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Bernard C. Patten

D. K. Young

Morris H. Roberts

Virginia Institute of Marine Science

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SPECIAL SCIENTIFIC REPORT NO. 44
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GLOUCESTER POINT, VIRGINIA

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This report does not
constitute final publication

W. J. Hargis, Jr.
Director

April 1963

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The Planktology Department at VIMS is engaged in a long-term study of plankton energetics at a station in the lower York River. In connection with this program, 15 determinations of instantaneous seston levels and ostensible rates of fallout were made at different depths between June 1961 and July 1962. This report summarizes the data obtained.

The station is situated about 300 yards off the VIMS pier at Gloucester Point. Investigation of suspended solids was prompted by prior dark and light bottle experiments in which integral respiration was observed to exceed integral gross production in several water columns. In Raritan Bay during the summer of 1959, for example, negative 24-hour energy balance was indicated in 9 out of 11 weekly experiments (Limnol. Oceanogr. 6: 369-387). Between June 1960 and June 1961 at the York River site of the present study, negative balance occurred in only 6 of 37 experiments (VIMS Spec. Sci. Rep. No. 22) so that the situation could be considered unusual. During the summer of 1961, however, at four stations widely spaced in the lower Chesapeake region, including the York River station, negative balance was consistently recorded for nine consecutive weeks under all conditions of incident solar radiation (VIMS Spec. Sci. Rep. No. 39).

Since it is extremely unlikely that the whole lower Chesapeake area was dystrophic for such an extended period, it seemed that suspended matter in the water mass must be presenting an oxygen demand which, in dark and light bottle results, would be indistinguishable from biotic respiration. The work reported here was intended to demonstrate in a general way whether or not allochthonous particulate materials other than those produced in the trophogenic zone form a significant contribution to the total suspensoid load at the York River productivity site. The data obtained include (i) instantaneous standing seston concentrations in the vertical water mass, and (ii) ostensible 24-hour rates of settling. We say "ostensible" because there is uncertainty about the effectiveness of the sediment traps employed in giving an assessment of fallout rates. Concentration data for the lower Chesapeake region have previously been reported (VIMS Spec. Sci. Rep. Nos. 20, 22 and 29), and short-term variability considered (Brehmer and Haven 1962, VIMS Progress Report to the U. S. Atomic Energy Commission: Concentration of suspended radioactive wastes into bottom deposits). The main concern of this report is rates of precipitation.

Fallout of material is only one of the rate factors relevant to a possible non-respiratory oxygen demand. Others are (i) lateral accrual and removal, and (ii) resuspension of previously deposited material. The balance between these variables and the net planktonic production determines the instantaneous standing seston load. If it were possible to assess fallout rates, then according to the following rationale it would also be possible to infer from these whether or not a significant influx of oxidizable solids occurs from sources other than the trophogenic zone.

The flux components of fallout can be formulated by the methods of vector algebra. Consider any point P_z in the water column as the origin of a right-handed Cartesian coordinate system (x, y, z). The following flux vectors can be recognized (Fig. 1):

$\vec{v}_{x+}$ = flux in the positive x - direction

$\vec{v}_{x-}$ = flux in the negative x - direction,

and similarly for the y and z directions. The net fluxes along the coordinate axes are then

$$\vec{V}_x = \sum \vec{v}_{x+} - \sum \vec{v}_{x-}$$

$$\vec{V}_y = \sum \vec{v}_{y+} - \sum \vec{v}_{y-}$$

$$\vec{V}_z = \sum \vec{v}_{z+} - \sum \vec{v}_{z-}$$

The flux of matter in any direction from P_z in the (x, y, z)- space, representable by a position vector $\vec{r}$, can now be written in component form as

$$\vec{r} = |\vec{V}_x|\hat{\imath} + |\vec{V}_y|\hat{\jmath} + |\vec{V}_z|\hat{k} ,$$

where $\hat{\imath}$, $\hat{\jmath}$, and $\hat{k}$ are unit vectors in the x, y and z directions, respectively. If we let $\vec{R}_{z+}$ represent the vector sum of the z components of all the $\vec{r}$ in the positive z direction, and $\vec{R}_{z-}$ that in the negative z direction, then clearly the latter represents fallout at the point P_z.

