IMITATIVE BEHAVIOUR BY INDIAN OCEAN BOTTLENOSE DOLPHINS (*TURSIOPS ADUNCUS*) IN CAPTIVITY

by

C. K. TAYLER and G. S. SAAYMAN [1])

(Museum, Snake Park and Oceanarium, Humewood, Port Elizabeth, South Africa)

(With 12 Figures)
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INTRODUCTION

The bottlenose dolphin (*Tursiops* sp.) has excited scientific interest because of its large, complex and highly convoluted cerebral cortex and its reputedly high intelligence (PILLERI, 1971). However, very few quantitative data have been published to substantiate claims for the intelligence of dolphins, and further, the significance of the development of the delphinid brain is far from clear and should be interpreted with caution (KRUGER, 1966).

Formidable problems face the experimentalist at the behavioural level: writing more than 20 years ago on the learning ability of dolphins (*Tursiops truncatus*) MCBRIDE & HEBB (1948) discussed the problem of obtaining a meaningful scale for the comparative assessment of animal intelligence. They suggested that the ability to solve problems by means of insight might provide a suitable index of superior intelligence but noted the difficulty of definition: the concept of insight was developed on terrestrial mammals — notably the chimpanzee (KÖHLER, 1925) — and the performance tests employed are not readily adapted for the virtually limbless dolphin. Further, dolphins rely primarily on acoustical mechanisms for navigational and discriminatory purposes (KELLOGG, 1961) and for transmitting information to each other (LILLY, 1963; TIETZ & TAYLER, 1964; CALDWELL & CALDWELL, 1967). It is therefore probable that tests derived from those applied to the predominantly visually oriented primates will not adequately reflect the performance of the primarily acoustically oriented dolphin (CALDWELL & CALDWELL, 1968).

Advanced play and exploratory activities in animals are generally accepted

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as evidence of advanced evolutionary development and are said to possess survival value in promoting rapid adaptation to new situations and environments (see review by Loizos, 1967). Several delphinids in captivity spontaneously display inventive and complex play patterns without apparent external reinforcement: pilot whale *Globicephala macrorhyncha* (Kritzler, 1952); Pacific whitesided dolphin *Lagenorhynchus obliquidens* (Brown & Norris, 1956); Atlantic bottlenose dolphin *Tursiops truncatus* (McBride & Hebb, 1948; McBride & Kritzler, 1951; Tavolga, 1966); Amazon dolphin *Inia geoffrensis* (Layne & Caldwell, 1964). However, it is particularly the accounts of the ability of some of the smaller odontocetes to learn by observation that suggest an advanced degree of perceptual development in these marine predators. Learning by imitation or observation has been reported in the Atlantic bottlenose dolphin *Tursiops truncatus* (McBride & Kritzler, 1951; Caldwell, Caldwell & Siebenaler, 1965); pilot whale *Globicephala macrorhyncha* (Kritzler, 1952) and the false killer whale *Pseudorca crassidens* (Brown, Caldwell & Caldwell, 1966). The present report presents further evidence of observational learning in the Indian Ocean bottlenose dolphin *Tursiops aduncus*.

THE ANIMALS

Visual and acoustical records of two species, the Indian Ocean bottlenose dolphin (*Tursiops aduncus* Ehrenburg, 1833) and the humpback dolphin (*Sousa plumbea/lentiginosa*) have been obtained in the Port Elizabeth Oceanarium. Some of the observations reported in this communication were made in the Main Tank (capacity 820 800 litres) of the Oceanarium when Haig and Lady Dimple, two mature *T. aduncus* cows, were maintained together with Tommy, a young but sexually mature bull Cape Fur Seal (*Arctocephalus pusillus*) or when Haig was kept together with an adult humpback dolphin cow. All other observations were made when the animals had been transferred to the large Dolphin Pool (capacity 4 742 400 litres). The conditions of maintenance, treatment and observation of the dolphins have been presented in detail elsewhere (Tayler & Saayman, 1972).

RESULTS

Imitation by a Bottlenose Dolphin of the behaviour of a Cape Fur Seal.

Haig and Lady Dimple, two mature bottlenose dolphin cows, were maintained for two years in the Main Tank prior to the introduction of Tommy, a young bull Cape Fur Seal. Initially the dolphins avoided the seal, but after several months Haig, the younger dolphin, began to follow him as he swam around the tank. Lady Dimple paid him little attention. Interactions between Haig and Tommy gradually increased over a period of two years, commencing when Haig began to adopt postures and to make movements

similar to those employed by the seal when he was swimming, sleeping or performing comfort movements. The apparent imitation by the dolphin of the seal culminated in protracted but unsuccessful attempts at copulation with ensuing aggression and attacks by the dolphin on the seal. A chronological account of imitative behaviour is presented in detail below.

Swimming.

The Cape Fur Seal, when swimming leisurely, employs a fore and aft stroke of the foreflippers, briefly retaining the soles of the foreflippers against the flanks whilst gliding. When swimming at speed, the strokes are made in quick succession. The dolphin, in contrast, uses its flippers mainly in steering, whereas dorsoventral strokes of the flukes provide the forward propulsion.

When Tommy had been with the dolphins for a few months, Haig was frequently seen moving forward very slowly on the surface, holding her flukes motionless and propelling herself with seal-like strokes of the flippers. Later she followed the seal on his regular daily route around the pool, at times swimming normally to maintain his speed, whereupon she would revert to the seal-like flipper motion until again left behind. This unusual mode of progression occurred sporadically throughout the day, and was subsequently seen when Haig swam in circles around the seal as it slept on the surface or even when it was not present in the tank (Plate VIIIa).

Comfort Movements.

