

THE NATURE OF LOVE¹

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Love is a wondrous state, deep, tender, and rewarding. Because of its intimate and personal nature it is regarded by some as an improper topic for experimental research. But, whatever our personal feelings may be, our assigned mission as psychologists is to analyze all facets of human and animal behavior into their component variables. So far as love or affection is concerned, psychologists have failed in this mission. The little we know about love does not transcend simple observation, and the little we write about it has been written better by poets and novelists. But of greater concern is the fact that psychologists tend to give progressively less attention to a motive which pervades our entire lives. Psychologists, at least psychologists who write textbooks, not only show no interest in the origin and development of love or affection, but they seem to be unaware of its very existence.

The apparent repression of love by modern psychologists stands in sharp contrast with the attitude taken by many famous and normal people. The word "love" has the highest reference frequency of any word cited in Bartlett's book of *Familiar Quotations*. It would appear that this emotion has long had a vast interest and fascination for human beings, regardless of the attitude taken by psychologists; but the quotations cited, even by famous and normal people, have a mundane redundancy. These authors and authorities have stolen love from the child and infant and made it the exclusive property of the adolescent and adult.

Thoughtful men, and probably all women, have speculated on the nature of love. From the developmental point of view, the general plan is quite

clear: The initial love responses of the human being are those made by the infant to the mother or some mother surrogate. From this intimate attachment of the child to the mother, multiple learned and generalized affectional responses are formed.

Unfortunately, beyond these simple facts we know little about the fundamental variables underlying the formation of affectional responses and little about the mechanisms through which the love of the infant for the mother develops into the multifaceted response patterns characterizing love or affection in the adult. Because of the dearth of experimentation, theories about the fundamental nature of affection have evolved at the level of observation, intuition, and discerning guesswork, whether these have been proposed by psychologists, sociologists, anthropologists, physicians, or psychoanalysts.

The position commonly held by psychologists and sociologists is quite clear: The basic motives are, for the most part, the primary drives—particularly hunger, thirst, elimination, pain, and sex—and all other motives, including love or affection, are derived or secondary drives. The mother is associated with the reduction of the primary drives—particularly hunger, thirst, and pain—and through learning, affection or love is derived.

It is entirely reasonable to believe that the mother through association with food may become a secondary-reinforcing agent, but this is an inadequate mechanism to account for the persistence of the infant-maternal ties. There is a spate of researches on the formation of secondary reinforcers to hunger and thirst reduction. There can be no question that almost any external stimulus can become a secondary reinforcer if properly associated with tissue-need reduction, but the fact remains that this redundant literature demonstrates unequivocally that such derived drives suffer relatively rapid experimental extinction. Contrariwise, human affection does not extinguish when the mother ceases to have intimate association with the drives in question. Instead, the affectional

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FIG. 1. Response to cloth pad by one-day-old monkey.

ties to the mother show a lifelong, unrelenting persistence and, even more surprising, widely expanding generality.

Oddly enough, one of the few psychologists who took a position counter to modern psychological dogma was John B. Watson, who believed that love was an innate emotion elicited by cutaneous stimulation of the erogenous zones. But experimental psychologists, with their peculiar propensity to discover facts that are not true, brushed this theory aside by demonstrating that the human neonate had no differentiable emotions, and they established a fundamental psychological law that prophets are without honor in their own profession.

The psychoanalysts have concerned themselves with the problem of the nature of the development of love in the neonate and infant, using ill and aging human beings as subjects. They have discovered the overwhelming importance of the breast and related this to the oral erotic tendencies developed at an age preceding their subjects' memories. Their theories range from a belief that the infant has an innate need to achieve and suckle at the breast to beliefs not unlike commonly accepted psychological theories. There are exceptions, as seen in the recent writings of John Bowlby, who attributes importance not only to food and thirst satisfaction, but also to "primary object-clinging," a need for intimate physical contact, which is initially associated with the mother.

As far as I know, there exists no direct experimental analysis of the relative importance of the stimulus variables determining the affectional or

love responses in the neonatal and infant primate. Unfortunately, the human neonate is a limited experimental subject for such researches because of his inadequate motor capabilities. By the time the human infant's motor responses can be precisely measured, the antecedent determining conditions cannot be defined, having been lost in a jumble and jungle of confounded variables.

Many of these difficulties can be resolved by the use of the neonatal and infant macaque monkey as the subject for the analysis of basic affectional variables. It is possible to make precise measurements in this primate beginning at two to ten days of age, depending upon the maturational status of the individual animal at birth. The macaque infant differs from the human infant in that the monkey is more mature at birth and grows more rapidly; but the basic responses relating to affection, including nursing, contact, clinging, and even visual and auditory exploration, exhibit no fundamental differences in the two species. Even the development of perception, fear, frustration, and learning capability follows very similar sequences in rhesus monkeys and human children.

Three years' experimentation before we started our studies on affection gave us experience with the neonatal monkey. We had separated more than 60 of these animals from their mothers 6 to 12 hours after birth and suckled them on tiny bottles. The infant mortality was only a small fraction of what would have obtained had we let the monkey mothers raise their infants. Our bottle-



FIG. 2. Response to gauze pad by six-month-old monkey used in earlier study.

