

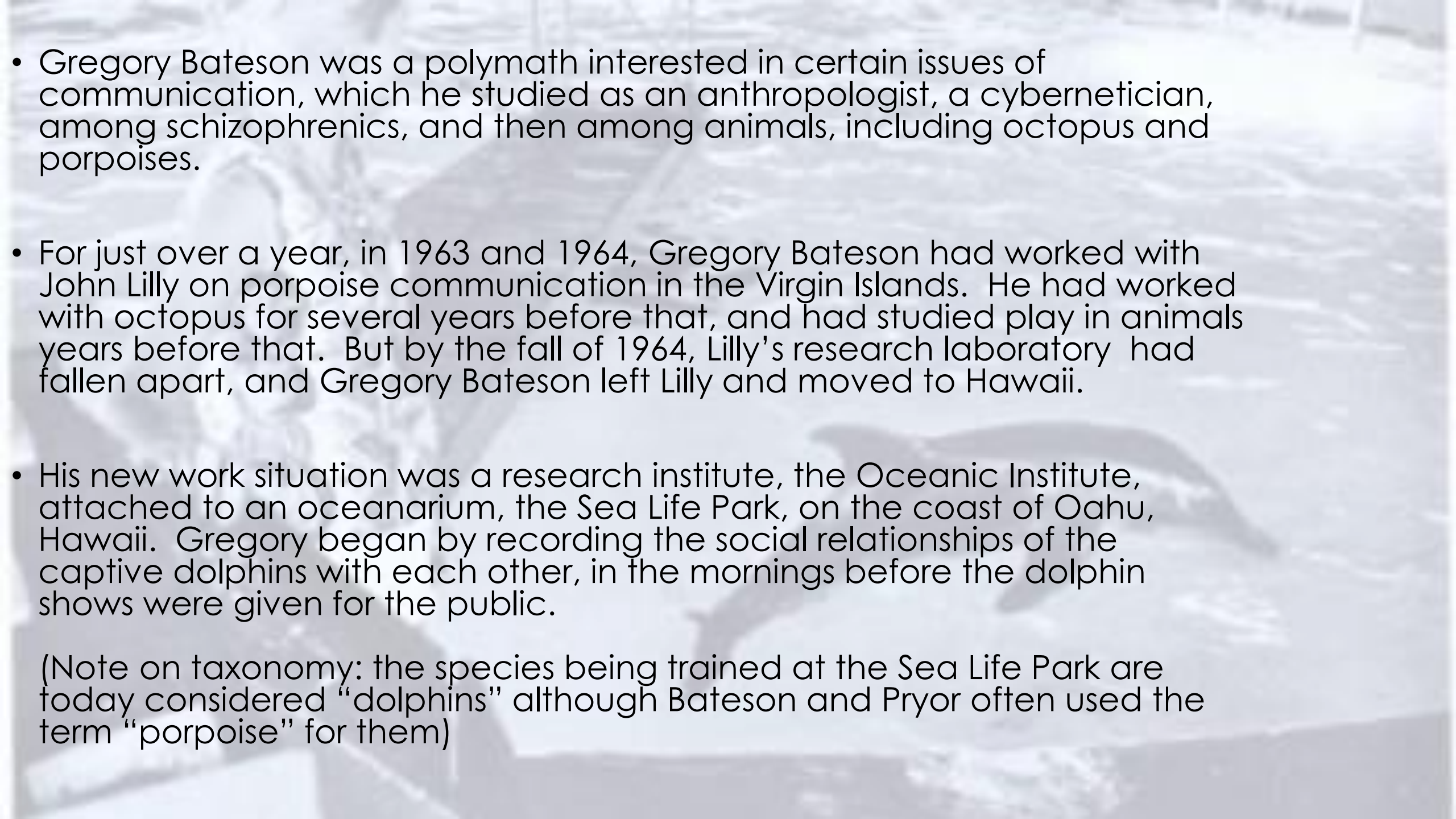
***The Creative  
Dolphin Climbs the  
Semiotic  
Scaffolding***

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Thanks to Karen Pryor for permission to use photos from her book, *Lads Before the Wind*

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- Gregory Bateson was a polymath interested in certain issues of communication, which he studied as an anthropologist, a cybernetician, among schizophrenics, and then among animals, including octopus and porpoises.
  - For just over a year, in 1963 and 1964, Gregory Bateson had worked with John Lilly on porpoise communication in the Virgin Islands. He had worked with octopus for several years before that, and had studied play in animals years before that. But by the fall of 1964, Lilly's research laboratory had fallen apart, and Gregory Bateson left Lilly and moved to Hawaii.
  - His new work situation was a research institute, the Oceanic Institute, attached to an oceanarium, the Sea Life Park, on the coast of Oahu, Hawaii. Gregory began by recording the social relationships of the captive dolphins with each other, in the mornings before the dolphin shows were given for the public.