Now consider another point $P_{z'}$ below P_z in the water mass (i.e., $z' > z$). The upward flux of material at this point is $\vec{R}_{z'+}$ and the downward flux $\vec{R}_{z'-}$. If net production in the trophogenic zone were the only source of suspended solids, then clearly $\vec{R}_{z-} > \vec{R}_{z'-}$ instantaneously since $\vec{V}_z > \vec{V}_{z'}$ due to light attenuation with depth. Hence, if sediment traps were suspended at different depths which were capable of collecting only particles which contributed to $\vec{R}_{z-}$, then it might be possible to infer from the results whether or not solids are contributed by means other than net production. In particular, the situation $R_{z-} < R_{z'-}$ would imply such a condition.

Theoretically, a sperical particle with radius ρ and density δ_2 would sink in a médium of density δ_1 and viscosity η in accordance with Stoke's law:

$$\vec{v}_{z-} = 2/9\left[\rho^2 g \eta^{-1} (\delta_2 - \delta_1)\right],$$

Where g is acceleration due to gravity. Of course no such simplicity is met with in the estuary. Suspended solids are amorphous, or at least not usually spherical; they vary widely in size and density, and may be biological or inorganic in origin. Viscosity, density, and electrical properties of the medium are also subject to great variation in time and space, influencing such variables important in suspension as hydration and surface potentials. Add to these factors some hydrodynamic considerations, and it is quickly apparent how complex a system we are involved with and why effective sediment traps are so difficult to design. For these reasons it was decided to avoid involvement with elaborate collection devices which might yield reasonable absolute fallout measures, and a simple system for obtaining relative values was employed instead. The collection method consisted of suspending opaque B.O.D. bottles for 24 hours on a weighted line, as in our routine dark and light bottle work, except that the bottles were uncapped. Thus, instead of a point P_z, our concern was with a circular area (the mouth of the bottles) assumed normal to the z axis. The contention is that the material collected in the bottles in a time interval relates to the vectors $\vec{R}_{z-}$ over this area, and not to the concentration of particulates in the medium surrounding the bottles (as consideration of fluid dynamics around the bottle mouths might suggest). The mean mouth diameter of 50 B.O.D. bottles was determined to be 29.79 ± 0.20 mm, giving an average collection area of 697.5 mm^2. Assuming no displacement from the vertical during suspension, $\vec{R}_{z-}$ was computed as increase in solids content of the bottles per unit area normal to the vertical per day (mg cm^{-2} day^{-1}).

Organic (O) and inorganic (I) solids were determined gravimetrically by the following technique. Initial concentrations of both fractions were ascertained by filtering a known volume of water sample through tared (HA) Millipore filters, desiccating filters plus residues, weighing for total seston (T=O+I), and then ashing at 600°C, rehydrating the ash, desiccating, and weighing again to obtain ash weight. For final concentrations (after 24 hours), a composite sample from treatment replications was put into a Waring blendor, 1 ml saturated sodium oxalate added to aid in suspension, and the mixture homogenized. Then an aliquot of convenient size for filtering was removed before any settling could occur and treated as described above for initials. The differences between final and initial concentrations were determined, to yield ΔT, ΔO and ΔI expressed as flux (mg cm^{-2} day^{-1}).

The data reported include vertical profiles of temperature (Table 1); chlorinity (Table 2); extinction coefficient (Table 3); dissolved oxygen (Table 4); initial solids concentrations: total (Table 5), organic and inorganic (Table 6), and organic/inorganic ratios (Table 7); daily flux of solids: total (Table 8), organic and inorganic (Table 9), and organic/inorganic flux ratios (Table 10); daily flux per unit concentration (Table 11); and fold-increase in organic and inorganic fallout rates between the 4 ft depth intervals studied (Table 12).

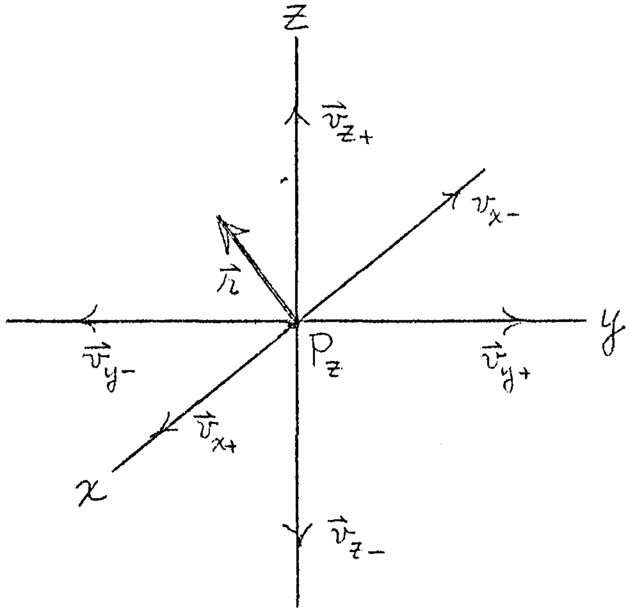
From the consistent increase with depth of the ostensible rates of fallout of total solids (Table 8), especially the inorganic fraction (Table 9), and from the lack of correlation between measured flux and concentration of total material (Table 11), it is concluded that allochthonous sources, particularly the bottom sediments, contribute importantly to the standing seston in the water column of this York River station.

