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THE ROLE OF NUCLEIC ACIDS IN THE GROWTH IN VITRO OF LIVER TISSUES

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Introduction

It is generally known that explanted tissues of adult organism either do not grow at all or they manifest considerably less growth potentiality than embryonic tissues do. The nature of those changes in the developing organism that cause the cells to lose their capacity for proliferation in vitro is not known. The problem is particulary interesting in connection with rat liver which, although its tissues in the adult state do not show any growth potentiality *in vitro*, is well known for its great regenerative power within the organism.

Researchers engaged in the culture of liver tissues *(Lynch, Dolianski, Nordmann, etc.)* employed almost exclusively embryonic liver. Only *Barta*, and *Harris* cultured non-embryonic rabbit liver; the former from adult animals, the latter from 7 to 20 days old rabbits. Both these authors observed growth. *Glinos* and *Bartlet* (1951) noticed that within a 6 day period liver tissue cultures of quite young rats grew in 100 per cent, whereas only 45 per cent of the liver of the 6 to 8 months old animals and a mere 8 per cent of that of rats a year and a half of age showed growth. (Connective tissue). The same authors observed that regenerated liver tissues removed from the organism behaved *in vitro* the same way as embryonic tissues did. *Abercombie* and *Harkness* (1951) made the same observations.

Searching for the cause that would explain the loss of growth potentiality suffered by the adult liver *in vitro*, we have investigated the behaviour of nucleic acids that play a decisive role in the synthesis of protein in the living cell, concentrating on investigations upon the nucleic acid content of explanted liver tissue. These seemed to hold out promises it being known that with the regeneration of the liver its nucleic acid content increases and, as has been seen, adult liver, too, can be cultivated *in vitro*, provided it had been explanted in a state of regeneration.

Methods

The liver explants have been prepared in hanging drop, according to the method of *Maximov*, from the liver of chick embryos from 10 to 15 days old and of embryonic, newborn, 1, 2, 3, and 4 weeks old, and adult rats. Explantation has invariably taken place in a 1 to 1 mixture of hen plasma and chicken embryo extract and the pieces to be explanted have been sunk on to the mica plate. Great care has been taken to secure identical conditions for the cultivation and the preparation of the embryonic extracts. At intervals of three days, the cultures have been washed in a fluid composed of 15 parts of chick embryo extract plus 30 parts of Thyrode solution plus 60 parts of human umbilical cord serum.

At the time required by the experimental conditions, the cultures have been fixed in Carnoy and, in the majority of cases, embedded in paraffin through benzol, following alcoholic dehydration. Sections 7 μ thick have been cut of the embedded tissues and stained with methyl green and pyronine prepared according to *Unna*. Differentiation and dehydration has been carried out first with an equal mixture of absolute alcohol and tertiary butyl alcohol, then with twice changed tertiary butyl alcohol.

Staining and differentiation have been carried out under identical conditions and for the same length of time. In some of the cases the sections have been mounted alternately upon two slides. One has been exposed to ribonuclease digestion prior to staining with methyl green pyronine. The ribonuclease solution has been prepared in the laboratory, from pancreas of cattle. The application of crystalline ribonuclease might have been more reassuring, yet the effect of the solution prepared has turned out to be sufficiently specific. Upon ribonuclease digestion the pyroninophile substance disappears completely from the liver tissue, and one may say that pyronine staining is specifically suitable to indicate ribonucleic acid in the liver. *Brachet*, too, established that the ribonucleic acid of liver is split under the effect of ribonuclease, and that this at the same time means the disappearance of stainibility with pyronine. Digestion having invariably produced uniform results, it has been dispensed with in the later stages of our experiments.

Several of the cultures have been stained in toto with methyl green pyronine, according to *Stein* and *Gerarde*. For differentiation and dehydration tertiary butyl alcohol was used.

Experimental Observations

1. Changes in the chick embryo liver tissue following explantation. The cytoplasm of liver cells of from 10 to 15 days old chick embryos contain a fairly large amount of material which stains with pyronine and which, on the basis of both several literary data and our ribonuclease digestion experiments, must be regarded as a complex containig ribonucleic acid. In the cytoplasm ribonucleic acid appears in the form of uniform granules. The cell nuclei stain light and show a loose chromatinic structure , with deeply staining, fairly large, rounded nucleoli. The liver cell cords are separated by wide sinusoids. Here and there haematopoietic islets are perceptible. The histological picture and the staining of explanted pieces of liver show no discernible changes in the first hour or two after explantation.

