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MODELE MATHEMATIQUE DE LA
POLLUTION EN MER DU NORD

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A FIRST STEP TO THE AUTOMATIZATION OF FIELD MEASUREMENTS OF PHYTO - PLANKTON ACTIVITY

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INTRODUCTION

For some years our laboratory has been investigating the South Bight of the North Sea as a part of a national research program on the mechanisms and effects of pollutants dispersion in the sea ecosystem. A strong need for interaction coefficients was soon felt, implying more particularly a better knowledge of in situ biological activity. In this respect, research on the use of autoradiography as a tool in primary production studies (Mommaerts, 1972) have led to the construction of an automatic sampling and incubating unit designed to be used on the field on platforms or - as a miniaturized version - on buoys. The prototype is described in this note and its philosophy and some results are discussed briefly. We gratefully acknowledge the assistance of Mr. O. CROMBOOM who built the prototype and of Mr. J. NIJS, who has much helped in the intercalibration proofs.

DESCRIPTION AND OPERATION OF THE PROTOTYPE

The analytical method used is the C-14 technique now widely used in primary production studies (Steemann Nielsen, 1952). The technology involved in the sampling and the incubation is inspired from the auto-analyser technology. The prototype is fully described in fig. 1. The autonomy of the apparatus is about 4 days. A simple modification of the monitoring unit and of the sample collector is sufficient to extend this autonomy to much longer periods.

Operation.

A sample of 39 ml is pumped every other 3 hours (rate : 2.33 ml/min.) out of the cooling circulation system, and inoculated with a $NaH^{14}CO_3$ solution (5 ml at the rate of 0.3 ml/min.). Air bubbles (rate : 0.75 ml/min.) are also introduced at this stage to avoid small flagellates swimming their way back. The sample enters then the incubating unit where it is allowed to incubate under constant illumination and at water temperature for 2 h 45. At the end of the incubation, the sample is washed out as another sample enters the system. Before being collected the sample is pickled with acetic lugol (rate : 0.3 ml/min).

DISCUSSION

The discontinuous sampling scheme and the very simple design of the whole apparatus have been chosen deliberately to ensure a satisfactory enough operation with regard to the aims pursued. A further development would be the automatic filtration of the samples. Extensions of autonomy are easy. To some extent, the sampling frequency can also be increased thus allowing a better screening of the daily variations of phytoplankton production. The apparatus showed good performances with laboratory cultures as well as with natural phytoplankton in a marine lagoon near Ostend (Sluice Dock). Phytoplankton was not damaged in the processing (with the possible exception of a small fraction of nannoplankton sensitive to acetic lugol). The preserved radioactive samples are partly used for autoradiography, partly for counting and partly for $^{14}CO_2$ incorporation measurement. As demonstrated in a previous paper (Mommaerts, 1972), autoradiography proves to be a very good method to determine the abundance of the cells that were active at sampling time.

We think that such an information is important in pollution research as inactivated cells might well look as healthy cells when looked at under microscope or be considered so when counted with a Coulter counter. However, the enumeration of the total number of cells (active + inactive) remains important as it gives the complementary information. The measurement of the radioactivity of a big subsample allows the computation of the potential primary production (mg C $m^{-3}hour^{-1}$). Table I gives the results of an intercalibration experiment made using a conventional incubator (15,000 lux, fluorescent tubes Philips 33, 15°C) and the automatic device. Seven algal cultures were used providing a variety of behaviours and concentrations. The correlation coefficient computed is good : $r = 0.91$. The lower activity exhibited in the automatic device is probably related to illumination and temperature differences in both incubators.

REFERENCES

Mommaerts, J.P., 1972. Autoradiography as a tool in primary production research. Neth. J. Sea Res., 5 (4) : 437-439.

Steemann Nielsen, E., 1952. The use of radioactive carbon (C-14) for measuring organic production in the sea. J. Cons. perm. int. Explor. Mer, 18 : 117-140.