Cape Fur Seals in captivity spend substantial periods grooming themselves on the surface of the water. The activity is characteristic and consistent in all age and sex classes. The seal rubs and scratches the entire body surface, using fore- and hindflippers and the incisors to preen through the fur. Rubbing is performed with the soles of the flippers. The seal either rolls on the surface or adopts an inverted vertical posture with only the hindflippers protruding above the surface while a continuous stream of air bubbles is released from the mouth. Intermittently the animal rears out of the water, breathes and vigorously shakes the upper body, flinging water from the guard hairs which are left standing in tufts. Yawning sometimes accompanies these behavioural sequences. (For a comprehensive description of the behaviour patterns of the Cape Fur Seal see SCHNEIDER, 1942).

Apart from mutual rubbing and massaging during precopulatory behaviour, dolphins in captivity occasionally rub against the walls, windows or floor of the tank, but are anatomically incapable of the self-grooming procedures employed by the seal. Haig, however, began to adopt postures very similar to

those used by Tommy during self-grooming (Plate VIIIb). Haig vigorously rubbed her belly with the ventral surface of one or both flippers whilst lying on the surface. She adopted an inverted vertical posture, flukes protruding above the surface, and released a stream of air bubbles from the blowhole whilst rubbing herself with her flippers. She surfaced intermittently and shook her entire rigid torso (the neck vertebrae in the dolphin being fused), occasionally holding her mouth open wide, although openmouthed yawning has never been observed in our dolphins. These movements were sometimes performed when Tommy was actively self-grooming, when he was not present in the tank, or when he was present but engaged in other activities. The clumsiness with which the dolphin executed these movements emphasised their unnaturalness.

Sleeping.

The Cape Fur Seal sleeps either on the surface of the water or hauls out onto land. When sleeping on the water a variety of postures are adopted, most notably lying on its side with one foreflipper extended rearwards and clasped between two hindflippers, forming an arch. The other foreflipper paddles beneath the water, the head hangs limply and is raised periodically above the surface to breathe. The seal may also sleep in an inverted position with its foreflippers crossed and held flat against the belly, whilst occasionally paddling with the hindflippers. Numerous variations of these two major sleeping postures are seen. In contrast, in our experience, newly captured Indian Ocean bottlenose dolphins are unable initially to even come to a halt and remain motionless on the surface; sleeping appears to occur when a dolphin maintains contact by means of an extended flipper with a second vigilant animal and is thus guided whilst both are in motion (TAYLER & SAAYMAN, 1972).

Haig began to adopt postures resembling those of a sleeping Cape Fur Seal. She lay on her side and extended a flipper whilst trying to lift the flukes clear of the water. She also lay inverted with the belly just protruding above the surface, with her flippers pressed flat against her belly, sometimes dabbling at the water with her partially open mouth. Periodically she righted herself to breathe. These unusual postures were maintained for protracted periods of time in the vicinity of the sleeping seal and at times when Tommy was engaged in other activities. The dolphin maintained the postures only with great difficulty and clumsiness. She also displayed her own variations at these times, such as releasing air and sinking slowly to the bottom but there was, in general, a striking similarity between her behaviour and that of the seal.

Further evidence of observational learning by Bottlenose Dolphins.

In addition to the apparent imitation by Haig of the behaviour of the seal, several further examples in other contexts were seen in different age and sex classes of dolphins.

Imitation of the postures and swimming behaviour of fish, turtles and penguins were frequently observed. For example, skates (*Raja* sp.), swimming in a straight line, often came into contact with the circular wall of the tank and then progressed for a distance using one wing to change direction by pushing away from the tank wall. Haig often swam behind the skate, similarly pushing herself from the wall with the outer surface of her flipper.

Haig lay flat on the bottom alongside a sleeping loggerhead turtle (*Caretta caretta*), rising to the surface together with it for air. Subsequently she began to take the turtle repeatedly down to the bottom just before it had reached the surface to breathe. A number of turtles were drowned in this way, particularly after Lady Dimple adopted a similar procedure.

The bull dolphin Daan, after repeatedly observing a diver removing algae growth from the glass underwater viewing port, was seen cleaning the window with a seagull feather while emitting sounds almost identical to that of the diver's air-demand valve and releasing a stream of bubbles from the blowhole in a manner similar to that of exhaust air escaping from the diving apparatus. Comprehensive ciné- and sound-recordings were obtained of this behaviour. Subsequently Daan used food-fish, seaslugs, stones and paper to perform similar cleaning movements at the window. He commandeered the vicinity of the viewing port for a period of 54 days, during which time he actively prevented divers from approaching the window by open-mouthed threats, jaw clapping and by forcibly pushing them away. The other dolphins were similarly prevented from approaching the window. At night, contrary to his normal practice of resting in the centre of the pool, he took up a resting position above the viewing port. Divers hold with one hand on the stainless steel frame of the viewing port whilst cleaning the window glass with a brush held in the other hand. In the absence of the diver, the dolphin cleaned the length and breadth of the window with similar strokes, rubbing away the filamentus algae which grows where the glass meets the frame, whilst maintaining contact with the window frame with his flipper. Haig displayed similar behavour, without the aggressive overtones. She was encouraged to perform this act, using a brush, but persistently put the hard wooden handle to the glass, holding the bristles in her mouth.

At six months of age the calf Dolly spontaneously began to manipulate the apparatus which her mother, Lady Dimple, had been trained to use during

public demonstrations, and, with appropriate reinforcement, soon became an integral part of the demonstrations.

Dolly saught the attention of observers scoring dolphin behaviour from the underwater viewing chamber by presenting a variety of objects, such as feathers, stones, seaweed or fish skins, which she pressed against the glass. Frequently the same objects, or a preferred stone, were used. When ignored, she made off and returned on three or four successive occasions with different objects.