(Note on taxonomy: the species being trained at the Sea Life Park are today considered "dolphins" although Bateson and Pryor often used the term "porpoise" for them)

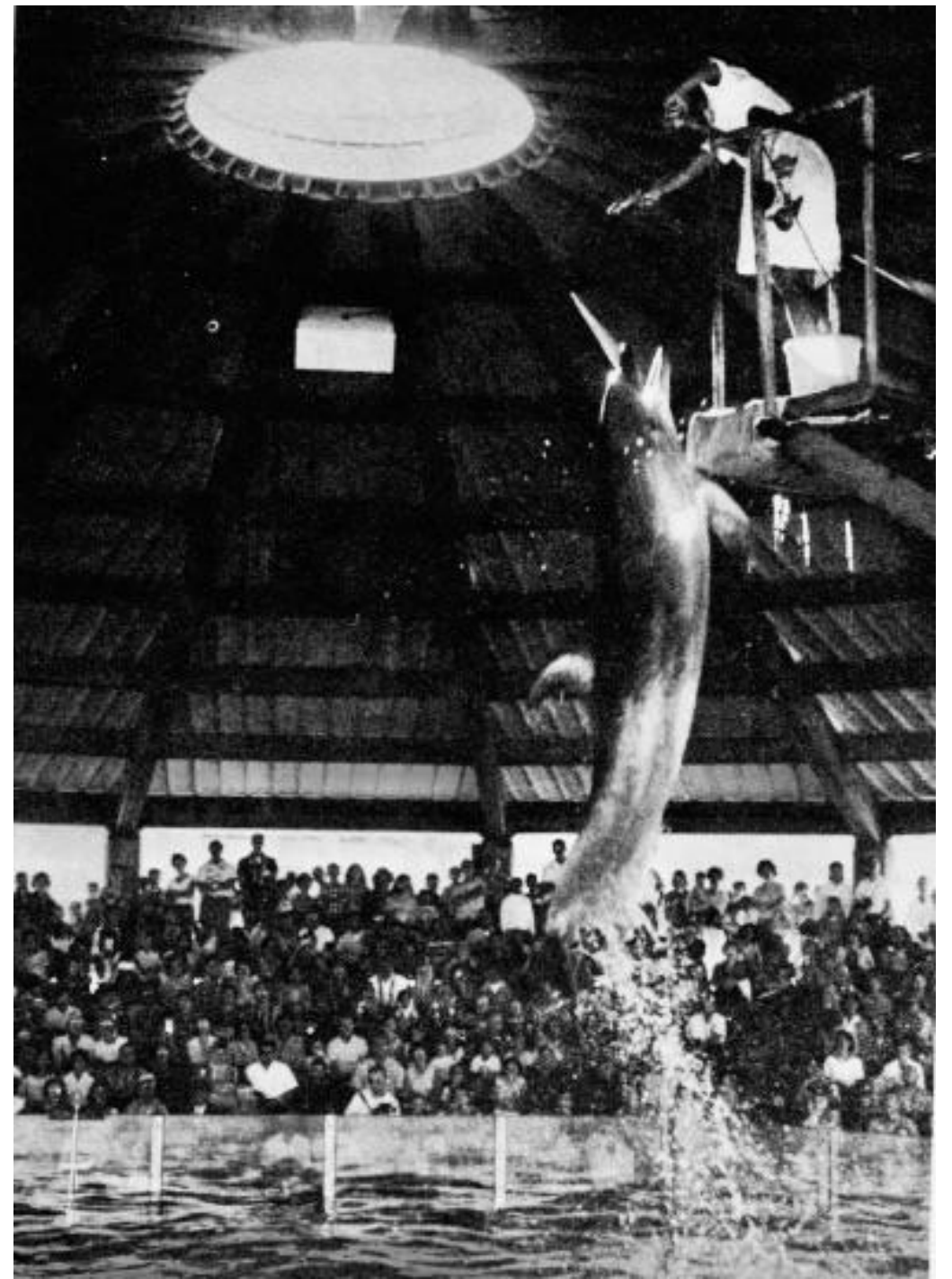


Karen Pryor

- The head trainer at the oceanarium was a woman named Karen Pryor who was trained in operant conditioning under B.F. Skinner. Bateson did not approve of Skinner's ideas as a theory of psychology, but Karen Pryor's interpretation of these ideas was non-punitive and involved maintaining good relationships with the animals. Bateson felt in fact that Skinnerian training did not (and could not) “work” without this dimension of affection and context, even though Skinner's explicit theory of psychology does not include these dimensions.

## Paradox of demonstrating how to train dolphins

- One of the two arenas at the park was called the Ocean Science Theater whose emphasis was on exposing audiences to dolphin science and research.
- Karen Pryor writes: “Ingrid and I decided one day that the show ... was getting a little too good, a little too slick, a little too polished.” The animals and narrators knew their routines too well. Time to introduce “something new and undeveloped.”
- The idea was to show audiences “the first step in training a porpoise” – reinforcing a spontaneous action until it became a conditioned “behavior” that could be repeated on purpose.
- Pryor 1975, quote p. 234, photo p.107



