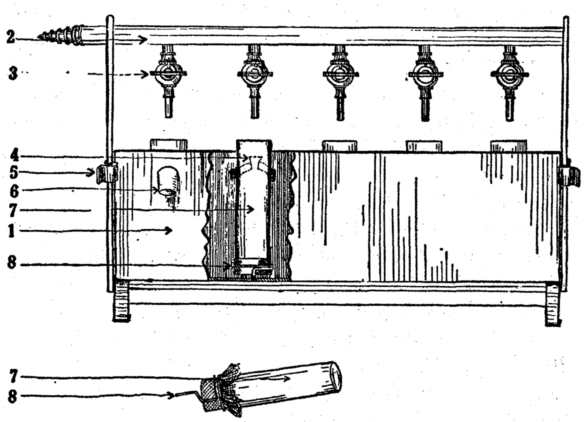
SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR WASHING HISTOLOGICAL MATERIALS

FOR years in preparing materials for histological study I had felt the need of a simple, practical piece of apparatus for washing from such materials the reagents used in killing and fixing them. Being unable to find any such apparatus listed by the leading dealers in biological equipment I had made and installed on a shelf above the sink in my laboratory a device that meets this need.

The apparatus, as shown in the accompanying



sketch, consists of a framework of brass supporting a tank (1) made of tin-lined copper. This tank is held in place by the springs (5) and may readily be detached for cleaning. Above the tank are a series of petcocks (3) attached to a brass water-pipe (2) supported by uprights of the frame and fitted with a coupling for attaching the pipe by pressure-resistant rubber tubing to the water-supply. To the inner side of the back wall of the tank near the top are attached a series of spring-clips (4), one immediately below each petcock. These clips hold in place the washing tubes (7) and permit their ready insertion and removal from the tank, which, when in use, is filled with water to the level of the overflow pipe (6), through which, when the apparatus is in use, the excess water overflows into the sink.

The washing tube consists of a simple piece of glass tubing of suitable diameter over one end of which is placed a strainer of cheese cloth, marquisette or other suitable material. This strainer is held in place by a brass wire spring (8), which is continued downward and under in such fashion as to form a "leg" under the center of the bottom of the tube. This leg rests on the bottom of the tank and thus prevents the strainer from coming into contact with the bottom of the tank.

Material to be washed is put into the washing tube and the tube is placed in the spring-clip holder under the petcock, from which water is admitted into the tube. Washing is positive, the water entering the tube at the top and passing gently downward over and around the material and out at the bottom of the tube. The rate of flow of the water can be regulated at will by means of the petcock, and the leg on the spring holding the strainer prevents the tube from dropping to the bottom and stopping the flow of the water through the tube. In putting material into the tube, the killing fluid together with the material in it is poured into the tube, from which the fluid escapes through the strainer, leaving the material to be washed in the tube. When washing is complete, the tube is lifted from the tank and inverted in a wide-mouthed bottle or other suitable receptacle and a stream of water from a faucet, or preferably from a washing bottle, is directed upon the strainer, thus washing the material out of the tube into the receptacle. In this way materials can be handled without touching them with instruments and the most delicate can be manipulated without injury.

The tank is fifteen inches long, four inches wide, and four inches deep. I have found a tube four inches long and one inch in diameter the most satisfactory for general work, but tubes of greater diameter may be used and also of shorter length, provided the leg on the spring be made correspondingly longer. My students have found this piece of apparatus entirely satisfactory.

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SPECIAL ARTICLES

DIAGRAMS RELATIVE TO HAMILTON'S CANONICAL EQUATIONS

HAMILTON'S equations are so extensively appealed to in modern physics, that the following diagrams which contain considerable information, may be found useful. The masterly treatment given by Sommerfeld has been followed.

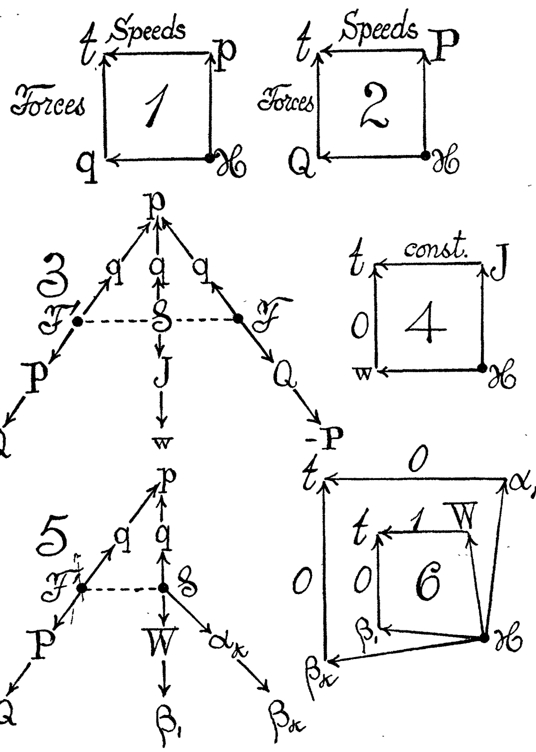
1. In figure 1, the arrows denote differentiations of the total energy H, either partial relative to the individual q_k, p_k, variables, or partial gradients.[1] Differentiations along parallel lines are equal and if the direction is up or to the right both are positive; otherwise one of them is negative. Thus the diagram is to be read

$$\partial H/\partial p_k = \partial q_k/\partial t \text{ or } \nabla_p H = \dot{\mathrm{q}} \text{ .... (speeds)}$$

and

$$\partial H/\partial q_k = -\partial p_k/\partial t \text{ or } \Delta_q H = -\dot{\mathrm{p}} \text{ .... (forces)}$$

[1] Vectors are given in roman, scalars in italics.