Distribution of this report does not constitute publication, and the data and interpretations are subject to correction and/or revision.

Bernard C. Patten
David K. Young
Morris Roberts

March 13, 1963

Fig. 1. Identification of flux vectors



EXPERIMENT DATES

Exp. No.	Date
1	Jun 11-12, 1961
2	Jul 25-26, 1961
3	Aug 8-9, 1961
4	Aug 29-30, 1961
5	Oct 9-10, 1961
6	Oct 23-24, 1961
7	Nov 6-7, 1961
8	Dec 11-12, 1962
9	Jan 8-9, 1962
10	Feb 15-16, 1962
11	Mar 15-16, 1962
12	Apr 16-17, 1962
13	May 8-9, 1962
14	Jun 4-5, 1962
15	Jul 10-11, 1962

Table 1. Vertical profiles of temperature, °C, at the beginning (B) and end (E) of each experiment.

Exp. No	S		2		6		10		14		18		22		B	
	B	E	B	E	B	E	B	E	B	E	B	E	B	E	B	E
1	24.5	24.6	24.5	24.5	25.0	24.4	24.8	24.4	24.8	24.2	24.6	23.9	24.6	24.0	24.0	24.0
2	29.2	28.8	28.8	29.3	28.2	28.3	27.8	27.8	27.5	27.4	26.4	25.8	26.2	25.3	26.5	24.9
3	28.0	28.5	28.0	28.5	27.7	28.4	27.2	27.5	26.9	26.8	26.1	26.4	25.0	25.8	26.0	25.5
4	28.4	28.1	29.8	28.1	29.0	27.7	28.8	27.1	27.9	27.3	27.7	27.0	28.0	27.0	27.7	27.2
5	22.5	22.0	22.2	23.0	21.6	22.0	21.2	21.7	21.2	21.6	21.2	21.5	21.1	21.4	21.2	21.5
6	12.1	12.0	12.2	12.0	12.2	12.1	12.2	12.1	12.1	12.0	12.1	12.0	12.1	12.0	12.1	12.0
7	18.2	18.0	18.1	17.9	17.6	17.9	17.3	17.8	16.7	17.5	16.7	17.5	16.7	17.5	16.7	17.8
8	8.19	8.15	8.03	7.89	7.96	7.81	7.86	7.77	7.84	7.77	7.83	7.78	7.82	7.78	7.80	7.78
9	8.04	8.00	7.88	7.74	7.81	7.66	7.71	7.63	7.69	7.63	7.68	7.64	7.67	7.64	7.65	7.64
10	3.25	-	3.14	-	3.08	-	3.07	-	3.06	-	2.96	-	2.72	-	2.64	-
11	5.68	6.33	5.65	6.26	4.83	6.15	4.65	5.95	4.35	5.10	4.32	5.05	4.31	4.83	4.32	4.78
12	10.54	11.84	10.47	12.08	10.58	12.22	10.70	12.39	10.82	12.35	10.50	12.21	10.07	11.95	9.96	11.90
13	19.08	19.99	19.02	18.41	18.05	17.52	17.79	17.27	17.77	17.01	17.77	16.92	17.07	16.92	16.92	16.92
14	22.54	22.97	22.30	22.95	22.30	22.56	22.30	22.24	22.30	22.44	22.12	21.55	22.12	21.25	22.12	21.09
15	26.51	29.00	25.99	28.00	25.14	27.50	24.53	26.50	24.33	25.50	24.33	25.00	24.10	25.00	24.10	25.00
$\bar{x}$	17.78	19.16	17.74	18.97	17.40	18.73	17.19	18.44	17.02	18.19	16.82	17.88	16.64	17.76	16.65	17.72

Table 2. Vertical profiles of chlorinity, ‰, at the beginning (B) and end (E) of each experiment.