The 5 hour explant. The liver cell cords begin to dissociate and in certain parts a decrease in the pyroninophile substance becomes noticeable.

The 8 hour explant. Marginal and surface zones from 5 to 15 cells wide appear, in which the ribonucleic acid content does not decrease, whereas from the cells in the inner parts of the explants it almost completely disappears. In the liver cells of the marginal zone the nucleus stains faintly with methyl

green, while the nucleolus is conspicuous for its deep staining with pyronine. The nucleoli in the inside of the explants betray no such pyroninophilia ; on the contrary, in some cases they are practically imperceptible. Karyolysis is noticeable along with the condensation of the nuclear material. The changes in the nucleus are similar to those described by *Cherry* in cytolyzing liver cells of mice (Figs. 2 and 3).

The 20 hour explant. Pyroninophilia becomes more emphasized in the marginal zone, this being clearly demarcated from the cells forming the interior of the explant, where pyroninophilia is restricted to the cells of some haematopoietic islets and of the connective tissue at the edge of the lobules. In these latter parts dense nuclei staining well with methyl green are only found.

The 30 hour explant. The picture is unchanged. Proliferation of connective tissue cells begins soon after the 20th hour of cultivation ; even earlier do wandering cells appear around the explanted tissue.

The 48 hour explant. Nuclei in the interior parts of the explant begin also to disappear.

The 110 to 120 hour explant. In the marginal zone, the parenchymal cells and those of the connective tissue show a picture characteristic of increasing proliferation and protein synthesis *(Caspersson, Brachet, Kedrovski* etc.), since their cytoplasm contains great amounts of ribonucleic acid. The nuclei are large and vesical. The nucleoli are also large, and stain deeply with pyronine ; they are particularly extensive in the outermost cells of the explant and in the area of outgrowth. In the parenchymal cells mitosis is observable. Quite marked is the »nucleolus associated chromatin« (Fig. 6.).

The 130 hour explant. The cells in the marginal zone display no change. The proliferating cells are well discernible.The epithelial cells in the proliferation zone are rather similar to the original liver cells. In some instances, the isolating epithelial cells are well discernible, although as a rule it is rather difficult to separate them from the cells of the connective tissue, in spite of their differing nuclei and rounded nucleoli. The nucleolus in endothelial and connective tissue cells is generally rod-shaped.

The 170—190 hour explant. No essential change occurs except a decrease in pyroninophilia. It is difficult to identify the remnants of liver cells, and the place of the perishing liver tissue is being taken by a network of blood cells, especially of reticular cells and connective tissue (Fig. 4.)

Summing up, it can be stated that from chick embryo liver tissue cultures the substance staining with pyronine disappears within a relatively short time, except from the marginal and surfaces zones. This indicates a rapid fall in the activity of the protein-building system of the nucleolus and cyptoplasm. The change in the desoxyribonucleic acid content of the nucleus constitutes a slower process. The ribonucleic acid content of the cells in the marginal zone does not change at all, and it is from here that proliferation starts. Here the equilibrium

between synthesis and decomposition of ribonucleic acid shifts in the direction of synthesis.

In order to establish whether it is a condition preliminary to proliferation that the parenchymal cells retain, or even increase, their ribonucleic acid synthetizing capacity during cultivation, the explanted pieces of liver tissue have been halved 8 to 20 hours, respectively, following explantation. Then the halves have been slightly moved apart and the space between them filled with fresh hen plasma and chick embryo extract. In this manner, such parenchymal cells were brought to the surface as have earlier been in the interior of the explants. From these, a considerable portion of the ribonucleic acid (in the 8 hour halvings), or almost the whole of it (in the 20 hour halvings), disappeared. On the fresh surfaces proliferation began as early as 12 hours after halving, and in 24 hours the halves grew together completely, provided that they lay not too widely apart. Histological examination of the halved cultures, made at different times after halving, rendered it possible to establish that the basophilia of the cytoplasm did not return in cells that had come to the surface. This proves that the process of ribonucleic acid disappearance becomes irreversible as early as within 8 hours, and that the cells are incapable of synthetizing fresh ribonucleic acid, although in 8 hours there is as yet nothing to indicate the commencing process except that the nucleolus and the cytoplasm lose their capacity to stain with pyronine.

