that among the double crossovers involving regions in opposite chromosomes arms, the majority involved only two strands. Recent work has not confirmed this report of an excess of 2-strand double crossovers." LINDEGREN and LINDEGREN pointed out that the ratio of 2-:3-:4-strand double exchanges occurring in regions I and IV analyzed by them were independent of events occurring in regions II and III, and it is clear that STADLER understands the significance of this statement by the quote above. Between regions I and IV, LINDEGREN and LINDEGREN reported a frequency of 15:7:6 of 2-:3-:4-strand double exchanges making STADLER's comments on the absence of evidence for chromatid interference described by LINDEGREN and LINDEGREN incomprehensible.

Throughout his discussion, STADLER has failed to discriminate between recombination and crossing-over. Since it is obvious that undetected multiple exchanges must be involved, WHITEHOUSE's correction must be applied before any conclusive interpretation can be drawn from his data.

Zusammenfassung

Für die Interpretation genetischer Ergebnisse wird den Autoren vorgeschlagen, Grundannahmen jeweils ausführlich zu formulieren.

STUDIORUM PROGRESSUS

The Use of Radioactive Bands in Tracing Hibernating Bats

By A. PUNT and P. J. VAN NIEUWENHOVEN[1]

Introduction.—In the southern part of the province of Limburg (the Netherlands) a number of caves are found, which are formed by excavating the limestone for building purposes. These caves provide an ideal shelter to hibernating bats. Hundreds of bats of 11 species can be found in these large labyrinths during the winter and it is clear that Dutch zoologists have studied physiological, ecological and ethological problems concerning bat hibernation (BELS[2]; SLUITER *et al.*[3]; DE WILDE and VAN NIEUWENHOVEN[4]).

When bat behaviour during the winter was studied some difficulties were met, which were not easy to overcome. The aim of this paper is to point out a method to deal with one of these problems and to report some results recently obtained by using this method.

As is generally assumed bats do not remain asleep for the whole winter season but get awake periodically. DE WILDE and VAN NIEUWENHOVEN tried to determine the mean duration of the sleep-period which was estimated to be a few weeks. They also studied the migration of hibernating bats, depending on this fact. They found that especially in the second half of the winter animals, being marked with aluminium bands disappeared from the cave and that new bats, without bands, appeared. It may be noticed, that this winter migration could have been forwarded by the act of banding itself, which may alarm the animals considerably. But the appearance of bats without bands, which probably never had been handled, was considered to be natural behaviour.

So it was very likely that local migration, from one cave to another took place during the winter, which was in accordance with observations of FOLK[5], ANCIAUX[6], VERSCHUREN[7], and KOWALSKI[8].

Much bats are hibernating in fissures of the rocky walls of the cave and they may enter into these crevices so far, that they cannot be detected visually. Now the disappearance of banded bats and the appearance of unbanded ones could also be explained by displacements of animals to and from this invisible bat-reservoir. So there are two possible explanations for the change in population of a cave: local-migration to and from other caves and movements within the cave to and from unaccessable fissures in the rock. In order to determine which of the two possibilities was the most likely, we provided bands with radioactive material, which made it possible to trace the animals even when they were quite invisible.

Methods.—Bands of the usual size (width 4 mm, weight 120 mg) were made of aluminium and stamped with a number. One of the ends was lengthened and folded back to form a small tube. In this tube a small rod of radioactive antimony (Sb^{124}) (approximately 2 mm long, diameter 1 mm, weight 10 mg) was inserted and fixed by pinching the aluminium edges of the tube.

Sb^{124} was used for some special reasons. In the first place the half life of this material is 60 days. So its radioactivity was lost after not to long a period. Our experiments had a duration of some months and we thought it better that the activity of the material vanished soon after that. As some banded animals escaped it was not possible to remove all bands at the end of the experiments. But now the escaped animals were not exposed to the radiation for a long time and the 'radio active' material was not scattered over the country. Moreover experiments in the next season could not be spoiled by the remained activity from earlier investigations. In the second place Sb^{124} produces γ-radiation, ranging from 0·12 to 1·7 MV, with a large quantity of the short wavelengths (up to 39% of the 1·7 MV rays). These hard rays penetrated sufficiently through the limestone, the animals were detectable even when hiding at a considerable distance in crooked fissures.