Exp. No.	S		2		6		10		14		18		22		B	
	B	E	B	E	B	E	B	E	B	E	B	E	B	E	B	E
1	8.66	8.52	8.58	8.58	8.59	8.55	8.78	8.90	9.08	9.17	9.57	9.56	9.66	9.77	10.55	9.86
2	10.60	10.89	10.70	10.87	10.72	10.90	10.64	10.91	10.90	11.19	11.42	11.75	11.56	11.15	11.70	12.54
3	10.92	10.87	10.94	10.83	11.13	10.86	11.42	11.51	11.75	11.98	12.32	12.17	12.40	12.46	12.74	13.06
4	11.26	11.32	11.26	11.23	11.20	11.23	11.20	11.24	11.21	11.26	11.26	11.30	11.20	11.31	11.20	11.32
5	11.08	11.16	11.16	11.28	11.20	11.31	11.20	11.21	11.20	11.31	11.27	11.31	11.24	11.32	11.26	11.28
6	11.53	11.59	11.53	11.59	11.53	11.60	11.71	11.63	11.71	11.67	11.69	11.62	11.69	11.60	11.69	11.60
7	10.01	10.81	10.01	10.71	10.71	10.97	11.71	11.01	11.21	11.20	11.45	11.42	11.52	11.42	11.53	11.41
8	12.00	11.94	12.00	11.95	12.09	12.09	12.02	12.06	12.19	12.09	12.34	12.11	12.32	12.06	12.34	12.24
9	10.95	9.77	11.08	10.84	11.46	11.28	11.58	11.48	11.48	11.48	11.72	11.56	11.26	11.58	11.28	11.58
10	10.61	10.02	10.71	10.00	10.71	10.01	10.89	10.11	10.91	10.16	11.09	10.61	11.74	10.79	11.64	11.81
11	7.51	8.23	7.85	8.23	8.30	8.13	9.10	8.23	9.41	8.84	10.26	9.45	10.37	9.65	10.47	10.22
12	8.34	7.67	8.26	8.17	8.46	8.39	8.61	8.68	8.80	8.79	9.04	9.09	9.30	9.65	10.01	9.88
13	9.39	9.32	9.30	9.52	9.32	9.82	9.48	9.74	9.81	9.92	10.11	10.01	10.22	10.02	10.28	10.12
14	9.80	9.20	9.80	9.20	9.38	9.30	9.31	9.50	9.38	9.50	9.57	9.60	9.72	10.00	9.96	10.30
15	8.73	8.13	9.42	8.18	9.52	8.83	9.82	9.72	9.99	10.02	10.21	10.30	10.61	10.91	10.84	11.21
$\bar{x}$	10.09	9.96	10.17	10.08	10.29	10.22	10.50	10.40	10.60	10.57	10.90	10.79	10.99	10.98	11.17	11.23

Table 3. Vertical profiles of extinction coefficient, m^{-1}, at the beginning (B) and end (E) of each experiment.

Exp. No.	S		2		6		10		14		18		22		B	
	B	E	B	E	B	E	B	E	B	E	B	E	B	E	B	E
1	0.782	1.150	1.012	1.104	0.879	1.116	0.920	1.081	0.943	1.035	0.529	1.173	0.575	1.587	1.978	2.300
2	1.357	0.839	1.299	0.678	2.047	1.150	1.840	0.678	1.472	0.690	1.207	0.839	1.575	0.828	3.818	9.683
3	1.208	1.495	1.380	1.610	1.092	1.495	0.978	1.265	0.862	0.805	0.742	0.690	0.862	0.690	2.760	71.30
4	1.621	1.104	1.863	1.506	1.886	1.380	2.162	1.388	2.794	1.598	2.645	1.840	4.266	2.150	4.393	2.748
5	0.724	1.162	1.104	1.000	1.081	0.954	1.150	0.506	1.000	1.392	0.862	1.552	0.862	1.633	5.612	1.610
6	1.012	1.150	1.403	1.484	1.702	1.484	2.082	1.484	2.484	1.564	2.392	1.507	3.381	1.507	12.662	4.612
7	0.713	1.162	0.966	1.300	0.794	1.564	1.288	1.702	0.966	1.817	1.116	1.760	1.771	1.874	13.34	2.001
8	0.345	0.610	1.277	0.759	0.656	0.483	0.851	0.472	0.943	0.667	1.116	0.736	1.127	0.805	0.736	4.911
9	0.138	1.280	0.529	1.127	0.725	1.127	0.713	1.127	0.828	1.127	1.012	1.092	1.120	1.311	1.700	1.645
10	0.771	0.437	1.472	0.552	1.162	0.771	0.840	0.771	0.782	0.437	0.782	0.610	0.702	0.368	0.748	3.439
11	1.012	0.552	1.852	0.552	0.989	0.633	0.920	0.725	1.093	0.702	1.288	0.817	1.288	0.955	2.714	8.993
12	2.542	1.093	2.542	1.162	2.542	1.346	2.507	1.346	2.000	1.277	2.000	1.196	1.978	1.530	14.341	4.232
13	0.805	0.936	0.886	1.093	0.828	1.000	0.667	1.000	0.874	0.989	0.874	1.058	1.173	1.000	5.083	1.449
14	1.116	1.058	1.173	0.529	1.208	0.460	1.288	0.529	1.277	0.610	1.392	0.529	1.242	0.472	1.564	0.943
15	0.414	0.724	0.552	0.840	0.782	0.586	0.414	0.667	0.460	0.483	0.920	0.483	0.598	0.667	2.944	2.323
$\bar{x}$	0.971	0.983	1.287	1.020	1.093	1.037	1.241	0.983	1.252	1.013	1.258	1.059	1.501	1.158	4.960	8.146