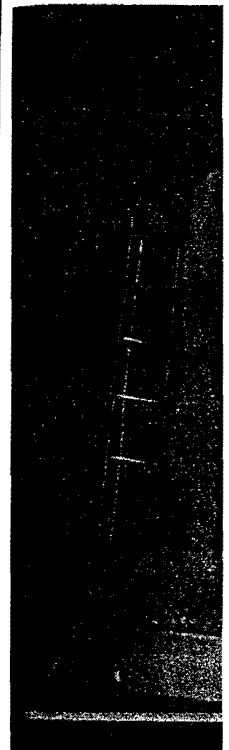


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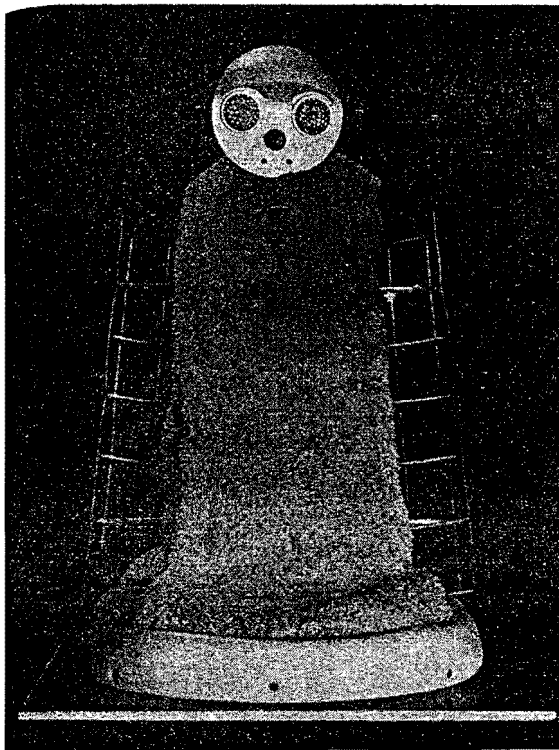


FIG. 3. Cloth mother surrogate.

fed babies were healthier and heavier than monkey-mother-reared infants. We know that we are better monkey mothers than are real monkey mothers thanks to synthetic diets, vitamins, iron extracts, penicillin, chloromycetin, 5% glucose, and constant, tender, loving care.

During the course of these studies we noticed that the laboratory-raised babies showed strong attachment to the cloth pads (folded gauze diapers) which were used to cover the hardware-cloth floors of their cages. The infants clung to these pads and engaged in violent temper tantrums when the pads were removed and replaced for sanitary reasons. Such contact-need or responsiveness had been reported previously by Gertrude van Wagenen for the monkey and by Thomas McCulloch and George Haslerud for the chimpanzee and is reminiscent of the devotion often exhibited by human infants to their pillows, blankets, and soft, cuddly stuffed toys. Responsiveness by the one-day-old infant monkey to the cloth pad is shown in Figure 1, and an unusual and strong attachment of a six-month-old infant to the cloth pad is illustrated

in Figure 2. The baby, human or m to survive, must clutch at more than

We had also discovered during some servational studies that a baby monkey a bare wire-mesh cage floor survives with d if at all, during the first five days of life. wire-mesh cone is introduced, the baby does bet and, if the cone is covered with terry cloth, husk healthy, happy babies evolve. It takes more than a baby and a box to make a normal monkey. We were impressed by the possibility that, above and beyond the bubbling fountain of breast or bottle, contact comfort might be a very important variable in the development of the infant's affection for the mother.

At this point we decided to study the development of affectional responses of neonatal and infant monkeys to an artificial, inanimate mother, and so we built a surrogate mother which we hoped and believed would be a good surrogate mother. In devising this surrogate mother we were dependent neither upon the capriciousness of evolutionary processes nor upon mutations produced by chance radioactive fallout. Instead, we designed the mother surrogate in terms of modern human-engineering principles (Figure 3). We produced a perfectly proportioned, streamlined body stripped of unnecessary bulges and appendices. Redundancy in the surrogate mother's system was avoided by reducing the number of breasts from two to one and placing this unibreast in an upper-thoracic, sagittal position, thus maximizing the natural and known perceptual-motor capabilities of the infant

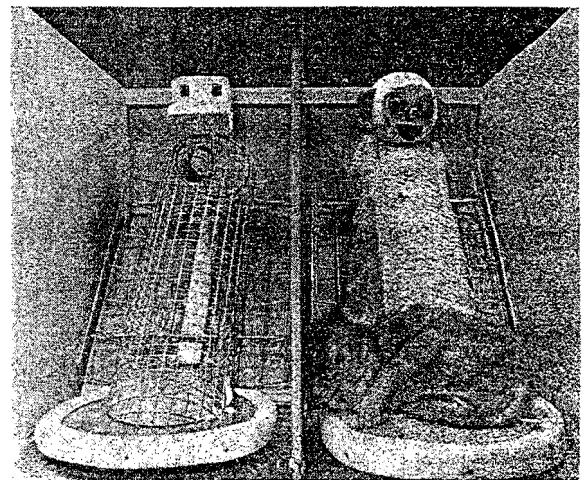


FIG. 4. Wire and cloth mother surrogates.

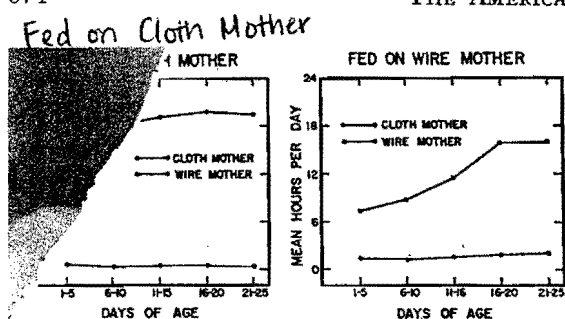


FIG. 5. Time spent on cloth and wire mother surrogates.

operator. The surrogate was made from a block of wood, covered with sponge rubber, and sheathed in tan cotton terry cloth. A light bulb behind her radiated heat. The result was a mother, soft, warm, and tender, a mother with infinite patience, a mother available twenty-four hours a day, a mother that never scolded her infant and never struck or bit her baby in anger. Furthermore, we designed a mother-machine with maximal maintenance efficiency since failure of any system or function could be resolved by the simple substitution of black boxes and new component parts. It is our opinion that we engineered a very superior monkey mother, although this position is not held universally by the monkey fathers.

