EMBRYOLOGY

A Movie That Is All "Heart Interest"

First Motion Picture of Development of an Embryo Chicken Heart Marks Triumph in Laboratory Technique

By FRANK THONE

HOLLYWOOD'S celluloid Napoleons will tell you unanimously that a film has got to have heart interest if it's going to "get over big."

If that dictum is true, then certainly a film which is now in the making in Cleveland ought to beat the best Hollywood product all hollow. For it's an affair of the heart from beginning to end. Every foot—every frame—is focussed on the most fascinating and most active piece of all the bodily mechanism.

To be sure, it's only the heart of a chicken. Not even the heart of one of the delectable slim-legged *poulettes* who high-heel in swarms wherever the celluloid Napoleons decree a sceneful of "extras, female"; no, nothing but a downy, cuddly chick that eventually grows up into a cackling, flowerbed-scratching Biddy, with no ambition beyond inspiring omelets and eventually herself becoming casserole filling.

Nevertheless, the heart affairs of even so lowly a citizeness form a most absorbing drama, of interest and practical importance to all of us. For the Colonel's Lady and Judy O'Grady are sisters under their skin, as Kipling melodically claims; and the democracy of nature extends far beyond that, to include Judy O'Grady's hens. Basically, all heart-beats, whether human or hen, start in the same way, involve much the same nervous and muscular machinery, and can be intensified or depressed by the same drugs and glandular secretions. So we can learn much about our own life process by clipping open incubated eggs and studying the early heart-beats of the chick inside.

The new film emancipates embryology from the messiness, from the tedium, from the deadness, from the whole hard grind of the laboratory, and brings it out where not only college seniors but anybody and everybody can get something out of it and capture a vivid idea of how life begins, how the heart starts its unintermitting pulsation, how the blood forms and begins to flow.

The scientists who have made this new magic are three: Prof. Bradley M. Patten of Western Reserve University School of Medicine, embryologist; S. Prentiss Baldwin, successful business man and by avocation a distinguished naturalist, and Theodore C. Kramer, research assistant at the Baldwin Laboratory, who proved to be a genius at inventing necessary gadgets and a natural adept in the manipulation of living material. The idea came into being once when Mr. Baldwin asked Prof. Patten to come out to his unique field laboratory in a bird sanctuary near Cleveland and show him what was going on inside the eggshell. Mr. Baldwin was fascinated at the pulsating drama spread out under the lens of the microscope.

Surmounting Difficulties

"There ought to be movies of this!" he exclaimed. "Has it ever been done?"

The embryologist had never heard of it; he knew vaguely something of the difficulties involved, both technical and fiscal but did not feel that they would be insurmountable.

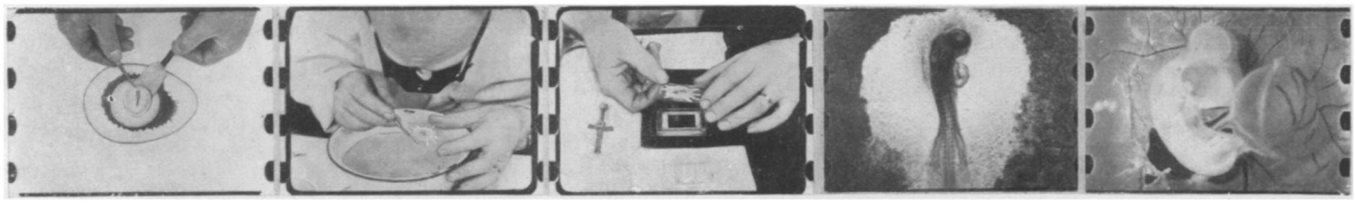
"Tell you what," said the enthusiastic Mr. Baldwin: "You put in the time and biological experience, and I'll supply the money."