Table 4. Vertical profiles of initial dissolved oxygen, mg l^{-1}.

Exp. No.	S	2	6	10	14	18	22	B
1	8.75	7.97	7.57	6.25	5.62	5.04	4.88	3.68
2	8.72	8.35	7.60	7.35	7.24	5.99	5.80	5.74
3	-	-	-	-	-	-	-	-
4	8.36	8.42	8.17	7.09	7.54	7.03	6.81	6.86
5	7.95	7.51	7.10	6.89	6.96	6.94	6.92	6.83
6	7.71	7.75	7.63	7.71	7.65	7.68	7.66	7.50
7	8.48	8.52	8.05	7.97	7.71	7.44	7.40	7.35
8	9.97	10.12	9.92	9.95	9.93	9.92	9.96	9.94
9	10.85	10.83	10.65	10.60	10.65	10.62	10.75	10.48
10	12.28	12.23	12.20	12.13	12.17	12.02	11.82	11.71
11	11.42	11.41	11.32	11.12	11.07	10.60	10.62	10.55
12	8.52	8.20	8.27	8.37	8.54	8.50	8.59	7.39
13	8.06	8.03	7.79	7.11	6.71	6.44	6.48	6.16
14	4.93	4.93	4.74	4.67	4.66	4.24	3.95	3.54
15	7.93	7.73	7.96	7.69	7.05	6.49	5.68	4.97
$\bar{x}$	8.85	8.71	8.50	8.21	8.11	7.78	7.67	7.34

Table 5. Initial concentrations of total solids (T) in the water column, mg l^{-1}.

Exp. No.	S	2	6	10	14	18	22	26	B
1	8.8	19.6	7.0	7.2	6.4	6.8	7.0	7.6	26.4
2	13.4	16.4	13.4	8.8	13.0	11.0	27.2	-	44.4
3	10.8	8.6	6.2	4.8	1.8	6.2	12.0	-	38.0
4	9.0	8.4	9.8	12.8	13.8	14.6	18.2	-	31.8
5	6.6	4.8	6.0	7.2	5.2	4.2	6.4	-	67.2
6	10.4	15.2	13.6	23.8	20.6	20.4	25.1	-	74.6
7	7.6	6.6	8.8	6.8	8.8	7.4	11.0	-	54.2
8	9.6	11.2	6.2	6.0	10.8	12.4	11.2	-	13.0
9	6.6	9.6	8.2	8.2	8.6	14.0	19.2	-	32.6
10	6.6	10.8	12.2	5.0	6.4	5.8	4.4	-	4.6
11	4.0	13.6	5.8	4.4	7.0	8.4	10.0	-	38.8
12	11.2	17.8	31.2	32.8	26.4	28.8	14.4	-	211.6
13	9.6	10.0	7.8	6.6	8.8	8.8	10.4	-	23.6
14	5.2	6.0	6.2	4.8	4.2	4.8	4.0	-	7.4
15	4.4	10.0	5.0	7.0	5.0	6.0	12.2	-	66.2
$\bar{x}$	8.2	11.2	9.8	9.7	9.8	10.0	12.2	7.6	49.0

Table 6. Initial concentrations of suspended organic (O) and inorganic (I) solids in the water column, mg l^{-1}.

