all uncertainty has been eliminated, and from which absolutely certain, “indubitable” propositions may be generated.<sup>126</sup>

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123. CHERRY, *supra* note 15, at 4.

124. Weaver, *supra* note 10, at 8–9, 13.

125. Immanuel Kant, *Critique of Pure Reason*, B xvi–xviii (Raymund Schmidt ed., Felix Meiner Verlag 1971) (1787) (author translation).

126. See John E. Smith, *Hegel’s Critique of Kant*, 26 REV. OF METAPHYSICS 438, 444 (1973):

Kant, not unlike Descartes, is a *foundationalist* who demands criteria and wants to establish knowledge on the universal and necessary, albeit in transcendental terms, which means the argument to the conditions rather than any appeal to the intuitively self-evident. By contrast, Hegel looked to *outcomes* and *results* so that for him the emphasis in criticism falls . . . on the action of thought in actually interpreting reality

### A. *The Value of Information*

“[I]n the statistical and communications perspectives,” writes Arrow, “information is a signal, that is, an observed random variable, which may be of *no economic interest itself* but which is not independent of unobserved variables which affect benefits or costs.”<sup>127</sup> The signal (the information) supports an *inference* about the state of the world, including its relevant “benefits or costs.” In this way, information may come to be viewed as having economic significance—at least indirectly—as a “commodity.” More specifically:

(a) Information will frequently have an economic value, in the sense that anyone possessing the information can make greater profits than would otherwise be the case.<sup>128</sup>

(b) Information is indeed then a commodity in some ways like other economic commodities; it is costly and it is valuable.<sup>129</sup>

But here we are thinking of information as a “commodity” only in a very special (perhaps even metaphorical) sense. The information may be of “no economic interest itself”—unlike, say, a ton of steel, which is useful in and of itself (as, say, an input in production). Arrow also notes that the “algebra” of information is different from that of ordinary goods: *repeating* a given piece of information adds nothing; whereas the same piece of information can profitably be *used* over and over again.<sup>130</sup>

Actually, this discussion highlights what might be called the “metaphysics” of information: more like an idea than an object, information is intangible. Its value lies in the truth of the inference it warrants, in its implied semantic reference (*Bedeutung*, as opposed to *Sinn*), and in its potential to be communicated as such.<sup>131</sup> Cherry writes that:

Now it is customary to speak of signals as ‘conveying information,’ as though information were a kind of commodity. But signals do not convey information as railway trucks carry coal. Rather we should say: signals have an information content by virtue of . . . the

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and in expressing its intelligible structure. In the former case one looks . . . to formal and transcendental criteria which are meant to define knowing as such. In the latter case, one starts with particular determinations of things for the purpose of discovering, through a critical analysis of the interrelation between the categories involved, just what and how much of reality these categories actually express.

127. Kenneth J. Arrow, *The Economics of Information: An Exposition*, 23 *EMPIRICA* 119, 120 (1996) (emphasis added).

128. Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, in *THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS* 609, 614 (Nat’l Bureau of Econ. Rsch., 1962).

129. Arrow, *supra* note 58, at 20.

130. *See id.* at 20–21.

131. *See* Gottlob Frege, *Über Sinn und Bedeutung*, 100 *ZEITSCHRIFT FÜR PHILOSOPHIE UND PHILOSOPHISCHE KRITIK* (n.s.) 25, 26–28, 31–32 (1892) (Ger.).

alternatives forming the recipient's doubt; they give the power to discriminate amongst, or select from, these alternatives.<sup>132</sup>

These peculiarities of information come even more to the fore when we consider what would be meant by “possessing the information” ((a) above). To possess information is to have access to, if not understand, its intellectual content—hence the odd term “intellectual property.” It may be economically useful (valuable) to know something that others do not know—but it is hard to keep them in the dark for long. “The acquirer of information may . . . try to keep it secret, but there are many paths by which knowledge is diffused.”<sup>133</sup> And it is even harder to sell secrets at a profit:

In the absence of special legal protection, the owner cannot . . . simply sell information on the open market. Any one purchaser can destroy the monopoly, since he can reproduce the information at little or no cost. . . .

However, no amount of legal protection can make a thoroughly appropriable commodity of something so intangible as information. The very use of the information in any productive way is bound to reveal it, at least in part. . . .

[T]here is a fundamental paradox in the determination of demand for information; its value for the purchaser is not known until he has the information, but then he has in effect acquired it without cost . . . .<sup>134</sup>

These considerations lead Arrow to despair of ever theorizing a decentralized “market for information” in a free enterprise economy: “It follows from the preceding discussion that . . . [t]here is a strong case for centralized decision making under these circumstances.”<sup>135</sup>

Conceptual problems can be traced back to the very beginning of the analysis. The fact that something is costly and valuable does not make it a commodity.<sup>136</sup> Mistakes can be very “costly”; “experience keeps a dear school” and all that. True love and friendship are rightfully counted among life's most “valuable” blessings, though the children's song is only figurative:

Make new friends,  
But keep the old.  
[One is] silver

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132. CHERRY, *supra* note 15, at 170–71.

133. Arrow, *supra* note 58, at 21.

134. Arrow, *supra* note 128, at 615.

135. *Id.* at 616; *cf. id.* at 623 (“[F]or optimal allocation to invention it would be necessary for the government or some other agency not governed by profit-and-loss criteria to finance research and invention.”).

136. See generally MICHAEL J. SANDEL, *WHAT MONEY CAN'T BUY* (2012).

[And the other's] gold.<sup>137</sup>

And even when Richard III cries out, “A horse! a horse! my kingdom for a horse!”<sup>138</sup> he is probably not thinking of (or bidding on) a commodity in any usual sense.