From where does proliferation start in these cases? Examination of serial sections appears to evidence that it does not really start from the halved surfaces, but exclusively from the layer of the old surface cells, that is, from where the amount of ribonucleic acid has revealed no diminution. Proliferation starting from the periphery forms a kind of bridge between the halves, yet at the same time the cells also grow upon the halved surfaces, from where they may become isolated and fill the gap between the halved parts. Growth in these cases is predominantly of connective tissue character.

The above permit the conclusion that there exists a definite parallelism between the growth of liver cells in tissue cultures and the RNA synthetizing capacity of liver cells on the margins of explants.

2. *Changes in the liver tissue of embryonic rats and different age following explantation.*

The above described processes and phenomena are essentially the same in explants from the liver of rat embryos, the only difference being that in the embryonic life of the rat hepatic haematopoiesis is intense, and different forms of blood cells render the histological picture rather varied. In the young forms of blood cells not only the behaviour of the pyroninophile substance but also the changes in the desoxyribonucleic acid content differ from those in the parenchymal cells of the liver (Fig. 7 and 8).

In repeated series of experiments we have, simultaneously and under identical conditions, explanted liver from embryos and mother animals. The

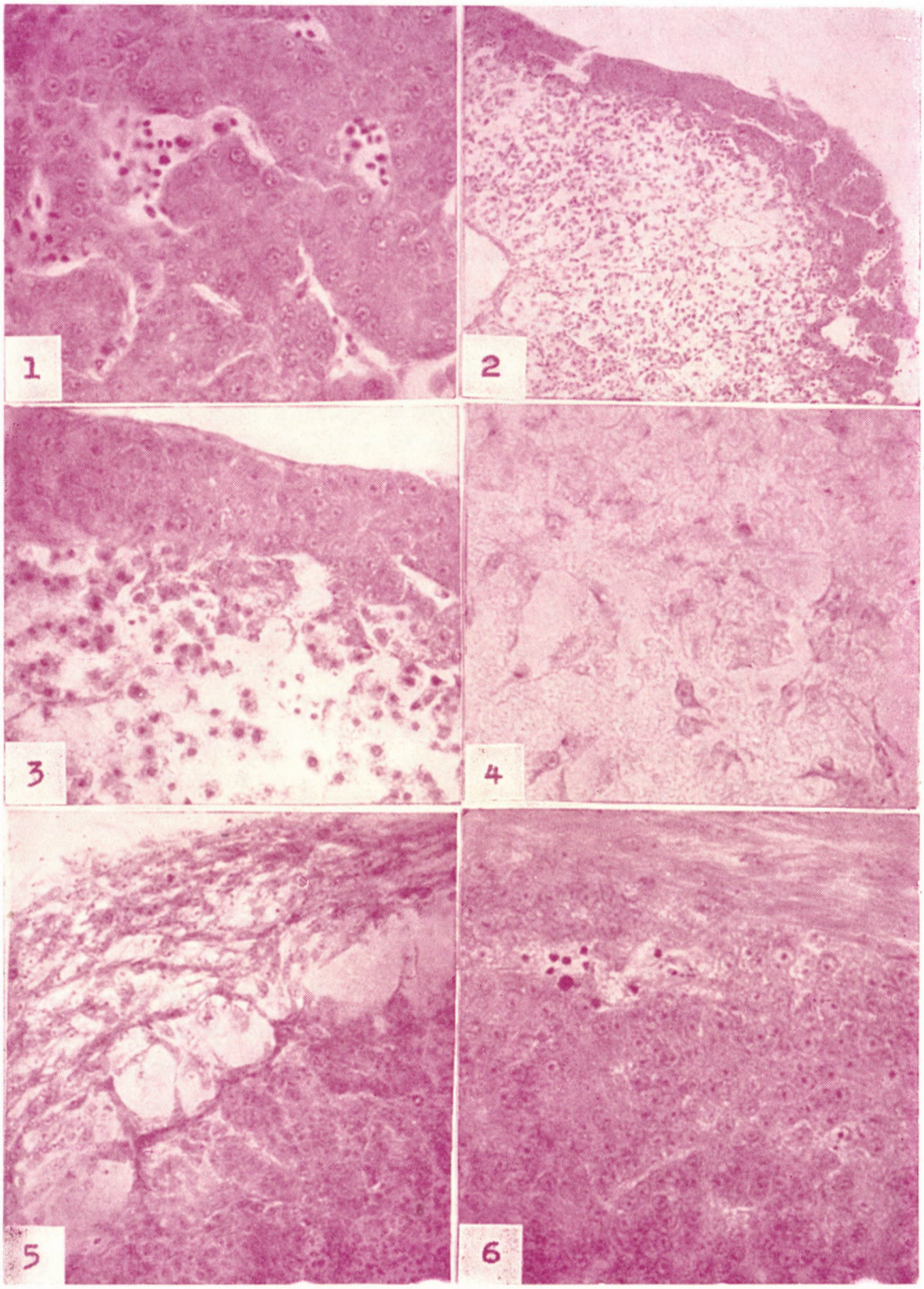

Fig. 1. Liver of 12 days old chick embryo. *Fig. 2.* Explant from liver of 12 days old chick embryo fixed 8 hours after explantation. Marked pyroninophilia in cells of marginal zone. *Fig. 3.* The same as Fig. 2 but with greater magnification. *Fig. 4.* Central portion of liver explant from 12 days old chick embryo, 5 days after explantation. Place of destroyed liver cells filled by loose network of connective tissue. *Fig. 5.* Three days explant from chick embryo liver. Cells of the proliferation zone connected arcadelike with the explanted piece. *Fig. 6.* Five days explant from chick embryo liver. Deeply staining, large nucleolus in cell nuclei of marginal zone.

