Powers and Prospects

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Reflections on Human Nature and the Social Order

Noam Chomsky

PlutoPress
www.plutobooks.com

First Edition published by South End Press

This edition published 2016 by Pluto Press
345 Archway Road, London N6 5AA

www.plutobooks.com

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This book was published with the generous support of
Lannan Foundation and Wallace Action Fund.

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN 978 0 7453 3564 3 Paperback
ISBN 978 1 7837 1746 0 PDF eBook
ISBN 978 1 7837 1748 4 Kindle eBook
ISBN 978 1 7837 1747 7 EPUB eBook

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Printed by CPI Antony Rowe, Chippenham, UK

Contents

Foreword vii

Preface xi

1 Language and Thought: Some Reflections on Venerable Themes 1
- The First Cognitive Revolution
- The Second Cognitive Revolution
- The Language Faculty
- Unification Problems
- Knowledge of Language

2 Language and Nature 41
- Naturalism and Language–World Relations: Weak and Strong Theses
- The Materialist Orthodoxy
- The Externalist Orthodoxy
- Language as a Natural Object

3 Writers and Intellectual Responsibility 71

4 Goals and Visions 91
- Goals versus Visions
- The ‘Humanistic Conception’
- ‘The New Spirit of the Age’
- Voices of Resistance
- ‘Tough Love’

5 Democracy and Markets in the New World Order 121
- ‘Enduring Truths’
- Markets in the Real World
- Democracy: ‘Containing the People’
- ‘Free Market Conservatism’
- Towards the End of History: the Utopia of the Masters

6 The Middle East Settlement: Its Sources and Contours 171
- ‘What We Say Goes’
- The Strategic Conception
- ‘Stalemate’
- ‘Victor’s Peace’: the Oslo Agreements

Terror and Punishment
Development Programs and Plans
'Human Dust and the Waste of Society'

7 The Great Powers and Human Rights: the Case of East Timor 219
Forbidden Territory
Asian Values
Western Values
'The Welfare of the World Capitalist System' and 'The Problem of Indonesia'
The Problem Solved
The Problem of East Timor

8 East Timor and World Order 265
The Rule of Law
International Responsibilities
Pragmatism and National Interest

Endnotes 289

Index 303

1

Language and Thought: Some Reflections on Venerable Themes

The study of language and mind goes back to classical antiquity—to Classical Greece and India in the pre-Christian era. It has often been assumed over these millennia that the two inquiries have some intimate relation. Language has sometimes been described as a 'mirror of mind', so that the study of language should then give unique insight into human thought. That convergence, which has been repeated over the centuries, took place again about 40 years ago, at the origins of what is sometimes called the 'Cognitive Revolution'. I will use the term intending you to hear quotes around the phrase 'cognitive revolution', expressing some scepticism; it wasn't all that much of a revolution in my opinion.

In any event, however one assesses it, an important change of perspective took place: from the study of behaviour and its products (texts, and so on) to the internal processes that underlie what people are doing, and their origin in the human biological endowment. The approach to the study of language that I want to consider here has developed in that context, and was a significant factor in its emergence and subsequent progress.

The First Cognitive Revolution

Much the same convergence had taken place in the seventeenth century, in what we might call 'the first cognitive revolution', perhaps the only real one. This was part of the general scientific revolution of the period—the 'Galilean revolution', as it is sometimes called. There are interesting features in common between the contemporary cognitive revolution and its predecessor. The resemblance was not appreciated at the outset (and still is hardly well known) because the history had been largely forgotten. Such scholarly work as existed was misleading or worse, and even basic texts were not available, or considered of any interest. The topic merits attention, in my opinion, not just for antiquarian reasons. My own view is that we have much to learn from the earlier history, and that there has even been some regression in the modern period. I will come back to that.

One element of similarity is the stimulus to the scientific imagination provided by complex machines. Today that means computers. In the seventeenth and eighteenth centuries it meant the automata that were being constructed by skilled artisans, a marvel to everyone. Both then and now the apparent achievements of these artefacts raises a rather obvious question: Are humans simply more complex machines? That is a topic of lively debate today, and the same was true in the earlier period. It was at the core of Cartesian philosophy—but it is worth remembering that the distinction between science and philosophy did not exist at the time: a large part of philosophy was what we call 'science'. Cartesian science arose in part from puzzlement over the difference—if any— between humans and machines. The questions went well beyond curiosity about human nature and the physical world, reaching to the immortality of the soul, the unchallengeable truths of established religion, and so on—not trivial matters.