Economically significant information is more like a secret recipe than a commodity. As sole proprietor of the recipe, I can produce a potentially valuable concoction; but its value will presumably plummet if the secret gets out.

The Coca-Cola Company learned this the hard way, when it (briefly) abandoned the “secret formula” behind the most successful and iconic soft drink of all time, in favor of so-called “New Coke”—a resounding flop.<sup>139</sup> Nevertheless, the company derived the correct economic lesson from this debacle; and now “as a publicity, marketing, and intellectual property protection strategy . . . the company maintains that the actual formula remains a secret, known only to a very few select (and anonymous) employees.”<sup>140</sup>

### B. *The Value of Knowledge*

The “secret formula” for Coca-Cola is undoubtedly a valuable piece of *information*, but it is hardly a paradigm of *knowledge*. By hypothesis, for a viable (and decentralized) “marketplace of ideas,” we need a broader form of knowledge—as opposed to secret information—whose value is not limited to “mak[ing] greater profits than would otherwise be the case.”<sup>141</sup> According to standard economic theory, “[i]f information is not property, the incentives to create it will be lacking,” but we would be seeking knowledge that could not or would not naturally be owned or appropriated.<sup>142</sup> “[I]t has been a classic position that a competitive world will underinvest in research and development, because the information acquired will become general knowledge,” but we would be seeking general knowledge that could be freely communicated, shared, and exchanged without dissipating in value.<sup>143</sup> Indeed, these intersubjective features of knowledge ought to *enhance* its value and may even be viewed as prerequisites for “objective” knowledge:

I *experience* the world (including others)—and, according to its experiential sense, *not* as (so to speak) my *private* synthetic formation but as other than mine alone [*mir fremde*], as an *intersubjective* world, actually there for everyone, accessible in respect of its [o]bjects to

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137. Joseph Parry, *New Friends and Old Friends*, <https://www.poetrynook.com/poem/new-friends-and-old-friends>, (last visited Jan. 3, 2022).

138. WILLIAM SHAKESPEARE, *RICHARD III* act 5, sc. 4.

139. *Coca-Cola Formula*, WIKIPEDIA, [http://en.wikipedia.org/wiki/Coca-Cola\\_formula](http://en.wikipedia.org/wiki/Coca-Cola_formula) (last visited Oct. 8, 2021).

140. *Id.*

141. Arrow, *supra* note 128, at 614.

142. Arrow, *supra* note 127, at 125.

143. ARROW, *supra* note 2, at 142.

everyone . . . . This is always co-intended where[ ]ver we speak of [o]bjective actuality.<sup>144</sup>

In standard neoclassical economic models, “an unrestricted flow of information . . . is incompatible with the complete decentralization of an ideal free enterprise system;” but a true marketplace of ideas would advance freedom of inquiry, thought, and expression wherever they might lead.<sup>145</sup> “*For nothing is hidden that will not be made manifest, nor is anything secret that will not be known and come to light.*”<sup>146</sup>

In terms of information theory, “the purpose of all communication is to influence the conduct of the receiver . . . . [C]ommunication either affects conduct or is without any discernible and probable effect at all.”<sup>147</sup> Likewise, a commodity is classically defined, in part, by its use value; but if knowledge is not a commodity, it could completely lack use value. While “information is socially useless but privately valuable,” general knowledge could be socially valuable but privately “useless.”<sup>148</sup> And just as virtue is supposed to be its own reward, so too could this form of knowledge plausibly be pursued for its own sake. Alternatively, one might say that the purpose of knowledge is to provide perspectives on meaning:

The exclusiveness with which the total world-view of modern man, in the second half of the nineteenth century, let itself be determined by the positive sciences and be blinded by the “prosperity” they produced, meant an indifferent turning-away from the questions which are decisive for a genuine humanity . . . questions of the meaning or meaninglessness of the whole of this human existence . . . . Scientific, objective truth is exclusively a matter of establishing what the world, the physical as well as the spiritual world, is in fact. But can the world, and human existence in it, truthfully have a meaning if the sciences recognize as true only what is objectively established in this fashion, and if history has nothing more to teach us than that all the shapes of the spiritual world, all the conditions of life, ideals, norms upon which man relies, form and dissolve themselves like fleeting waves, that it always was and ever will be so, that again and again reason must turn into nonsense, and well-being into misery?<sup>149</sup>

Obviously, such considerations go well beyond “profit” and “value” in the narrow economic (monetary) sense. But these departures are justified by the

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144. Edmund Husserl, *Cartesian Meditations* § 43 (Dorion Cairns trans., Martinus Nijhoff Publishers 1982) (1960).

145. Arrow, *supra* note 128, at 618–19.

146. *Luke* 8:17 (emphasis added).

147. Weaver, *supra* note 10, at 5.

148. ARROW, *supra* note 2, at 143.

149. Edmund Husserl, *The Crisis of European Sciences and Transcendental Phenomenology*, in *THE CRISIS OF EUROPEAN SCIENCES AND TRANSCENDENTAL PHENOMENOLOGY* § 2 (David Carr trans., Northwestern Univ. Press 1970) (1954).

otherwise gloomy prospects for developing a marketplace of ideas within standard economic theory. “The chief point made here,” Arrow reminds us, “is the difficulty of creating a market for information if one should be desired for any reason.”<sup>150</sup> “The presumption that free markets will lead to an efficient allocation of resources is not valid in this case.”<sup>151</sup> Information theory cannot underwrite even a “marketplace of information,” much less a marketplace of ideas.

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150. Arrow, *supra* note 128, at 616; *cf. id.* (“[I]nformation is a commodity with peculiar attributes, particularly embarrassing for the achievement of optimal allocation.”).

151. ARROW, *supra* note 2, at 142.