The rods of antimony were made by us and afterwards activated in the cyclotron at Kjeller, Norway, by the mediation of Philips-Roxane N. V., Holland, which firm also estimated the activity to be about 250 μc per rod of 10 mg. No bands were used till three weeks after the process of activation was finished, the material having lost in this time most of the β-radiation caused by equally formed Sb^{122} (half life: 2·8 days).

As far as we know, no damage was done to the animals. At the end of our experiments the bats were as normal as they could be. This was as we expected for by a very rough calculation the dose of radiation was estimated to be 16 r/week in the beginning of the experiments (clinical dose in man: 20 r/week). The radioactive bats were traced by means of a portable battery monitor, provided with a low voltage halogen quenched gamma-counter tube, Philips No. 18502. The monitor was built according to GODFREY[9], with some modifications of minor importance. The Geiger-Müller tube was housed in an aluminium cylinder (Philips Probe PW 4101) which was attached to the end of a bamboo rod, which

[1] From the Laboratory of comparative Physiology University of Amsterdam.

[2] L. BELS, Publicaties van het Natuurhist. Genootschap in Limburg *V* (1952); Thesis, Utrecht.

[3] J. W. SLUITER, P. F. VAN HEERDT, and J. TH. DE SMIDT (review of literature), *De Levende Natuur*, Linders, Arnhem (1956).

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[5] G. E. FOLK, J. Mammal. *21*, 306 (1940).

[6] F. ANCIAUX DE FAVEAUX, J. Mammal. *16*, 148 (1952).

[7] J. VERSCHUREN, Bull. Mus. Hist. nat. Belg. *25*, 1 (1949).

[8] K. KOWALSKI and R. J. WOJTUSIAK, Cracova Bull. *3*, 33 (1952).

[9] G. K. GODFREY, Ecology *35*, 5 (1954).

could be shoved out to a lenght of 5 m in order to survey fissures in the ceiling of high galleries. For audible detection of counts earphones were connected to the instrument.

Results.—In the winter of 1954–1955 bats were banded with radioactive material in the cave 'Apostelhoeve' near Maastricht. As most of the bats hibernating there were subjected to observations concerning the periodical awakening (*cf.* DE WILDE and VAN NIEUWENHOVEN[4]), only a small number of animals was available for our purpose. So bats were gathered in another abode, the Riesenberg cave, and after being banded liberated in the 'Apostelhoeve'. This took place with 27 animals on January 6th 1955 at 10·30 p.m. The next day 25 out of these 27 bats were recovered, all asleep again. Only 17 out of this number were equally found by experienced bat-finders which demonstrates the rather high percentage of invisible or overlooked bats. This was the more striking as the galleries in this cave are very low-pitched and therefore could easely be surveyed. Indeed radioactivity transpired from very small fissures and it was amazing to find that actually bats were hiding there. On January 7th another 15 bats were collected, banded and released in the 'Apostelhoeve'-cave and from that date on the whole cave was surveyed with the monitor at regular intervals of time. In Table I the results of these investigations are summarized and compared with the counting of bats which had not been marked with Sb^{124}.

Table I

Recoveries of bats in the 'Apostelhoeve'-cave, Winter 1955

	with radioactive bands %	with normal bands %	without bands
Number on January 7th	42 = 100	26 = 100	0
After 1 week	32 = 76		
After 4 weeks	27 = 64	6 = 23	10
After 7 weeks	18 = 43	4 = 15	6
After 10 weeks	15 = 35	2 = 8	5

It turned out that, using the radioactive tracing method, the number of bats which could be recovered after the indicated intervals of time was much higher than in the conservative way of bat banding. It is obvious that there are two reasons for this discrepancy. In the first place the bats were detected even when invisible, and secondly no handling was needed to decide whether the found animal was a recently banded one or not. From these results may be concluded that an invisible bat reservoir exists even in a cave which is well surveyable. On the other hand the gradually decreasing number of radioactive bats points to the fact that local migration occurs in the second half of the winter.