Exp. No.	S		2		6		10		14		18		22		26		B	
	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I
1	4.2	4.6	17.2	2.4	5.2	1.8	2.4	4.8	3.0	3.4	3.6	2.2	3.6	3.4	2.8	4.8	-	-
2	1.4	12.0	2.8	13.6	2.0	11.4	1.4	7.4	0.5	12.5	1.0	10.0	14.7	12.5	-	-	5.7	38.7
3	5.0	5.8	3.2	5.4	2.2	4.0	0.4	4.4	0.4	1.4	1.4	4.8	3.4	8.6	-	-	6.0	32.0
4	0.6	8.4	2.0	6.4	1.6	8.2	4.4	8.4	3.2	10.6	3.8	10.8	4.2	14.0	-	-	3.6	28.2
5	2.2	4.4	2.6	2.2	2.4	3.6	3.0	4.2	2.2	3.0	1.6	2.6	0.4	6.0	-	-	7.6	59.6
6	3.0	7.4	3.2	12.0	4.0	9.6	5.2	18.6	3.6	17.0	1.6	18.8	5.94	22.1	-	-	8.9	65.7
7	2.0	5.6	2.0	4.6	2.0	6.8	1.0	5.8	1.0	7.8	1.4	6.0	3.2	7.8	-	-	4.4	49.8
8	3.8	5.8	4.4	6.8	1.8	4.6	1.2	4.8	3.0	7.8	0.8	11.6	2.4	8.8	-	-	1.4	11.6
9	0.2	6.4	2.4	7.2	1.0	7.2	0.6	7.6	0.2	8.4	1.0	13.0	1.0	18.2	-	-	2.4	30.2
10	1.8	4.8	4.2	6.6	4.8	7.4	1.0	4.0	2.6	3.8	2.4	3.4	2.6	1.8	-	-	0.2	4.4
11	1.2	2.8	1.8	11.8	0.8	5.0	2.8	1.6	3.8	3.2	5.0	3.4	2.8	7.2	-	-	28.2	10.6
12	0.2	11.0	3.8	14.0	14.4	16.8	12.4	20.4	11.6	14.8	15.6	13.2	3.6	10.8	-	-	19.2	192.4
13	7.0	2.6	6.8	3.2	6.4	1.4	5.0	1.6	7.6	1.2	6.0	2.8	8.4	2.0	-	-	9.6	14.0
14	5.0	0.6	4.8	1.2	4.0	2.2	3.2	1.6	3.4	0.8	4.2	0.6	3.2	0.8	-	-	1.8	5.6
15	3.1	1.3	6.8	3.2	4.0	1.0	2.8	4.2	4.0	1.0	3.8	2.2	4.4	7.8	-	-	7.4	58.8
$\bar{x}$	2.7	5.6	4.5	6.7	3.8	6.1	3.1	6.6	3.3	6.4	3.5	6.8	4.3	8.8	2.8	4.8	7.6	43.0

Table 7. Organic to inorganic (O/I) ratios of suspended solids in the water column.

Exp. No.	S	2	6	10	14	18	22	26	B
1	0.913	7.167	2.889	0.500	0.882	1.636	1.059	0.583	-
2	0.117	0.206	0.175	0.189	0.040	0.100	1.176	-	0.147
3	0.862	0.426	0.550	0.091	0.286	0.292	0.395	-	0.188
4	0.071	0.312	0.195	0.524	0.302	0.352	0.300	-	0.128
5	0.500	1.082	0.667	0.714	0.733	0.615	0.067	-	0.128
6	0.405	0.267	0.417	0.280	0.212	0.085	0.269	-	0.136
7	0.357	0.435	0.294	0.172	0.128	0.233	0.410	-	0.088
8	0.655	0.647	0.391	0.250	0.385	0.069	0.273	-	0.121
9	0.031	0.333	0.139	0.079	0.024	0.077	0.055	-	0.079
10	0.375	0.636	0.649	0.250	0.684	0.706	1.444	-	0.045
11	0.429	0.152	0.160	1.750	1.188	1.470	0.389	-	1.717
12	0.018	0.271	0.857	0.608	0.784	1.182	0.333	-	0.100
13	2.692	2.125	4.571	3.125	6.333	2.143	4.200	-	0.685
14	8.333	4.000	1.818	2.000	4.250	7.000	4.000	-	0.321
15	2.385	2.125	4.000	0.667	4.000	1.727	0.564	-	0.126
$\bar{x}$	1.210	1.352	1.185	0.747	1.349	1.179	0.996	0.583	0.286

Table 8. Daily (24-hour) flux of total suspended solids (ΔT) at various depths in the water column, mg cm^{-2} day^{-1}.