TABLE I. Results of the intercalibration experiment between a conventional incubator and the automatic incubator

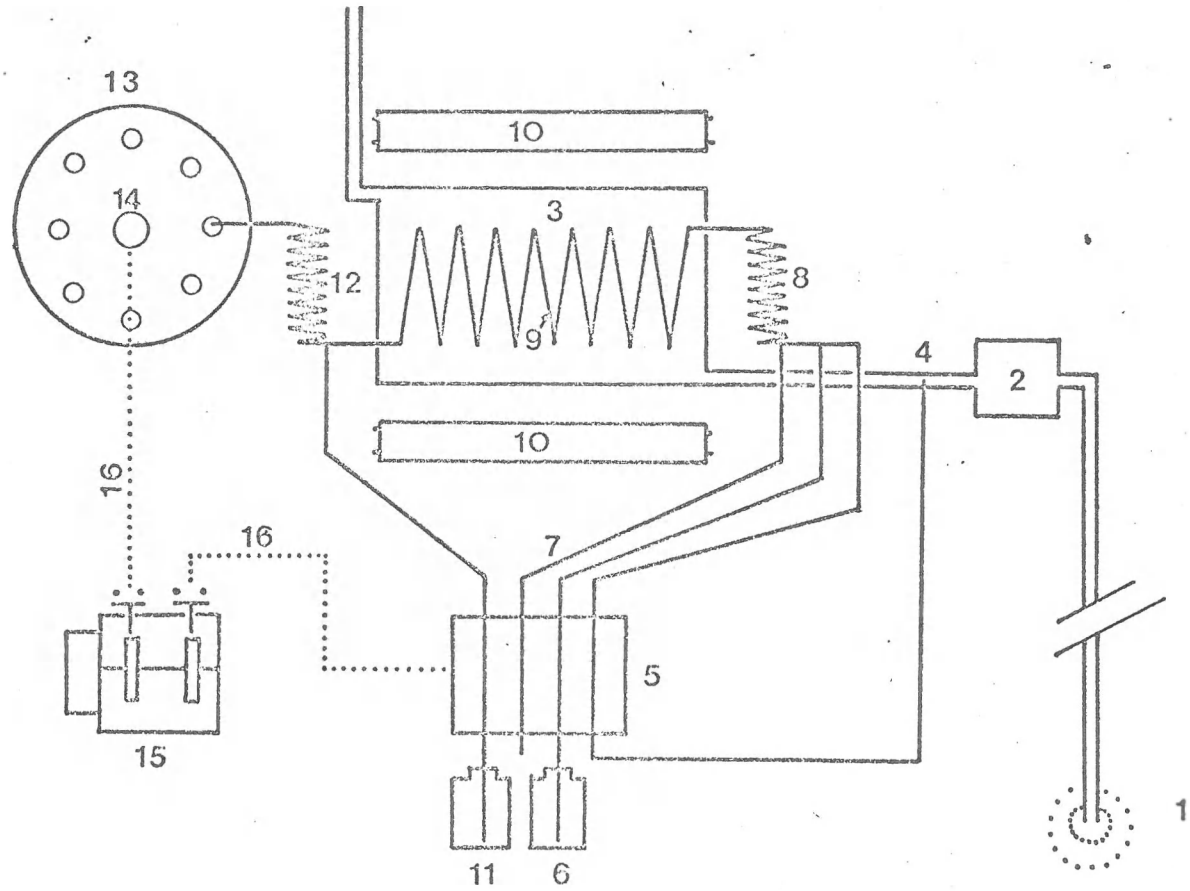
culture	potential production (mg C $m^{-3} hour^{-1}$)	
	conventional	automatic
Cricosphaera carterae[1]	404	131
Skeletonema costatum	396	191
Cryptomonas calciformis[1]	45	15
Nannochloris sp.	200	75
Pavlova gyrans[1]	181	84
Phaeodactylum tricornutum	204	29
Navicula sp + Chlorella vulgaris	4	5

[1] Cultures supplied by Dr. M. PARKE, Marine Biological Association, Plymouth.

LEGEND OF FIG. 1.

Diagram of the prototype

1. Sampling probe with plankton net gauze
2. Peristaltic pump
3. Cooling tank
4. Sampling point in the cooling circulation
5. Peristaltic pump CENCO (max. 12 tygon tubes)
6. C-14 tank
7. Air
8. Mixing coil
9. Incubation coil
10. Fluorescent tubes
11. Acetic lugol tank
12. Mixing coil
13. Sample collector
14. Motor
15. Monitoring unit : synchronous motor, cam-shaft and switches
16. Power lines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