At the end of an observation session, a cloud of cigarette smoke was once deliberately released against the glass as Dolly was looking in through the viewing port. The observer was astonished when the animal immediately swam off to its mother, returned and released a mouthful of milk which engulfed her head, giving much the same effect as had the cigarette smoke. Dolly subsequently used this behaviour as a regular device to attract attention.

Tool-using derived from observational learning.

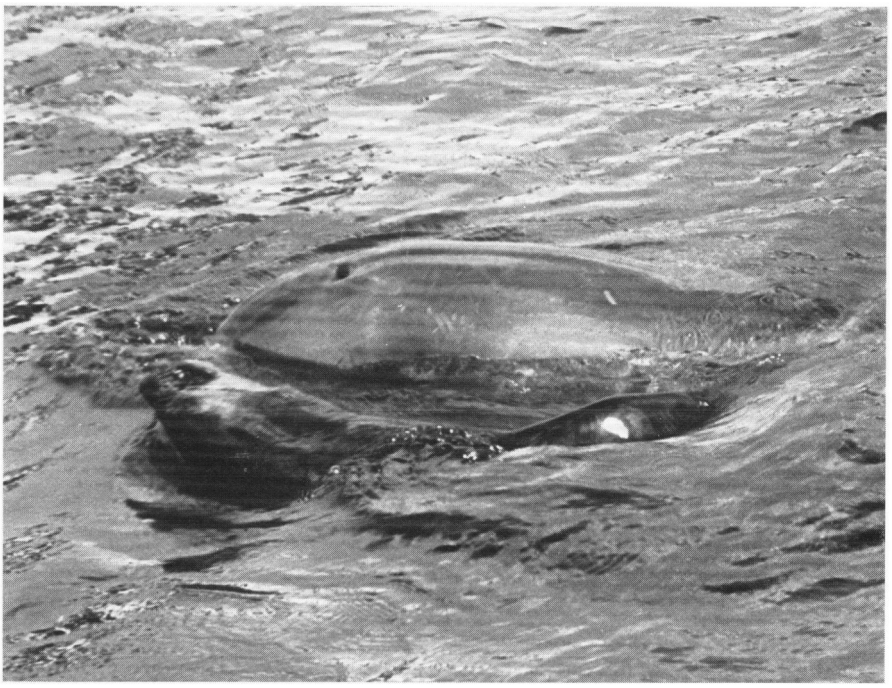
During tank cleaning operations, the dolphins showed a close interest in the manipulation of the steel hollow scraper attached to the suction hose which the diver pushed along the concrete bottom of the tank to remove and dispose of debris and a thick growth of seaweed (*Enteromorpha*). The dolphins hovered above and around the diver and watched his every move. After several days of use the apparatus was on one occasion left in the tank overnight. In the morning, Haig, the younger dolphin, was found manipulating the apparatus by lying flat along the hose, which she clasped with her flippers, her rostrum resting on the metal scoop. She investigated the apparatus from a variety of angles, manipulating it by pushing it in all directions and repeatedly rolling it over. Employing a rocking motion, she moved the apparatus back and forth, raising a cloud of debris from the pool bottom and dislodging seaweed which she ate. (The dolphins regularly eat considerable quantities of this seaweed. However, we have no evidence of plant eating in free-ranging dolphins, and consequently do not imply that this behaviour occurs under normal conditions). Hours after the apparatus had been removed, Haig was seen holding a piece of broken tile, approximately 6×8 cm in her mouth. She dislodged quantities of seaweed by swimming with the tile in contact with the bottom of the pool. She then dropped the tile, ate the seaweed, picked up the tile and repeated the process. After watching Haig for some time, Lady Dimple used the same piece of tile to scrape off seaweed and subsequently both dolphins were seen, each with their own piece of tile, removing seaweed together. This apparently had novelty value, since the dolphins initially removed large quantities of seaweed, far in ex-

cess of their eating requirements. The frequency of this behaviour decreased with time until the pieces of tile were removed for fear that the dolphins would shallow them.

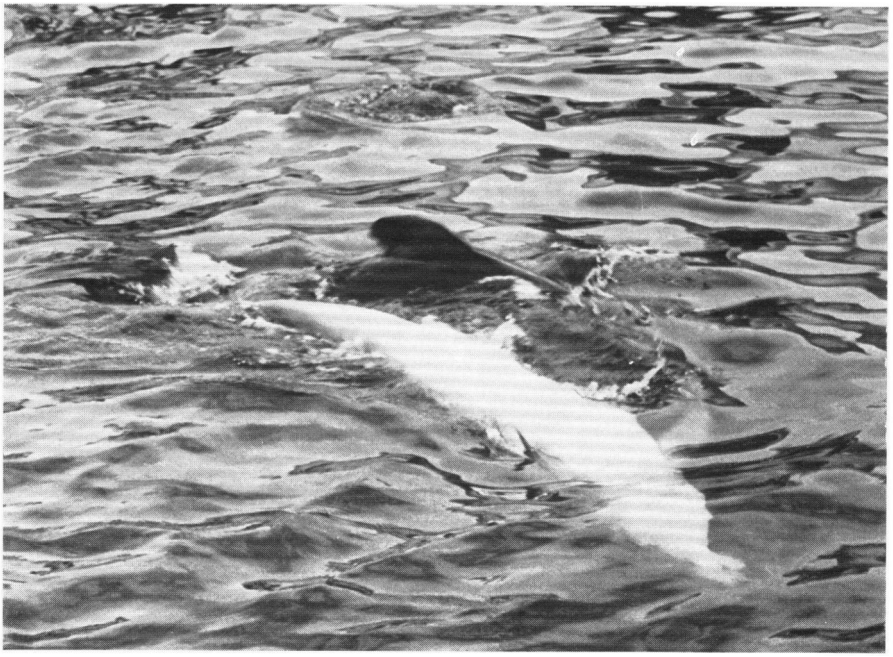
Mating attempts between a dolphin and a seal.