In the background was 'the mechanical philosophy', the idea that the world is a complex machine, which could in principle be constructed by a master craftsman. The basic principle was drawn from simple common sense: to interact, two objects must be in direct contact. To carry through the program of 'mechanisation of the world view', it was necessary to rid science of neoscholastic sympathies and antipathies and substantial forms, and other mystical baggage, and to show that contact mechanics suffices. This endeavour was considerably advanced by Descartes' physics and physiology, which he regarded as the heart of his achievement. In a letter to Mersenne, his confidant and most influential supporter in the respectable intellectual world of the day, Descartes wrote that his *Meditations*, today commonly considered his fundamental contribution, was a work of propaganda, designed to lead readers step-by-step to accept his physics without realising it, so that by the end, being entirely convinced, they would renounce the dominant Aristotelian picture of the world and accept the mechanical world view. Within this context, the question of limits of automata could not fail to be a prominent one.

The Cartesians argued that the mechanical world view extended to all of the inorganic and organic world apart from humans, even to a substantial part of human physiology and psychology. But humans nevertheless transcend the boundaries of any possible machine, hence are fundamentally different from animals, who are indeed mere automata, differing from clocks only in complexity. But however intricate a mechanical device might be, the Cartesians argued, crucial aspects of what humans think and do would lie beyond its scope, in particular, voluntary action. Set the machine in a certain state in a particular external situation, and it will be 'compelled' to act in a certain way (random elements aside). But under comparable circumstances, a human is only 'incited and inclined' to do so. People may tend to do what they are incited and inclined to do; their behaviour may be predictable, and a practical account of motivation may be possible. But theories of behaviour will always miss the crucial point: the person could have chosen to act otherwise.

In this analysis, the properties of language played a central role. For Descartes and his followers, notably Géraud de Cordemoy, the ability to use language in the normal way is a criterion for possession of mind—for being beyond the limits of any possible mechanism. Experimental procedures were devised that could be used to determine whether some object that looks like us is actually a complicated machine, or really has a mind like ours. The tests typically had to do with what I have called elsewhere the 'creative aspect of language use', a normal feature of everyday usage: the fact that it is typically innovative, guided but not determined by internal state and external conditions, appropriate to circumstances but uncaused, eliciting thoughts that the hearer might have expressed the same way. If an object passes all the tests we can devise to determine whether it manifests these properties, it would only be reasonable to attribute to it a mind like ours, the Cartesians argued.

Notice that this is normal science. The available evidence suggests that some aspects of the world, notably the normal use of language, do not fall within the mechanical philosophy—hence cannot be duplicated by a machine. We therefore postulate some further principle, a kind of 'creative principle', that lies beyond mechanism. The logic was not unlike Newton's, to which I'll return. In the framework of the substance metaphysics of the day, the natural move was to postulate a second substance, mind, a 'thinking substance' alongside of body. Next comes the problem of unification: how do we relate these two components of the world? This was a major problem of the period.

These intellectual moves were not only normal science, but also pretty reasonable. The arguments that were given are not without force. We would frame the issues and possible answers differently today, but the fundamental questions remain unanswered, and puzzling.

Fascination with the (possible) limits of automata is one respect in which the first cognitive revolution has been in part relived in recent years, though the usual preoccupation today is the nature of consciousness, not the properties of normal human action that concerned the Cartesians; crucially, the apparent fact that it is coherent and appropriate, but uncaused. Another similarity has to do with what are nowadays called 'computational theories of mind'. In a different form, these were also a salient feature of the first cognitive revolution. Perhaps Descartes' most lasting scientific contribution lies right here: his outline of a theory of perception with a computational flair (though our notions of computation were unavailable), along with proposals about its realisation in bodily mechanisms.

To establish the mechanical philosophy, Descartes sought to eliminate the 'occult properties' invoked by the science of the day to account for what happens in the world. The study of perception was an important case. How, for example, can we see a cube rotating in space when the surface of the body—the retina, in this case—records only a sequence of two-dimensional displays? What is happening in the outside world and in the brain to bring about this result?

