een mannetje) na ruim een jaar als mascotte te hebben gediend, op een ongelukkige manier aan z'n einde. Hij was toen 4½ jaar oud en had een vlucht van 1.45 meter. Dat het gedrag van deze kalong, die we als een kale zuigeling kregen, geen uitzondering was, bewees een tweede exemplaar dat we als volwassen dier met gebroken vleugelspits in bezit kregen. Binnen een maand was de vleugel genezen en zij (dit was een wijfje) werd toen even tam en aanhankelijk als de eerste.
Over deze zeer pientere dieren en hun wilde soortgenoten wil ik bij een volgende gelegenheid nog verschillende, misschien weinig gekende bijzonderheden vertellen.

Summary

OBSERVATIONS ON KALONGS AND OTHER BATS

Mr. P i e t e r s describes how he established the fact that fructivorous bats locate their food by smell. He states that these animals are frequently killed by electric current, if the fruitbearing trees are standing near live wire.
Moreover he often witnessed small, insectivorous bats coming to grief by hitting telephone wires and such-like inconspicious obstacles, that had been put up recently. Thence it is argued that our confidence in their ability for sounding space by hearing is not fully justified. The author even feels sure that S p a l l a n z a n i's much quoted experiments never could be made without meeting complete failure. Neither is he satisfied with the results of recent experiments as reported in popular communications.
His own observations would seem to suggest that the co-operation of several senses is involved.

DISCUSSION

THE SUPERSONIC HEARING OF BATS

by

C. J. Jaski

Mr. Pieters' observations suggest quite convincingly :
that bats learn to remember artificial obstacles;
that they move circumspectly where obstacles are expected (thickets, tangled creepers and such-like);
that all accidents reported were caused by thin wires;
that death or damage from the impact of these wires only occurred where they had been put up *recently in open spaces;*
that the behaviour of bats depends to a considerable extent on experience.

We may safely surmise that no biologist is going to contest the assumption that *under normal conditions* the navigation of bats is guided by the co-operation of several senses. Therefore the point at issue would seem to be whether these animals could and would rely on their hearing *under such conditions as to exclude the use of other senses.*

Now what exactly is hearing ?

For our present purpose we might call it the perception of periodic waves in the air by means of the ear. Characteristic for such waves is that the air at any point is alternately compressed and rarefied. The distance between two subsequent points of maximum compression we call the *wave-length.* The longer this wave-length of a sound, the lower will be it's *frequency,* e.g. the number of waves passing at any given point per second. Variations in frequency are registered by the ear as variations in *pitch.*

Only a comparatively narrow range of pitches is perceptible to the human ear. The corresponding waves (30 — 20000 cycles/second) are called soundwaves. Of course other animals are entitled to their own ranges of „soundwaves". Man has acknowledged the fact for centuries: Certainly for as long as poachers have been using „soundless" dog-whistles !

For several decades science has been aware of the fact, that *our* soundwaves could be of no use whatever to bats for locating obstacles as thin as telephone-wires. Only waves of a very short length (high frequency) can be deflected with perceptible intensity by so narrow a body. Thence it was suggested by H a r t r i d g e (as early as 1920), that bats might well make use of *super-sonic waves.*

This appears to be a feasible hypothesis, but before we may accept it we shall have to answer several questions:

1) What wave-lenghts would suit the bats?
2) Is the bat itself able to produce the corresponding vibrations ?
3) Is the bat's ear sensitive to these waves?

Calculations show that the required deflection may be expected if the vibrations have a frequency of the order of 50000 cycles/second or more.

As a matter of fact bats do emit super-sonic waves (30000 — 70000 cycles/second). G a l a m b o s, G r i f f i n and co-workers established the fact by placing microphones near to flying bats. Such a microphone of course would „translate" the vibrations of the air into electric currents of corresponding frequencies. There are several ways to examine these currents, for instance by cathoderay-oscillograph. On the other hand analysis of the currents in the auditory nerve proved the bat's cochlea to be adapted to the perception of frequencies of the order of 100000 cycles/second (actually G a l a m b o s registered 98000 cycl./sec.).