## Malia, in front of the audience

- The two trainers, Karen and Ingrid, began this demonstration by letting the dolphin Malia into the holding tank. She was a trained dolphin, who would normally expect a cue, a "signal" that had already been set up, prompting her to perform a specific behavior which she had already been taught. " But this time no cue was given, no signal, no hint. Malia was annoyed and slapped her tail, in a common dolphin expression of frustration or anger. This was not a behavior that had been reinforced before, but this time it was reinforced with a fish. She slapped her tail again, and again was reinforced with a fish. She slapped her tail for the rest of the session, and the audience applauded.
- But for the next show, again no cues being given, Malia started slapping her tail, since this was what was rewarded in the previous show. But this time, no fish. Again, and again no fish. "Getting mad," she exhibited another dolphin frustration behavior, called breaching, "throwing herself into the air and coming down sidewise to slap the water with her body." This, now, was reinforced. She spent the rest of the session breaching, to the applause of the audience.
- For each show this kind of thing would happen. The behavior from the previous show was not reinforced, but then some different behavior that "accidentally" happened, was immediately reinforced. The trainers felt they were, this way, honestly showing their audiences the first step of how to train a dolphin (before specific behaviors were put on cue). But after three days or fourteen shows, the trainers felt they were running out of usual dolphin behaviors to reward in this way.

## Malia solves the problem, and here comes Gregory

- But at the end of the third day, in the fifteenth show, instead of some known behavior, Malia “suddenly got up a good head of steam, rolled over on her back, stuck her tail in the air, and coasted about 15 feet with her tail out.” This was reinforced and she repeated it a dozen times, coasting farther each time.
- Gregory heard about this and had to see the next show. Malia tried to repeat this behavior, and when that and a few other things didn’t work, she “threw herself into the air backwards and made a beautiful arching leap upside down.”
- Show after show she thought of new things that the trainers had never imagined and would have been hard pressed to condition.
- “Gregory was fascinated.”
- Pryor 1975, text p. 236, photo p. 237



## Second order learning

- It seemed to Gregory Bateson that Malia had exemplified something which he called a higher order of learning, “deutero-learning.” She had learned that, in the relationship between herself and the trainer, she needed to do something “new” – this “newness” being a higher level of abstraction or classification of behavior.
- Newness at the level of French “neuf” or truly novel behavior, not only “nouveau” or merely different.
- Gregory Bateson: “This is an understanding of the context beyond the primary order of having the porpoise respond in a certain way to a buzzer to a particular signal, right.”
- Gregory Bateson unpublished audio Flagstaff, 1977



... threw herself into the air backward  
upside down. . . .”

In the world of science, being repeatable is good, and so is funding from the U.S. Navy

- Bateson urged that the experiment be repeated with a different dolphin, properly recorded, and published. Multiple observers, including two graduate psychology students, were found. Observations would be tape recorded and some filming would be done. The U.S. Office of Naval Research, who had not been strangers to the research at Sea Life Park, funded this experiment, which was published in a Navy publication.
- The experiment was done with another female dolphin named Hou. She had been in the training facility but had not performed. Unlike Malia's training, this experiment was not done before the audience but was done in the mornings before the park opened to the public.
- This was the experiment that Gregory Bateson observed.



## Hou and the unearned fish

Like Malia, Hou started each session with the behavior that had been reinforced in the previous session. When this was **not** rewarded, Hou seemed to express frustration by simply circling around the tank endlessly. ("Porpoising" in this context refers to simply jumping out of the water as in the photo.)

Similarly to Malia, Hou would often be reinforced for a "random" behavior late in a session, but not reinforced for that behavior in the next session. Sometimes an elaboration or refinement of that behavior would be reinforced.

(Sometimes behaviors would be "shaped" by trainers to break the frustration behavior; a "shaped" behavior could be reinforced once in the next session, to keep it from being "extinguished," but not rewarded throughout the session.)

Sometimes the trainers would give Hou fish just to keep the relationship. (Usually reward fish was accompanied by a whistle but this fish was not.)