Exp. No.	2	6	10	14	18	22	26
1	8.30	10.44	16.51	28.33	37.22	55.47	113.22
2	6.72	18.42	20.20	36.04	39.14	87.46	-
3	4.75	17.64	12.49	45.57	57.63	84.34	-
4	15.89	35.48	51.18	89.65	132.22	240.05	-
5	8.48	33.04	49.42	68.90	77.20	98.10	-
6	42.03	62.01	70.78	92.49	73.89	115.81	-
7	7.62	27.87	41.96	50.74	50.28	74.12	-
8	26.03	40.68	46.52	50.74	57.37	61.42	-
9	17.84	35.99	51.72	59.44	67.38	86.28	-
10	3.53	4.77	6.56	8.50	12.01	18.59	-
11	3.67	10.36	21.89	25.52	33.54	31.39	-
12	20.09	26.99	42.92	42.85	41.18	49.80	-
13	10.00	35.40	50.32	76.13	123.95	167.70	-
14	12.08	24.68	26.83	27.03	34.57	24.08	-
15	4.17	6.56	7.87	13.17	16.34	22.42	-
$\bar{x}$	12.75	26.02	34.48	47.67	56.93	80.54	113.22

Table 9. Daily flux of organic (△O) and inorganic (△I) suspended solids in the water column, mg cm^{-2} day^{-1}.

Exp. No.	2		6		10		14		18		22		26	
	△O	△I	△O	△I	△O	△I	△O	△I	△O	△I	△O	△I	△O	△I
1	0.51	7.79	1.29	9.15	1.33	15.18	2.67	25.66	3.05	34.17	4.25	51.22	9.96	103.26
2	0.26	6.46	1.28	17.14	1.62	18.58	2.56	33.48	2.88	36.26	6.58	80.88	-	-
3	0.38	4.37	2.86	14.78	6.94	5.55	3.20	42.37	4.63	53.00	6.29	78.05	-	-
4	1.30	14.59	2.45	33.03	4.33	46.85	6.30	83.35	9.92	122.30	21.21	218.84	-	-
5	0.23	8.25	2.94	30.10	5.96	43.46	6.34	62.56	6.89	70.31	9.42	88.68	-	-
6	4.73	37.30	6.43	55.58	6.03	64.75	7.50	84.99	5.67	68.22	8.61	107.20	-	-
7	1.04	6.58	2.78	25.09	4.13	37.83	4.30	46.44	5.16	45.12	7.34	66.78	-	-
8	2.94	23.09	4.36	36.32	3.86	42.66	5.09	45.65	5.88	51.49	5.81	55.61	-	-
9	1.46	16.38	4.57	31.42	4.32	47.40	4.34	55.10	7.61	59.27	6.91	79.37	-	-
10	2.51	1.02	0.83	3.94	0.56	6.00	0.49	8.01	1.38	10.63	0.58	18.01	-	-
11	2.80	0.87	3.36	7.00	3.70	18.19	4.53	20.99	7.45	25.59	4.75	26.64	-	-
12	0.70	19.39	1.46	25.53	7.99	34.93	6.45	36.40	5.41	35.77	7.85	41.96	-	-
13	2.23	7.77	3.99	31.41	5.18	45.14	8.54	67.59	13.13	110.82	15.46	152.24	-	-
14	1.79	10.29	3.39	21.29	3.86	22.97	2.98	24.05	3.64	30.93	2.99	21.09	-	-
15	0.66	3.51	2.86	3.70	1.79	6.08	2.61	10.56	2.26	14.08	3.02	19.40	-	-
$\bar{x}$	1.57	11.18	2.99	23.03	4.11	30.37	4.53	43.15	5.70	51.20	7.40	73.73	9.96	103.26

Table 10. Flux ratios, △0/ △I, at various depths in the water column.