Mating behaviour between different delphinidae in captivity has been well documented (BROWN & NORRIS, 1956; BROWN, CALDWELL & CALDWELL, 1966). Homosexual behaviour between Haig and a humpback dolphin cow occurred regularly, although the pattern of mating behaviour differs between the two species. However, mating interactions between delphinids and pinnipeds in captivity have not previously been reported.

The adoption by the dolphin Haig of the postures of Tommy, the Cape Fur Seal, described in a previous section on observational learning, resulted in physical contact between the two animals: Haig initiated contact by gently rubbing against all parts of the body surface of the seal as typically occurs in the precopulatory behaviour of both dolphins and seals (Plates IXa and b). The seal then commenced to nuzzle the head of the dolphin in a typical greetings gesture. Tommy then permitted Haig to gently grasp his head (Plate Xa) and later to tow him underwater. These encounters sometimes initiated playful chasing which gradually emerged as clear sexual approaches by the dolphin (Plate Xb) which repeatedly presented its belly to the seal in a sexual invitation characteristic of bottlenose dolphins. At first the seal responded to these approaches by gently clasping the dolphin with its flippers and later by mounting whilst both were stationary on the surface (Plate XIa). For anatomical reasons, copulation in the seal is normally a *posteriori* whilst in the bottlenose dolphin it occurs, with the ventral surfases in contact. These incompatible mating procedures frustrated the copulatory attempts of both partners and led to fierce fighting and separation. When the seal had mounted on the surface, the dolphin submerged and swam slowly with the seal clasped firmly on its back making pelvic thrusts (Plates XIb, XIIa). The dolphin attempted to turn whilst swimming in order to present its belly to the seal (Plate XIIb), effectively displacing the seal from its position above the dorsal fin. The seal, slipping down the length of the dolphin, was ultimately shaken free, sometimes violently (Plate XIIIa). The dolphin thereupon turned and threatened the seal with open mouth. Violent chasing and biting ensued, Haig drawing blood on the hindflippers of the seal. Alternatively, Haig displaced him by swimming in reverse and in a circular manner (Plate XIIIb). The whole process was frequently repeated, sometimes daily, but progressively diminished until, a year after its inception, all interactions between the pair of animals ceased.

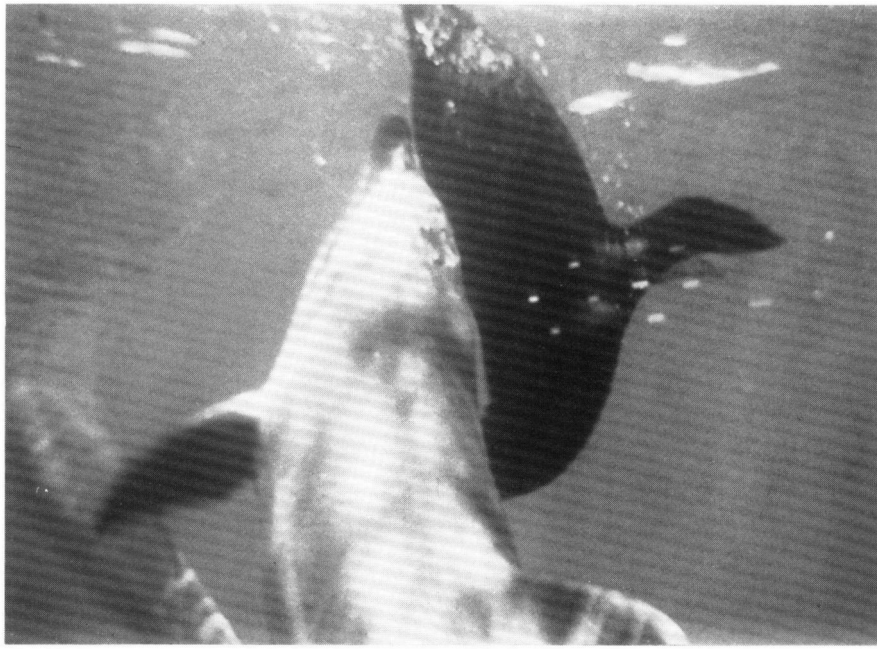


a. The dolphin and seal, swimming in unison, surface to breathe.

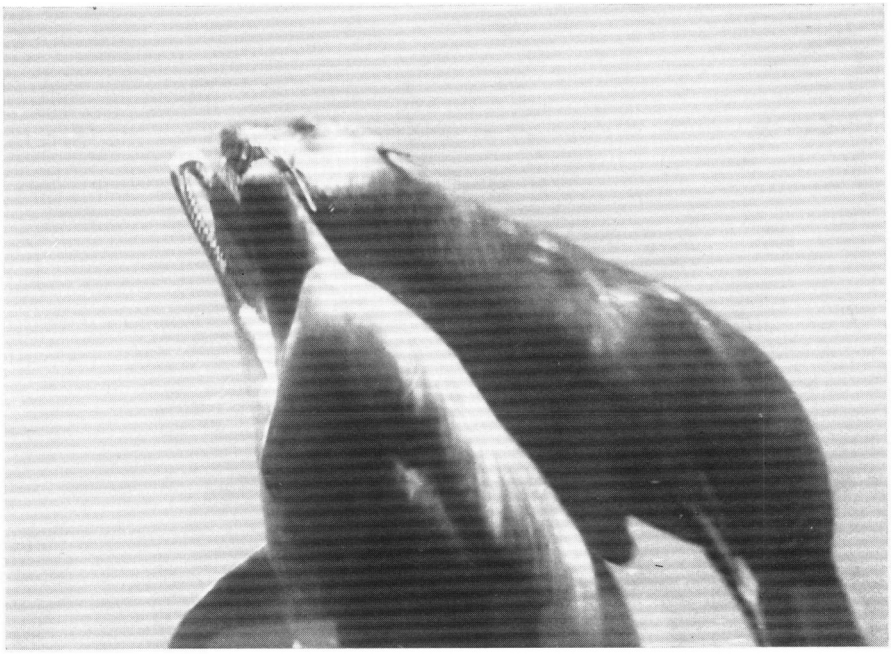


b. The dolphin lies inverted on the surface, flipper protruding, alongside the seal which is engaged in self-grooming procedures.