There is no discrepancy between the frequencies 70000 (shortest waves emitted) and 98000 (shortest waves perceived) as we have

to make allowance for variations in pitch according to D o p p l e r 's principle.
It really fits beautifully! Yet any lawyer would point out at once that nothing but „opportunity" has been adduced so far. Technically bats appear to have the means for sounding space by super-sonic waves. But do they actually try and use them?
Well: The microphones have been telling a good deal more than we mentioned just now. The super-sonic waves are not emitted continuously but in short *pulses* and the frequency of these pulses varies with the speed of the animal and with the suspected proximity of obstacles. Stationary bats give out only a few pulses per second, one starting to fly will produce something like 30, whereas frequencies of as much as 50 or even 60 are registered when the animals are approaching obstacles. All of this appears tot be in accordance with the requirements. So the inference is justified that they really are trying: Opportunity and intention have been established ! Would our lawyer surrender ? Certainly not ! As yet there is even no corroborative evidence that the deed was committed.
Now your average scientist is as suspicious and as resourceful as the most obstinate of lawyers. So bats in numbers were submitted to a very difficult test :
Across the experimental room a grid was arranged of vertical, 1 mm wires, 30 cm apart. In complete darkness the bats struck the wires about 35% of the times they were passing the grid. Now assuming that they were unable to sound the wires, we ought to expect about twice this percentage of „failures". This comes very near to proof !
We had better disregard all experiments in which gaged or deafened bats were used. As long as they yield nothing but fully negative results, their results can be explained in almost any number of ways.
To our mind the results of these pre-arranged experiments are fully compatible with Mr. P i e t e r s' observations, as long as we keep in mind that we are comparing observations, that were made *under different conditions*. Therefore facts and inferences derived from one set of observations should not be applied implicitly to the other one !
Results might have been quite different if the grid had been transferred from the experimental room to some open space in the jungle or — conversely — if a single wire had been fixed in that room. We feel inclined to assume that in the first instance the number of accidents would have been a good deal more than 35%. The unsuspecting animals would cross a space, which they „knew" from experience to be void, at topspeed and without troubling to increase the frequency of their soundings. Moreover the sounding of a single wire could mean but one, irrelevant thing to them:
A single, harmless tendril or aerial root !

On the other hand we expect highstrung animals — such as bats certainly are — to become panicked when confined in a room. As a matter of fact I have known them to strike a *single thread* several times in the first minute after I had turned them loose in a spacious room. However it took them but a few minutes to take their bearings (even in a full black-out) and after that period none but a single bat ever touched the thread. But that one and only exception made up for the lot of them ! It appeared to be tugging at the thread as if it were tolling a fire-bell ! Somebody got intrigued and switched on the light : Sure enough the creature was dangling from the thread, scratching it's back and yawning insolently at our note-books !

That was thirty-five years ago and for thirty-five years I have been satisfied that my bats and S p a l l a n z a n i's bats and all other bats, ever submitted to the same test, actually became performing bats, as soon as they became aware of their confinement. Suspiciously, circumspectly they would move about in the way, Mr. P i e t e r s is describing, until they were sure of their bearings. Thenceforth they could wheel and swerve and flash in the darkness, vigilant and guided by their super-sonic „radar".

KORTE MEDEDELINGEN

COMMENDABLE EXAMPLE

The „Nieuwsblad voor Indonesië" (30-12-'52) brings a piece of news, which makes us feel very much indebted to the Prime Minister of South Africa. According to the paper M a l a n dispatched a Dakota of the airforce to Madagascar with orders to fetch a single fish. This rather unusual mission was decided on - and surely the decision had to be made at a moments notice! - on request of Professor J. B e l l S m i t h of Rhodes University.

The heavy expenditure involved is certainly justified, as this might be our last opportunity to secure a living or - at least - a freshly preserved specimen of the almost extinct *Coelacanthini.*

For fourteen years we have been waiting anxiously for the news, which appears to have reached prof. Bell Smith :

A second Coelacanth fish has been caught !

The first one was landed at East London in 1938 and zoölogists all over the world may remember how we were tearing our hair, when news arrived that the creature had been skinned and the insides had been thrown away, before a competent scientist got the opportunity to make an inspection. For fourteen years we had to content ourselves with a stuffed skin and a new name: *Latimeria.* All that time we have been waiting for the "inside information" and now - possibly - our day has come. Until 1938 it was generally assumed, that Coelacanthini became extinct some sixty million years ago (They appeared in late Devonian and they were common through the Mesozoic period). Together with the *Osteolepidoti* and the *Dipnoi* (lung-fishes) they represented the pattern of vertebrate organisation, from which the terrestrial vertebrates probably originated.

We are indebted to M a l a n and as much to all those other people, fishermen and officials, who contributed to what may prove to be a magnificent present to science. They may rest assured that science is going to make the most of it!

C. J. Jaski.