Prevailing orthodoxy held that, somehow, the form of the cube rotating in space passes into your brain. So there is a cube in your brain, rotating presumably, when you see a cube rotating. Descartes ridiculed these fanciful and mysterious notions, suggesting a mechanical alternative. He asked us to consider the analogy of a blind man with a stick. Suppose there is an object before him, say a chair, and he taps on it with the end of his stick, receiving a sequence of tactile sensations in his hand. This sequence engages the internal resources of his mind, which compute in some manner, producing the image of a chair by means of their inner resources. In this way, the blind man perceives a chair, Descartes reasoned. He proposed that vision is much the same. According to the mechanical world view, there can be no empty space: motion is caused by direct contact. When Jones sees a chair, a physical rod extends from his retina to the chair. If Jones's eye is scanning the surface of the chair, his retina is receiving a series of sensations from the rod that extends to it, just as the fingers of the blind man are stimulated when he taps on the chair with a stick. And the mind, using its intrinsic computational resources, constructs the image of a chair—or a cube rotating in space, or whatever it may be. In this way, the problem of perception might be solved without mysterious forms flitting through space in some immaterial mode and mystical fashion.

That was an important step towards eliminating occult ideas and establishing the mechanical world view. It also opened the way to modern neurophysiology and theory of perception. Of course, Descartes' efforts to work all of this out have a quaint tone: tubes with animal spirits flowing through them and so on. But it's not very hard to translate them into contemporary accounts in terms of neural systems transmitting signals which somehow do the same thing—still just stories in a certain measure, in that not a great deal is understood. The logic is rather similar whether it is instantiated by tubes with animal spirits or neural nets with chemical transmitters. A good deal of the modern theory of vision and other sensorimotor activities can be seen as a development of these ideas, obviously a huge improvement, but based on similar thinking. The mechanisms are no longer mechanical; rather, electrical and chemical. But the pictures are similar. And at a more abstract level, explicit computational theories of the operations of the internal mechanisms have now been devised, providing much insight into these matters: for example, Shimon Ullman's demonstration that remarkably sparse stimulation can lead to rich perception when intrinsic design interprets it in terms of rigid objects in motion—his 'rigidity principle'.

These two achievements—the establishment of the mechanical world view and of the basis for modern neurophysiology and theory of perception—fared very differently. The latter was developed in the medical sciences and physiology of the years that followed, and has in a certain sense been revived today. But the mechanical philosophy collapsed within a generation. Newton demonstrated that the world is not a machine. Rather, it has occult forces after all. Contact mechanics simply does not work for terrestrial and planetary motion. Some mystical concept of 'action at a distance' is required. That was the great scandal of Newtonian physics. Newton was harshly criticised by leading scientists of the day for retreating to mysticism and undermining the achievements of the mechanical philosophy. He seems to have agreed, regarding the idea of action at a distance as an 'absurdity', though one must come to terms somehow with the refutation of the mechanical philosophy.

Notice that Newton's invocation of immaterial forces to account for ordinary events is similar in its basic logic to the invocation of a second substance by the Cartesians to overcome the limits of mechanism. There were, of course, fundamental differences. Newton *demonstrated* that the mechanical philosophy could not account for the phenomena of nature; the Cartesians only argued—not implausibly, but not conclusively—that aspects of the world fell beyond these limits. Most importantly, Newton provided a powerful theoretical account of the operation of his occult force and its effects, whereas the Cartesians had little to say about the nature of mind—at least, in what records we have (some were destroyed).

The problems that Newton sought to overcome remained very troubling for centuries, and many physicists feel that they still are. But it was soon understood that the world is not a machine that could in principle be constructed by a skilled craftsman: the mechanical philosophy is untenable. Later discoveries demolished the picture even more fully as science moved on.

We are left with no concept of body, or physical, or material, and no coherent mind-body problem. The world is what it is, with its various aspects: mechanical, chemical, electrical, optical, mental, and so on. We may study them and seek to relate them, but there is no more a mind-body problem than an electricity-body problem or a valence-body problem. One can doubtless devise artificial distinctions that allow such problems to be formulated, but the exercise seems to make little sense, and indeed is never undertaken apart from the mental aspects of the world. Why it has been commonly felt that these must somehow be treated differently from others is an interesting question, but I am aware of no justification for the belief, nor even much recognition that it is problematic.