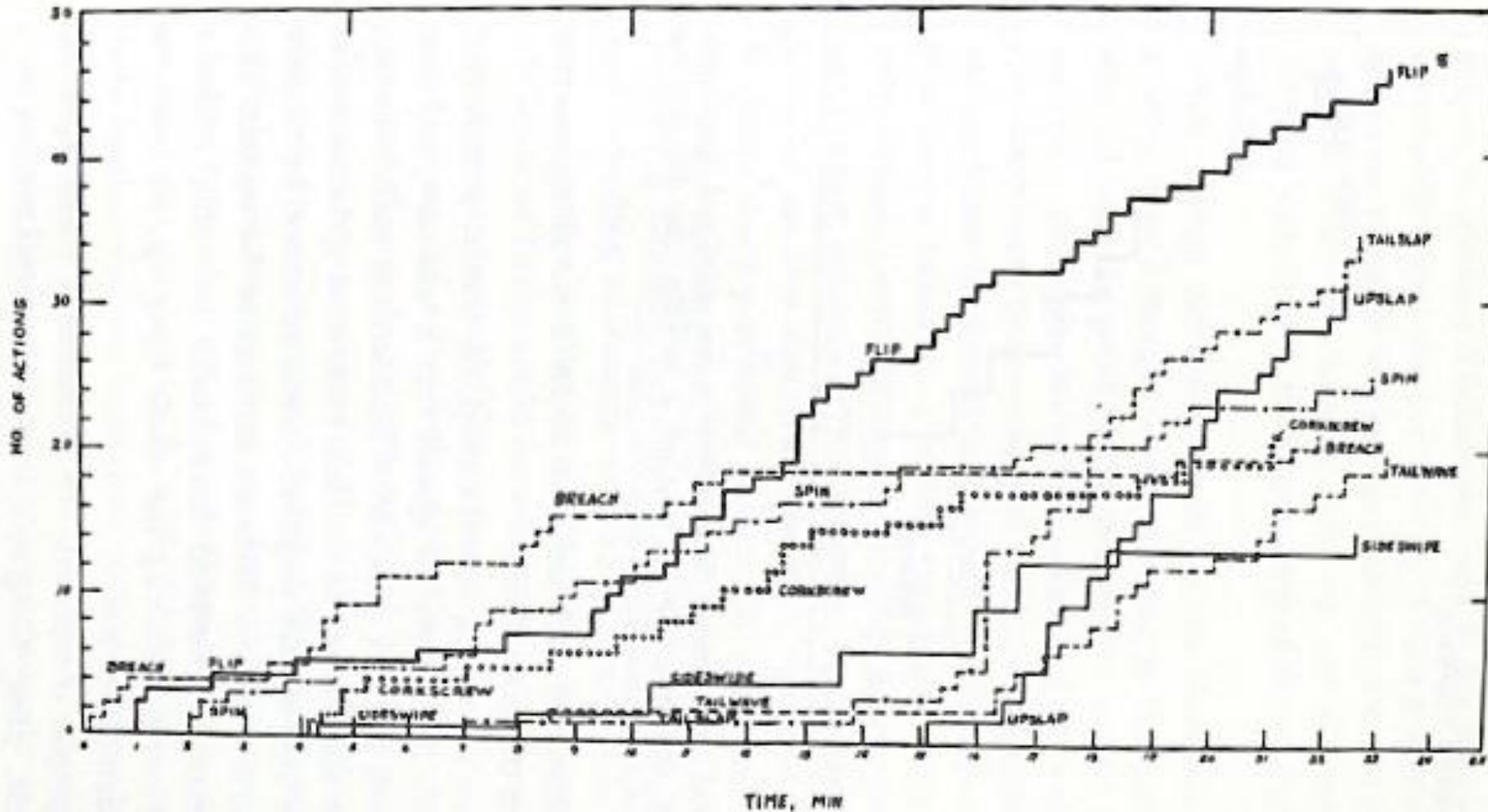


Hou was "easily discouraged, and . . . she developed a pattern of circling, porpoising, circling, porpoising, over and over again. . . ."

## Hou gets the picture

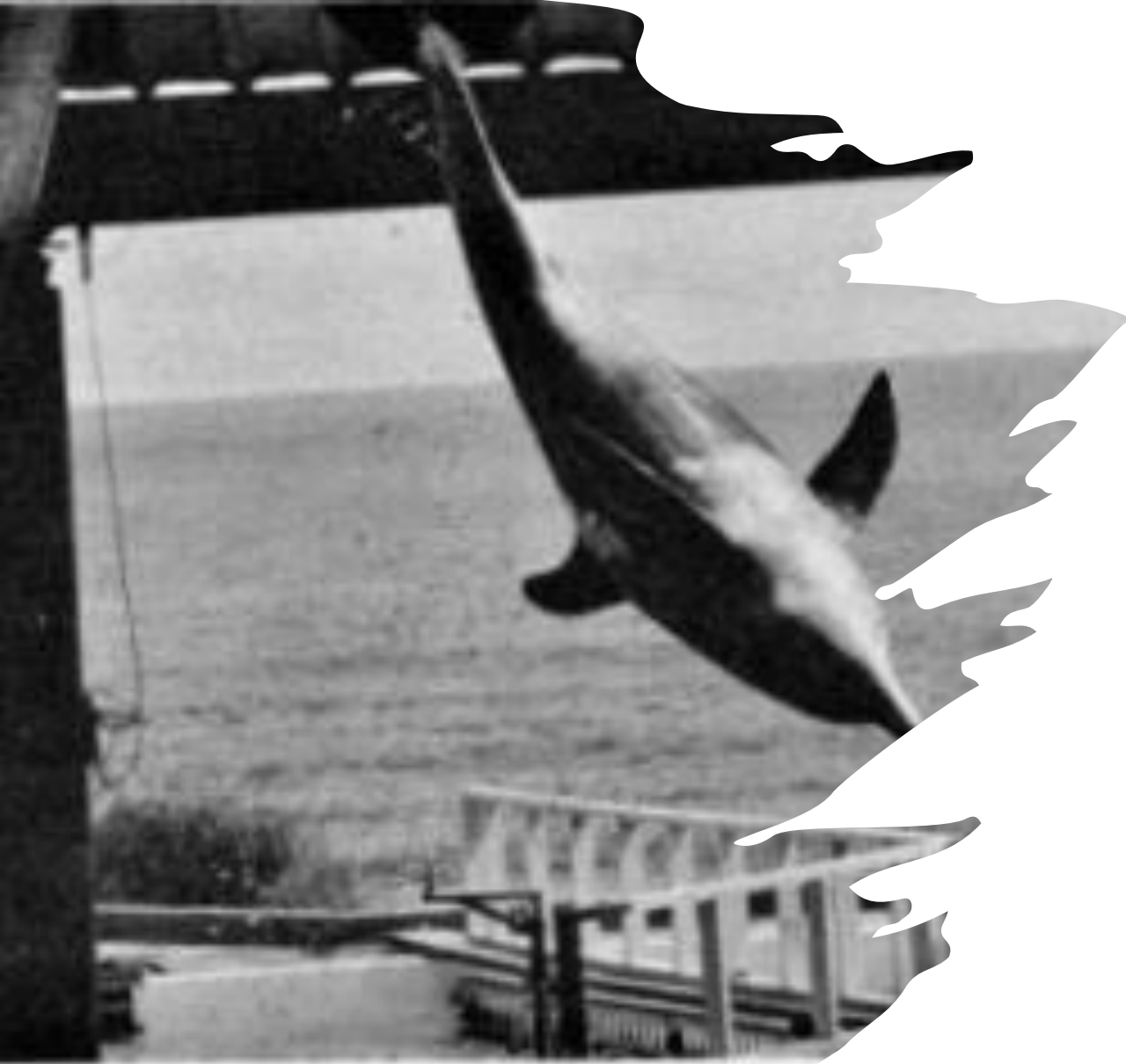
- After 14 sessions, two or three sessions a day, the first part of the breakthrough began. In session 15, Hou tried to do *three* of the previously reinforced behaviors, but no luck. She then circled around but with a tail slap (of anger), and *this*, the tail slap, was reinforced. Hou mixed the tail slap with other behaviors and ended up doing it all over the tank 17 times.
- There was ten minutes break and then session 16 began. Hou seemed visibly excited. She started by doing twisting breaches and somersaults, beginning a session in which she (as Karen Pryor put it) “went wild” with a total of eight behaviors four of which were completely new.
- This pattern of novelty continued in the following sessions.

