

Cogito ergo sumus! or psychology swept inside out by the fresh air of the upper deck...

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A review of Ed Hutchins *Cognition in the Wild*, MIT Press, 1995, in ***Mind, Culture, and Activity: An International Journal*** , Vol.3, n°1, pp.54-63

“Découvrez-vous, messieurs,
car nous sommes dans St Pierre de Rome!”
Captain Haddock in **Le Trésor de Rackam le Rouge**

There is an old and inevitable feud every sailman has lived through, and that is the one that pits the skipper in the breeze, mist and cold of the cockpit against the navigator, down in the cabin, slightly nauseated, looking over the chart and leafing through the Nautical Instructions. “The buoy should be there straight ahead and the tower on starboard” claims the navigator, cursing the lack of faith and the poor eyesight of the skipper; but the skipper detects no buoy at all and cannot take this slim rock battered by the surf for the tower of the Nautical Instructions, and she too curses the bookish knowledge and arrogant superiority of the navigator stuck in the cabin comforting himself with arithmetics and brandy... And it is indeed an extraordinary achievement when the skipper and the navigator reconcile the chart inside with the landmarks outside and reconcile together to lead the frail ship safely in the harbor. This marvelous book is about this feud and this truce and about the feat of coordinating actions across so different social and mental spaces. But it is not about small boats like the one I used to sail in Brittany, but about the dreadnoughts of the US Navy that San Diegans are accustomed to see sailing by, together with the whales deep down and the hang-gliders high above the cliff.

The feud between the world of navigators and skippers is also a good metaphor for the divide between two cognitive sciences, the one that believes in laboratory experiments, mental state, internal representation, and the other one, in the wind, in the wild, that claims to represent the real cognitive tasks in an organized and

collective work site. Ed Hutchins has written the book that adds to cognitive psychology the view from the upper deck that was missing until now.

The expression “in the wild” in his title would appear strange given that it leads the reader into one of the most disciplined, formalized, structured and routinized human culture there is, that of the military. And yet, his field site is as wild and naturalistic as the Kenya where Shirley Strum decided to study baboons on foot instead of the caged and trapped animals of psychology laboratories. It is as wild as the scientific laboratories some of us decided to study, twenty years ago, to escape from the stuffy atmosphere of epistemology. All of these field sites are wild because the subjects of study -sailors, baboons, scientists- are allowed to raise the questions that interest them and to deploy the courses of action of their daily behaviour, instead of answering the narrow range of questions that until then interested psychologists, primatologists or epistemologists. The results of Hutchins’ enquiry are as devastating for psychology as the results of sociology of science was for epistemology or those of Shirley Strum for primatology. Every thing that was crammed inside the mind of individuals is deployed outside and shared collectively with the culture, with the social connections and with the many cognitive artefacts the group has been able to devise.

It is one of the great merits of the book to take cognitive science seriously enough to make, in the last chapter, the extraordinary claim that computers -the darling model of mind in the classical view- might actually be good descriptions of the socio-cultural systems, but not of the human cognitive functions. This claim puts this book completely apart. Many anthropologists and sociologists, disgruntled by the sweeping claims of cognitive sciences, when they object with tears in their eyes “but where is the rest of humanity, where is the body, the feel, the emotion, the social?”, still accept that the more formal, abstract, and symbolic functions of the human mind have been at least well modeled by their cold and scientific enemies. They simply want the “human dimension” to be put back in. Hutchins, on the contrary, denies that cognitive science has even been able to model those “higher functions”. For him, this is a case of mental surgery (p.363) which put a computer in place of the mind. The very description of formal reasoning remains to be made, and to do so, one has to get on the deck, with the artefacts, in a work site, within a group. This refusal to grant to the classical view even the description of computation and formalism, makes this book infinitely better than most social psychology and should interest, for that reason, not only the “softies”, but also the hard core of cognitive scientists. What is at stake here is not the human dimension or the “lower” aspects of thought, but the very content of the higher cognitive functions.¹