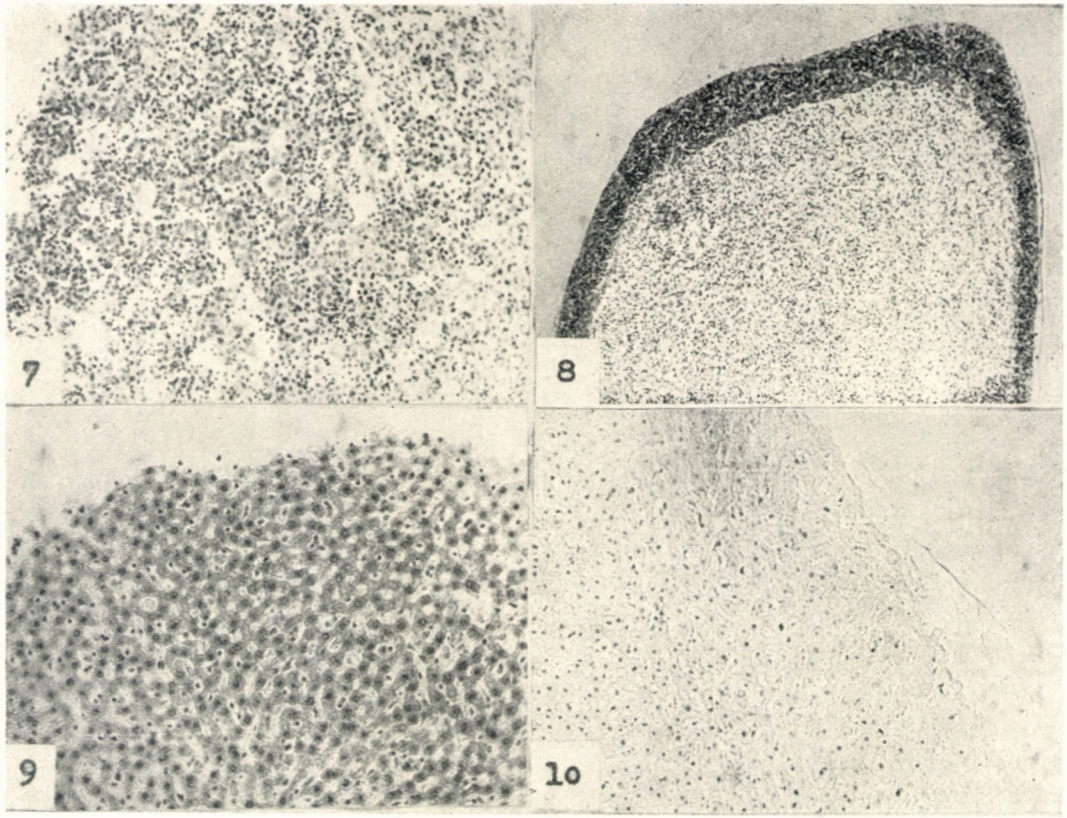

Fig. 7. Explant from liver of about 12 days old rat embryo. Fixed half an hour after explantation.
Fig. 8. Same explant as in Fig. 7. 21 hours after explantation. Marked pyroninophile marginal zone.
Fig. 9. Explant from the liver of the mother of the rat embryo referred to in Figs. 7. and 8. Fixed half an hour after explantation.
Fig. 10. Explant from the liver of the rat referred to in fig. 9. Fixed 21 hours after explantation. Pyroninophile substance completely disappeared from parenchymal cells ; also from cells of marginal zone if compared with the embryonic one.

explants have been prepared in a uniform manner and fixed at one and the same time. From these, it could be established that from the maternal liver, that is, from the liver of the adult animal, ribonucleic acid disappears more rapidly, and no marginal zone forms. After 24 hours, when in the embryonic explant the ribonucleic acid containing liver cells from the marginal zone begin to show the above described characteristic picture, the pyroninophile material disappears almost completely from both the centrally and peripherally situated cells of the adult animal's liver, and no sign of proliferation can be traced. Similar observations have been made with explants from the liver of non-pregnant adult rats (Figs. 9 and 10).

In embryonic liver explants displaying a 100 per cent growth potentiality the ribonucleic acid metabolism of the parenchymal cells situated in the marginal zone appeared to be very lively. In explants from adult rat liver, where the rate of growth is nil, the pyroninophile substance disappeared from the parenchymal cells which, under the given circumstances, proved to be incapable of replacing it.