Exp. No.	2	6	10	14	18	22	26
1	0.065	0.140	0.088	0.104	0.089	0.083	0.096
2	0.040	0.075	0.087	0.076	0.079	0.081	-
3	0.087	0.194	1.250	0.076	0.087	0.080	-
4	0.089	0.074	0.092	0.076	0.081	0.097	-
5	0.028	0.098	0.137	0.101	0.099	0.106	-
6	0.127	0.116	0.093	0.088	0.083	0.080	-
7	0.158	0.111	0.109	0.092	0.114	0.110	-
-	-	-	-	-	-	-	-
8	0.127	0.120	0.090	0.112	0.114	0.104	-
9	0.089	0.145	0.091	0.079	0.128	0.087	-
10	2.461	0.211	0.093	0.061	0.130	0.032	-
11	3.218	0.480	0.203	0.216	0.311	0.178	-
12	0.036	0.057	0.229	0.177	0.151	0.187	-
13	0.287	0.127	0.115	0.126	0.118	0.102	-
14	0.174	0.159	0.168	0.124	0.118	0.142	-
15	0.188	0.773	0.294	0.247	0.160	0.156	-
$\bar{x}$	0.478	0.192	0.209	0.117	0.124	0.108	0.096

Table 11. Ratios of total solids flux to concentrations ($\triangle T/T$), in mg cm^{-2} day^{-1}/mg l^{-1}.

Exp. No.	2	6	10	14	18	22	26
1	0.42	1.49	2.29	4.43	5.47	7.92	14.89
2	0.41	1.37	2.30	2.77	3.56	3.22	-
3	0.55	2.85	2.60	25.32	9.30	7.03	-
4	1.89	3.62	4.00	6.50	9.06	13.19	-
5	1.77	5.51	6.86	13.25	18.38	15.33	-
6	2.77	4.56	2.97	4.61	3.62	4.61	-
7	1.15	3.17	6.17	5.77	6.79	6.74	-
8	2.32	6.56	7.75	4.70	4.63	5.48	-
9	1.86	4.39	6.31	6.91	4.81	4.49	-
10	0.33	0.39	1.31	1.33	2.07	4.23	-
11	0.27	1.79	4.98	3.65	3.99	3.14	-
12	1.13	0.87	1.31	1.62	1.43	3.46	-
13	1.00	4.54	7.62	8.65	14.08	16.13	-
14	2.01	3.98	5.59	6.44	7.20	6.02	-
15	0.42	1.31	1.12	2.63	2.72	1.84	-
$\bar{x}$	1.22	3.09	4.21	6.57	6.47	6.86	14.89

Table 12. Fold increase in ΔO and ΔI for each 4 ft depth interval in the water column.

Exp. No.	6/2		10/6		14/10		18/14		22/18		26/22	
	ΔO	ΔI	ΔO	ΔI	ΔO	ΔI	ΔO	ΔI	ΔO	ΔI	ΔO	ΔI
1	2.5	1.2	1.0	1.7	2.0	1.6	1.1	1.3	1.4	1.5	2.3	2.0
2	4.9	2.7	1.3	1.1	1.6	1.8	1.1	1.1	2.3	2.2	-	-
3	7.5	3.4	2.4	0.4	0.5	7.6	1.4	1.3	1.4	1.5	-	-
4	1.9	2.3	1.8	1.4	1.4	1.8	1.6	1.5	2.1	1.8	-	-
5	12.8	3.6	2.0	1.4	1.1	1.4	1.1	1.1	1.4	1.3	-	-
6	1.4	1.5	1.1	1.2	1.2	1.3	0.8	0.8	1.5	1.6	-	-
7	2.7	3.8	1.5	1.5	1.0	1.2	1.2	1.0	1.4	1.5	-	-
8	1.5	1.6	0.9	1.2	1.3	1.1	1.1	1.1	1.0	1.1	-	-
9	3.1	1.9	0.9	1.5	1.0	1.2	1.8	1.1	0.9	1.3	-	-
10	0.3	3.9	0.7	1.5	0.9	1.3	2.8	1.3	0.4	1.7	-	-
11	1.2	8.0	1.1	2.6	1.2	1.1	1.8	1.2	0.6	1.0	-	-
12	2.1	1.3	5.5	1.4	0.8	1.0	0.8	1.0	1.4	1.2	-	-
13	1.8	4.0	1.3	1.4	1.6	1.5	1.5	1.6	1.2	1.4	-	-
14	1.9	2.1	1.1	1.1	0.8	1.0	1.2	1.3	0.8	0.7	-	-
15	4.3	1.0	0.6	1.6	1.4	1.7	0.9	1.3	1.3	1.4	-	-
$\bar{x}$	3.3	2.8	1.5	1.4	1.2	1.8	1.3	1.2	1.3	1.4	2.3	2.0