¹ The author seems, however, to ignore the work done on the history, sociology, materiality of formalism by scholars like Livingston, E. (1985). The Ethnomethodological Foundations of Mathematical Practice. London, Routledge or Warwick, A. (1992). “Cambridge Mathematics and Cavendish Physics: Cunningham, Campbell and Einstein's Relativity 1905-1911. Part I: The Uses of Theory.” Studies in History and Philosophy of Science: 625-656. More surprisingly, he seems unaware of the work of Leigh Star and her many colleagues on the work site of computers although much of his methods are entirely

Hutchins has done for the Navy what he did so magnificently, for the Trobrianders in his first book.² Instead of finding excuses for the bad reasoning of the Trobrianders by jumping at their symbolic order, as so many anthropologists had been prone to do, he singlehandedly went for their land tenure system, and, sure enough, all the so called “mistakes in reasoning” that had taxed the charity of cognitivists for decades disappeared away. In his rendering, Trobrianders were thinking like everyone else, but on a very different material: their incredibly complex land tenure. For the Navy, for the Trobrianders, of for the Pacific navigators - beautifully rehabilitated in chapter two- the material world, the work site, the groupware, replaced the many extravagant and unwarranted assumptions about what it is to think or not to think. Through this beautiful instance of symmetry, the difference between primitive and advance thinking disappears away:

“If one believes that technology is the consequence of cognitive capabilities, and if one further believes that the only place to look for the source of cognitive capabilities is inside individual minds, then observed difference in level of technology between a “technologically advanced” and a “technologically primitive” culture will inevitably be seen as evidence of advanced and primitive minds” p355;

Hutchins, is one of the few symmetric anthropologists, like Jean Lave, Lucy Suchman, Chuck Goodwin or Helen Watson³ who had the chance to study in the course of the same career, low-tech traditional people and high-tech “modern” culture. One of the main advantages of the field study presented here, however, is that Hutchins has hit on a task which is much more richly endowed with mathematics, formal reasoning, and metrological traditions than any of the other described by anthropologists interested in “mundane reasoning”.⁴ Jean Lave’s shoppers have to do arithmetics, to be sure, but when they can’t get at the solution they abandon the problems. Navigators aboard ships have to find their bearings and complete the calculation even when there is no steam -this is what happens on the gripping first chapter of the book. So the chosen setting with its strong hierarchy, its massive use of formal procedures, its necessity of carrying out the calculations no matter what, makes it one of the best “fruit flies” of cognitive science. Hutchins demonstrates that one can be “in the wild” and yet better equipped empirically than

compatible with ethnomethodology -minus the jargon, Hutchins writes beautifully- and symbolic interactionism.

² Hutchins, E. (1980). Culture and Inference. A Trobriand Case Study. Cambridge, Harvard University Press, curiously not even referred to in this one!

³ The latter is not cited in the book although her work on the contradictions of Australians whites and Aborigines is one of the very few instances of real symmetric field study.

⁴ Traweek, S. (1988). Beam Times and Life Times, The World of High Energy Physicists. Cambridge Mass, Harvard University Press, would have been extremely useful here since she describes physicists environments producing new knowledge, but she is not cited.

in any psychological laboratory with all the variables controlled. The amusing paradox is that in leaving psychological laboratories for the deck of an helicopters-carrier, Hutchins has managed to build a better laboratory, equipped with video and tape recorders and able to describe in excruciating details the achievements of navigational tasks. Out in the wild, it is even better than inside as far as laboratory experimentation goes...

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So what is left of cognitive science after this study of those fruit flies? One central phenomenon, repeated over the whole book, although it is not treated as a full blown theory:⁵ cognition has nothing to do with minds nor with individuals but with the propagation of representations through various media, which are coordinated by a very lightly equipped human subject working in a group, inside a culture, with many artefacts and who might have internalized some parts of the process.

