chosen to take the risk of misrepresenting the character of the book by writing a very lop-sided review with its emphasis chiefly on the appendix because I know that this has offered difficulties to some very intelligent readers, because it appears logically fundamental to the whole system, and because some of its important logical implications seem not to have been expressed by the author in the main text.

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SPECIAL ARTICLES

TELESCOPIC OBSERVATION OF CATHODE AND ANODE POINTS

1. *Bright and dark sparks.* While the behavior of the anode in case of a mucronate electrode has been summarized,[1] further consideration of the cathode point is desirable. In this case the needle is to be critically set, so that the convection current is just about to pass into the spark condition. The set may often be made more sensitive, by waiting for some time until a convection current incidentally strikes and this may often be hastened by drawing sparks out of the cathode with a metal bridging the spark gap.

Since the U-tube interferometer is rather cumbersome for general observation, it may often be replaced by a suitable ear trumpet listening for the frequency of the crackle of sparks; or still better by a short range telescope (objective 6 or 8 inches off) focussed on the cathode point. Whenever the convection current passes, a bright oval cathode glow is seen in the telescope like the nucleus of a comet, while in the dark even the convection current itself may be seen looking much like a cometary tail. As soon as any spark transfer takes place, this oval glow is extinguished.

The spark successions which follow the extinction of the cathode glow are not, however, of the same kind. There are two distinct types, bright and dark.

[1] *Proceedings National Academy of Sciences,* February, 1928.

The first consists of diffuse bright purple spark filaments, passing with marked crackling between many favorable points of the electrode plates, the needle point being ignored. Being relatively luminous, they are the most desirable, but they often refuse to appear or are not sustained.

The second type which I shall have to call by a misnomer dark sparks, show no spark lines at all, but consist of a faint violet surface glow at the edges of the anode plate. The cathode glow is none the less extinguished. They are apt to be the more usual (and undesirable) occurrence, particularly after long observation. There is no appreciable crackling heard in the ear trumpet. I have therefore (without certain evidence) regarded the bright sparks, since they nearly always appear when the cathode is earthed, as resulting from a promiscuous issue of positive electrons from preferred parts of anode plate (since it here has no needle point), whereas the so-called dark sparks may be the corresponding convection discharge of positive ions from such parts of the anode plate.

2. *Negatively charged body.* The most available instrument for extinguishing the cathode glow is the charged hard rubber rod. If this is highly charged and the critical set sensitive, the rod may be passed normally along the arc of a vertical circle even 50 cm in radius around the spark gap, from right to left, always keeping the glow dark (Fig. 1). As soon as the rod passes outside of the circle by a few centimeters, the glow at once relights. This may be repeated indefinitely. A brass ball, 8–10 cm in diameter on an insulated handle and charged at the cathode of the machine is also convenient, though it acts from a smaller radius (15 cm) from the spark gap. A proof plane is still weaker. Now if the negative rod at a radius of 50 cm (say) evokes a shower of bright sparks persistently, then it usually happens that at a smaller radius of say 20 cm these bright sparks disappear, to reappear at the radius of 50 cm again. This was at first a very puzzling observation; but as the cathode glow is kept extinguished, it is a passage of the bright type of spark into the dark equivalent

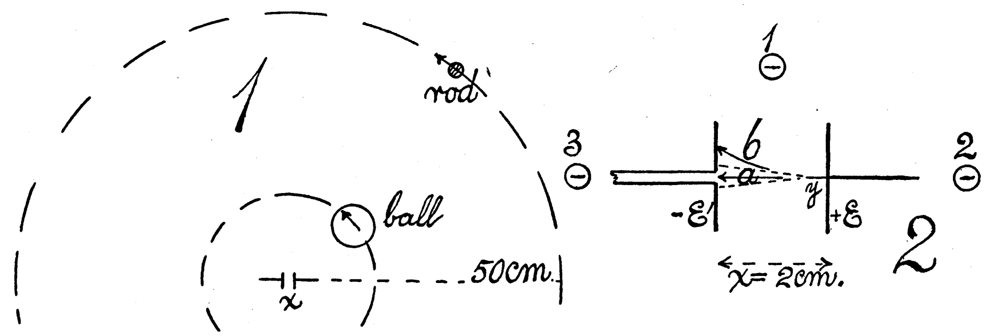

FIG. 1

just described. Since it requires a greater protrusion, y, of positive needle ($y > .3$ cm) to evoke the anode convection current than the anode spark succession ($y = .10$ to $.14$ cm for darts, $y > .14$ cm for cones), the above inference for bright and dark sparks is not unreasonable. The impression is often made as if the negative glow were transferred to the edge of the positive plate and became a positive surface glow.

