by means of a cylindrical lens, on a slit in front of a drum carrying a sensitized film. As the drum rotates the film behind the slit is blackened, except where it is protected by the shadow of the fiber. Thus a record of the motion of the fiber may be made in the usual way.

This instrument may be used as a voltmeter and as an oscillograph.

(1) When used as a voltmeter for constant differences of potential the fiber may be connected to a dry cell battery of perhaps 200 volts, and the plates to the source to be measured.

When so connected (Fig. 1) the sensitivity may be varied by changing the distance between the plates and by changing the potential on the fiber. Fig. 2

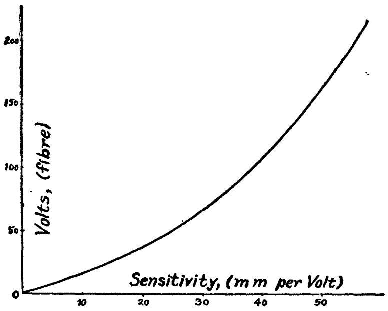

FIG. 2

is a typical curve showing the relation between sensitivity in mm of deflection per volt and fiber potential in volts. The sensitivity through a wide range is very evenly proportional to the potential gradient of the field between the plates. With properly chosen fibers the sensitivity may range from 200 or more mm per volt on the plates to 10 volts per mm, and it may be accurately controlled.

If, instead of connecting the fiber to a battery of dry cells, the fiber is connected through a resistance to one of the plates, the instrument will give steady deflections for alternating differences of potential. When used on differences of potential of this sort, it is very sensitive and readings may be repeated with accuracy.

The fiber should be drawn from ordinary sodium glass tubing and silvered. Its diameter should be something like .2 mm and for voltmeter work should be uniform throughout the whole length. The fact that it is a hollow cylinder insures high elasticity and small inertia, and these properties give high damping in ordinary air and a short period to the moving member. Fibers of this sort usually come to rest at the position of maximum steady deflection in less than .1 second.

(2) When used as an oscillograph a differently shaped fiber is required.

If the instrument as described above is used on alternating differences of potential with the uniform fiber charged from the battery as in Fig. 1, it is easily possible to set up nodes and loops like those in a vibrating rod in the fiber. While not useful in this condition for the study of wave forms, it is very good for the study of vibrations of rods and the like. It lends itself nicely to projection before a class, and when used with a stroboscope it shows the vibrations of the fiber clearly and distinctly in detail.

If the fiber is drawn so as to taper from a reasonable thickness (perhaps .5 mm) at the upper end to hair-like thinness at the free lower end, the stiffer upper part will not vibrate, but the lower fourth or thereabouts will, because of its extreme lightness, follow the variations of the field with no period of its own.

In this condition the fiber will follow audio frequency waves with fidelity when the plates are connected across a source. In connection with a microphone and a one-stage amplifier, voice currents, etc., may be recorded with great nicety. Records have been made of complex waves from various sources, such as organ pipes, orchestral music through the radio, the human voice, etc.

Since the moving part of this instrument is very small and light its motion in the field between the parallel plates disturbs the uniformity of the field very little. Therefore the source of the potential under measurement has to supply a very small charging current to the plates, and consequently very little energy. The exceedingly small amount of energy required to operate the instrument makes it useful in work where the source under investigation is very weak.

Because of the fact that its current requirement is so small, the authors have spoken of the instrument somewhat loosely as an "electrostatic oscillograph."

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SPECIAL ARTICLES

EFFECT OF INHIBITING FACTOR FROM NORMAL TISSUES ON SPONTANEOUS TUMORS OF MICE

IN a previous communication evidence was presented which indicated that a factor or substance could be extracted from mouse placenta and embryo skin which had a definite inhibiting action on the growth of transplanted mouse carcinoma. It has also been shown that an inhibiting factor isolated from a fowl sarcoma which was capable of neutralizing the causative agent of this tumor also inhibited the growth of transplantable mouse sarcoma. It was suggested that these factors were related to the substances which control the growth tendency of normal cells. The present report is an account of the effect of the normal tissue factor on the spontaneous mouse tumors.