In Table II the results are classified as to species and sex of the animals under investigation. In the second space the number of bats is shown, in the third one the animals which were still present on March 17th, when the experiment was finished and the bands were removed.

One thing was unsatisfactory in this experiment. We had collected our bats from a cave at some distance from the 'Apostelhoeve'. And as we know bats to have a high fidelity to their winter abodes, local migration could have been favoured by this factor. We found indeed by a superficial survey of the large cave Riesenberg (7 km east of 'Apostelhoeve') two animals (*Myotis daubentoni* ♀, *M. dasycneme* ♂) which had returned to their original hibernating cave (February 24th).

Table II

Species and sex of radioactive banded bats in the 'Apostelhoeve' cave

		Freed on January 6th and 7th	Recovered on March 17th
Myotis daubentoni	♀	4	3
	♂	5	2
Myotis mystacinus	♀	9	5
	♂	5	2
Myotis emarginatus	♂	1	1
Myotis nattereri	♀	4	–
Myotis dasycneme	♀	4	–
	♂	3	1
Plecotus auritus	♀	5	1
Barbastella barbastellus	♀	2	–

In the next season the experiment was repeated. This time in the Flessenberg cave, in the vicinity of Valkenburg. This cave resembles the 'Apostelhoeve'-cave very much, being of the same stretch, with low-pitched galleries and a short sloping tunnel forming the entrance.

Table III

Recoveries of radioactive banded bats in the 'Flessenberg' cave, Winter 1956

Date	Traced bats	Invisible	Movements since previous survey	In entrance area	Not banded
January 13th	24	0	–	12	–
January 14th	15	3	–	5	0
January 25th	13	4	8	9	9
February 10th	13	5	4	10	6
February 29th	13(14?)	2(3?)	9	8	5
March 14th	13	3	1	8	6
March 29th	9	4	3	7	11

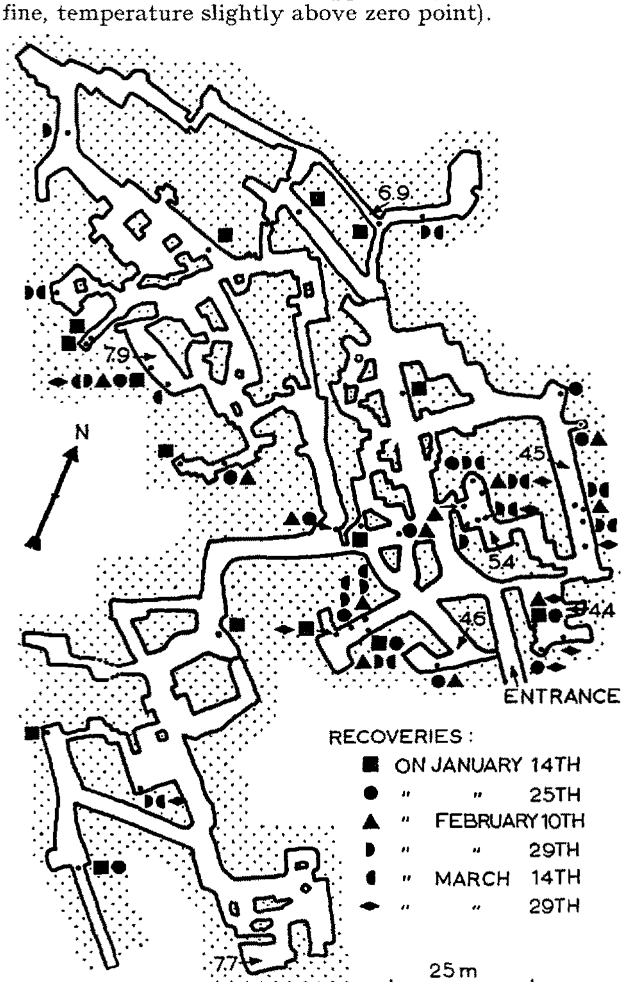
The cave has two parts, the back-part being only accessable by a small passage. This part was much warmer than the entrance area. In Figure the temperatures on March 29th are indicated. On January 13th 1956 all bats which could be collected in the Flessenberg by 5 experienced bat-finders were weighed and banded within the cave and released at a central spot at 17·30 p.m. These bats, to the number of 24, are represented in Table IV.