It's only science if there's a graph (reprinted from Pryor p. 245)



■ REINFORCED BEHAVIOR

Our graph of the "Aha!" session in which Hou finally caught on that she could be reinforced only for new behavior. Each line represents one kind of behavior, each upward jig an individual response. Hou did eight kinds of things at once, four of which were brand new. *Oceanic Institute photo*



precipitously threw herself into  
arching leap upside down

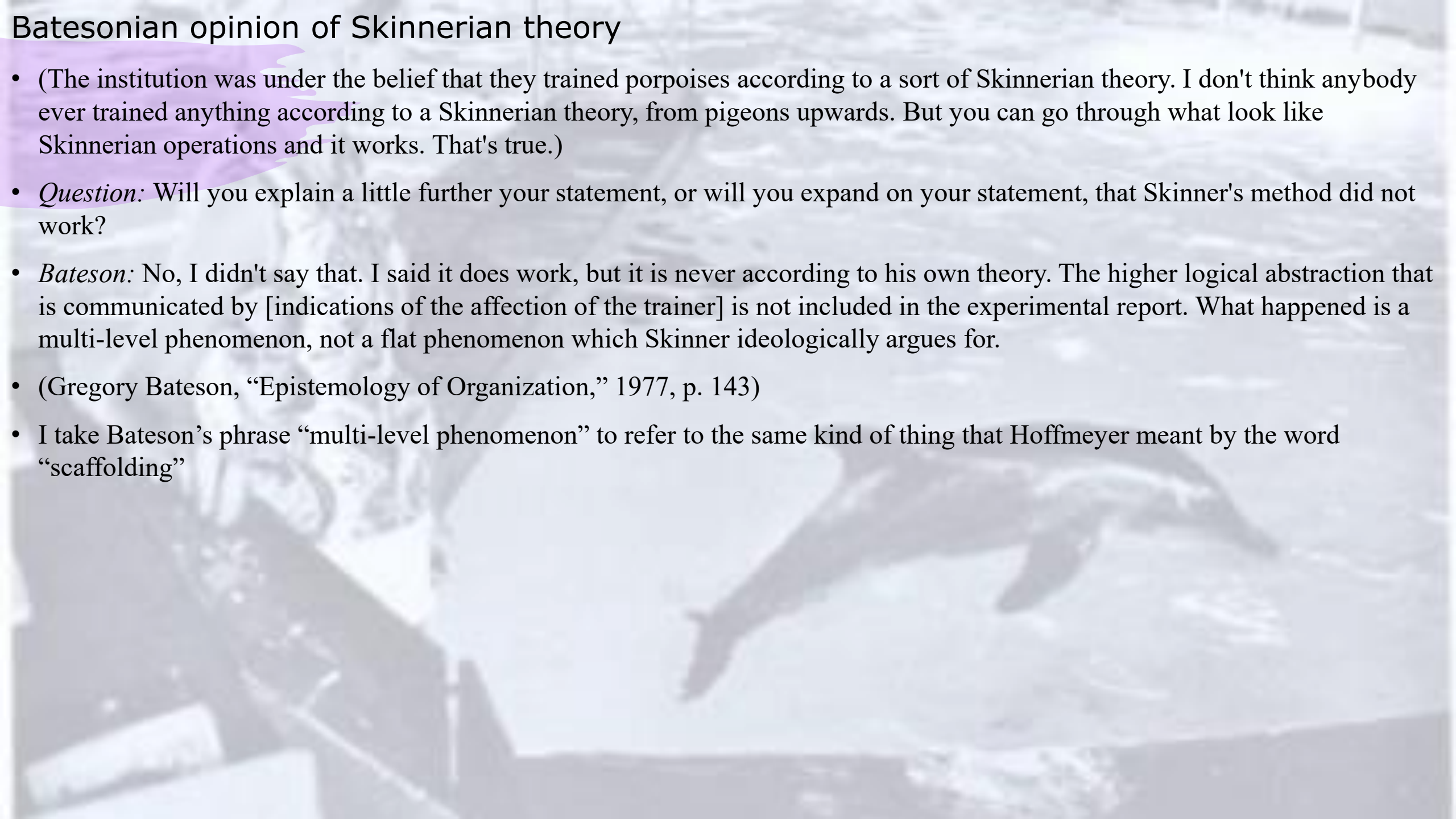
# Changes in personality

- Karen Pryor noted that both these dolphins exhibited a permanent change in personality. Hou had been a very "placid" animal, but changed to an "active, observant animal full of initiative." But both of them became so "active and imaginative" that they became "nuisances." They opened gates and let each other out. Hou jumped the tank partitions, and Malia learned to slide around on the cement. In one memorable event they even learned to imitate each other's routines.

• Pryor 1975, text p. 251, photo p. 237

## Batesonian opinion of Skinnerian theory

- (The institution was under the belief that they trained porpoises according to a sort of Skinnerian theory. I don't think anybody ever trained anything according to a Skinnerian theory, from pigeons upwards. But you can go through what look like Skinnerian operations and it works. That's true.)
- *Question:* Will you explain a little further your statement, or will you expand on your statement, that Skinner's method did not work?
- *Bateson:* No, I didn't say that. I said it does work, but it is never according to his own theory. The higher logical abstraction that is communicated by [indications of the affection of the trainer] is not included in the experimental report. What happened is a multi-level phenomenon, not a flat phenomenon which Skinner ideologically argues for.
- (Gregory Bateson, "Epistemology of Organization," 1977, p. 143)
- I take Bateson's phrase "multi-level phenomenon" to refer to the same kind of thing that Hoffmeyer meant by the word "scaffolding"



## Batesonian points

- You see, the porpoise could not have done the trick in a single session. The porpoise has to have the experience of a succession of sessions in order to discover this generality \*about\* sessions, that no one is like the other. You can't discover that from a single session. So, what the porpoise discovered was presumably non-verbal, so far as the porpoise is concerned -- I don't know that -- but it's very close to things that we use words for, very close to the business we were talking about at the beginning with Socrates and the class of men who die. What he has discovered is a difference between the individual item and the class. A very extraordinary discovery, but one which looked at from the backside of, after the fact of the discovery is very simple, you see. But looked at from this side, before you know it, is very difficult to get at.
- (Bateson lecture, "Simple Thinking," Esalen 1980)
- ...it was necessary (in the trainer's judgment) to break the rules of the experiment many times. The experience of being in the wrong was so disturbing to the porpoise that in order to preserve the relationship between porpoise and trainer (i.e., **the context of context of context**) it was necessary to give many reinforcements to which the porpoise was not entitled.