The question still remained unanswered, how would explants behave prepared from the liver of animals of different age, i. e. explants the growth potentiality of which falls between the extremes — embryonic and adult — and in which, depending upon the age of the animal, the rate of proliferation is varying, and other signs, too, point to a diminuation of growth potentiality (e. g. period of latency, etc.).

Histochemical examination of cultures prepared from the liver of 2, 3, and 4 weeks old rats made it possible to establish that here again there exists a certain parallelism between the ribonucleic acid content of the marginal cells and the growth potentiality.

In liver explants from 14 days old rats a marginal zone is still observable, in which the parenchymal cells retain their pyroninophilia, but in respect of extension and activeness the zone falls short of those seen in embryonic liver explants. In the latter, growth in 48 hours is 100 per cent; in other words, all the explanted pieces of liver grow.

In the cultures of liver from 3 and 4 weeks old animals no continuous pyroninophile marginal zone of parenchymal cells is formed. Only groups of liver cells are here and there observable in which basophilic staining of the cytoplasm is still present and the nucleolus distinct. Contiguity of the marginal zone is more marked in explants from the 21 days old animal than in those from the 4 weeks old ones. In the latter, the cells on the margin stain but faintly with pyronine, the cytoplasm is often vacuolated, and the cells reveal signs of degeneration. It should, however, be noted that the presence of vacuoles does not necessarily mean necrobiosis since mitotic division can be observed even in the most highly vacuolated cells. In these cultures binuclear cells are rather frequent. There seemed to exist a definite interrelation between the