Let me sketch this central claim which is so radical that it may very well reorganize around itself the whole of the cognitive sciences, once the hopes of AI and scientific psychology will be recognized for what they are, beautiful ruins in an old romantic landscape. The first point is not to follow mental or individual activities but trajectories of modified representations.⁶ In other words, there is not, according to Hutchins, any meaning in the expression “I think” or “I represent”. What can be documented is a shift in representation through different medias. For instance, there is no observable in the chart itself, but there is one in a group trying to make features of the landscape correspond with features on the chart. There is no meaning in asking what is in the mind of the plotter. But there is meaning in observing how the plotter coordinates various media -bearings reported on the phone by the pelorus operators, instructions precoded on the chart, orders from the captain- in one single line on the paper.

This attention to modification of medias instead of “mental events” has, in my reading, three decisive consequences.

The first one is a renewed attention to intellectual technologies -attention that is shared with the history and sociology of science that Hutchins almost totally ignore, I will come back to this later. His notion of mediation by artefacts is infinitely much more advanced than those who see technology -compasses, hoey, rulers- as situated “in between” mental events. It is much more interesting, for instance, than the

⁵ Except p 230 where it is named “the theory of computation by propagation of representational state”.

⁶ In intent if not in method this move from cognition in the subjects or in the objects, to trajectories is similar to the move advocated by A. Cussins -another San Diegan- with his notion of “trails” which are made the new embodiment of cognitive virtue. See Cussins, A. (1992). “Content, Embodiment and Objectivity : The Theory of Cognitive Trails.” *Mind* 101 (404): 651-688.

conception of Don Norman -Hutchins's mentor.⁷ A few quotations will make the originality of Hutchins clearer:

“None of the component cognitive abilities has been amplified by the use of any of the tools. Rather, each tool presents the task to the user as a different sort of cognitive problem requiring a different set of cognitive abilities or a different organization of the same set of abilities” p.154. “In this sense, this mediating technologies do not stand between the user and the task. Rather, they stand with the user as resources used in the regulation of behavior in such a way that the propagation of representational state that implements the computation can take place” p 154 “Rather than focus on the mediating artifact as something that “stands between”, I will view it as one of many structural elements that are brought into coordination in the performance of the task. Any of the structure that are brought into coordination in the performance of the task can be seen as a mediating structure” p290 (my italics).

This definition of mediation and technology allows him to pay a passionate attention to the details of practice which do not take him away from cognition, as if cognition was “implemented” into the artefacts, but, and this is the decisive move, as if technology was the real stuff cognition was made of. Having a cognition is devising intellectual technologies.

The second consequence, is that Hutchins thus escapes the pitfalls of pliabilism, this dire intellectual disease due to excessive reading of Wittgenstein -and Harry Collins, I should add.⁸ Pliabilists are disappointed rationalists, so the only way for them to show that a task is not formal, is to show that some human, some locally situated action, is always necessary to make sense of the formalism or to interpret the data. Fortunately, with his theory of propagation through different medias, Hutchins does not have to insist on the indefinite pliability of interpretations or to show with endless delight that there is no formal rule to describe the application of a rule. On the contrary, he shows, very convincingly, that every propagation through a different media modifies the distribution of the required skills and allows for simpler cognitive processes to be brought in:

“In producing the coordination between the hoey and the chart, the task performer can transform the task to an easier one by achieving coordination with an internal artefact: the knowledge of this technique” p144; “These tools permit the people using them to do the tasks that need to be done while doing the kinds of things the people are good at: recognizing patterns, modeling

⁷ Norman, D. (1993). Things that Make Us Smart. New York, Addison Wesley Publishing Company, is only superficially in accordance with Hutchins's thesis, precisely because of the complete difference in the theory of mediation.