Before beginning our initial experiment we also designed and constructed a second mother surrogate, a surrogate in which we deliberately built less than the maximal capability for contact comfort. This surrogate mother is illustrated in Figure 4. She is made of wire-mesh, a substance entirely adequate to provide postural support and nursing capability, and she is warmed by radiant heat. Her body differs in no essential way from that of the cloth mother surrogate other than in the quality of the contact comfort which she can supply.

In our initial experiment, the dual mother-surrogate condition, a cloth mother and a wire mother were placed in different cubicles attached to the infant's living cage as shown in Figure 4. For four newborn monkeys the cloth mother lactated and the wire mother did not; and, for the other four, this condition was reversed. In either condition the infant received all its milk through the mother surrogate as soon as it was able to maintain itself in this way, a capability achieved within two or three days except in the case of very immature infants. Supplementary feedings were given until the milk

intake from the mother surrogate was adequate. Thus, the experiment was designed as a test of the relative importance of the variables of contact comfort and nursing comfort. During the first 14 days of life the monkey's cage floor was covered with a heating pad wrapped in a folded gauze diaper, and thereafter the cage floor was bare. The infants were always free to leave the heating pad or cage floor to contact either mother, and the time spent on the surrogate mothers was automatically recorded. Figure 5 shows the total time spent on the cloth and wire mothers under the two conditions of feeding. These data make it obvious that contact comfort is a variable of overwhelming importance in the development of affectional responses, whereas lactation is a variable of negligible importance. With age and opportunity to learn, subjects with the lactating wire mother showed decreasing responsiveness to her and increasing responsiveness to the nonlactating cloth mother, a finding completely contrary to any interpretation of derived drive in which the mother-form becomes conditioned to hunger-thirst reduction. The persistence of these differential responses throughout 165 consecutive days of testing is evident in Figure 6.

One control group of neonatal monkeys was raised on a single wire mother, and a second control group was raised on a single cloth mother. There were no differences between these two groups in amount of milk ingested or in weight gain. The

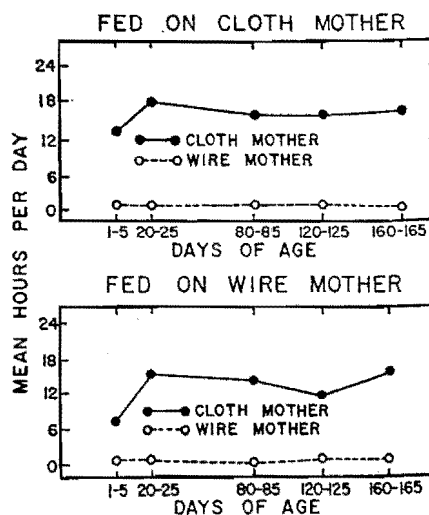


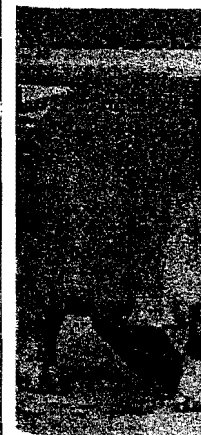
FIG. 6. Long-term contact time on cloth and wire mother surrogates.

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only difference between the groups lay in the composition of the feces, the softer stools of the wire-mother infants suggesting psychosomatic involvement. The wire mother is biologically adequate but psychologically inept.

We were not surprised to discover that contact comfort was an important basic affectional or love variable, but we did not expect it to overshadow so completely the variable of nursing; indeed, the disparity is so great as to suggest that the primary function of nursing as an affectional variable is that of insuring frequent and intimate body contact of the infant with the mother. Certainly, man cannot live by milk alone. Love is an emotion that does not need to be bottle- or spoon-fed, and we may be sure that there is nothing to be gained by giving lip service to love.

A charming lady once heard me describe these experiments; and, when I subsequently talked to her, her face brightened with sudden insight: "Now I know what's wrong with me," she said, "I'm just a wire mother." Perhaps she was lucky. She might have been a wire wife.

We believe that contact comfort has long served the animal kingdom as a motivating agent for affectional responses. Since at the present time we have no experimental data to substantiate this position, we supply information which must be accepted, if at all, on the basis of face validity:



—From *Look*, August 19, 1958

The Hippopotamus

This is the skin some babies feel
Replete with hippo love appeal.
Each contact, cuddle, push, and shove
Elicits tons of baby love.



—From *Zoo Guide*, Zoological Society of London

The Rhinoceros

The rhino's skin is thick and tough,
And yet this skin is soft enough
That baby rhinos always sense,
A love enormous and intense.

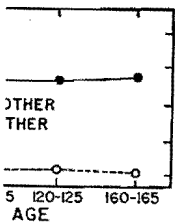


From *All About Snakes*, E. M. Hale & Co.

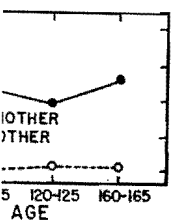
The Snake

To baby vipers, scaly skin
Engenders love 'twixt kith and kin.
Each animal by God is blessed
With kind of skin it loves the best.

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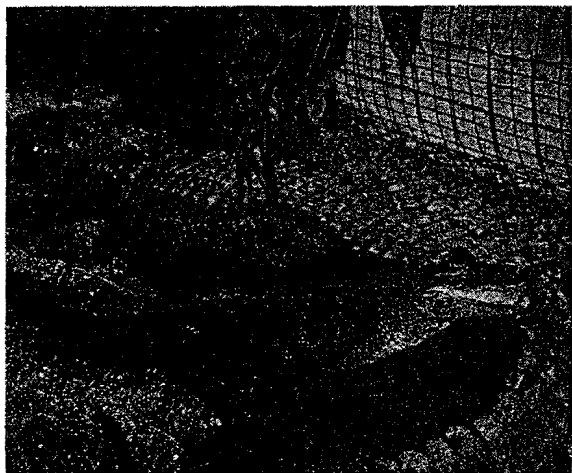
on cloth and wire mother



