

THE HUMAN HAIR GROWTH CYCLE

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Synopsis

Four post pinkus events changed the course of dermatology:

1-the publication, in 1926, of Dry's article he described the growth cycles of the haircoat of mice, coining the dreadful terms anagen, catagen and telogen.

2-The publication of Butcher's article in 1934 indicates the intensity with which biologists of yore studied hair.

3-The publication, in 1951 by N.Y. Academy of Science of the proceedings of a conference on "Growth Replacement and Types of hair", organized by J.B. Hamilton

4-it was not until 1954, when Chase's review article, "Growth of the Hair", on the hair growth cycles of the mouse, that hair research really caught on.

This last event, was, for all practical purposes, the dawn of modern hair reasearch in the United States and everywhere else in the world. Soon after that event, the number of publications dealing with hair growth became very numerous.

It is amusing that the same questions that were asked by the pioneers remain unanswered: what initiates anagen, and, what terminates it?

Riassunto

Quattro fondamentali eventi hanno cambiato il corso della conoscenza dermatologica sul "ciclo" di crescita del pelo.

1-La pubblicazione nel 1926 dell'articolo di Dry che descrisse tale ciclo coniano i termini anagen, catagen e telogen.

2-La pubblicazione dell'articolo di Butcher nel 1934 che confermava l'importanza di questo ciclo.

3-La pubblicazione nel 1951 da parte della N.Y. Academy of Science di una conferenza di J.B. Hamilton sul tema della "caduta patologica dei capelli".

4-La pubblicazione dell'articolo di Chase "sulla crescita del pelo" che rappresenta il vero inizio USA di tutti gli studi sperimentali sui capelli.

Molti sono i lavori pubblicati a tutt'oggi sul ciclo del capello. Ciò che lascia perplessi è che ancora oggi non è stata data una risposta sicura a questo interrogativo.

Quale fenomeno permette l'inizio della fase anagen del pelo e quale fenomeno l'induce a regredire?

If nothing had been written on hair research since Felix Pinkus (1927) wrote his article on skin in Jadasson's Handbook, our knowledge would not be very far behind what it is today. Even if one's knowledge of German is limited, one should leaf through that monumental work. It contains almost everything that is important on what is known about the hair Growth Cycle. Pinkus was a visionary and his masterpiece in Jadasson's Handbook is perfection, like Beethoven's 9th symphony.

Now I will review the four post-Pinkus events that changed the course of dermatology: 1) the publication, in 1926, of Dry's article in which he described in painful details the growth cycles of the haircoat of mice, coining the dreadful terms anagen, catagen and telogen. The German terms Haarkeim- (hair germ stage), Haarzapfen- (hair-peg stage), Bulbuszapfen- (bulb-peg stage), and Scheidenhaartstadium (hair sheath stage) cover the same territory but are more cumbersome. Anagen: literally means the reproduction of a structure; catagen: the regression (destruction) of a structure; and telogen: can mean a mature structure or distant formation: cf. tele-control or as in distant or remote control, telephone, distant sounding or voice. Dry did not explain his reasons for using these barbarous terms. The identification and the naming of these phases was one of the most important contributions to modern cutaneous biology. 2) The second event, the publication of Butcher's article in 1934, indicates the intensity with which biologists of yore studied hair. Even though Butcher published his observation on the hair growth in rats, eight years after Dry's publication, he either ignored or deliberately avoided citing Dry. In the introduction of his paper Butcher stated that "The quiescent condition and the growth stage together, constitute a cycle". 3) The third historical event is, perhaps the most significant: the publication in 1951 by the N.Y. Academy of Science of the proceedings of a conference on "Growth Replacement and Types

of Hair", organized by James B. Hamilton, whose article "Patterned Loss of hair in Man: Types and Incidence", became the keystone of all subsequent articles on baldness. And yet, 4) it was not until 1954, when Chase's review article, "Growth of the Hair", another very dull contribution on the hair growth cycles of the mouse, that hair research really caught on. This last event, was, for all practical purposes, the dawn of modern hair research in the United States and everywhere else in the world. I wonder still about the importance of that article; perhaps both the academic and medical environments were ready for it. Chase resuscitated Dry's terminology but was more crisp than Dry and Chase also made some allusions to human hair growth. The publication of his review, then, may be the most important event in modern dermatology since it caught its imagination as well as that of experimental biologists. Soon after that event, the number of publications dealing with hair growth became very numerous. Chase's publication was the turning point of dermatology which emerged as a really exciting medical speciality. Every conceivable new discipline was eventually applied to better explain the phenomenon of the growth cycle. And yet, it is amusing that the same questions that were asked by the pioneers remain unanswered: what initiates anagen, and, what terminates it?