Table IV

Species and sex of the radioactive banded bats in the 'Flessenberg' cave

		Freed on January 13th	Recovered on March 29th
Myotis daubentoni	♀	2	0
Myotis mystacinus	♀	3	2
	♂	4	3
Myotis emarginatus	♀	1	0
	♂	1	1
Myotis nattereri	♀	1	1
	♂	1	0
Myotis dasycneme	♀	4	1
	♂	1	1
Plecotus auritus	♂	1	0
Rhinolophus hipposideros	♀	2	0
	♂	3	0

The next day the cave was thoroughly surveyed and this was repeated at intervals of two weeks till March 29th. Then the remaining animals were collected and weighed after removing the bands. The loss of weight over this lapse of time will be discussed elsewhere [van Nieuwenhoven, thesis (Amsterdam 1956), in the press]. In Table III the results of these periodical surveys are shown. In the second space of this table we find the number of bats, refound on the indicated date. The striking decrease in number, one day after banding, demonstrates the alarming influence of handling the animals: 9 out of 24 had disappeared (the weather was fine, temperature slightly above zero point).



Plan of the Flessenberg-cave.

During the winter, which was very severe, the number of recoveries remained rather constant. Still there was evidence that local migration had not stopped, and at any rate considerable movements took place within the cave (4th space of Table III).

In the Figure we have tried to summarize these movements. The places where radioactive bats were found at the different data are marked by a different sign. Only 1 animal was found at the same spot during the whole period of observation (11 weeks) (*M. emarginatus*), 1 bat remained at the same place during 9 weeks, 1 during 7 weeks and so on.

Local migration had occurred too, as was concluded from the following facts. On February 29th a very high radiation intensity was measured at one place near a fissure, probably caused by two animals, hiding close together. This would bring the total number on that date on 14, one more than in the previous search. Another evidence was, that from January 25th till February 29th we could only trace one specimen of *Rhinolophus hipposideros*. On March 14th there were two. One of them must have returned in the cave after being absent for 6 weeks. It is quite impossible that this radioactive banded bat had been overlooked till then, these animals hanging always absolutely free and the radiation being perceptible at considerable distance (about 10 m).

The third space of Table III gives the number of quite invisible bats and it is obvious, that without radioactive banding the number of recoveries would have been much smaller. In Table III the distribution of radioactive bats in the cave is also shown. When captured, they were equally devided over both parts of the Flessenberg-cave, but later on they concentrated more in the entrance area, which phenomenon was equally found in the 'Apostelhoeve'-cave and which will be studied in detail by one of us (van Nieuwenhoven).

Homing Experiments.—As beforementioned an accidental homing experiment was performed in the winter of 1955, when two bats were recovered in their original hibernating abode, after being displaced to the 'Apostelhoeve'-cave, where they were released. Early in 1956 (January 12th) we performed a real homing experiment by catching 26 bats in three caves on the east side of the valley of the river Maas (Cave 'Hotsboom', 9 bats; 'Wijngaardsberg', 10 bats; 'Riesenberg', 7 bats), and transporting them to a small cave ('Schark') on the east side of the Jeker-valley. This cave was at a distance of 6 km from the place of origin of the bats and was separated from it by the St. Pietersberg (120 m), the river Maas and the broad Maas-valley. The animals were collected, banded with radioactive bands and released on the same day at 20·00 p.m. The weather was clear, temperature 6° C, wind moderate, SW. The next day the radioactive search of the cave of liberation and of the caves of origin started. These surveys were repeated regularly.

