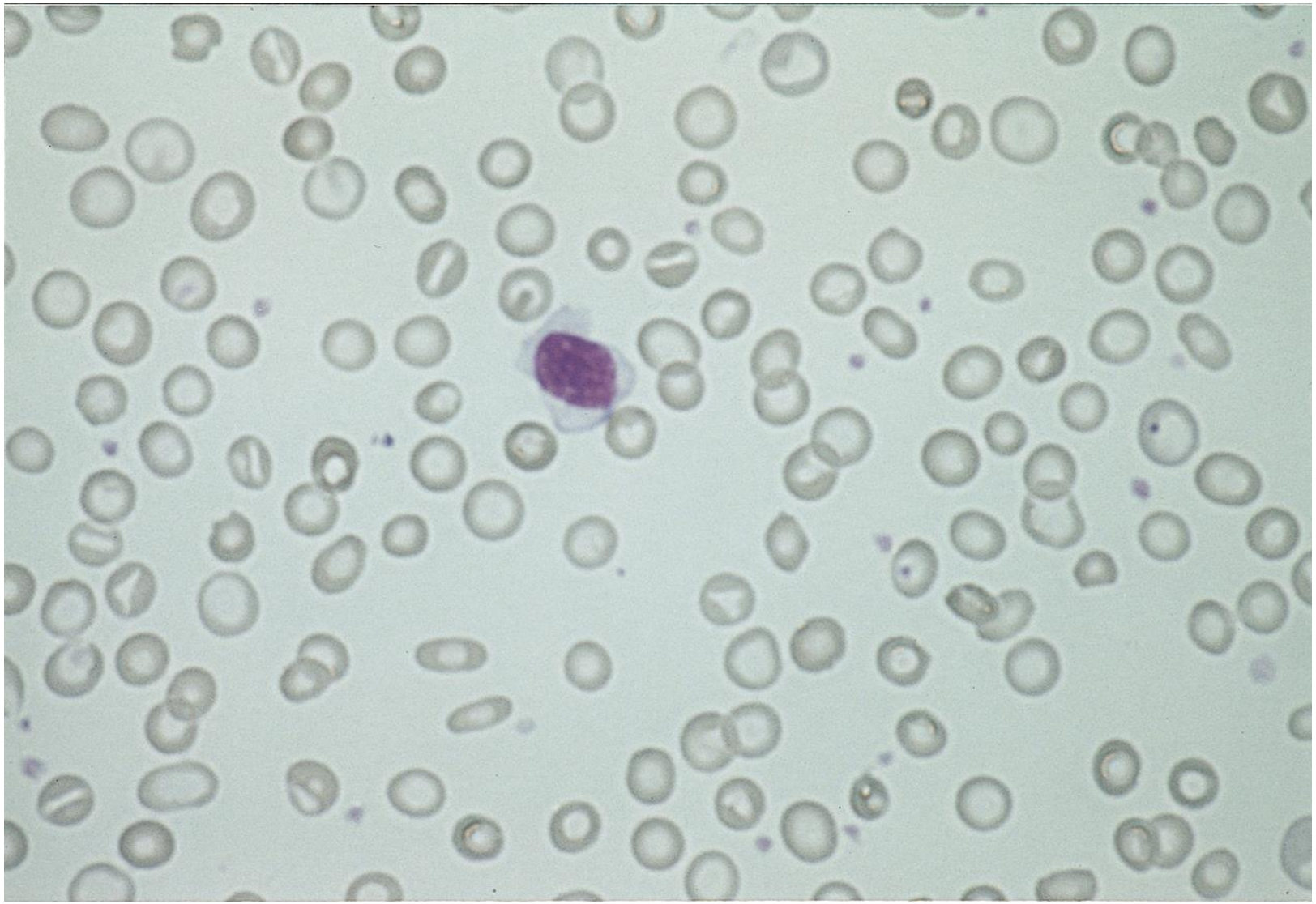
Erythrocyte variations in May-Giemsa-stained smears

Giemsa stain (or May–Grünwald–Giemsa stain) is a type of Romanowsky stain named after Gustav Giemsa, a German chemist. It was primarily designed for the demonstration of malarial parasites in blood smears, but it is also employed in routine examination of blood smears.