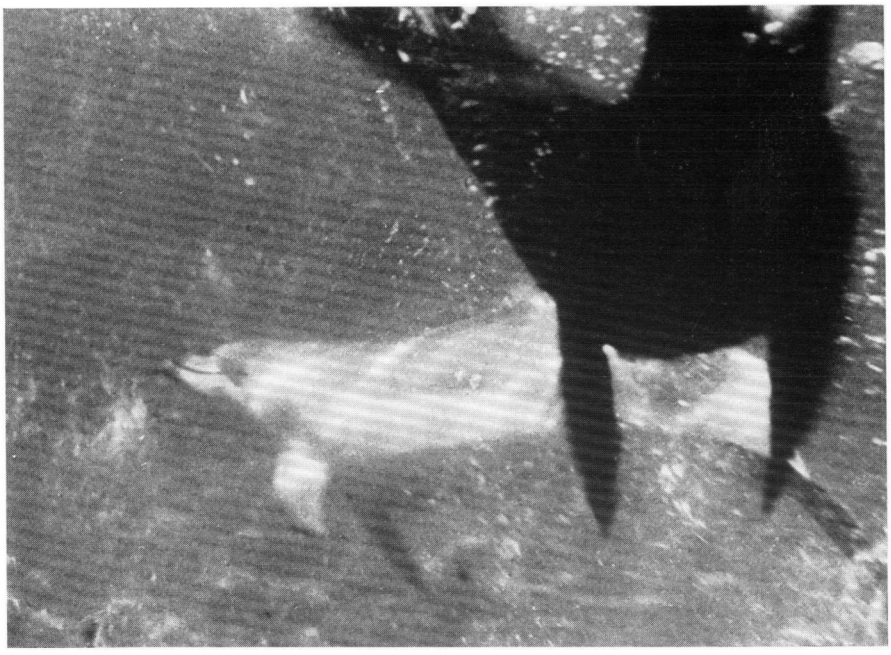
a. Underwater views illustrate the nature of physical contact typical of the precopulatory activity of both species.



b. Underwater views illustrate the nature of physical contact typical of the precopulatory activity of both species.

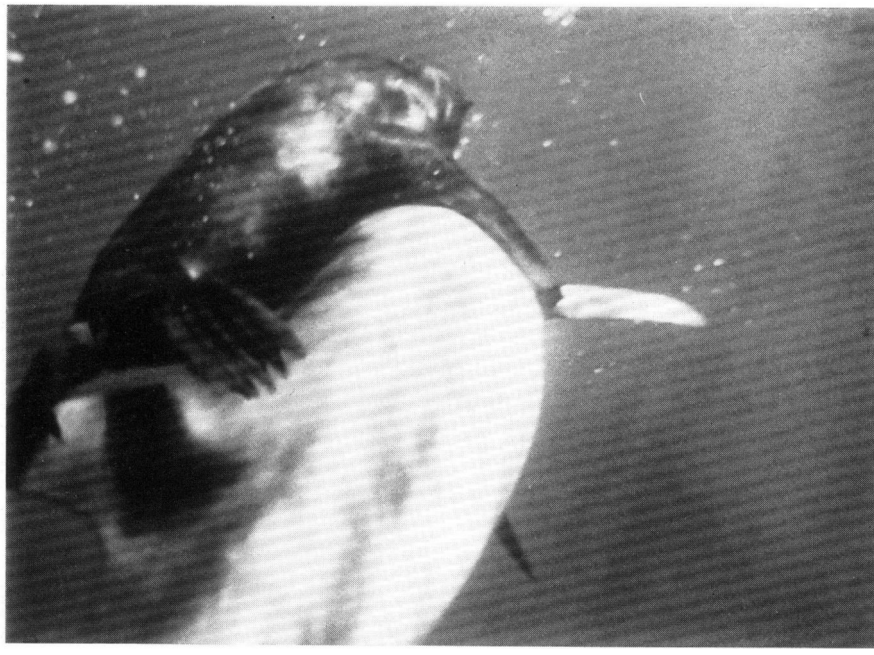


a. The seal manoeuvres to be gently clasped by the head, prior to towing, in this underwater encounter.



b. The dolphin displays sexually to the seal by adopting a characteristic S-shaped posture with outstretched flippers.

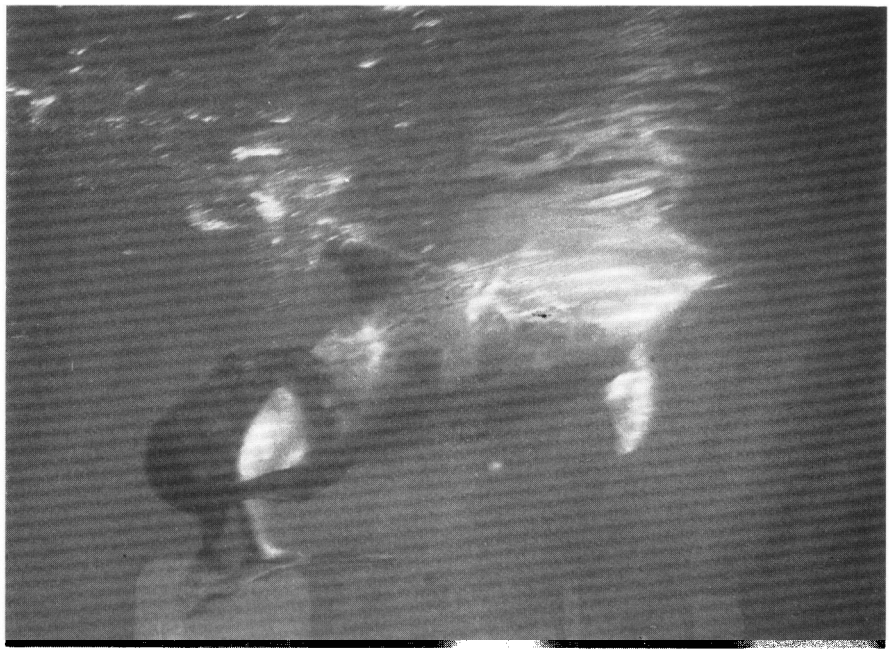
a. The seal mounts the dolphin whilst both animals are stationary on the surface.