- (Bateson, "Double Bind, 1969," in *Steps to an Ecology of Mind*, p. 277, emphasis added)
- You see, she is in a situation in which she is essentially being penalized for having learned that which she has learned. And this is a situation which drives her into her creativity. And this, in a sense, is \*the\* situation which drives critters, and us, into creativity...
- (Bateson lecture, "Metaphors and Butterflies," Esalen 1975)

## Special features of animal-human performance context

- From a biosemiotics point of view the *umwelt* of an animal in a situation such as Sea Life Park is very specialized and atypical. The natural history of an oceanarium or a zoo is not the same as the full natural history of the animals observed there.
- (I am not endorsing the “ethics” of such environments, and Bateson wasn’t fond of their epistemological basis. In particular he felt that behaviorism was a radical oversimplification and reduction of the natural world – and even an incomplete explanation of the trainer/animal relationship.)
- What is made visible in this experiment is the human-animal relationship which becomes the animal’s world. What is possible in this relationship should not be confused with the intrinsic or potential capabilities of a particular animal or species of animals.
- In particular the concept of “intelligence” tends to confuse this issue. It is not really what this experiment is concerned with.
- The animal did not *develop* creativity as the result of an experimental procedure. Rather, the procedure *revealed* (and perhaps *released*) the creativity which was potential in the animal. The animal did not necessarily develop new capacities, but rather developed a new approach to the context in which it found itself.

## More features of performance context

- Note also that the specific “behaviors” reinforced by trainers have different biosemiotic meanings in what Bateson calls the “free natural history” of the organism. A tail flap may express anger, etc. Some “new” behaviors may not have occurred as part of dolphin social semiosis.
- Thus the animal has to learn the implicit category of “behavior” in the mind of the trainer (or community of trainers). Because parsing activities into “behaviors” in that way is not part of dolphin natural history outside this relational context.
- The “behavior” is a sign within the mutual communicative field (or *umwelt*) of the dolphin/ trainer relationship. The “meaning” of this sign is different, perhaps “impoverished” compared to its possible dolphin-meaning in the relational system of dolphins to each other. The “synonymy” of such “behaviors” is such that they are considered the same kind of thing in the performance environment, though they would not be equivalent in dolphin-meaning.
- Only when the animal has learned how to parse activity into “behaviors” can it develop the idea that the trainer wants, first “different” behavior, and then “new” behavior.
- When it develops the habit of showing off “new” behaviors, this transfers to an innovative and “creative” way of dealing with its environment in general. (But does it learn “how to be” creative, or simply that creativity can be a live possibility in its particular specialized oceanarium *umwelt*?)



