Polled references:

One of the original papers showing what happens when polled goats are bred together—large sample size:

<http://www.genetics.org/content/genetics/30/1/51.full.pdf>

<http://onlinelibrary.wiley.com/doi/10.1111/j.1601-5223.1994.00071.x/pdf>

From Smith and Sherman (Goat Medicine):

The Polled Goat Alternative

It seems logical to avoid all the problems and dangers of dehorning by simply selecting for the absence of horns. Although this works in some breeds, the U.S. dairy goats of European extraction (i.e. Saanen, Alpine, Toggenburg) unfortunately have a serious genetic reproductive disorder linked to the polled condition. In these breeds, the presence of horns is determined by a recessive gene. The polled trait is dominant but is linked to a recessive gene for infertility. A female goat that is homozygous for the polled gene develops into a sterile intersex. The homozygous polled male has an increased risk of developing sperm granulomas in the head of the epididymis. These problems are discussed in chapter 13. Polled goats of normal reproductive potential can be obtained if one member of each breeding pair is polled and one is naturally horned; eliminating all horned goats from the breeding program results in the production of many infertile goats.

<http://www.merckvetmanual.com/mvm/management_and_nutrition/health-management_interaction_goats/overview_of_health-management_interaction_goats.html>

 “In the European dairy breeds, the genetically homozygous polled doe usually is anatomically an intersex and, therefore, infertile. Aberrations vary from a slightly enlarged clitoris visible only after puberty, to a buck-like conformation with a scrotum, penis (often shortened), and ovotestes. Some phenotypically male pseudohermaphrodites show male libido with breeding activity. Because these animals are infertile, early recognition and culling is advisable. Some homozygous polled males may be able to sire kids, but these bucks are likely to develop sperm granulomas as they mature and should be culled rather than used for breeding. Most owners reduce the incidence of homozygous polled animals by never mating two polled animals. While most intersex goats are polled, similar anatomic aberrations are seen occasionally in horned goats. These would most probably be chimeras (freemartins), the result of anastomoses developing in utero between males and females. Such chimeras in goats are rare (considering the high frequency of twins) when compared with cattle.”

Person reporting the birth of an abnormal doe kid to a polled to polled Nubian breeding:

<http://www.homesteadingtoday.com/livestock-forums/goats/290484-polled-genetics.html>

The polled “gene” is actually a single large deletion; “Females that are

homozygous for the polled gene (PP) will become infertile in-

tersex (7); fertile polled females therefore must be heterozygous

for the polled gene (Pp) (16).”

<http://www.ingentaconnect.com/content/aalas/jaalas/2002/00000041/00000005/art00009?crawler=true>

Reference 16 is: Basrur, P. K. and A. O. McKinnon.

1986. Caprine intersexes and

freemartins, p. 596-600.

In

D. A. Morrow (ed.), Current therapy in

theriogenology: diagnosis, treatment, and prevention of reproduc-

tive diseases in small and large animals. W. B. Saunders Co.,

Philadelphia.

Where Allison Spacek posted that she had gotten a hermie from a polled to polled breeding of meat breeds: <http://www.thegoatspot.net/forum/f217/breeding-polled-goats-123425/>

 Another person who bred polled to polled twice and got hermies both times: <http://goatwisdom.proboards.com/thread/1086/appenzell-goats>

Another Google books result: <https://books.google.com/books?id=bqz9-IUUwdcC&pg=PA123&lpg=PA123&dq=homozygous+polled+doe+goat&source=bl&ots=Y9Zy0RxbqF&sig=tGVakDykjDVC7FBZsMp2sWnvgEk&hl=en&sa=X&ved=0ahUKEwjky4yc9fXLAhVI6iYKHU_pBGY4HhDoAQgmMAM#v=onepage&q=homozygous%20polled%20doe%20goat&f=false>

From Diseases of the Goat, John G. Matthews:

“*Intersex (pseudohermaphrodite)* - an animal that shows both male and female characteristics. In goats the dominant gene for the absence of horns (polled condition) is associated with a recessive gene for intersex. Thus, an intersex is normally polled with two polled parents. Intersex is a recessive sex-linked incompletely penetrant trait resulting from the breeding of two polled goats - intersex goats are homozygous for the polled (hornless) gene and homozygous for the intersex gene.

A mating between a homozygous (PP) polled male and a heterozygous (Pp) polled female will produce 50% intersexes; a mating between a heterozygous (Pp) polled male and a heterozygous (Pp) polled female will produce 25% intersexes. In theory, mating two homozygous (PP) polled animals should produce 100% intersexes, but the gene has incomplete penetrance. Affected animals are genetically female with a normal female chromosome complement (60 XX), but phenotypically show great variation from phenotypic male (Plate 1.4) to phenotypic female. Some animals are obviously abnormal at birth with a normal vulva but enlarged clitoris or penile clitoris. The gonads are generally testes or ovotestes which may be abdominal or scrotal, and phenotypic males may have a shortened penis (hypospadias), hypoplastic testes or sperm granuloma in the head of the epididymis. Other animals may reach maturity before being detected and may present as being anoestrus. A phenotypically female animal may have male characteristics due to internal testes.