Finally, since the negative body acts to extinguish the cathode glow from a definite radius, one may argue, as I have heretofore, that it imposes an effective negative increment of potential throughout the field of the spark gap.

3. *Telescopic anode reactions.* To obtain darts (snapping white linear sparks) from the cathode point in the absence of the anode needle has not been possible. They appear at the anode point (cathode point absent) as an integration of the earlier diffuse spark filaments for the narrow ranges of protrusion y, given, unless there is special stimulation (earthing the cathode, for instance) when darts appear sooner. The positive convection current does not appear until $y = .3$ cm or later, when a mere point of light tips the anode in the dark spark gap. Between these limits the dart degenerates into a purplish diffuse cone with its apex at the anode needle (see fig. 2). In the telescope the divergence is filamentary and scattering. As y ($< .3$ cm) increases, the cone grows narrower and weaker, and in the ear trumpet the crackling runs up into high frequencies. The spark gap is now in a good form for experiment. If, for instance, the negative rod[2] is put in the symmetrical position (1), figure 2, the straight symmetrical axis a of the cone changes to an axis b concave towards the rod, and more so as the rod is nearer. This proves adequately that the emitted rays, a, are positive ions and the method may be useful for measurement. Again let y be further increased until the luminous cone just vanishes and the dark convection current appears. Then it will be found that the negative rod at (2) on the anode side restores the cone a and keeps it; whereas the negative rod at (3) on the cathode side quenches the cone. The test may be repeated indefinitely. The negative rod at (2) or (3) is thus equivalent to a decrement or increment, respectively, of the protrusion y.

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[2] The magnetic field arising from a metal conductor is not convenient. The anode is much more capricious than the cathode. The convection current may strike too soon, or too late, or again not at all. The above data are good averages for the given machine and spark gap. Some control is possible, however, by the methods of § 3. The axial flexure of fig. 2 can not be obtained with the negative convection current.

FACTOR H IN THE NUTRITION OF TROUT

SINCE the time of Magendie, investigators have tried to develop purified rations which would meet all the requirements of the animal body for growth and reproduction. The greatest success in these attempts has undoubtedly been attained with the rat. That even the rat fails to show an optimum growth upon a simplified ration containing all the known elements, is evident from many experiments and especially from the recent reports of Osborne and Mendel,[1] and Palmer and Kennedy.[2]

The fact that many of the discoveries in nutrition that have been made in rearing rats have found ready applications in feeding the higher animals has led to the subtle assumption that the nutritional requirements of all species of animal life are the same. The reflection of such natural philosophy is seen in the wide-spread use of cod liver oil, yeast and other vitamin supplements in the hatcheries of the United States that are engaged in rearing trout. Although Laufberger[3] has stated that fish require vitamins in their food, his work fails to furnish convincing evidence that these are related to any of the known accessory substances required by the higher animals.

In order to furnish a more rational basis for feeding trout we have conducted a series of experiments upon their growth curves when they are fed diets of widely different compositions. These experiments have been performed at the Burlington hatchery in the state of Connecticut. This hatchery is unusually well equipped for such experiments, since it has a constant supply of pure spring water which exhibits very slight temperature variations. Each experimental group of trout contained fifty fingerlings which were confined in separate troughs with individual water supplies and outlets. The efficacy of a given diet was judged by the average growth rate and by the mortality rate.

In our first series of ten experiments we employed nine purified rations made up of casein, boiled starch, salt mixture, cod liver oil and yeast. In four of these the protein was incorporated at various levels from ten to seventy-five per cent. In two, lard was included at twenty-two and fifty-seven per cent. levels varying the other factors to secure adequate salt and protein intake. From one, cod liver oil was omitted; in another yeast was lacking and still another contained no salt mixture. For purposes of comparison a diet of dried skimmed milk was employed. For seven weeks all the fingerlings, except those upon the

[1] Osborne, T. B., and Mendel, L. B., *J. Biol. Chem.*, 1926, LXIX, 661.

[2] Palmer, L. S., and Kennedy, C., *J. Biol. Chem.*, 1927, LXXV, 619.

[3] Laufberger, V., *Physiol. Abstracts*, 1926, XI, 221.