Material: The animals used in the tests all came from inbred families of mice with high mammary cancer rates. The source of the inhibitors tested was late term mouse placenta and the skin of embryos of the same period. The tissues were finely minced, spread in a thin layer and dried *in vacuo* at sub-zero temperature. After desiccation was complete the material was powdered, thoroughly extracted with water (0.1 gm to 1 cc) and the larger particles removed by centrifugation.

Group I: This series was made up of 59 mice having a total of 85 primary mammary tumors, which were classed as medium to large size. The tumors were removed by operation and the operated field washed with embryo skin or placenta extract. In 57 of the animals, two grafts were taken from the removed tumor, one immersed in the test fluid and the other in Ringer's solution, and then both were inoculated into the mouse from which the tumor had been removed. Only those animals living over five weeks after the operation are included in the following table. For controls tumor mice from the same families were operated on and grafts returned without treatment to the field of operation or to the tumor grafted to another site.

TABLE I

FATE OF AUTOGRAFTS

	Grew Per cent.	Doubtful or no growth Per cent.
20 tumors removed:		
Autografts treated with embryo skin extract	50.0	50.0
Autografts not treated	75.0	25.0
37 tumors removed:		
Autografts treated with placenta extract	21.6	78.4
Autografts not treated	78.4	21.6
64 tumors removed:		
Autografts, no treatment to graft or wound	96.9	3.1

LOCAL RECURRENCE FOLLOWING OPERATION

		Per cent.
27 treated with skin extract	3 recurrences	11.1
58 treated with placenta extract	3 recurrences	5.2
89 with no treatment	44 recurrences	49.4

Judged by the marked reduction in local recurrences and the large number of treated autografts which failed to grow the results seem definite. The average length of life is sometimes over 80 days with 18.6 per cent. still living. There is a suggestion in the above table of some generalized action of the inhibitors in that the untreated autografts grew less well in animals which had received a certain amount of the inhibitor in the operated wound and with the treated graft (75 and 78.4 per cent.) than the autografts in animals receiving no treatment (96.9 per cent.). It is of interest to note that in a control series 32 per cent. of the 50 mice developed new primary tumors, while in the treated group only 4, or 6.8 per cent., had new tumors.

Group II: The more crucial test of the inhibiting action would be its effect on the spontaneous tumor undisturbed by operative procedure. To eliminate any possible local interference with blood supply to the tumors the injections of the test fluids were made intraperitoneally at weekly intervals. The group includes 91 mice with 127 well-established primary tumors, all from inbred stocks with high mammary cancer rates. Of these 40 were treated with embryo skin extract and 51 with placenta extract. The average size of these tumors was somewhat smaller than those used in the operated series. The results are given in Table II.

TABLE II

			Per cent.
Number of tumors in mice treated with embryo skin extract	60		
Continued growth	20		33.3
Stationary or slight retrogression	17	28.3 Per cent.	66.7
Marked retrogression	7	11.7 " "	
Complete absorption	16	26.7 " "	
Number of tumors in mice treated with placenta extract	67		
Continued growth	21		31.3
Stationary or slight retrogression	16	23.9 Per cent.	68.7
Marked retrogression	17	25.4 " "	
Complete absorption	13	19.4 " "	

The figures given above, where only 33.3 per cent. of the tumors in one series and 31.3 per cent. in the other continued to grow after treatment was started, may be compared with our experience with hundreds of untreated tumor animals from the same stocks followed in this laboratory. Steady, progressive growth is the rule, with temporary cessation of growth or retrogression a rare occurrence, and the absorption of an established tumor of such unusual occurrence as to require no consideration in the analysis of the above figures. The average time the treated animals have been under observation has been about 60 days, with a number still living.