Intersexes with female appearance are sometimes presented as kids or goatlings with a history of anoestrus. Although the vulva is normal, there is no true vagina or cervix, the clitoris may be enlarged and the anogential distance may be >3cm. The presence or absence of a vagina of proper length should always be investigated in anoestrus kids. The absence of a vagina can be demonstrated by gently inserting a lubricated plastic rod, e.g. a ball-point pen, into the vulva (Plates 1.5 and 1.6) or endoscopically. Care should be taken not to mistake a persistent hymen for a shortened vagina.

Intersexes with male appearance may have a penis or penis-like structure just below the anus. These animals may have urine scalding down their hind legs or have dysuria. Urine may accumulate in the perineal area causing dermatitis. In some cases, the urethra does not pass through the vestigial penis/clitoris and surgery may be required to establish an effective urethral opening. Localised hypospadia has been described in some cases. “

<https://books.google.com/books?id=SLKlAhm7sJEC&pg=PT21&lpg=PT21&dq=homozygous+polled+doe+goat&source=bl&ots=u982eVJ66B&sig=TsbC6rMwZcGAWld4bcYAbGdFvBc&hl=en&sa=X&ved=0ahUKEwjky4yc9fXLAhVI6iYKHU_pBGY4HhDoAQgjMAI#v=onepage&q=homozygous%20polled%20doe%20goat&f=false>

Homozygous polled bucks are normally infertile in Icelandic goats:

<http://www.fao.org/3/a-a0070t/a0070t0a.htm>

A casual reference to “a sex-linked trait for hermaphroditism associated with naturally polled goats” in “The Meat goat Handbook” : <https://books.google.com/books?id=RKzPbXwCYLMC&pg=PA214&lpg=PA214&dq=homozygous+polled+doe+goats&source=bl&ots=KJda_GrdkR&sig=K2UKeFU1fkKHThaMYNLMQUd4h6c&hl=en&sa=X&ved=0ahUKEwi7y_Tb9_XLAhWIbSYKHfxQDl84HhDoAQgmMAI#v=onepage&q=homozygous%20polled%20doe%20goats&f=false>

From page 6 of a lecture on goat theriogenology

“This is essential knowledge for every veterinary student planning to write the NEB examinations. This is the intersex condition in goats. So listen carefully:

These are the things you have to remember

1. Although these are all XX goats, they are practically all male pseudohermaphrodites. In other words, they all have testicles and the rest of the tractis ambiguous. The testicles may be located within the scrotum or these goats may be cryptorchid. The structure of the rest of the tract is highly variable.

2. The genes for the intersex and polled conditions are carried on the X chromosome.

3. Because the intersex gene is linked to the gene for the polled condition it is known as the Polled Inter-Sex (PIS) gene.

4. The intersex condition only expresses itself if a goat is homozygous for the PIS gene.

5. To do it avoid the homozygous condition, one of the parents should always be a horned animal because a horned animal cannot possibly be carrying the polled gene. Why? It is because the gene for polling is dominant.

6. So the intersex condition can be avoided by using a horned male for breeding. That’s the really important thing to remember.

Now: I don’t expect you to know the following details but for those of you who may be interested, it is fascinating to know that these animals are not positive for the SR-y gene. Instead it is a homozygous allele deletion on the PIS gene on the X chromosomes that makes it impossible for the female to suppress the formation of testicles. You see, the formation of testicles is not only because of a positive “switch on testicles” effect by the SR-y gene but due to an active homozygous “switch off testicles” signal from both X chromosomes. If the “switch off testicles” transcription is somehow screwed up as it is here, testicles will form. I had a stallion like this a little while ago. He was pure XX but he had testicles and I couldn’t understand

why because he was also negative for the SR-y gene. Now I think there must be some gene deletions on his XX chromosomes”

<http://people.upei.ca/lofstedt/public/chromosome.puzzle/images%20for%20chromosomes/private/vhm321/vhm321.pdfs/small.rum.female/caprine.theriogenology.pdf>

## From Maurice Shelton, Texas A&M, 1978 (Shelton, M., 1978: Reproduction and breeding of goats. Journal of Dairy Science 61(7): 994-1010)

## References for the usual story on polled to polled and intersex:

## 30 Eaton, O. N. 1945. The relation between polled and hermaphroditic characters in dairy goats. Genet. 30:51.

## 74 Ricordeau, G., J. Bouillon, and F. Hulot. 1972. Penetrance de 1-effet de sterilite tolale lie au gene sans comes P, chez les coucs. Ann. Genet. Selection Anim. 4:534.

## 48 Laor, M, R. Barnea, H. Angel, and M. Soller. 1962. Polledness and hermaphroditism in Saanen goats. Israel J. Agr. Res. 12:83.