—Ylla

The Elephant

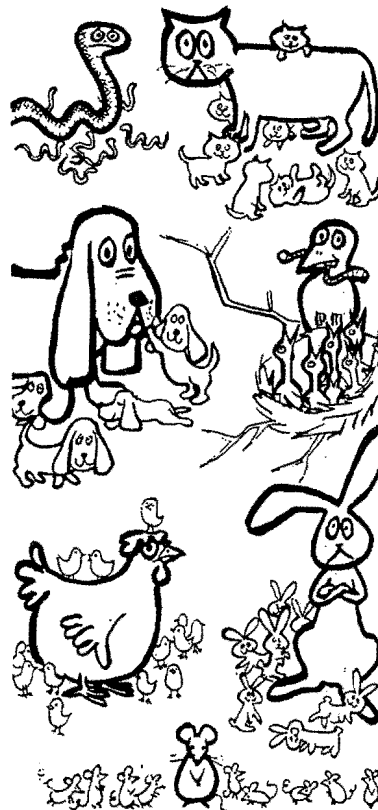
Though mother may be short on arms,
Her skin is full of warmth and charms.
And mother's touch on baby's skin
Endears the heart that beats within.



—Sponholz

The Crocodile

Here is the skin they love to touch.
It isn't soft and there isn't much,
But its contact comfort will beguile
Love from the infant crocodile.



You see, all God's chillun's got skin.

One function of the real mother, human or sub-human, and presumably of a mother surrogate, is to provide a haven of safety for the infant in times of fear and danger. The frightened or ailing child clings to its mother, not its father; and this selective responsiveness in times of distress, disturbance, or danger may be used as a measure of the strength of affectional bonds. We have tested this kind of differential responsiveness by presenting to the infants in their cages, in the presence of the two mothers, various fear-producing stimuli such as the moving toy bear illustrated in Figure 13. A typical response to a fear stimulus is shown in Figure 14, and the data on differential responsiveness are presented in Figure 15. It is apparent that the cloth mother is highly preferred over the wire one, and this differential selectivity is enhanced by age and experience. In this situation, the variable of nursing appears to be of absolutely no importance: the infant consistently seeks the soft mother surrogate regardless of nursing condition.

Similarly, the mother or mother surrogate provides its young with a source of security, and this

role or function is : mother and child are present time we have tionship on four of signed to the dual introducing them for environment of a re feet by six feet (als and containing mul curiosity-manipulator The subjects were p week for eight wee present during alte: mother present durin was always available out all sessions. Af sions, the infants alw rogate when she w: rubbed their bodies manipulated her bod ditional sessions, th mother surrogate as operations. As is s they would explore a then return to the mo



FIG. 13. T

role or function is seen with special clarity when mother and child are in a strange situation. At the present time we have completed tests for this relationship on four of our eight baby monkeys assigned to the dual mother-surrogate condition by introducing them for three minutes into the strange environment of a room measuring six feet by six feet (also called the "open-field test") and containing multiple stimuli known to elicit curiosity-manipulatory responses in baby monkeys. The subjects were placed in this situation twice a week for eight weeks with no mother surrogate present during alternate sessions and the cloth mother present during the others. A cloth diaper was always available as one of the stimuli throughout all sessions. After one or two adaptation sessions, the infants always rushed to the mother surrogate when she was present and clutched her, rubbed their bodies against her, and frequently manipulated her body and face. After a few additional sessions, the infants began to use the mother surrogate as a source of security, a base of operations. As is shown in Figures 16 and 17, they would explore and manipulate a stimulus and then return to the mother before adventuring again



FIG. 14. Typical response to cloth mother surrogate in fear test.



FIG. 13. Typical fear stimulus.

into the strange new world. The behavior of these infants was quite different when the mother was absent from the room. Frequently they would freeze in a crouched position, as is illustrated in Figures 18 and 19. Emotionality indices such as vocalization, crouching, rocking, and sucking increased sharply, as shown in Figure 20. Total emotionality score was cut in half when the mother was present. In the absence of the mother some of the experimental monkeys would rush to the

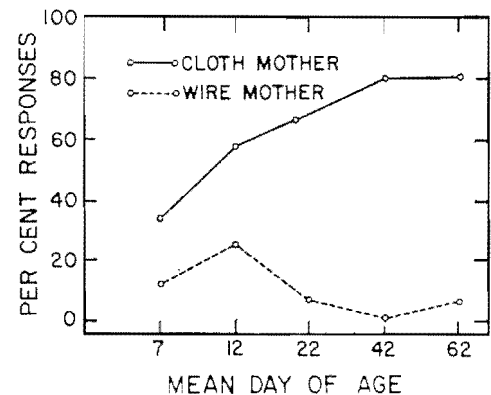


FIG. 15. Differential responsiveness in fear tests.



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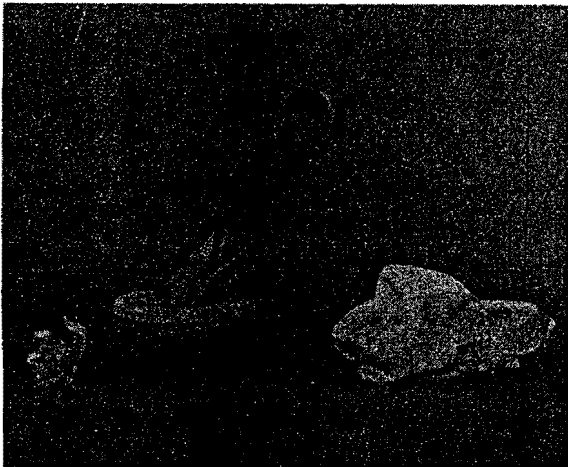


FIG. 16. Response to cloth mother in the open-field test.

center of the room where the mother was customarily placed and then run rapidly from object to object, screaming and crying all the while. Continuous, frantic clutching of their bodies was very common, even when not in the crouching position. These monkeys frequently contacted and clutched the cloth diaper, but this action never pacified them. The same behavior occurred in the presence of the wire mother. No difference between the cloth-mother-fed and wire-mother-fed infants was demonstrated under either condition. Four control infants never raised with a mother surrogate showed the same emotionality scores when the mother was absent as the experimental infants showed in the absence of the mother, but the controls' scores were slightly larger in the presence of the mother surrogate than in her absence.