There seems to be little doubt that the extracts of the two tissues which have previously been shown to reduce the takes of transplanted cancer have an influence on natural or spontaneous cancer. This inhibiting action is evident not only on the local post-operative recurrence, and the growth of autografts where there was direct contact between the extracts and the cancer cells, but is observable likewise on untreated or unoperated tumors at a distance when the inhibiting materials were injected into the peritoneal cavity.

We do not consider that the results stated necessarily establish the hypothesis on which the experiment was based, for the complexity of the materials makes it quite possible that this explanation is not the correct one. The general relations between the factors which influence the origin and growth of spontaneous tumors, the balancing mechanism of normal tissues, and the inhibitor which has been isolated from the chicken sarcomas can not be seriously discussed until further knowledge is available.

A more detailed report, including data on histological types of the tumors, metastasis occurrence, etc., will be published later. At present the results recorded here are considered of only theoretical importance.

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FUNDAMENTAL LIMITS TO THE SIZES OF CLASTIC GRAINS

TEN years ago the writer presented a scale of size limits for the terms boulder, cobble, pebble, granule and sand, silt and clay grains.[1] The scale was based on average prevailing opinion and stated in units to conform to certain sieve openings in the mechanical analysis scale first used extensively by Udden.[2] With growing precision in terminology and increasing use of quantitative methods of analysis of detrital materials, the usage suggested by the writer has been generally accepted, with only occasional modification of certain terms.

Names for the unconsolidated and consolidated aggregate were also proposed and differ from the fragment names chiefly in the bracketing of the aggregates of boulders, cobbles, pebbles and granules under the single name "gravel." In this usage there is tacit implication that the materials gravel, sand, silt and clay are of equal rank in classification. Aside from purely arbitrary division into classes of equal width on an arithmetic or geometric scale, equality of rank would result only from the use of limits having coordinate natural or genetic significance.

Recently, the writer was led to further consideration of these terms and the conclusion was reached that the seeming narrow unity of the materials sand, silt and clay and the wide size range in the gravel class probably represent an unconscious recognition by man, layman as well as geologist, of certain genetic units based on the several fundamental modes of transport by running water and on several modes of derivation from parent rocks. This interpretation is shown in the following table:

TABLE I

Mode of transport	Usual source	Name of aggregate
Traction	All available hard rocks	Gravel
Inertia suspension	Mono-mineral grains of phanerites (chiefly)	Sand
Viscous suspension	Mono-mineral grains of any rocks (chiefly)	Silt
Colloidal suspension	Molecularly decomposable materials	Clay

In Table I there are listed four distinct modes of handling which occur in running water. Both traction and inertia suspension take place approximately in accordance with the so-called Sixth Power Law, which postulates a complete transfer of kinetic energy from water to particle and which makes no allowance for the subsidiary effect of viscous drag. Viscous suspension, on the other hand, accounts for the transport of finer particles in which the surface effect is greater relative to the mass. The size-velocity relationship in this range is defined by the well-known Stokes Law.[3] Still smaller particles are kept in suspension chiefly by the kinetic effects found in dispersed systems, *i.e.*, colloid systems.

It should, of course, be recognized that none of the lines of demarcation between these modes of transport are sharp and that water-transported detrital materials occur in a continuous series from large boulders to clay particles. However, it appears that each of the processes of transportation has an optimum range in nature and that only partial overlapping occurs. Where more than one of the

[1] C. K. Wentworth, "A Scale of Grade and Class Terms for Clastic Sediments," *Jour. of Geology*, 30: 377–392. 1922.

[2] J. A. Udden, "Mechanical Composition of Clastic Sediments," *Geol. Soc. Amer. Bull.*, 25: 655–744. 1914.

[3] G. G. Stokes, "On the Effect of the Internal Friction of Fluids on the Motion of Pendulums," *Trans. Cambridge Philos. Soc.*, Vol. 9, part 2, pp. 8–106, espec. sec. 4, pp. 48–57, 1851.