7. Schwartz, H.E., et al.: Int. J. Environ. Anal. Chem. *6*, 133 (1979)
8. Corcoran, E.F., Curry, R.W.: Rev. Biol. Trop. *26* (Supl. 1), 125 (1978)
9. Bove, J.L., Dalven, P., Kukreja, V.P.: Int. J. Environ. Anal. Chem. *5*, 187 (1978)
10. Hom, W., et al.: Science *184*, 1197 (1974)
11. Müller, G., Grimmer, G., Böhnke, H.: Naturwissenschaften *64*, 427 (1977)
12. Müller, G., Kanazawa, A., Teshima, S.: ibid. *66*, 520 (1979)
13. Müller, G., Dominik, J., Mangini, A.: ibid. *66*, 261 (1979)
14. Giam, C.S., Chan, H.S., Neff, G.S.: Anal. Chem. *47*, 225 (1975)
15. Giam, C.S., Wong, M.K.: J. Chromatogr. *72*, 283 (1972)
16. Giam, C.S., et al.: Mar. Poll. Bull. (in press)
17. Morita, M., Nakamura, H., Mimura, S.: Water Res. *8*, 781 (1974)
18. Wilson, W.B., et al.: Bull. Environ. Contam. Toxicol. *20*, 149 (1978)
19. Bell, F.P., Patt, C.S., Gilles, P.J.: Lipids *13*, 673 (1978)
20. Sugawara, N.: Toxicol. Appl. Pharm. *30*, 87 (1974)
21. Pfuderer, P., Francis, A.A.: Bull. Environ. Contam. Toxicol. *13*, 275 (1975)

Chlorophyll *a* Fluorescence Transients of Leaves from Sun and Shade Plants

D.C. Fork
Carnegie Institution of Washington, Stanford, CA 94305, U.S.A.
Govindjee
Department of Botany University of Illinois, Urbana, Illinois 61801, U.S.A.

Chlorophyll *a* fluorescence induction has been used in photosynthesis research to obtain information on excitation energy transfer, heterogeneity of electron acceptors, size of the electron acceptor pool(s) of photosystem II (PSII), the electron flow on the electron donor or the acceptor side of PSII, etc. [1, 2]. Malkin and Fork [3] have obtained information on the size of the photosynthetic unit (PSU) in DCMU [3-(3,4-dichlorophenyl)-1,1-dimethyl urea]-infiltrated leaves from sun and shade plants. The size of the PSU defined as the ratio of the number of bulk chlorophyll (Chl) molecules to the number of "Q" (the electron acceptor of PSII) molecules was about twice in all the shade plants to that in the sun plants. In this communication, we present comparative measurements on the Chl *a* fluorescence induction of untreated leaves from seven sun and six shade plants. It is shown that the time of the appearance of the peak P (t_p, see [1] for nomenclature) in the fluorescence induc-

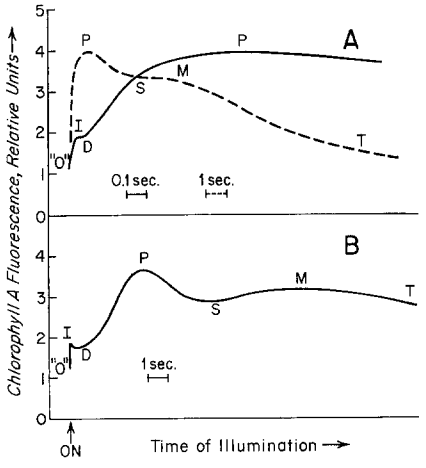

Fig. 1. Time course of chlorophyll *a* fluorescence on two time scales (20 s, and 500 ms full scale) for a leaf from (A) a shade plant, *Viola sempervirens*, and (B) from a sun plant, *Convolvulus arvensis*. For explanation of the transient points (O, I, D, P, S, M, and T), see [1]

Table 1. Time of the appearance of the peak P in chlorophyll *a* fluorescence transient (t_p) and the size of the photosynthetic unit (PSU)

Name of the plant (common name)	Time of the appearance of the peak P(t_p) [ms]	PSU size [3] [Chl/Q]
Shade Plants (from redwood forrest, Woodside, California, USA)		
Viola glabella Nutt. ex T. & G. (Smooth yellow violet)	1000	940
Viola sempervirens (Redwood violet)	900	850
Oxalis oregana Nutt.	600	848
Clintonia andrewsiana Torr. (Red clintonia)	800	780
Adenocaulon bicolor Hook. (Trail plant)	900	750
Disporum hookeri (Torr.) Nichols. (Hooker's fairy bell)	750	625
Average:	825	800
Sun Plants (from Carnegie Institution of Washington (Stanford, California) grounds)		
Opuntia basilaris Engelm. & Bigel. (Beaver tail cactus)	3000	480
Marrubium vulgare L. (Common or white hoarhound)	2000	480
Plantago lanceolata L. (English plantain or buckthorn)	1500	450
Oenothera hookeri T. & G. (Monterey evening primrose)	1500	440
Brassica campestris (Common or field mustard)	2000	340
Convolvulus arvensis (Field bindweed or orchard morning glory)	3500	330
Chenopodium album L. (White goose foot)	3000	220
Average:	2400	390

tion (Kautsky phenomenon) can be taken as a semi-quantitative monitor of the size of the PSU. In shade plants, t_p ranges from 500 to 900 ms, whereas the size of the PSU (defined as above) ranges from 600 to 1000 Chl per Q [3]. In sun plants, however, t_p ranges from 1500 to 3500 ms, whereas Chl/Q from 200 to 500 [3].