Some years ago Robert Butler demonstrated that



FIG. 17. Object exploration in presence of cloth mother.

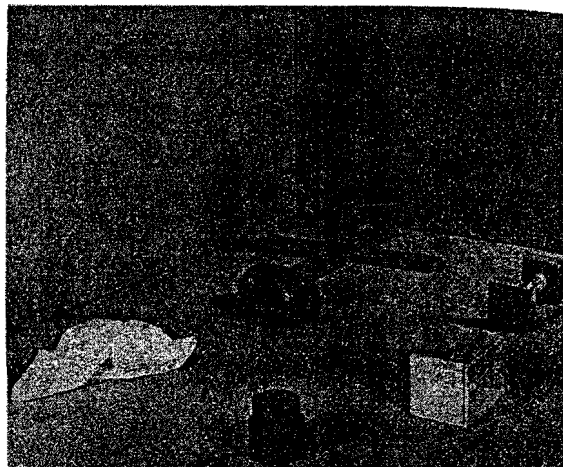


FIG. 18. Response in the open-field test in the absence of the mother surrogate.

mature monkeys enclosed in a dimly lighted box would open and reopen a door hour after hour for no other reward than that of looking outside the box. We now have data indicating that neonatal monkeys show this same compulsive visual curiosity on their first test day in an adaptation of the Butler apparatus which we call the "love machine," an apparatus designed to measure love. Usually these tests are begun when the monkey is 10 days of age, but this same persistent visual exploration has been obtained in a three-day-old monkey during the first half-hour of testing. Butler also demonstrated that rhesus monkeys show selectivity in rate and frequency of door-opening to stimuli of differential attractiveness in the visual field outside the box. We have utilized this principle of



FIG. 19. Response in the open-field test in the absence of the mother surrogate.

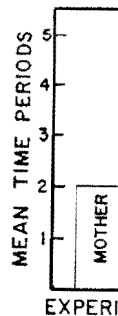


FIG. 20. Emotionality scores in the presence of the mother.

response selectivity in the baby versus the adult sequence involves in which four stimulus infant monkey, and a 30-minute period for four subjects in the apparatus, and only one set of four tests to obtain information.

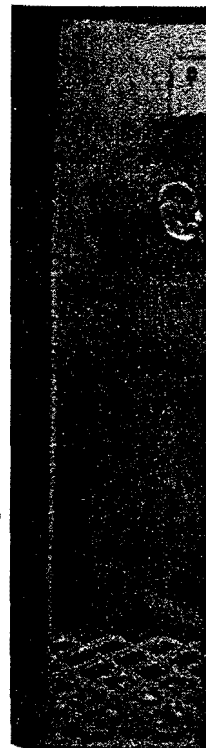


FIG. 21. Visual exploration in the presence of the mother.

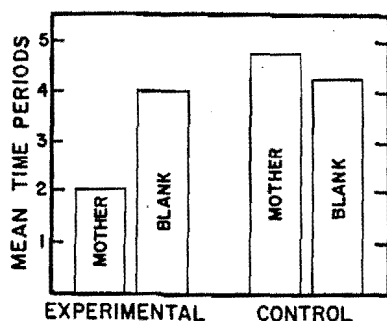


FIG. 20. Emotionality index with and without the presence of the cloth mother.

response selectivity by the monkey to measure strength of affectional responsiveness in our infants in the baby version of the Butler box. The test sequence involves four repetitions of a test battery in which four stimuli—cloth mother, wire mother, infant monkey, and empty box—are presented for a 30-minute period on successive days. The first four subjects in the dual mother-surrogate group were given a single test sequence at 40 to 50 days of age, depending upon the availability of the apparatus, and only their data are presented. The second set of four subjects is being given repetitive tests to obtain information relating to the develop-

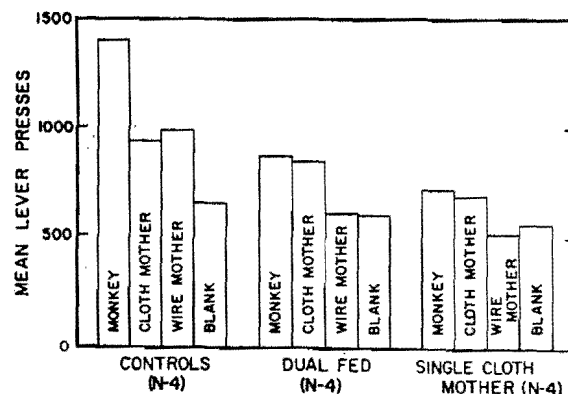


FIG. 22. Differential responses to visual exploration.

ment of visual exploration. The apparatus is illustrated in Figure 21. The data obtained from the first four infants raised with the two mother surrogates are presented in the middle graph of Figure 22 and show approximately equal responding to the cloth mother and another infant monkey, and no greater responsiveness to the wire mother than to an empty box. Again, the results are independent of the kind of mother that lactated, cloth or wire. The same results are found for a control group raised, but not fed, on a single cloth mother; these data appear in the graph on the right. Contrariwise, the graph on the left shows no differential responsiveness to cloth and wire mothers by a second control group, which was not raised on any mother surrogate. We can be certain that not all love is blind.