So the most important thesis—the mechanical philosophy—did not last; it was gone in a generation, much to the consternation of leading scientists. On the other hand, Cartesian physiology had a lasting impact, and ideas of a somewhat similar cast about neurophysiology and perception have re-emerged in modern theories in the cognitive and brain sciences.

An interest in language provides a third point of contact between the first and second cognitive revolutions. The study of language was greatly stimulated by Cartesian thought, leading to a good deal of productive work which, in a rational world, would have provided much of the foundations of modern linguistics, had it not been forgotten. This work had two components: particular grammar and rational grammar, also called 'universal grammar' or sometimes 'philosophical grammar', a phrase that translates as 'scientific grammar' in modern terminology (these notions did not mean quite the same thing, but we can abstract from the differences). Rational grammar was the study of the basic principles of human language, to which each particular language must conform. Particular grammar was the study of individual cases: French, German, etc. By the mid-seventeenth century, studies of the vernacular were being undertaken, and interesting discoveries were made about French, notably 'the rule of Vaugelas', which was the focus of inquiry for many years. The first explanation for it was given by the linguists and logicians of Port Royal in the 1660s, in terms of concepts of meaning, reference, and indexicals in pretty much their contemporary sense. Much influenced by Cartesian thought along with earlier traditions that remained alive, these same investigators also formulated the first clear notions of phrase structure, along with something similar to grammatical transformations in the modern sense. They also developed a partial theory of relations and inference involving relations, among other achievements. In the case of language, these early modern contributions were scarcely known, even to scholarship, until they were rediscovered during the second cognitive revolution, after somewhat similar ideas had been independently developed.

The last prominent inheritor of this tradition before it was swept aside by behaviourist and structuralist currents was the Danish linguist Otto Jespersen, who argued 75 years ago that the fundamental goal of linguistics is to discover the 'notion of structure' of sentences that every speaker has internalised, enabling the speaker to produce and understand 'free expressions' that are typically new to speaker and hearer or even the history of the language, a regular occurrence of everyday life. A specific 'notion of structure' is the topic of particular grammar, in the sense of the tradition.

This 'notion of structure' in the mind of the speaker finds its way there without instruction. There would be no way to teach it to anyone, even if we knew what it is; parents certainly don't, and linguists have only limited understanding of what is a very hard problem, only recently studied beyond the surface of phenomena. The 'notion of structure' somehow grows in the mind, providing the means for infinite use, for the ability to form and comprehend free expressions.

This observation brings us to a much deeper problem of the study of language: to discover the basis in the human mind for this remarkable achievement. Interest in this problem leads to the study of universal grammar. A theory of universal grammar can be envisaged for syntax, Jespersen believed, but not for morphology, which varies among languages in accidental ways.

These ideas seem basically correct, but they made little sense within the prevailing behaviourist or structuralist assumptions of Jespersen's day. They were forgotten—or worse, rejected with much scorn and little comprehension—until new understanding made it possible to rediscover something similar, and still later, to discover that they entered into a rich tradition.

It makes sense, I think, to view what happened in the 1950s as a confluence between ideas that have a traditional flavour but that had been long forgotten, and new understanding that made it possible to approach at least some of the traditional questions in a more serious way than heretofore. Previously, fundamental problems could be posed, though obscurely, but it was impossible to do very much with them. The core idea about language, to borrow Wilhelm von Humboldt's formulation in the early eighteenth century, is that language involves 'the infinite use of finite means', something that seemed paradoxical. The means must be finite, because the brain is finite. But the use of these means is infinite, without bounds; one can always say something new, and the array of expressions from which normal usage is drawn is astronomical in scale—far beyond any possibility of storage, and unbounded in principle, so that storage is impossible. These are trivially obvious aspects of ordinary language and its use, though it was not clear how to come to grips with them.

The new understanding had to do with computational processes, sometimes called 'generative' processes. These ideas had been clarified enormously in the formal sciences. By the mid-twentieth century, the concept of 'infinite use of finite means'