rate of proliferation and the amount of border cells containing pyroninophile material, yet, it occured more than once that explants from the liver of a 4 weeks old animal showed no signs whatever of proliferation, in spite of definite pyroninophilia and a clearly defined nucleolus, staining deeply with pyronine, in the marginal cells. Never in the course of the experiments have cells been noticed in the liver of adult animals to retain their cytoplasmic basophilia 24 hours after explantation. The observations seem to suggest that the liver tissue of the 4 weeks old animal has not yet completely lost its growth potentiality. In the explant the growth potentiality of a tissue is determined concurrently by its proliferating capacity and the environmental conditions. If the proliferating capacity is considerable, as for instance in embryonic fibroblasts, growth will be perhaps not optimal, yet complete even though external conditions be changing substantially and within wide limits. If, on the other hand, the internal growth potentiality is decreased the slightest adverse external circumstances will result in the suppression of that potentiality and no signs of growth will show in the particular culture. In a given case, such adverse external effects may be exercised, for instance, by the unfavourable submicroscopic stucture of the medium developing around the explant, or by a shift in the chemism of that etc. Such are the considerations on the basis of which we try to interpret the fact that, e. g. in the liver of animals of a certain age, signs of growth were only found in part of the explanted cultures, notwithstanding the greatest care taken to ensure identical conditions when preparing them. The existence of explants in which pyroninophile groups of cells showing no signs of growth can be found, might be explained on a similar basis.

To sum up, histological examination of explants from the liver of rat embryos, and rats of different age, made us to conclude that a marked parallelism exists between the ribonucleic acid synthetizing capacity of the parenchymal cells on the margin of the explant and the growth potentiality *in vitro* of the respective liver tissue.

Discussion

Numerous data concerning the nucleic acid metabolism in tissue cultures can be found in the literature since 1942, when *Willmer*, and *Cunningham* and *Kirk*, first suggested the possibility of its chemical examination *(Davidson* and *Waymouth* 1943, 1944, 1945, 1946, 1949, *Hull* and *Kirk* 1950, et.) Authors, in general, have made experiments on fibroblast cultures, and have produced valuable data regarding the correlation of growth of tissue cultures and the changes in the nucleic acids. The present paper, on the other hand, contains data which, being derived from histochemial examination of liver explants, can only in respect of certain of their features be compared with the results obtained by chemical methods in fibroblast cultures. The cause of the divergency is mul-

tidirectional. First of all, liver tissue is known for its very high ribonucleic acid content, also in the adult animal. In the latter, the ratio of ribonucleic acid to desoxyribonucleic acid is 4 to 1, (for the literature, see *Davidson*, 1947) while in the heart of the 12 days old chick embryo this ratio varies between 2,2 and 2,8 *(Davidson* and *Waymouth*, 1949). Possibly, the ribonucleic acid and, in general, the nucleic acid content of embryonic liver can be still higher (see below). Besides, it is known that the ribonucleic acid content of the liver changes upon the most diverse effects, and can in its major part disappear; for instance, upon starvation, or when fed a diet low in protein *(Davidson* 1947, *Lagerstedt* 1949, *Campell* and *Kosterlitz* 1947, *Bieloussova*, 1951, etc.). The high ribonucleic acid content in the liver is probably correlated with the protein-forming capacity of that organ. Obviously, in this case the change taking place in the ribonucleic acid content does not stand in quite the same relation to the growth potentiality *in vitro*, as it does in the case of embryonic fibroblasts.

Compared to fibroblast cultures, another essential difference is that in liver explants growth is not of one uniform type, but all three common types of growth occur, growth of wandering cells, growth of the fibroblast type, and epithelial growth.

Because of this mixed type of growth and because, as has been seen, the ribonucleic acid disappears very rapidly from a considerable portion of the parenchymal cells, we feel that in certain respects histochemical methods are preferable to chemical ones in examining the connection between growth potentiality and nucleic acid content. By means of purely chemical methods it would not be possible to give an answer, for instance, to the question in what degree does responsibility for the changes in the nucleic acid content rest upon the interstitial, the parenchymal, and the blood cells (!) respectively? Nor could it be established in what manner nucleic acid metabolism changes in the cells that constitute the source of proliferation, seeing that the changes in the components of the great mass of cells perishing in the centre greatly influence the analytical results. This holds true particularly in respect of the liver in which, as has been seen, the changes in the ribonucleic acid contents during cultivation are so very great and rapid. *Davidson* and *Waymouth* mention in one of their papers (1949) that in fibroblast cultures, they failed to notice any permanent increase in the level of desoxyribonucleic acid. This they explain by assuming that the phosphorus content of the cultures keeps on increasing only until the central necrosis is balanced by peripheral growth, and vice versa. Wishing to obviate this interference they cut the explants into considerably smaller pieces, presumably reducing thereby the ratio of the mass of cells undergoing necrosis. In liver cultures, as could be seen, marked necrosis of the central parts is preceded by a rapid decrease in the ribonucleic acid content.