b. The seal, clasping the dolphin firmly with its foreflippers, makes pelvic thrusts as the dolphin swims slowly underwater.

a. The seal, clasping the dolphin firmly with its foreflippers, makes pelvic thrusts as the dolphin swims slowly underwater.

b. The dolphin twists in an attempt to present its ventral surface to the seal.



a The dolphin dislodges the seal from its back.

b. The dolphin shakes the seal free by swimming in reverse.

Interactions between free-ranging dolphins and seals.

Close associations between feeding dolphins and seals are not uncommon under free-ranging conditions, particularly when pilchards (*Sardinops ocellata*) and squid (Loligidae) form the prey. Both species feed as competitors, dispersed over the same shoal of prey, sometimes intermingling, but in general ignoring each other. However, dolphins have previously been observed to make exploratory approaches to seals lying inactive on the surface (TAYLER & SAAYMAN, 1972).

During our current systematic studies of free-ranging dolphins at Plettenberg Bay (34°S. 24°E.), approximately 20 bottlenose dolphins, all judged by the size and shape of the dorsal fin to be fully adult, were observed to encircle a group of sleeping seals and then to herd some of them for more than 2 km. The incident occurred in a dead-calm sea on 13th May, 1971 in the late afternoon when an orderly group of the bottlenose dolphins, initially progressing along the surf-zone, changed direction and swam through the centre of a cluster of approximately 15 Cape Fur Seals which were lying inactive on the surface, flippers extended upwards in attitudes of repose. The dolphins, some individuals leaping and beating their flukes, turned back immediately they had passed the seals, formed a circle around some eight individuals, and swam back towards the shore, with the seals moving in their centre. Dolphins which formed the vanguard of the ensemble did not appear to make physical contact with the seals, whereas those on the periphery made constant approaches to the seals, diving under and around them; the flurries of white water and the close proximity of individual dolphins and seals indicated that some form of physical contact was taking place. At this point, the seals appeared to become agitated, some of them leaping at speed repeatedly clear of the water ("porpoising"). Some dolphins on the periphery of the group then commenced to leap repeatedly and slap down heavily on their sides, a form of behaviour generally associated with fish herding procedures. Two dolphins in the rear of the group constantly circled around those seals lagging behind and appeared to be preventing their escape from the encircling cetaceans. When, however, these two dolphins moved away to engage a stray seal on the periphery, most of the seals turned through this gap and swam rapidly towards the centre of the Bay. The leading dolphins then turned, overtook the seals, re-established the circle and once again herded them in the original direction. After 40 minutes the dolphins appeared to gradually lose interest in the procedure, and, one by one, the seals were able to make their escape, occasionally chased and harried by individual dolphins. At dusk, the dolphins formed up in a compact group and slowly left

the area. The seals rejoined those out in the Bay which had not been involved in the encounter and which were still apparently sleeping. The dolphins were followed and observed for some distance along the surf-zone when their behaviour indicated that they were herding fish and feeding.

The significance of this encounter was not at all obvious but there was no doubt that the dolphins had initiated the contact with the initially passive seals which had in no way appeared to represent competition to the subsequent feeding procedures of the dolphins.

DISCUSSION

The evidence presented in this report suggests that the faculty to learn by observation is well developed in adult as well as in immature bottlenose dolphins. The examples given are not exhaustive but represent the most striking of the numerous instances observed in over 8 years of maintenance of dolphins. These observations support the conclusion that the bottlenose dolphin displays a remarkable propensity and ability to learn a wide variety of motor patterns and to imitate sounds previously unfamiliar both to the individual animal as well as to its species, and, further, that these patterns are displayed spontaneously, practiced and elaborated, both in the presence and in the absence of the original stimulus, seemingly without any reinforcement apart from the performance of the activity itself.

The incidents reported, anecdotal though they are, indicate that observational learning and imitation, by several dolphins of varying age and sex classes, occurred in a wide variety of situations. The most remarkable of these perhaps was the reproduction of fine details by Haig of the comfort movements of the seal and the close resemblance to the sounds and activities of divers achieved by the bull Daan in cleaning the underwater viewing port. The refined reproduction of these motor performances necessitated a highly developed ability to perceive detail, to retain the perception for long periods of time in the absence of the stimulus originally evoking the act, and to practice and ultimately to so elaborate the behaviour imitated as to culminate in new modes of behavioural integration. For example, the original imitation by Haig of the sleeping and comfort movements of the seal Tommy culminated in unsuccessful mating attempts whereas observations by Haig of the cleaning operations by divers culminated in elementary tool-using by two dolphins.