It is regrettable that research on hair growth, with singular exceptions, has been poor. Perhaps, behind this shoddiness is the lure of the rewards that would come from the cosmetic industry which is forever looking for panacea drugs that might restore the "crowning" glory of bald people; I suspect that they believe to have found such a drug.

Have we made any progress in understanding the mysterious ways of the hair growth cycles? In the skin of mammals which are born naked, (most rodents, logomorphs, and a few others) hair neogenesis occurs largely postnatally. This may be one of the reasons why so many biolo-

gists have studied the growth of the hair coat of mice and rats. In other mammals, such as the primates, including man, hair growth is already well established at birth. The postnatal continuation of hair growth cycles are a reflection of the phenomenon that began in utero. All development proceeds cephalocaudally, and it follows that hair is formed first on the head, and hair growth cycles are established first there. In human fetal scalps, and in newborn infants, three or more cycles may already have occurred. The mechanism that triggers catagen, then, is phylogenetically and ontogenetically ancient. The human fetal scalp of 7 months or older contains numerous club hairs, quiescent follicles, as well as hair follicles in early anagen. In rhesus monkeys, which have a gestation period of roughly 150 days, hair differentiation begins (on the head) at about 54 days; many telogen follicles can be found at 100 days or earlier (Bell, 1969, 1973). Why hair follicles stop producing a hair after a period of growth is still unknown. Uno et al. (1985), however, seems to have the answer. These authors dismiss the issue by saying: "Individual hair follicles cannot, however, produce shafts indefinitely." It is a calamity that the only people in the world who have the answer, don't tell us why follicles cannot "produce shafts indefinitely." We don't really know why and how follicles grow and rest.

Antagen is a truly miraculous event. Every hair follicle in anagen is a microcosm where growth and differentiation, similar to what had occurred in utero when the follicles were first formed and repeated in almost every detail during our entire life. And, here is something that is not usually appreciated: every individual hair formed is a structurally unique entity. Its structure can be very different from segment to segment, as are subsequent hairs formed by the "same" follicle. I emphasize here that consecutive hair generations are not formed by the same follicle since the reproducing part of every follicle is destroyed during each phase of catagen and

each hair is produced by a new and different follicle. The only things that all succeeding hair generations have in common is that they come from a common stock, the cells of the outer root sheath, and that they emerge from an established pilary canal and orifice.

One might suppose that years of fierce research on human hair growth by morphologists, whether they used the light or the electron microscope, would have resulted in the unveiling of every conceivable detail in the anatomy of a growing follicle. And yet, it was not until recently that certain things have come to light. For instance, the Arao body, discovered in 1969 by Arao and Perkins, continues to be ignored by nearly everybody. Also, no one takes cognizance of the fact that the dermal papilla is not just a candle wick flame-shaped structure. In sections of human hair follicles made exactly through the center of the bulb, the papilla is drawn out into very thin tracks for some distance into the prekeratogenous zone, as in the follicles of rodents and swine. I wonder what the specific tinctorial peculiarities of the dermal papilla in anagen follicles mean: a brilliant metachromatic staining with toluidine blue, PAS-positivity, deep azurophily when treated with the Giemsa stain, and materials that stain with colloidal iron techniques. The identity of the substances responsible for these tinctorial attributes does not enlighten us about how the follicle produce a hair. A final point is that anagen, as Uno et al. (1985) have shown, is not the explosive phenomenon it appears to be in healthy rodents (Chase and Eaton, 1954) but can sometimes lag for years in its early stages. For example, in my own long forgotten paper (Montagna, 1959), I observed that the hair follicles in children's axillae remain in a form of arrested anagen until early puberty.

Furthermore, what makes the well-oiled machinery of anagen stop is a mystery that has yet to be solved. Catagen, which is often mistaken for a calamitous event when things go to dust, is a-

ctually an orderly and process during which the follicles form a club and proceed to largely discard the cells of the bulb, and select only a few cells mostly from the outer root sheath to form a new hair follicle anlage, and prepare for the next growth cycle which could come soon or much later.

Most dermatologists know the stage telogen because Kligman (1959) made many acute observation on human hair growth and because he coined the clever term 'telogen effluvium' (Kligman, 1961). Telogen is like a time bomb, ready to explode. No one has yet discovered what sets it off.

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