In the course of the experiments it has been found that ribonucleic acid disappears very quickly from the major part of parenchymal cells. *Davidson*

and *Waymouth* also had observed that in fibroblast cultures the initial decrease in ribonucleic acid is far more marked than in desoxyribonucleic acid, and that the greatest decrease takes place in the first 24 hours (see also *Waymouth* 1949, *Hull* and *Kirk* 1950). In the present experiments it was not possible to establish the extent to which ribonucleoprotein decomposes or disappears; it could only be stated that it has lost its ability to stain with pyronine. From the histological preparations it seems that under given circumstances one has to take into account not only the enzymatic decomposition of ribonucleic acid, but also the possibilities that the parenchymal cells give off bits of plasma containing ribonucleoprotein, or that the pyroninophile substance is being detruded from the cells. The fact that in necrobiotic processes the ribonucleic acid content of the cytoplasm coagulates to granules of larger size had also been observed by *Brachet* in transplants grafted into blastocoele (1947).

According to our findings a definite parallelism can be established between the ribonucleic acid content of the marginal cells of the liver explant and the growth of the culture. The question is thereby raised whether the difference in the growth potentiality of the liver of embryonic and adult animals of different age can be brought into relation with the changes of the nucleic acid content, first of all of the ribonucleic acid content, of the liver. The data in the literature disagree on the point of how the ribonucleic acid and the desoxiribonucleic acid contents of the liver change in the embryonic life and after birth. According to *Geschwind* and *Li* (1949), in rats the ratio of ribonucleic acid to desoxyribonucleic acid rises from 0.98 to 1,94 from the 16th to the 31st day, and reaches 2,83 on the 40th day after birth. The same authors state that following birth both the ribonucleic and the desoxyribonucleic acid levels decrease, the rate of decrease being more marked with the former. *Flexner* and *Flexner* (1951) found that in the foetal guinea pig the ribonucleic acid content decreases by 50 per cent from the 30th day of gestation until birth. At birth the liver contains the same amount of ribonucleic acid as that of the adult, in spite of the fact that it is still growing. According to these authors, the rate of protein synthesis not being in proportion to the increase in ribonucleic acid, our views of the correlation between the two should be revised. Also, they draw attention to the interference in analytical work caused by the presence of haematopoietic islets. While according to *Caspersson* (1941), in the liver of the chick embryo the concentration of nucleotides decrease with development, *Leslie* and *Davidson* found that the average ribonucleic acid content of its cells does not change between the 8th day of incubation and the second day after hatching. No data are given concerning the later life.

It is obvious from the above that no definite attitude can be taken in respect of the changes taking place in the nucleic acid content of liver tissue. There is a lack of congruity in the analytical data, and widely diverging results follow from their different interpretations. Thus, for instance, while *Caspersson*

has essentially based his results upon the changes in nucleotid concentration, *Leslie* and *Davidson* approach the changes in the ribonucleic acid content of one single cell. We have found no data on the changes in the growth potentiality of hepatic, or of any other, tissue in dependence on the nucleic acid content of the tissue to be explanted.