The circularity of arguments resulting in the questionable attribution of intentionality to the seemingly intelligent acts of cetaceans has been comprehensively dealt with by EVANS & BASTIAN (1969). On the other hand, although we do not wish to imply a necessary relationship between insight or

purpose and the imitative behaviour described here, it seems clear that some of the incidents reported indicate the operation in the dolphin of cerebral processes which render the animal less "stimulus-bound" than appears to be the case in many other lower mammals. NISSEN (1951) has pointed out that the perception of complex relationships on the basis of learning and experience is possible only for phylogenetically advanced forms with highly developed neural capacities: "Somewhere among the higher mammals, perhaps not before the primate level, there emerges a new instrumentality for perceptual and conceptual organisation, namely, symbolisation" (p. 381).

Whereas primates are generally considered to represent the apex of this ability, KÖHLER (1925), writing on this point, states "... we have not been able to tell how far back and forward stretches the time 'in which the chimpanzee lives' ... A great many years spent with chimpanzees lead me to venture the opinion that, besides in the lack of speech, it is in the extremely narrow limits in *this* direction that the chief difference is to be found between anthropoids and even the most primitive human beings" (p. 227).

The lack of experimentation on problem solving in delphinids leaves, for the present, the question of the relative cognitive abilities of dolphins and non-human primates an open-ended one and possibly explains the fact that delphinids have not figured prominently in comparative assessments of animal intelligence in the literature. Further, nonhuman primates, which have received proportionately more attention, have possibly been considered to be more important because of theories concerning the evolutionary development of man. Although the question of the use of tools by animals is also a highly controversial one (HALL, 1963), it is generally agreed that the predisposition to manipulate, explore and exhibit advanced object-play is a fundamental prerequisite for the emergence of the skillful use of tools (JAY, 1968), for which the primate, both anatomically and neurologically, has been admirably selected by evolutionary pressure.

It is therefore remarkable that the virtually limbless dolphin, specialised for high-speed locomotion in a three-dimensional aquatic environment, all but barren of inanimate objects, can readily demonstrate in captivity unconditioned and spontaneous behavioural sequences, including the elementary use of tools, on a level comparable to that displayed by nonhuman primates when similarly placed in captive surroundings.

It is interesting to speculate concerning the functional role which imitation may play in the social life of dolphins under normal conditions. It is noteworthy that the active and passive roles in precopulatory behaviour and courtship displays in captive bottlenose dolphins are continuously interchangeable between bulls and cows so that it is not possible to identify the sex of the

individuals in unknown pairs on the basis of their behaviour alone (SAAYMAN, TAYLER & BOWER, in press). We have obtained similar findings from the frame-by-frame analysis of ciné-films of mating trios of southern right whales (*Eubalaena australis*) in Algoa Bay (unpublished observations). Furthermore, the sequence of events in bottlenose dolphins varies constantly, and it may differ markedly in the same animal with different partners. In our current systematic studies of free-ranging dolphins, as many as three bulls, all displaying erections, have been observed simultaneously attempting to mate with a single cow in groups of up to 10 animals all engaged in courtship displays. In these courtship contexts, imitation may very well play a decisive role in the selection of mating partners. This explanation is particularly suggested when both partners engage in closely coordinated formation swimming, in which both simultaneously adopt identical postures, prior to mating attempts. It is proposed therefore, that imitation of the behavioural posture of the partner may provide the stimulus for selective mating responses or, at the least, may serve to reinforce social bonds and to strengthen group cohesiveness in a highly social animal whose mode of social progression is generally characterised by closely co-ordinated formation swimming. The imitative propensity in the dolphin, therefore, may be so inherently programmed as to be inappropriately released under abnormal conditions in captivity.

As increasing amounts of data accumulate from the systematic studies of trained observers on a variety of animals in their natural habitat, the significance of encounters between different forms, such as those reported here as well as the numerous instances in which dolphins have approached human bathers (ALPERS, 1963; TAYLER & SAAYMAN, 1972), may become clear. At present no explanation for the behaviour observed can be offered, but it is nevertheless noteworthy that the approaches thus far observed have been initiated by the dolphins.

SUMMARY

Evidence is presented for the ability of Indian Ocean bottlenose dolphins (*Tursiops aduncus*) to learn complex behavioural sequences by observation and to imitate a wide variety of previously unfamiliar motor patterns and sounds, without any apparent external reinforcement apart from the performance of the activity itself, both in the presence and in the absence of the stimulus which originally evoked the imitative behaviour. The reproduction in fine detail by a dolphin of the comfort and sleeping movements of a Cape Fur Seal (*Arctocephalus pusillus*), leading to behavioural interactions between the two forms with attempts at copulation, and culminating in aggression is described. Further instances of observational learning are cited, including the imitation by dolphins of the activities and sounds of human divers during maintenance operations in the pool which resulted in elementary tool-using behaviour by the dolphins. Interactions between dolphins and seals occurred not only in captivity but also under free-ranging conditions. The

significance of imitation in delphinids for comparative assessments of animal intelligence is discussed and the possible function under normal conditions of the delphinid faculty to imitate is considered. It is proposed that the tendency to imitate may be genetically programmed in delphinids to operate in the selection of compatible sexual partners, in the reinforcement of social bonds and in the strengthening of group cohesiveness.

REFERENCES

ALPERS, A. (1963). Dolphins. — John Murray, London.

BROWN, D. H. & NORRIS, K. S. (1956). Observations of captive and wild cetaceans. — J. Mammal. 37, p. 311-326.

——, CALDWELL, D. K. & CALDWELL, M. C. (1966). Observations on the behavior of wild and captive false killer whales, with notes on associated behavior of other genera of captive delphinids. — Los Angeles County Mus., Contri. Sci. 95, p. 1-32.

CALDWELL, M. C. & CALDWELL, D. K. (1967). Intraspecific transfer of information via the pulsed sound in captive odontocete cetaceans. — In: R. G. BUSNEL. Les systèmes sonars animaux. Frascati. p. 879-936.