The first four infant monkeys in the dual mother-surrogate group were separated from their mothers between 165 and 170 days of age and tested for retention during the following 9 days and then at 30-day intervals for six successive months. Affectional

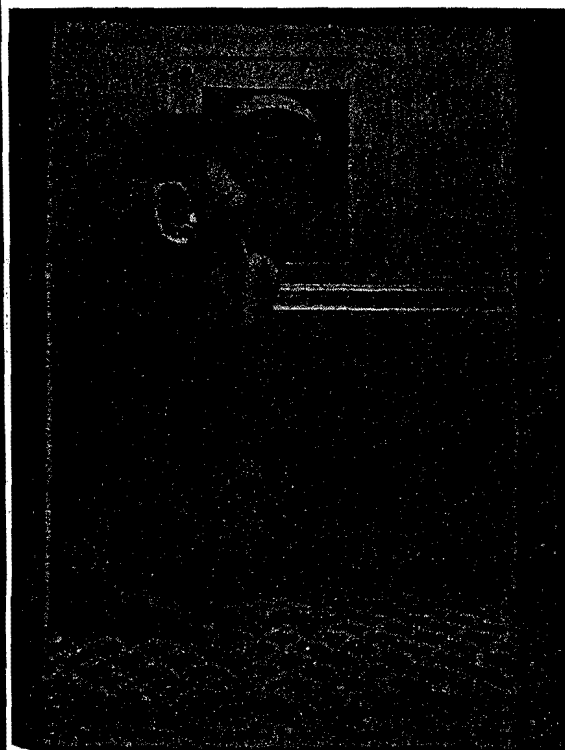


FIG. 21. Visual exploration apparatus.

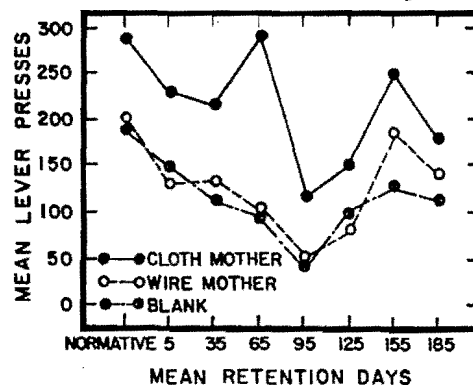


FIG. 23. Retention of differential visual-exploration responses.

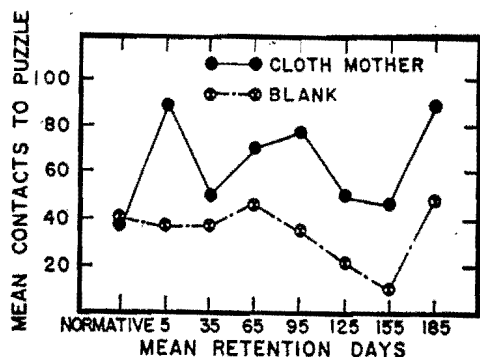


FIG. 24. Retention of puzzle manipulation responsiveness.

retention as measured by the modified Butler box is given in Figure 23. In keeping with the data obtained on adult monkeys by Butler, we find a high rate of responding to any stimulus, even the empty box. But throughout the entire 185-day retention period there is a consistent and significant difference in response frequency to the cloth mother contrasted with either the wire mother or the empty box, and no consistent difference between wire mother and empty box.

Affectional retention was also tested in the open field during the first 9 days after separation and then at 30-day intervals, and each test condition was run twice at each retention interval. The infant's behavior differed from that observed during the period preceding separation. When the cloth mother was present in the post-separation period, the babies rushed to her, climbed up, clung tightly to her, and rubbed their heads and faces against her body. After this initial embrace and reunion, they played on the mother, including biting and tearing at her cloth cover; but they rarely made any attempt to leave her during the test period, nor did they manipulate or play with the objects in the room, in contrast with their behavior before maternal separation. The only exception was the occasional monkey that left the mother surrogate momentarily, grasped the folded piece of paper (one of the standard stimuli in the field), and brought it quickly back to the mother. It appeared that deprivation had enhanced the tie to the mother and rendered the contact-comfort need so prepotent that need for the mother overwhelmed the exploratory motives during the brief, three-minute test sessions. No change in these behaviors was observed throughout the 185-day period. When the mother was absent from the open field, the behavior of the infants was similar in the initial retention test

to that during the pre-separation tests; but they tended to show gradual adaptation to the open-field situation with repeated testing and, consequently, a reduction in their emotionality scores.

In the last five retention test periods, an additional test was introduced in which the surrogate mother was placed in the center of the room and covered with a clear Plexiglas box. The monkeys were initially disturbed and frustrated when their explorations and manipulations of the box failed to provide contact with the mother. However, all animals adapted to the situation rather rapidly. Soon they used the box as a place of orientation for exploratory and play behavior, made frequent contacts with the objects in the field, and very often brought these objects to the Plexiglas box. The emotionality index was slightly higher than in the condition of the available cloth mothers, but it in no way approached the emotionality level displayed when the cloth mother was absent. Obviously, the infant monkeys gained emotional security by the presence of the mother even though contact was denied.

Affectional retention has also been measured by tests in which the monkey must unfasten a three-device mechanical puzzle to obtain entrance into a compartment containing the mother surrogate. All the trials are initiated by allowing the infant to go through an unlocked door, and in half the trials it finds the mother present and in half, an empty compartment. The door is then locked and a ten-minute test conducted. In tests given prior to separation from the surrogate mothers, some of the infants had solved this puzzle and others had failed. The data of Figure 24 show that on the last test before separation there were no differences in total manipulation under mother-present and mother-absent conditions, but striking differences exist between the two conditions throughout the post-separation test periods. Again, there is no interaction with conditions of feeding.

The over-all picture obtained from surveying the retention data is unequivocal. There is little, if any, waning of responsiveness to the mother throughout this five-month period as indicated by any measure. It becomes perfectly obvious that this affectional bond is highly resistant to forgetting and that it can be retained for very long periods of time by relatively infrequent contact reinforcement. During the next year, retention tests will be conducted at 90-day intervals, and further plans are depend-

ent upon the results that affectional response to extinction contrasted for learned such data would be in common human observation.

The infant's response in the fear tests, the baby Butler box and tests cannot be described. For supplementary information picture record.