⁸ Collins, H. (1990). Artificial Experts: Social Knowledge and Intelligent Machines. Cambridge Mass., MIT Press, which is not cited here although it tackles, but with the opposite conclusions, much of the same issues.

simple dynamics of the world, and manipulating objects in the environment' p155 (my italics).

So the notion of propagation is clearer. It does not mean a transportation without deformation, but a modification, a translation, a shift, a reformatting of the skills. Thinking becomes an ingenious way of constantly shifting from one medium to the other until one reaches “simpler” or “easier” tasks by delegating more and more tasks to other actors in the setting, either humans or non-humans. Thanks to Hutchins’s theory, one is freed from the stifling alternative either to believe in formalism in the head, or to be stuck in the indefinite pliability of local skilled practice. To be a local skilled practitioner is to be able to propagate representational states in other and simpler forms elsewhere. Attention to local practices leads away from the locus and in tasks that requires different practices.⁹

The third consequence is even more interesting for cognitive science. With this positive notion of mediating artefacts, and this idea of propagation as redistribution of skills, Hutchins, going much further than Vygotsky, can extend his definition to internal phenomena. As he shows in great details, cognitive processes are not internal, but rather partially and provisionally internalized. In one of the most radical sentence of the book, Hutchins writes:

“Internalization has long connoted some thing moving across some boundary. Both elements of this definition are misleading. What moves is not a thing, and the boundary across which movement takes place is a line that, if drawn too firmly, obscures our understanding of the nature of human cognition. Whithin this larger unit of analysis, what used to look like internalization now appears as a gradual propagation of organized functional properties across a set of malleable media” p312.

This means that is nothing below the skin except the continuation of the same processes that go on outside. But this is not to be seen as a socialisation of psychology as if sociology and context were taken over what psychology would be unable to reveal. This is not the case because what gets inside is cognition through and through, but a cognition distributed, materialized and propagated. Approaching the mental states of the subject leads the analyst away and beyond, and if it is possible to seize the internalized translations, they have the same mediating properties as what occurs outside.

Language also, in this sweeping view, becomes a mediating artefacts like the ruler, the chart, or the hoey, even when we talk to ourselves, memorize a routine, or invent shortcuts and rules of thumb to overcome the difficulty of calculating -see the marvelous case of the rule of three. One rather radical sentence summarizes the author’s point:

“It is tempting to think that the words and the world are coordinated by language in order to produce the meanings. It is more accurate to say that the

⁹ It seems to me that his theory should have led Hutchins to differentiate himself on this point from Suchman’s and from Goodwin’s works who are cited but not discussed.

meanings, the world, and the words are put into coordination with one another via the mediating structure of language” p300.

What is true of language is of course truer of symbols which are not seen as what is in the head but what is written, marked, underlined, manipulated, reshuffled, and which only later, through other routines and by reformating once again the tasks, may be put in the head. “Ontogenetically speaking, it seems that symbols are in the world first, and only later in the head” p 370.

To pay full justice to the book, it is crucial to realize that internalized cognition is almost the exact opposite of internal cognition as it is conceived by all the other psychologists.¹⁰ If you believe in internal processes, you can start with individual cognition, and then, by aggregation or implementation, you may reach the collective level or the material world. If you talk about internalized artefacts and if you observe the propagation of different media inside, there is no way you will ever be able to talk again about a disembodied or an individual cognition. You will be forced to start from collective tasks and cultural systems. Rephrasing the old sensualist motto, one could say that for Hutchins, “there is nothing in the mind that was not before in the senses”, provided that “the senses” now mean shifts from one representational mediator to another one.

“Putting the question of the flexible constitution of functional systems first means approaching the study of cognition from a different starting point. It requires a different view of cognition, and it demands that our models of cognition be capable of different sorts of computations. This is a consequence of an attempt to build a theory of cognition that comes after, rather than before, a description of the cultural world in which human cognitive behavior is embedded” p291.