So it was started; and the skilled Mr. Kramer transferred himself from Mr. Baldwin's laboratory to Prof. Patten's, and helped in the difficult job of evolving the right combination of microscope and motion picture camera and lights that had to be built specially for the work. About the motion-picture end of the task Prof. Patten does not talk much, except to say that it wasn't at all easy. Several times they thought they had the job licked, only to find new technical difficulties that made it necessary to tear the whole layout apart and start all over again. In these trying times the advice of Mr. E. S. Carpenter, a local movie expert who had become interested in the problem, proved valuable. At last they got an apparatus built that makes the pictures exactly as they want them.

As for the winning of the secrets of the first heart-beats, the film itself shows how it was done, though it gives only a few hints of the technical skill that was necessary for the handling of the delicate living material, and tells nothing of the patience with which a scientist must begin anew after each setback or failure. The smooth-running half-hour of life drama that you can see on the screen is the fruit of many months of often disheartening labor.

The opening scene shows the beginning: getting the embryo out of the eggshell so that it can be seen and studied. It would really be more considerate of the hen if she would lay eggs with shells of glass instead of limestone, for then all this preliminary labor might be spared. But as it is, the embryo has to be lifted out of the egg and placed in an artificial glass house for its brief career as a movie star. It is not unlike the Hollywood favorites in the amount of privacy it gets during its time in the spotlight.

At first you see the outline of the unbroken egg. Then, by swift animated drawings, the cutting away of a circle of the shell is shown, disclosing the little spot of life resting on top of the yolk. Into the picture come the scientist's fingers, with a pair of needle-pointed scissors that clip free the delicate membrane with the embryo in its



BEATS HOLLYWOOD

Three steps in preparing the chick embryo for its movie debut, and two "close-ups" from the film.

center, and lift it out of the egg on a flat bit of thin metal.

The idea of moving the actual hands of the operator into the animated drawing and synchronizing them with its action, was declared impractical by professional camera experts; but Prof. Patten proved to them that it could be done. It was merely a matter of controlling one's movements, making them sufficiently slow and smooth.

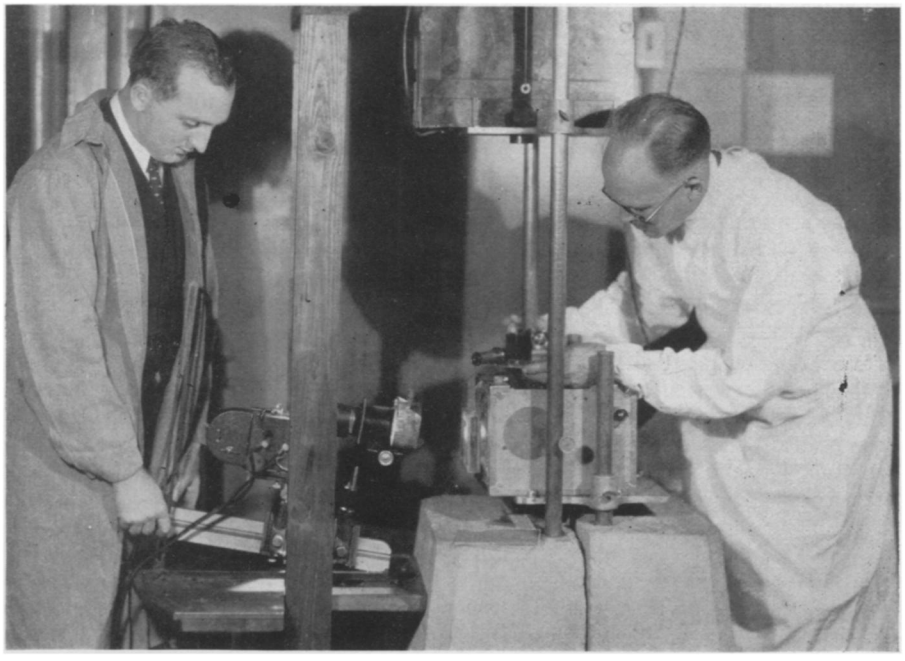
Delicate Job

Then comes the delicate job of stretching that bit of living membrane with the embryo at its center on a small sheet of glass, so that it can be placed under the microscope and photographed. You see the operator, with a special magnifying device strapped before his eyes, bending over his task, carefully pulling the edges smooth and fastening them down with bits of sterilized wet filter paper. This must be done rapidly, yet not in a hurry; here is where technique really counts.