We have already described control infants that had any mother surrogate sign of affection or so cloth mothers introduced these infants reached containing both a cloth were attached to their tion in these mothers solid-food diet. The keys to the alteration ance. All the infants repeated attempts to door was opened. T. from the mother surrogate amount of rocking indicative of emotion that the critical period maternally directed these macaque child affectional orphans.

continued for only 12 ally ebbed, changing contact on, and explosive home-cage behavior slowly became similar with the mother surrogate manipulation and play progressively more violent mutilation, particularly the cloth mother had of terry covering. I actively running to ened and had to be from the cage for food.

Objective evidence given in Figure 25, w

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ent upon the results obtained. It would appear that affectional responses may show as much resistance to extinction as has been previously demonstrated for learned fears and learned pain, and such data would be in keeping with those of common human observation.

The infant's responses to the mother surrogate in the fear tests, the open-field situation, and the baby Butler box and the responses on the retention tests cannot be described adequately with words. For supplementary information we turn to the motion picture record. (At this point a 20-minute film was presented illustrating and supplementing the behaviors described thus far in the address.)

We have already described the group of four control infants that had never lived in the presence of any mother surrogate and had demonstrated no sign of affection or security in the presence of the cloth mothers introduced in test sessions. When these infants reached the age of 250 days, cubicles containing both a cloth mother and a wire mother were attached to their cages. There was no lactation in these mothers, for the monkeys were on a solid-food diet. The initial reaction of the monkeys to the alterations was one of extreme disturbance. All the infants screamed violently and made repeated attempts to escape the cage whenever the door was opened. They kept a maximum distance from the mother surrogates and exhibited a considerable amount of rocking and crouching behavior, indicative of emotionality. Our first thought was that the critical period for the development of maternally directed affection had passed and that these macaque children were doomed to live as affectional orphans. Fortunately, these behaviors continued for only 12 to 48 hours and then gradually ebbed, changing from indifference to active contact on, and exploration of, the surrogates. The home-cage behavior of these control monkeys slowly became similar to that of the animals raised with the mother surrogates from birth. Their manipulation and play on the cloth mother became progressively more vigorous to the point of actual mutilation, particularly during the morning after the cloth mother had been given her daily change of terry covering. The control subjects were now actively running to the cloth mother when frightened and had to be coaxed from her to be taken from the cage for formal testing.

Objective evidence of these changing behaviors is given in Figure 25, which plots the amount of time

these infants spent on the mother surrogates. Within 10 days mean contact time is approximately nine hours, and this measure remains relatively constant throughout the next 30 days. Consistent with the results on the subjects reared from birth with dual mothers, these late-adopted infants spent less than one and one-half hours per day in contact with the wire mothers, and this activity level was relatively constant throughout the test sessions. Although the maximum time that the control monkeys spent on the cloth mother was only about half that spent by the original dual mother-surrogate group, we cannot be sure that this discrepancy is a function of differential early experience. The control monkeys were about three months older when the mothers were attached to their cages than the experimental animals had been when their mothers were removed and the retention tests begun. Thus, we do not know what the amount of contact would be for a 250-day-old animal raised from birth with surrogate mothers. Nevertheless, the magnitude of the differences and the fact that the contact-time curves for the mothered-from-birth infants had remained constant for almost 150 days suggest that early experience with the mother is a variable of measurable importance.

The control group has also been tested for differential visual exploration after the introduction of the cloth and wire mothers; these behaviors are plotted in Figure 26. By the second test session a high level of exploratory behavior had developed, and the responsiveness to the wire mother and the empty box is significantly greater than that to the cloth mother. This is probably not an artifact

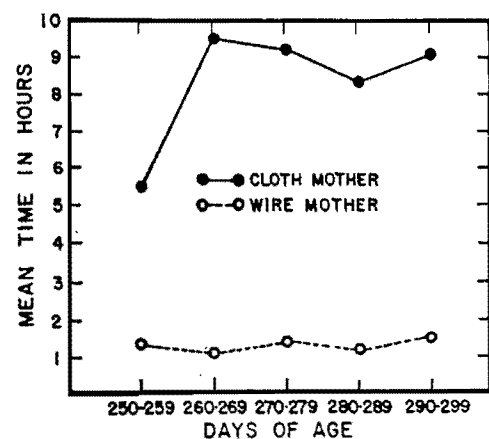


FIG. 25. Differential time spent on cloth and wire mother surrogates by monkeys started at 250 days of age.

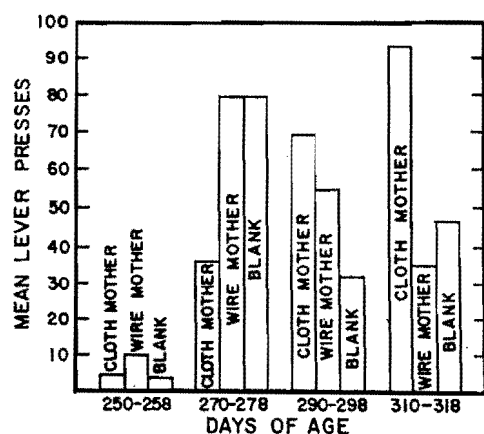


FIG. 26. Differential visual exploration of monkeys started at 250 days of age.

since there is every reason to believe that the face of the cloth mother is a fear stimulus to most monkeys that have not had extensive experience with this object during the first 40 to 60 days of life. Within the third test session a sharp change in trend occurs, and the cloth mother is then more frequently viewed than the wire mother or the blank box; this trend continues during the fourth session, producing a significant preference for the cloth mother.