The main interest of this definition of cognition as propagation through different media, is that it gives a very original role not only to the artefacts, not only to internalized tasks, but also to the social structure of the Navy and to the local groups. Usually, when groups and societies are brought in psychology, it is with the worst consequences, producing the monster known as “social psychology” which cumulates the worst of both disciplines. This is not the case here, since Hutchins does not abandon cognition when talking about groups. He simply goes on distributing the tasks further, hence sentences which would make no sense either to an internalist psychologist or to a contextualist sociologist:

“When a problem has a deeply nested goal structure, a social hierarchy can provide a mechanism for distributing the attention to various parts of the goal structure” p203; “The computational dependencies among the steps of the procedure for the individual watchstander are present as interpersonal

¹⁰ Including Roy D’Andrade’s own brand of cognitive anthropology which is totally opposite to that of Hutchins, hence the rather embarrassed praise for the book on the dust cover... “I think this is a great book”. It is indeed but one that will for ever forbid to D’Andrade the use of “I think”!

dependencies among the members of the team” p 282 “The novices’ understandings of the social relations of the workplace are a partial model of the computational dependencies of the task itself” p283; “Because society has a different architecture and different communication properties than the individual mind, it is possible that there are interpsychological functions that can never be internalized by any individual” p284.

In the detailed analysis of the groupware -which I cannot even summarize in this brief note- Hutchins offers a very compelling extension of his propagation argument to the social relations.¹¹ Exactly in the same way as internalized cognition reformat the tasks -so that they are not the same tasks as those outside-, exactly in the same way as externalized artefacts redefine the tasks -so that they are not the implementation of mental events-, then the social organization modifies once again the representational media. The question is no longer to know whether cognition is in the mind, in the things, in the group, but what are the modifications in the formats of the tasks which are necessary at each point of the trajectory which from now on forms the only observable content of cognition?

But who is doing the coordination of all those shifting media? A very lightly equipped human agency, not defined by Hutchins as an individual mind endowed with consciousness and foresight, but more precisely, and more originally in my view, as being itself a mediator, a shifter, a propagator. That it is lightly equipped -like the actor of ethnomethodology strangely absent from the discussion- this is very clear from the deflation strategy of the book. Instead of cramming endless numbers of modular boxes and special purposes rules in the head, Hutchins, takes everything out and “render to Caesar what pertains to Caesar”. The only clear definition of the human agency -the “most active integral parts” p287- is this cryptic but decisive sentence:

“The thinker in this world is a very special medium that can provide coordination among many structured media -some internal, some external, some embodied in artefacts, some in ideas, and some in social relationships” p316

This is the final dissolution of psychology since there is no agency left that could sustain a psyche at all. Instead of the huge crates and heavy luggages that was necessary before for the internal actor to carry around all the rules and boxes necessary to think about the world, Hutchins’s thinking agent is more like the desk of a well organized executive: empty since everything else has been delegated outside to something or to someone else.

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¹¹ He also offers an amusing computer simulation of which type of social division of cognitive labor offers the best ability to contemplate alternatives view points.

After having summarized the setting and sketched the radical theory of the book, I would like to offer not so much objections as openings for what I hope will be a long lasting trail of field studies and discussion.

In spite of the definition offered of cognition:

“I propose a broad notion of cognition because I want to preserve a concept of cognition as computation, and I want the sort of computation that cognition is to be as applicable to events that involve the interaction of humans with artifacts and with other humans as it is to events that are entirely internal to individual persons” p118.

nothing, absolutely nothing of what is considered essential to the very existence of psychology is left in the book.¹² However, Hutchins seems convinced that it is a question of better study and that an alternative to psychology will be taken on board provided it is empirically grounded, productive and convincing. This looks to me as overly naive. Psychology is not there to describe events but precisely to cram cognition inside an individual mind endowed with consciousness and responsibility. This is one half of the modernist project -the other being on the nature side and the building of objectivity and that part of the dirty job is done by epistemology which is as impervious to facts and empirical studies and for the same reason. To believe that a better cognitive science will simply take over, is to miss the anthropology of the moderns and to underestimate the history that made the myth of internal state so essential to our Occidental life.