In the rather small cave in which they had been released 9 out of 26 bats remained hibernating, at least for two weeks. Afterwards this number decreased to 5 in 2 months whereupon the experiment was stopped by removing the bands. From 17 animals which disappeared 8 could be recovered, 6 in the original cave where they bad been found hibernating on January 12th, 2 (*Plecotus auritus*) in a small cave about 300 m to the North of the 'Hotsboom'-cave, from where they originated. The first bat which returned was a specimen of *Barbastella barbastellus*, which was found asleep on January 13th in exactly the same place where it had been captured the previous day. As this cave (the Wijngaardsberg) is an extremely small one we are sure, that no other bats had returned at that moment. The next one was found in this cave on January 24th, at a date, that the number of bats which had remained in the cave of liberation (Schark) had not yet decreased. So this bat must have stayed somewhere else between January 12th and January 24th, to return eventually in its original hibernating abode. The same can be said from the first animal, which was recovered in the Hotsboom cave on January 24th. A third radioactive bat was recovered in the Wijngaardsberg in February 9th. In the Riesenberg, one animal had returned on January 14th, the second was found February 29th. But as this cave is a very large one, and the animal was found in a very dangerous part, which was not visited every time, we are not sure, that it did not return before that date.

Summarizing we can report that the following bats returned exactly to the place of origin: *Barbastella barbastellus* 1, *Myotis dasycneme* 3 (out of 5), *M. mystacinus* 1 (out of 10), *M. nattereri* 1.

This work was made possible by a grant from the Netherlands Organisation for Pure Research (Z.W.O.) for which we are deeply appreciative. We also wish to acknowledge our thanks to the biological students from the University of Amsterdam for their assistance and interest.

Zusammenfassung

Winterschlafende Fledermäuse wurden mit Ringen markiert, die radioaktives Antimonium (^{124}Sb) enthielten.

Dadurch konnte gezeigt werden, dass in unzugänglichen Felsspalten ein unsichtbares „Fledermausreservoir" vorhanden ist. Ferner wurde gezeigt, dass im Verlaufe des Winters Wechsel von Höhle zu Höhle stattfinden.

Im Januar 1956 wurden in einer Höhle 26 Fledermäuse gefangen, mit radioaktiven Ringen markiert und in einer 6 km entfernten Höhle ausgesetzt. Nach einem Tag konnte in der Ausgangshöhle der erste Rückkehrer festgestellt werden und kurz hernach 7 weitere Tiere.

3ème Journée Suisse de Microscopie Électronique et 9ème Séance annuelle du Comité Suisse d'Optique

Institut de Physique de l'Université de Genève, le 29 juin 1956.

Comptes rendus des communications

Einige Bemerkungen zur technischen Situation der Elektronenmikroskopie

Es werden die Forderungen abgeschätzt, welche an ein Routine-Elektronenmikroskop gestellt werden, insbesondere von Seite der Hauptanwendungsgebiete Histologie und Metallurgie. An Hand von Schnittaufnahmen von Mitochondrien wird gezeigt, dass das Elektronenmikroskop mit kalter Kathode und elektrostatischem Objektiv diese Forderungen erfüllen kann.

L. WEGMANN

Trüb Täuber & Cie., Zürich.

Erfahrungen mit einer kompensierten Aufhängung der kalten Kathode des Trüb-Täuber-Elektronenmikroskops

Das ältere Modell des TTC-EM hat eine horizontal angeordnete kalte Kathode. Auf dem Hochspannungsisolator sitzt ein Aluminiumzwischenstück als Halter für den Kathodenzylinder aus Chromstahl. Die Kathode ist konzentrisch vom Anodenzylinder umgeben. Während des Betriebes erwärmt sich die Kathode und dehnt sich quer zur Strahlrichtung aus. Dadurch wandert der Kathodenkrater in bezug auf die Anodenblende vor- und rückwärts. Der Halter der Kathode wurde so umgebaut, dass sich die Wärmeausdehnung des Halters und der Kathode kompensieren. Der Hochspannungsisolator trägt einen Zylinder aus Invar, über welchen der Aluminiumhalter geschoben ist. Die beiden Teile sind so verschraubt, dass sich an der Stelle des Strahlaustrittes die Längenausdehnung des Invarkernes, des Aluminiumzwischenstückes und der darübergeschobenen Chromstahlkathode aufhebt.