Before the introduction of the mother surrogate into the home-cage situation, only one of the four control monkeys had ever contacted the cloth mother in the open-field tests. In general, the surrogate mother not only gave the infants no security, but instead appeared to serve as a fear stimulus. The emotionality scores of these control subjects were slightly higher during the mother-present test sessions than during the mother-absent test sessions. These behaviors were changed radically by the fourth post-introduction test approximately 60 days later. In the absence of the cloth mothers the emotionality index in this fourth test remains near the earlier level, but the score is reduced by half when the mother is present, a result strikingly similar to that found for infants raised with the dual mother-surrogates from birth. The control infants now show increasing object exploration and play behavior, and they begin to use the mother as a base of operations, as did the infants raised from birth with the mother surrogates. However, there are still definite differences in the behavior of the two groups. The control infants do not rush directly to the mother and clutch her violently; but instead they go toward, and orient

around, her, usually after an initial period during which they frequently show disturbed behavior, exploratory behavior, or both.

That the control monkeys develop affection or love for the cloth mother when she is introduced into the cage at 250 days of age cannot be questioned. There is every reason to believe, however, that this interval of delay depresses the intensity of the affectional response below that of the infant monkeys that were surrogate-mothered from birth onward. In interpreting these data it is well to remember that the control monkeys had had continuous opportunity to observe and hear other monkeys housed in adjacent cages and that they had had limited opportunity to view and contact surrogate mothers in the test situations, even though they did not exploit the opportunities.

During the last two years we have observed the behavior of two infants raised by their own mothers. Love for the real mother and love for the surrogate mother appear to be very similar. The baby macaque spends many hours a day clinging to its real mother. If away from the mother when frightened, it rushes to her and in her presence shows comfort and composure. As far as we can observe, the infant monkey's affection for the real mother is strong, but no stronger than that of the experimental monkey for the surrogate cloth mother, and the security that the infant gains from the presence of the real mother is no greater than the security it gains from a cloth surrogate. Next year we hope to put this problem to final, definitive, experimental test. But, whether the mother is real or a cloth surrogate, there does develop a deep and abiding bond between mother and child. In one case it may be the call of the wild and in the other the McCall of civilization, but in both cases there is "togetherness."

In spite of the importance of contact comfort, there is reason to believe that other variables of measurable importance will be discovered. Postural support may be such a variable, and it has been suggested that, when we build arms into the mother surrogate, 10 is the minimal number required to provide adequate child care. Rocking motion may be such a variable, and we are comparing rocking and stationary mother surrogates and inclined planes. The differential responsiveness to cloth mother and cloth-covered inclined plane suggests that clinging as well as contact is an affectional variable of importance. Sounds,

particularly natural as either unlearned. Visual responsiveness it is possible that printing may develop. There are indications of importance during some maturational.

John Bowlby has affectional variable following," characteristic of the mother's face. Baby monkeys are as are human neonates. But by 30 days of age, the infant's response to the mother's face, learning, maturation to believe that the infant's attention.

Our first surrogate mother whose head the baby was a model time to design a model baby had contact with 180 days and was then, one motionless. Endowed with painted surprise the animal faces 180 degrees smooth face and face. Furthermore, patience of the infant faces persisted. T fear or anxiety, but. Subsequently pulsively removing its cage as fast as triggered by this observation systematically in the development. Indeed, these observations series of ethological faced female.

particularly natural, maternal sounds, may operate as either unlearned or learned affectional variables. Visual responsiveness may be such a variable, and it is possible that some semblance of visual imprinting may develop in the neonatal monkey. There are indications that this becomes a variable of importance during the course of infancy through some maturational process.

John Bowlby has suggested that there is an affectional variable which he calls "primary object following," characterized by visual and oral search of the mother's face. Our surrogate-mother-raised baby monkeys are at first inattentive to her face, as are human neonates to human mother faces. But by 30 days of age ever-increasing responsiveness to the mother's face appears—whether through learning, maturation, or both—and we have reason to believe that the face becomes an object of special attention.

Our first surrogate-mother-raised baby had a mother whose head was just a ball of wood since the baby was a month early and we had not had time to design a more esthetic head and face. This baby had contact with the blank-faced mother for 180 days and was then placed with two cloth mothers, one motionless and one rocking, both being endowed with painted, ornamented faces. To our surprise the animal would compulsively rotate both faces 180 degrees so that it viewed only a round, smooth face and never the painted, ornamented face. Furthermore, it would do this as long as the patience of the experimenter in reorienting the faces persisted. The monkey showed no sign of fear or anxiety, but it showed unlimited persistence. Subsequently it improved its technique, compulsively removing the heads and rolling them into its cage as fast as they were returned. We are intrigued by this observation, and we plan to examine systematically the role of the mother face in the development of infant-monkey affections. Indeed, these observations suggest the need for a series of ethological-type researches on the two-faced female.

Although we have made no attempts thus far to study the generalization of infant-macaque affection or love, the techniques which we have developed offer promise in this uncharted field. Beyond this, there are few if any technical difficulties in studying the affection of the actual, living mother for the child, and the techniques developed can be utilized and expanded for the analysis and developmental study of father-infant and infant-infant affection.

Since we can measure neonatal and infant affectional responses to mother surrogates, and since we know they are strong and persisting, we are in a position to assess the effects of feeding and contactual schedules; consistency and inconsistency in the mother surrogates; and early, intermediate, and late maternal deprivation. Again, we have here a family of problems of fundamental interest and theoretical importance.

If the researches completed and proposed make a contribution, I shall be grateful; but I have also given full thought to possible practical applications. The socioeconomic demands of the present and the threatened socioeconomic demands of the future have led the American woman to displace, or threaten to displace, the American man in science and industry. If this process continues, the problem of proper child-rearing practices faces us with startling clarity. It is cheering in view of this trend to realize that the American male is physically endowed with all the really essential equipment to compete with the American female on equal terms in one essential activity: the rearing of infants. We now know that women in the working classes are not needed in the home because of their primary mammalian capabilities; and it is possible that in the foreseeable future neonatal nursing will not be regarded as a necessity, but as a luxury—to use Veblen's term—a form of conspicuous consumption limited perhaps to the upper classes. But whatever course history may take, it is comforting to know that we are now in contact with the nature of love.