We have additionally $\partial T/\partial \dot{q}_k = p_k$ or $\nabla_{\dot{q}} T = \mathrm{p}$, T being the kinetic energy. One notes that diagonally opposite corners of figure 1 are essentially scalars and vectors, respectively, and the variables in H are indicated by the diagram.

2. Point transformations, where $Q_k = f_k(q_1 \cdots q_n)$, follow the same rules as given in figure 2. Thus $\nabla_{\mathrm{P}} H = \dot{\mathrm{Q}}$; $\nabla_{\mathrm{Q}} H = -\dot{\mathrm{P}}$; $\mathrm{P} = \nabla_{\dot{\mathrm{Q}}} T$ with the variables in H indicated as before.

3. A similar diagram is available to show the conditions under which canonical or contact transformations are admissible. In figure 3, F is a qQ function such that the canonical conjugates are $\nabla_{\mathrm{q}} F = \mathrm{p}$ and $\nabla_{\mathrm{P}} F = -\mathrm{P}$; whereas F' is a qP function, the conjugates appearing as $\nabla_{\mathrm{q}} F' = \mathrm{p}$ and $\nabla_{\mathrm{P}} F' = -\mathrm{Q}$. Thus the diagram shows the variables in F and F', but both may also contain time, t, explicitly.

With the new Q and P so defined, the diagram figure 2 is again at hand for use with the understanding that $H + \partial F/\partial t$ or else $H + \partial F'/\partial t$ are in general to replace H, as for instance in the adiabatic and perturbation phenomena.

4. In case of varied action a function corresponding to F' and which turns out to be the characteristic function $S = \int_0^\tau 2T dt$ may be made free from explicit time. Moreover if cyclic coordinates are in question P and Q may, as shown in Figure 3, be replaced by $\mathrm{J} = \S \mathrm{p} \cdot d\mathrm{q}$ and the cyclic variable w. This cyclic integral § is here to be taken in a vector sense (much like a ∇) so that $\mathrm{i}_1 \mathrm{J}_1 + \mathrm{i}_2 \mathrm{J}_2 + \cdots = \mathrm{i}_1 \S p_1 dq_1 + \mathrm{i}_2 \S p_2 dq_2 + \cdots$ whence generally $J_k = \S p_k dq_k$. Moreover $\mathrm{J} = \S \nabla_{\mathrm{q}} S \cdot d\mathrm{q}$ $= \Sigma \S \mathrm{i}_k (dS/dq_k) dq_k$ is thus the vector sum of the increments of S in cycles of all the $q_1, q_2 \cdots$ in q; *i.e.*, $J_k = \S (dS/dq_k) dq_k$.

Finally in the present case, figure 2, is replaced by figure 4, where H (αJ) and J(αW) are free from explicit time. Thus $\Delta_{\mathrm{w}} H = -\partial \mathrm{J}/\partial t = 0$ since by definition H does not contain w, and $\Delta_{\mathrm{J}} H = \partial \mathrm{w}/\partial t$ is constant or $w_k = \nu_k t + w_0$.

If the system varies adiabatically conformably with a slowly changing parameter a, H is to be replaced by $H + \phi da/dt$ where H and ϕ contain the same variables. Hence $\nabla_{\mathrm{w}} H = -\dot{a} \Delta_{\mathrm{w}} \phi = \partial \mathrm{J}/\partial t$.

5. Jacobi's transformations start with the same time free characteristic function $S(q_1 \cdots q_n \alpha_1 \cdots \alpha_n)$ supposedly integrated, and the partial differential equation $H(\mathrm{q}_1 \cdots q_n \partial S/\partial q_1 \cdots \partial S/\partial q_n \alpha_1 \cdots \alpha_n) = W$ $= H(\mathrm{q}_1 \cdots q_n \beta_1 \cdots \beta_n \alpha_1 \cdots \alpha_n)$ integrated, but they then vary the constants, *i.e.*, treat the parameters α, β, as variables However, as α_1, the last of the arbitrary constants (therefore additive and vanishing in the differentiations) is to be replaced by the time free energy W, the condition for contact transformations is conveniently forked at S as shown in figure (5), where $\Delta_{\mathrm{q}} S = \mathrm{p}$; $\partial S/\partial W = \beta_1$; and $\partial S/\partial \alpha_k = \beta_k$.

Figure 2 is now replaced by the duplicated square distorted for clearness, figure 6, conformably with the forked figure 5. All the differential coefficients of H here are necessarily zero except (since $H = W$), $\partial H/\partial W = \partial \beta_1/\partial t = 1$, whence $\beta_1 = t_1 + t_0$, which is the time specification of the motion. Hence $\beta_k = \partial S/\partial \alpha_k$ = const., since $\partial \beta_k/\partial t = 0$, give the orbital equations in $q_1 \cdots q_n$ with the constants specified, there being thus in all n equations for the $n+1$ variables including t.

In case of perturbations, H is replaced by $\mathrm{H} + \phi$, expressed as functions of α, β, W, ϕ vanishing for the unperturbed motion. Thus, for instance, $\partial \beta_1/\partial t = 1 + \partial \phi/\partial W$; $-\partial \phi/\partial \beta_1 = \partial W/\partial t$.

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THE GERM CELL CYCLE OF THE DIGENETIC TREMATODES[1]

THE life cycle of the digenetic trematodes has been a subject for both conjecture and investigation by zoologists for more than a century. Metagenesis, paedogenesis, metamorphosis extending over several generations, dissogenie and heterogony have been put forward as explanations on either theoretical or cytological grounds. Since the investigations on the

[1] From the Department of Helminthology, Johns Hopkins University. This work was done in partial fulfilment of the requirements for the degree of doctor of science in the School of Hygiene and Public Health. A full account will be published later.