## Semiotic Scaffolding

- Jesper Hoffmeyer noted that **semiotic scaffolding** can happen in the life of an individual, as well as in species and ecological relationships among species. He describes this as an evolutionary building of semiosis on top of semiosis.
- The “creativity” of the dolphin in this experiment, is **scaffolded** therefore by (1) its training to behave in a behaviorist manner, performing a “behavior” on cue and getting a reward, (1a) its intuitive learning of the category of what trainers think a “behavior” is, (2) its understanding that when a cue is missing it needs to exhibit some “behavior” to be potentially rewarded, (3) learning that it will (in this experiment) be rewarded only for something that was **not** rewarded in the previous session.
- Ultimately the dolphin behaves in a way that shows a sophisticated layering of *levels of abstraction* from the concrete embodiment or even dolphin-meaning of its particular behaviors.

## Bateson, "logical type," and scaffolding

- In an unpublished paper, written close to the time of the experiment, Bateson uses the concept of "logical type" in ways which are similar to how Hoffmeyer uses "scaffolding." At the "lowest level" are the premises of operant conditioning itself, which Bateson shows to be complex: the linking of whistle and food, the linking of the dolphin's own actions and whistle, and the "stringing together" of these linkings which scaffolds on both of them.
- The experiment set up a further or "higher" scaffolding in that, for the purposes of the experiment, what the dolphin had already "learned" was insufficient (for the trainer's reward). The dolphin then learns to provide something "different," but repetition of this "different" behavior in a following session was also insufficient.
- The dolphin had to scaffold on a *series* of session experiences in order to put together the even "higher-level" idea that what was required was for the dolphin to perform something truly *new*. This concept of newness – which itself seemed to lead to an "aha" experience of semiotic freedom – could not have been achieved by the dolphin without the previous scaffolding.

## Semiotic Freedom

- The result of this scaffolding up levels of abstraction is a sense of increased **semiotic freedom** (another Hoffmeyer concept) for these dolphins. The dolphins liberated their sense of what could be afforded in the environment, by learning that the *play development* of novel responses would be rewarded. (Hoffmeyer mentioned *play* in this sense as key to semiotic freedom.) This led to change in “character,” involving a sense of novel possibilities in the “same” relationship and environment.
- The context for these dolphins is the human-animal relationship. Relationship with trainers etc. is not merely fish or reward based, but also approbation-based etc. Malia was surely reinforced by the applause of the audience, while Hou did not have the opportunity for this.

## Semiotic Freedom quotes

- Semiotic freedom was defined as 'the depth of meaning that an individual or species is capable of communicating' (Hoffmeyer 1992, 109). The use of the word *depth* in this connection is related to Charles Bennet's concept of *logical depth* – his attempt to supply the concept of *information* with a measure for the *meaningfulness* or *complexity* of the information, quantified as the number of calculatory steps spent upon producing it...intuitively it seems clear that the meaning of different messages may indeed have different depths.
- (Hoffmeyer 2008 pp. 186-7)
- I opted for the expression semiotic "freedom" rather than semiotic "depth" in order to save giving the (false) impression that we are dealing with a quantitative term on a par with logical depth. My aim, in calling it semiotic depth, is to establish the creative dimension of the semiosphere. But just because semiotic freedom cannot be weighed up in the same way as a quantitative measurement does not mean to say that the term could not be defined – according, for example, to principles similar to those involved in the term *logical depth*. For the moment this remains open to question.
- (Hoffmeyer 1993 p. 66)
- An increase in semiotic freedom implies an increased capacity for responding to a variety of signs through the formation of (locally) 'meaningful' interpretants.
- (Hoffmeyer, "The Natural History of Intentionality: A Biosemiotic Approach," p. 19)

- By Hoffmeyer's, and to some extent Bateson's definitions, the "creative" behavior of the dolphins in the "aha" sessions is a form of "play" – as Jesper Hoffmeyer notes:
- “Thus, to the extent nature is engaged in an open ended or non settled exploration of relationships between systems at many levels of complexity, nature does in fact exhibit play like behaviour, and it will be as legitimate to talk about 'natural play' as it is to talk about 'natural selection'. ”
- Jesper Hoffmeyer, 1997



## *From Bateson's "Addiction" Esalen talk*

The learning is not a smooth curve – it is a jump. A quantum change as they say now. And what I am saying is that there is a particular sort of frustration, of misery, rage, which is imposed upon you when you are asked to behave at the next highest level of abstraction or any higher level of abstraction than that which you were behaving at. You are being forced to a sort of insight which your previous ways of thinking did not contemplate. This can be very painful.