H. STUDER

Laboratorium für Elektronenmikroskopie der Universität Bern.

Elektronenmikroskopische Verfolgung der Texturänderung bei der Kaltbearbeitung und Rekristallisation von Kupferdrähten

Die Oberfläche von elektrolytisch polierten und anschliessend geätzten Kupferkristallen zeigt unter dem Elektronenmikroskop eine orientierte Lamellenstruktur. Nach schwacher Kaltbearbeitung erscheinen die Lamellen insbesondere in der Nähe der Kristallitgrenzen verbogen, nach stärkerer tritt eine neue Oberflächenstruktur auf. Stark abgezogene Drähte aus Reinstkupfer rekristallisieren schon bei 100°. Die Keime der neuen Kristalle erscheinen zum Teil als kleine orientierte Würfelchen ($\sim 1\ \mu$). Bei 225° sind die Keime grösser und unregelmässig.

W. FEITKNECHT und E. FREUDIGER

Institut für anorganische Chemie der Universität Bern.

Zur Morphologie des Fangos von Acquarossa

Die eisenhaltige Mineralquelle von Acquarossa (Tessin) liefert einen roten Fango, welcher für Heilpackungen verwendet wird. Im Elektronenmikroskop findet man meist spiralig gewundene faden- und bänderförmige Ausscheidungen. Präparate, welche nach dem Kohlehüllenverfahren hergestellt wurden, zeigen, dass die Bündel aus Primärfäden von ungefähr 0,2 μ Durchmesser aufgebaut sind. Diese Grösse entspricht der Dicke von fadenförmigen Mikroorganismen, welche im jungen Fango gefunden werden. Röntgenographische Aufnahmen eines «jungen Fangos» zeigen neben einer einzigen Linie, welche auf β-FeOOH schliessen lässt, nur Linien von Kalziumkarbonat. Der gealterte Fango zeigt die Reflexe von Hydrogoethit. Unter Luftabschluss wird der Fango dunkel bis schwarz. Das schwarze Material besteht aus Eisensulfid, welches offenbar durch die verwesenden Mikroorganismen mit dem im Wasser enthaltenen Sulfat durch Reduktion gebildet werden kann.

H. STUDER

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Contribution de la microscopie électronique à l'étude de foies normaux ou soumis à des influences variées

Etude de foies: 1° de rats normaux ou sacrifiés de cours de diverses expériences: jeûne, réalimentation, hépatectomies partielles, intoxication au CCl_4; 2° de rats nourris avec des régimes cancérigènes, 3° d'hépatomes humains, en étudiant notamment le gonflement réversible (tuméfaction trouble), la dégénérescence et la régénération des mitochondries, l'ultrastructure des petits corpuscules (microbodies) et leurs rapports avec les mitochondries, les modifications et la régénération de l'ergastoplasme, l'appareil de GOLGI et les modifications du nucléole.

C. ROUILLER

Laboratoire de Médecine Expérimentale du Collège de France et Institut de Recherches sur le Cancer Gustave Roussy (Villejuif).

Zur Struktur des Peritoneal-Mesothels

Die Mesothelzellen ruhen auf einer Basalmembran von etwa 1000 Å Dicke. Die Zelloberfläche trägt Mikro-Villi (2,5 μ lang, 0,1 μ breit), deren Enden oft köpfchenförmig erweitert sind. Die freie Zellmembran, die auch die Fortsätze überzieht, besteht aus zwei dichteren Schichten, die durch eine solche geringerer Dichte getrennt sind. Einige der Bläschen, die im Zytoplasma verteilt sind,