I was equally disturbed by the idea, frequent in the book, that on one side there is the world and on the other the cognitive skills. Distribution, in my view, does not go all the way. This leads Hutchins to make mistakes even in navigational matters. In a sentence like this one “the problem of identifying landmarks may be one of direct reconciliation of the chart and the world” p.136, the author obviously forgets his own attention to mediation. If there is a coordination that is far from “direct”, it is that one. The pelorus operators are not reconciling the world with the map, they are reconciling readings on the compass with landmarks which have been put there at the tip of Point Loma because of the map and by the same body of nautical engineers and cartographers. As many mediations are required to transform the world into a map-like or a map-compatible shape as they are inside the ship and then inside the heads of the calculators. The common organization in which the ship, the sailors, the landmarks and the Nautical Instructions all inhabit, is curiously absent from the book. This is even more telling with the Global Positioning System which transforms the whole Earth in the inside of a laboratory -imitating, curiously enough, the strategy of the “primitive” islanders with their navigation system. In other words, Hutchins still hesitates between a menso-centrism that would pit a mind -albeit redistributed- against a world which is simply there, and a truly symmetric anthropology, symmetry meaning not only that between Trobrianders and Americans, but that between the world and cognition. A sentence like the following,

¹² Cognition is so broadly conceived that it seems to have no limits. There is only one brief allusion to the fact the writing would have been different if the author had paid attention to energy instead of cognition.

indicates the hesitation of the author, since it advocates one thing and then exactly its opposite:

“Instead of conceiving the relation between person and environment in terms of moving coded information across a boundary, let us look for process of entrainment, coordination, and resonance among elements of a system that includes a person and the person’s surrounding” p288 (my italics).

The reason for this lapse of symmetry comes, in my view, from another disturbing feature of the book. Hutchins makes almost no use of the literature on history and sociology of science -except kind references to some of my work- which would have made such a strong complementary case on many of the same points.¹³ This is even stranger when knowing that the Science Studies group at UC San Diego is about 200 metres from the Cognitive Science Building! No doubt this is another case of the division of cognitive labor so well studied by him (for instance p.178)... This is all the more unfortunate since science studies would have allowed him to answer a strong objection to his point of view. When he writes, cogently in my view:

“The system for ship navigation (...) is based on formal manipulation of numbers and of the symbols and lines drawn on chart. It is a system that exploits the powerful idea of formal operations in many ways. But not all the representations that are processed to produce the computational properties of this system are inside the heads of the quartermasters. Many of them are in the culturally constituted material environment that the quartermasters share with and produce for each other.” (p 360)

the objection from the traditional view would be that what is true for “mere” quartermasters is certainly not true for “higher minds”, for the Thales, Galileo, Mercator, Le Verrier, whose work went into the fabrication of those artefacts.

Hutchins should have countered the objection that there must be a huge difference in applying routine knowledge and producing new knowledge.¹⁴ Without the help of social history of science, the myth of “higher cognitive functions” would simply shift elsewhere and abandon the deck of helicopters-

¹³ He does not use Lynch, M. (1985). Art and Artifact in Laboratory Science A Study of Shop Work and Shop Talk in a Research Laboratory. London, Routledge, whose descriptive stand, attention to details and many of the conclusions are very much in resonance with his.