Figure 1 shows representative Chl *a* fluorescence transients, measured at 685 nm using excitation with saturating green light (550 mn), for two leaves selected from a shade plant *Viola sempervirens* and a sun plant *Convolvulus arvensis*. The time of the appearance of the peak (t_p) in *V. sempervirens* is around 900 ms and 3500 ms in *C. arvensis*. Table 1 shows a compilation of t_p in seven sun and six shade plants; also shown are the sizes of the PSU calculated from DCMU-treated leaves of the same plants [3]. An average of 800 Chl/Q corresponds to a t_p of about 825 ms in shade plants, and an average of about 400 Chl/Q corresponds to a t_p of about 2400 ms. An overall inverse correlation between the t_p and the PSU is observed in the two groups of plants although no quantitative correlations were observed in individual species as the two measurements were not made on identical leaves. This work extends the usefulness of fluorescence measurements to ascertain the physiological status of higher plants.

CIW Pub. No. 704.

Received July 2, 1980

1. Papageorgiou, G., in: Bioenergetics of Photosynthesis, p. 319 (Govindjee, ed.). New York: Academic Press 1975
2. Lavorel, J., Etienne, A.-L., in: Primary Processes of Photosynthesis, p. 203 (J. Barber, ed.). Amsterdam: Elsevier 1977
3. Malkin, S., Fork, D.C.: Carnegie Inst. Wash. Year Book (in press)

Ultrastructural Observations on the Post-synaptic Membrane of Denervated Frog Muscle

V. Verma*

Laboratoire de Cytologie, Universitié Pierre et Marie Curie, Paris, France

The post-synaptic membrane in the frog has three to four equidistant folds per sarcomere and the breadth of each fold is 0.1 μm each [1]. After denervation, within four to five days, the axon terminal is engulfed by the Schwann cell and this latter establishes a contact with the post-synaptic membrane [2–4].

After about one month of denervation, small depressions are observed on the post-synaptic folds. The number and the depth of these depressions increase with the increasing durations of denervation. We have called these depressions "furrows". A tangential section of the post-synaptic membrane shows that the whole surface of the post-synaptic membrane is folded by the furrows and these furrows are covered by the basal lamina all along their surface (Fig. 1). This observation has been verified by semiserial sections.

It has been observed that often the occurrence of these "furrows" in the post-synaptic membrane is in correlation with the presence of fissures in the Schwann cell present in front of it [4]. In the junctions where Schwann cell is integral and does not show the presence of fissures, the post-synaptic membrane has relatively few furrows. On the contrary, when Schwann cell is divided into small fissures the surface of the post-synaptic membrane has more profound "furrows".

If the muscle is kept denervated for more than three months, the post-synaptic folds sequester from the parent muscle [4]. It seems very likely that the furrows in the post-synaptic membrane are ultimately responsible for the sequestration of the folds.

* Present address: Laboratory of Neuroanatomy, Bldg. 36, Room 3B26. National Institutes of Health, Bethesda, Maryland 20205, USA.

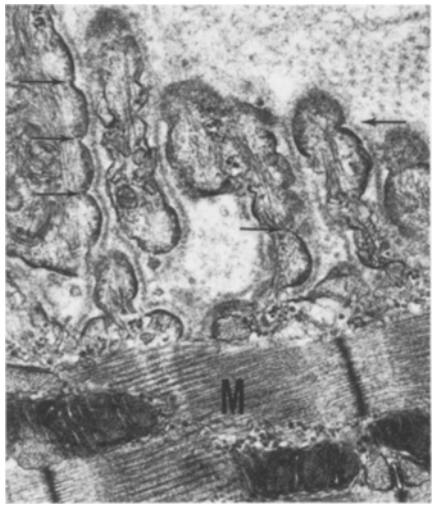

Fig. 1. Tangential section of the neuromuscular junction of muscle rectus internus major of frog *Rana esculenta*, 68 days after denervation. Note the presence of furrows (arrows), on the surface of the post-synaptic membrane. The furrows are covered by basal lamina. The Schwann cell is present at this stage of denervation, but it is out of the plane of the section (*M* muscle fiber, 28000 ×)

Received June 18, 1980

1. Birks, R., Huxley, H.E., Katz, B.: J. Physiol. *150*, 134 (1960)
2. Birks, R., Katz, B., Miledi, R.: ibid. *150*, 145 (1960)
3. Verma, V., Pécot-Dechavassine, M.: Cell Tiss. Res. *185*, 451 (1977)
4. Verma, V.: Cytologia (in press)

Food Recruitment in *Messor rufitarsis*

M. Hahn and U. Maschwitz

Fachbereich Biologie der Universität, D-6000 Frankfurt/M.

The typical old-world harvester ants of the genus *Messor* are of great economic importance in dry areas of Mediterranean countries. Up to 100 l of seeds can be stored in the nest chambers of the abundant colonies. It has been estimated that 10% of the whole crop of corn from North African countries can be lost due to the collecting activities of the harvester ants [1]. The recruiting system which enable such an effective harvesting is still unknown.

The harvester ant *Messor rufitarsis* (Hymenoptera, Formicidae) is found in an isolated northern habitat, in the Rheingau area of Hessen. During ethoecological in-