One of the interesting things about it is that we could never persuade the trainer to obey the rules of the game. The rules were strict – no fish for that porpoise unless it does something new. But the wretched trainer would always throw an occasional fish to the porpoise and we, the scientists said, “You mustn’t do that, is against the rules of the experiment”. And the trainer said, “But I will lose the porpoise if I don’t”. That is, she would lose her relationship to the porpoise. Once she’s lost the relationship with the porpoise she was not a useful trainer for that porpoise you see – she’d broken the thread.

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## ***Bateson's unpublished ms: "Deutero Learning in Steno Bredaensis"***

- The sorts of orders of learning which have been variously called "learning to learn," "deutero-learning" (Bateson, 1942), set learning (Harlow, xx), "transference of learning," etc., have obvious theoretical importance. But, at the present time, there is a serious lack of experimental data which exemplify these phenomena, no classification of the phenomena and even no defined criteria by which the phenomena may be distinguished from those simpler phenomena which are the prime subject matter of S-R theory. Indeed it is even claimed that inductive argument from the experimental data of operant conditioning will cover the phenomena of higher order.
- The task of the present essay will therefore be to use the story of the "creative" porpoises as an example, an illustration, in an attempt to classify the phenomena and propose some necessary criteria.
- It is first appropriate to subdivide the questions which the scientist must ask, and here I follow McCulloch (xx). He proposed two questions: "What is a number that a man may know it?" and "What is a man that he may know a number?"
- An analogous pair of questions can be asked of any knowing.
- We ask then first what logics or redundancies or patterns were implicit in the event sequences through which the porpoises passed. An exhaustive answer to this question would give us an upper limit to what could have constituted *data* for the animals. From these data, they learned but, of course, there is no *a priori* assumption that they used all the data which were available to them.
- McCulloch's answer to his second question, "What is a man that he may know a number?" is in terms of minimal neurological circuitry. This type of answer is in the present instance not available to us from the porpoise experiment.
- However, our questions are not precisely analogous to those of McCulloch. The problem of *learning* is not quite the same as the problem of *knowing*, and McCulloch does not ask, "What is a man that he might *discover* a number?" Knowledge may be stored in the brain but the prerequisites for a *change* in knowing are not all contained within the neural circuitry.



- For an organism to discover some pattern or regularity in the external universe must always depend in some degree upon the shape and habits of the organism. Are its sequences of action – its patterns of search – such as to make a particular environmental regularity maximally or minimally perceptible? (cf Bateson xx)
- And note, in passing, that a *change* in an animal's pattern of search, even unaccompanied by insight, will usually have an effect of making some environmental regularities easier to discover while others will become more difficult. Perhaps all transference of learning can be comprised within the concept of change in patterns of search, either external or intra-cranial.
- Be that as it may, the question "What is a porpoise that it may learn in the described experiment?" is in part answerable in terms of the observable characteristics of the animal.
- Beyond that, it may still appear that the habits of the animal and the data presented to it in the experimental sequence are still insufficient to account for the observed learning. In such a case, we would be forced to suppose that the porpoise either did some *guessing* or it arrived in the experimental setting already equipped with relevant information, derived either from previous experience outside the experimental setting or from the genome. We know, for example, that the porpoise, Hou, brought to the experiment previous training in contexts of instrumental reward, and that this training had proceeded to the point at which the whistle was effective as a secondary reinforcement and ostensive time marker. The animal was able to use as a premise or source of information: a. the fact of sequential redundancy between whistle and food: b. the fact of sequential redundancy between certain of its own actions and the whistle, and c. the higher order "fact" that a. and b. could be strung together.
- The above considerations provide a program of questions which can be asked of the story of the "creative" porpoise.
- The orders of redundancy provided for the animal necessarily define the orders of learning which he must achieve. Therefore, we ask first --

- 1. What redundancies were implicit in the porpoise's data.
- a. Throughout the experiment, the patterns which the porpoise was required to learn included actions of the animal itself. At no stage did these redundancies exist outside the animal. (In contrast, Harlow's early experiments in set learning were designed to show transference of learning in cases where the successive problems presented to his Rhesus monkeys contained similar gestalten which could be said to exist (pace Bishop Berkeley) outside the animals.)
- b. The experience of having solved the problem once – the performance in the appropriate context of some action which earned whistle and fish – did not contain the information necessary to solve the same problem in the next learning session. Indeed, the immediate and most obvious induction from the single experience was precisely *wrong* in the next session; and the necessary information was contained only in a *class* of two or more such experiences.
- It is this distribution of the information over a class of experiences that demonstrates that the porpoise achieves a true deutero-learning, i.e. that the final learning from the class of experiences is an acquisition of information of higher logical type in Bertrand Russell's sense.
- c. The class of completed sequences contains another type of information, which may perhaps be of still higher order: the action which will earn reward in a given session had to be not only a member of a class of actions perceptible to the trainer, but must be a member of that class *different from* the action rewarded in the previous session.
- In mathematical terminology, a distinction is drawn between a "set" and a "group." In a set, there is no ordering of the numbers, no defined relationship between them; whereas in a group, the members are derivative from each other by specific operations.
- The class of sequences presented to the porpoise is still very far from being a true mathematical group, but the beginnings of an ordering within the class are already present. After any given action, which is a member of the reinforced class, some other member of that class must be presented in the following session. (We may well ask whether a porpoise could acquire the information necessary to