¹⁴ Law, J. and M. Lynch (1990). Lists, Field guides, and the Descriptive Organization of Seeing: Birdwatching as an Exemplary Observational Activity. Representation in Scientific Practice. M. Lynch and S. Woolgar. Cambridge, Mass, MIT Press: 267-300, would have allowed him, for instance, to clearly state the different skills in recognizing that this bird is an instance of a mocking bird compared to the invention of the new mockingbird species.

carriers for the mind of scientific geniuses. The fascinating thing, in my eyes at last, is that, when turning to those “geniuses”, many of the same results that Hutchins obtain with his sailors have been documented. Exactly in the same way as thinking is a property of the navigation team aboard the ship, so that there is no sense for any sailor to say “I compute”, the making of major discoveries, according to the new history of science, is a property of whole subcultures of science and of their artefacts, so that there is no sense for an isolated scientists to exclaim “cogito!” or “eureka!”. Laboratories think, communities discover, disciplines progress, instruments see, not individual minds.

The lack of coordination -to use one of the fetish word of the book- between science studies and “wild” cognitive science, is all the more a pity since Hutchins’ definition of the distribution of cognitive tasks and his understanding of context are much more sophisticated than most accounts in history of science. The groups of navigators, the artefacts, the work site, the requirements of the Navy, are not influencing or constraining the individual mind -as if we had to chose between the individual mind thinking freely beneath its skin, and a social entity which would be endowed, somewhat mysteriously, with emergent cognitive abilities. Hutchins’ point is to turn cognitive science inside out, but not to turn it into sociology. It is the very boundary between what goes inside and what goes outside which is at stake in the book. The individual mind endowed with internal state is certainly gone, but so is the “context” into which thinking was supposed to take place. The context is cognitive as well, and not composed of malign and dark social forces foreign to thought and constraining it. Distributed intelligence is exactly that: distributed and intelligent.

On the other hand, Hutchins would have benefited, in my view, from history of science in order to make more precise what exactly is propagated from one representational medium to the next. On the surface, Hutchins’ vocabulary is very reminiscent of the one used in the sociology of scientific instrument, metrology, collections and centres of calculation in general. Mobility, immutability and connectability are crucial to all these media.¹⁵ But this is not the end of the story and immutable mobiles -to use my own wording- are typical of very few cognitive trajectories. It is already clearly different when Hutchins tries to follow the legal requirements of all the same elements when they are used not to take bearings but to offset a litigation. Now that Hutchins has redefined cognition in terms of coordination of representational media, his responsibility is to specify the various modes of coordination. Instead, he uses very weak and spongy metaphors sensing the difficulty but escaping it:

“The people are the glue that sticks the hardware together... The causal relationship is a tissue of human relationships in which individuals watchstanders consent to have their behavior constrained by others, who are themselves constrained by the meaningful states of representational

¹⁵ See for instance the crucial and classic piece by Star, S. L. and J. Griesemer (1989). “Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-1939.” *Social Studies of Science* **19**: 387-420.

technologies.” p 202 again “This permits the human component of the system to act as a maleable and adaptable coordinating tissue, the job of which is to see to it that the proper coordinating activities are carried out” p219 (my italics).

Escaping from the traps and artefacts of cognitive science is one thing -and Hutchins does the job beautifully- but the tasks that lies ahead will not be easier for that. It would be a pity, in my eyes at least, if this revamped cognitive anthropology was not collaborating closely with those scholars in science studies who have the same interest -and much of the same enemies.

I hope it is clear from the critical as well as from the positive remarks that this is a remarkable and foundational book.¹⁶ Let me add one personal note. When I published Science in Action, in 1987, I proposed a “moratorium” on cognitive explanations which had been so freely and cheaply entertained by epistemologists. I already knew Hutchins’s work and made good use of his first book, but I did not know that I will be able to safely lift the ban, less than ten years later, since in the meantime, cognitive explanations would have been dissolved beyond recognition by the very same Hutchins and made thoroughly compatible with the social explanations of science, technology and formalism devised by my colleagues and I. Let us now exclaim together “cogito ergo sumus”!...

¹⁶ There are very few mistakes in this very nicely produced work. I noticed however the following: p110 2 lines from bottom “of” is missing; p 282 second paragraph a “the” should be crossed; p 323 should be figure 1.2 instead of 1.7; p 371 should be 1994 instead of “in press”.