The glass slip now becomes the top of the square "glass egg" in which the embryo lives while it is "in the pictures." The slip, embryo and all, is inverted and set as a lid on a glass box, the edges sealed against the air with vaseline. To lay down this seal, an old hypodermic syringe is filled with vaseline and used as a miniature grease gun.

Within its "glass egg" the embryo is nourished on solutions artificially made up more or less in imitation of the fluid portion of the blood. Such fluids have for some years been used with success in keeping minute pieces of tissue alive, but the difficulties of keeping an entire embryo properly nourished and free from toxic waste products are much greater. The longest that Prof. Patten has been able to keep an entire embryo alive and under continuous photographic observation has been thirty hours. Unfortunately he is not able to give them unmodified egg yolk, their natural food, for that is opaque and would interfere with the photography. So many partially incubated eggs have had to be sacrificed to make his film. He is still experimenting with nutrient media, hoping to find something better than the ones now being used.

However, during the brief span that is allowed it outside the eggshell, the embryo carries on its life processes apparently normally, though at a somewhat lower rate than that prevailing under natural conditions. You can see, in the bright circle of the microscope's illuminated field, the lump that is destined to be the head, with its bulges that will be eyes. You can see the segmented muscles of the body, and the growing spinal cord.



MOVIE STAR

Theodore C. Kramer, left, and Prof. Bradley M. Patten putting the heart of an embryo chick "in the pictures."

But most dramatically of all, you can see the heart, the only thing that shows pronounced movement even in early stages of life. After only a day and a half of incubation, it bulges forth at one side, quite out of proportion to the rest of the body.

Its first beats are not the even, rhythmical pulsations that are characteristic of heart action once it has really got going. They are unevenly spaced, tentative, sometimes a few in quick succession, again coming many minutes apart. To picture them, it was necessary to run the camera at normal speed of sixteen exposures a second while a spell of beating was on, and then wait for the heart to begin again.

During the first uncertain stage in the development of the heart beat, when the heart is really preparing for its task, you can see things in this film that no book will tell you. Prof. Patten was able to show that the beat starts in different parts of the heart at different stages in its development, and further that the region that has always been believed to be the first part of the heart to become active did not begin to function until other parts of the heart had long been at work.

The eye of the camera shifts, out onto the membranes enveloping the yolk, to which arteries and veins run from the embryo. You see the smallest blood channels, and along them, pushing in crowds, the red corpuscles. The circulation is a going concern, and the heart will keep up the steady pulsation you see as long as life lasts.

Yet other wonders are shown by the film before the "Finis" title flashes on the screen. The embryo not only provides itself with blood-vessel supply lines to the food stored in the yolk; it must have oxygen, too. Obviously, its lungs, as yet undeveloped, can be of no use to it. It therefore takes care of its respiratory requirements by means of a second membrane, a sac-like organ called the "allantois," almost as large as the embryo itself and supplied with blood vessels to and from the heart.

Meanwhile, the whole little unhatched chick is enveloped in a third membrane known as the "amnion." This keeps it moist, guards it against mechanical injury, and as it advances in days begins to rock it rhythmically.

And here, fed from its yolk-sac, breathing through its allantois and rocked in its amnion, the film leaves the little chick—always to a burst of applause by the small audiences of scientists and laymen who have thus far seen the film in its pre-views. Before long it will be seen by many others, for arrangements are being made to place a copy of the film on permanent run at the museum of the National Academy of Sciences in Washington.