It has been found that from explants of adult rat liver the pyroninophile substance disappears completely within 24 hours. In embryonic liver explants, on the other hand, a marginal zone is formed in which the ribonucleic acid content of the cells does not appear to decrease even temporarily. The formation of this zone should obviously be interpreted as a consequence of the capability of the parenchymal cells to synthetize ribonucleic acid under given circumstances, and of the failure of irreversible decomposing processes to assert themselves within that zone. As against this, and under the given circumstances of culture, the parenchymal cells of the adult liver are incapable of synthetizing ribonucleic acid, wherefore exlusively decomposition processes take place in it. Presumably, the decisive difference between the adult and the embryonic liver cells ought not to be sought in their ribonucleic acid contents, but in the different rates and conditions of ribonucleic acid synthesis. Ribonucleic acid has a double function in liver tissue. Firstly, as long as the liver is growing (embryonic life, postnatal period of growth, regeneration, neoplastic growth) the compound has a role in the synthesis of protein for the new cells, quite in the sense of *Caspersson* et al., *Brachet*, *Kedrovski*, etc. Secondly, another part of ribonucleic acid in the cytoplasm of the liver cell is likely to play a certain part in the production of plasma protein probably already during embryonic life. It can also be presumed that in the adult animal synthesis of plasma protein remains the only function of some considerable part of the ribonucleic acid in the hepatic parenchyma. The cells are unable to resynthetize this part of the ribonucleic acid under the given experimental conditions *in vitro*. (Formulating the same problem on another plane, one may say that the nutritional and respiratory conditions adequate for the growth of the embryonic liver tissue, are insufficient for that of the adult liver). The conception that ribonucleic acid fulfills such a double function in the liver seems to find support in the observation of *Chantienne* (cit. *Brachet* 1947), according to which ribonucleic acid is present in the liver cells in (both) ultracentrifugable and non-ultracentrifugable forms. In embryonic liver the proportion of the latter is considerably greater. It may be assumed that with development the granules containing ribonucleic acid become inreased in size and more complex, in the forming of which various enzymes also participate (e. g. oxidative enzymes). Also, it is possible that the enzymes in the granules play an important role in the synthesis of ribonucleic acid, but that the conditions for their activity are not given under the circumstances prevailing in the usual cultures. Of course, further investigations are needed to answer these questions, which are all of a hypothetical nature.

The problems are made more complex by the fact that while we have observed chiefly the basophilia of the epithelial cells and its change, at the same time in many cases merely proliferation of the interstitium was experienced. This speaks for a close parallelism between the differentiation of the epithelium and the interstitium built into it, considering that in tissue cultures from adult liver no outgrowth of connective tissue cells can be observed. Questions concerning the conditions and the potentiality of growth of epithalial tissue constitute, however, a further problem.

In some of our preparations it was noticeable that the marginal zone containing pyroninophile substance has not entirely been formed from the outermost cells. The latter may be destroyed when preparing the sections and it is quite possible that the products thereby released contribute to the increase in nucleic acid synthesis in the adjoining cells. Whether the explantation was made with or without embryonic extract seems to have little influence either upon the dissapperance of ribonucleic acid or the formation of the marginal zone staining with pyronine.

The above permit the assumption that the capacity of hepatic cells to synthetize ribonucleic acid has a definite part in the determination of the growth of liver explants. In this, however other factors and complex enzymatic processes certainly participate as well.

Summary

By means of histochemical examination of tissue cultures prepared from the liver of chick and rat embryos, and of rats of different age, it could be established that — (i) from explants made of adult liver RNA disappears completely within 24 hours, and that these explants show no sigus of growth; (ii) in embrionic liver explants a marginal zone forms in which the RNA content of the parenchymal cells does not decrease, and that these cultures show 100 per cent growth; (iii). The process of disappearance of the RNA content becomes irreversible as soon as in 8 hours.

The observations revealed a definite parallelism between the RNA-synthetizing capacity of the liver cells and their capacity to proliferate in tissue culture. The findings are discussed in detail.

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SO РОЛИ НУКЛЕЙНОВЫХ КИСЛОТ В РОСТЕ ПЕЧЕНОЧНОЙ ТКАНИ IN VITRO

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Резюме

Авторы путем гистохимического исследования тканевых культур, приготовленных, из печени зародышей кур, крыс, а также из печени крыс различного возраста, установили следующее.

В тканевых культурах, приготовленных из печени взрослых животных, рибонуклеиновая кислота полностью исчезает и рост культуры не наблюдается.

2. На краю тканевых культур, приготовленных из печени зародышей, образуется зона, в паренхимальных клетках которой содержание рибонуклеиновой кислоты не уменьшается. В этих культурах наблюдался прирост в 100%.

3. Процесс исчезновения рибонуклеиновой кислоты уже через 8 часов является невозвратимым.

Наблюдения указывают на то, что имеется определенный параллелизм между способностью печеночных клеток синтетизировать рибонуклеиновую кислоту с одной стороны, и способностью к пролиферации в тканевых культурах с другой стороны.

Авторы подробно обсуждают результаты своих наблюдений.