CALDWELL, D. K. & CALDWELL, M. C. (1968). The dolphin observed. — Nat. Hist., N.Y. 77, p. 58-65.

CALDWELL, M. C., CALDWELL, D. K. & SIEBENALER. J. B. (1965). Observations on captive and wild Atlantic bottlenose dolphins, *Tursiops truncatus*, in the northeastern Gulf of Mexico. — Los Angeles County Mus., Contri. Sci. 91, 1-10.

EVANS, W. E. & BASTIAN, J. (1969). Marine mammal communication: social and ecological factors. — In: H. T. ANDERSEN. The biology of marine mammals. Academic Press. New York and London. p. 425-475.

HALL, K. R. L. (1963). Tool-using performances as indicators of behavioral adaptibility. — Current Anthropology 4, p. 479-494.

JAY, P. (1968). Primate field studies and human evolution. — In: P. JAY. Primates: Studies in adaptation and variability. Holt, Rinehart and Winston. New York. p. 487-503.

KELLOG, W. N. (1961). Porpoises and sonar. — University of Chicago Press. Chicago and London.

KÖHLER, W. (1925). The mentality of apes. — Penguin Books Ltd. Harmondsworth.

KRITZLER, H. (1952). Observations on the pilot whale in captivity. — J. Mammal. 33, p. 321-334.

KRUGER, L. (1966). Specialised features of the cetacean brain. — In: K. S. NORRIS. Whales, dolphins and porpoises. University of California Press. Berkeley and Los Angeles. p. 232-254.

LAYNE, J. N. & CALDWELL, D. K. (1964). Behavior of the Amazon dolphin, *Inia geoffrensis* (Blainville), in captivity. — Zoologica 49, p. 81-108.

LILLY, J. C. (1963). Distress call of the bottlenose dolphin: stimuli and evoked behavioral responses. — Science 139, p. 116-118.

LOIZOS, C. (1967). Play behaviour in higher primates: a review. — In: D. MORRIS. Primate Ethology. Weidenfeld and Nicolson. London. p. 176-218.

MCBRIDE, A. F. & HEBB, D. O. (1948). Behavior of the captive bottlenose dolphin, *Tursiops truncatus*. — J. Comp. physiol. Psychol. 41, p. 111-123.

—— & KRITZLER, H. (1951). Observations on pregnancy, parturition, and postnatal behavior in the bottlenose dolphin. — J. Mammal. 32, p. 251-266.

NISSEN, H. W. (1951). Phylogenetic comparison. — In: S. S. STEVENS. Handbook of experimental psychology. John Wiley and Sons, Inc. New York and London. p. 347-386.

PILLERI, G. (1971). Intelligence under water — the dolphin brain. — Documenta Geigy Nautilus 9, p. 2-4.

SAAYMAN, G. S., TAYLER, C. K. & BOWER, D. (1973). Diurnal activity cycles in captive and free-ranging Indian Ocean bottlenose dolphins (*Tursiops aduncus* Ehrenburg). — Behaviour 44, 212-233.

SCHNEIDER, K. M. (1942). Von Südafrikanischen Zwergseebären. — Zool. Gart. Lpz. 14, p. 69-95.

TAVOLGA, M. C. (1966). Behavior of the bottlenose dolphin (*Tursiops truncatus*): Social interactions in a captive colony. — In: K. S. NORRIS. Whales, dolphins and porpoises. University of California Press. Berkeley and Los Angeles. p. 718-730.

TAYLER, C. K. & SAAYMAN, G. S. (1972). The social organisation and behaviour of dolphins (*Tursiops aduncus*) and baboons (*Papio ursinus*): some comparisons and assessments. — Ann. Cape Prov. Mus. (Nat. Hist.) 9, p. 11-49.

TIETZ, R. M. & TAYLER, C. K. (1964). Dolphin talk. — Scientific South Africa 1, p. 385-390.

ZUSAMMENFASSUNG

Das vorliegende Material zeigt, dass der Delphin (*Tursiops aduncus*) imstande ist, eine komplexe Verhaltensfolge durch Beobachtung zu lernen. Er imitiert eine grosse Verschiedenartigkeit ihm vorher unbekannter motorischer und akustischer Ausdrücke ohne ersichtlichen äusseren Zwang, abgesehen von der Vorführung der Ausdrücke oder Tätigkeiten als solche. Dabei ist nicht massgebend, ob die Demonstration der Tätigkeit, die die Imitation stimulierte, gleichzeitig stattfindet oder nicht. Es wird beschrieben, wie ein Delphin die Entspannungs- und Schlafbewegungen eines südafrikanischen Zwergseebären (*Arctocephalus pusillus*) in feinem Detail wiedergibt, wobei es zu Paarungsversuchen zwischen den beiden Tierarten kommt, die in Aggression ausarten. Das Zusammenspiel zwischen Delphin und Zwergseebären wurde nicht nur in Gefangenschaft, sondern auch in freier Natur beobachtet. Weitere Beispiele des Lernens durch Beobachtung bei Delphinen werden aufgezeigt; unter anderem die Imitation der Tätigkeit von Tauchern akustisch sowie in der Bewegung während Instandhaltungsarbeiten im Delphinbecken, wobei die Delphine versuchten, in elementarer Weise, die Werkzeuge der Taucher zu benutzen. Die Bedeutung dieser Imitation für eine vergleichende Bestimmung der Intelligenz bei Tieren im allgemeinen wird diskutiert, wobei die mögliche Funktion der Imitationsfähigkeit der Delphine unter normalen Bedingungen in Betracht gezogen wird. Es wird die Möglichkeit vorgeschlagen, daß die Tendenz, zu imitieren bei Delphinen genetisch programmiert ist, um bei der sexuellen Partnerwahl wirksam zu werden, die Geselligkeit zu fördern und den Zusammenhalt der Gruppe zu stärken.