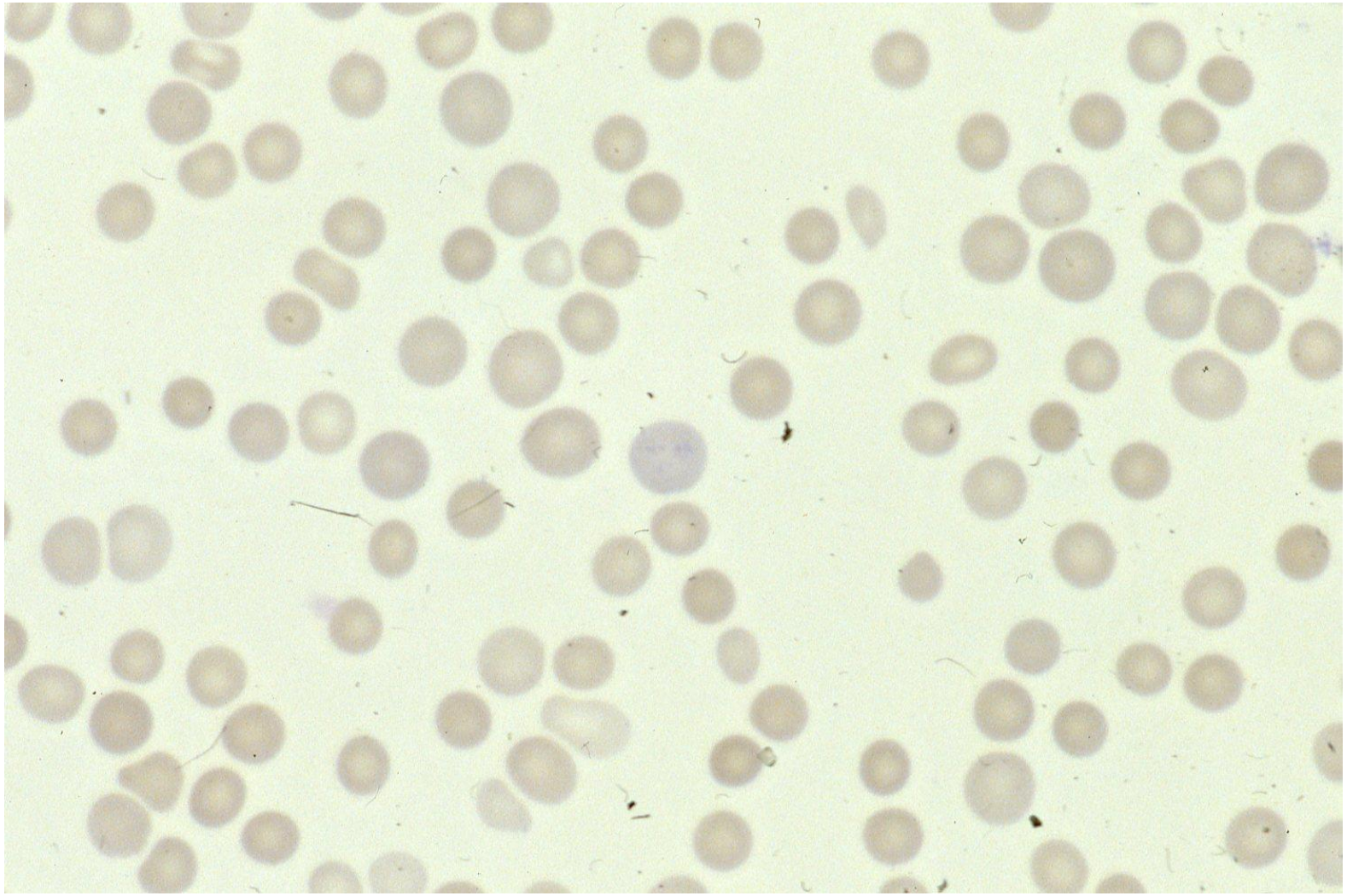
The smeared cells are promptly dried and fixed in methanol. The staining solution contains a mixture of azure, methylene blue, and eosin dyes. Azure and eosin are acidic dye that variably stains the basic components of the cells like the cytoplasm and granules. Methylene blue, the basic dye, stains the acidic components, especially the nucleus of the cell.

Here, variations of red cell morphology are shows as an atlas.

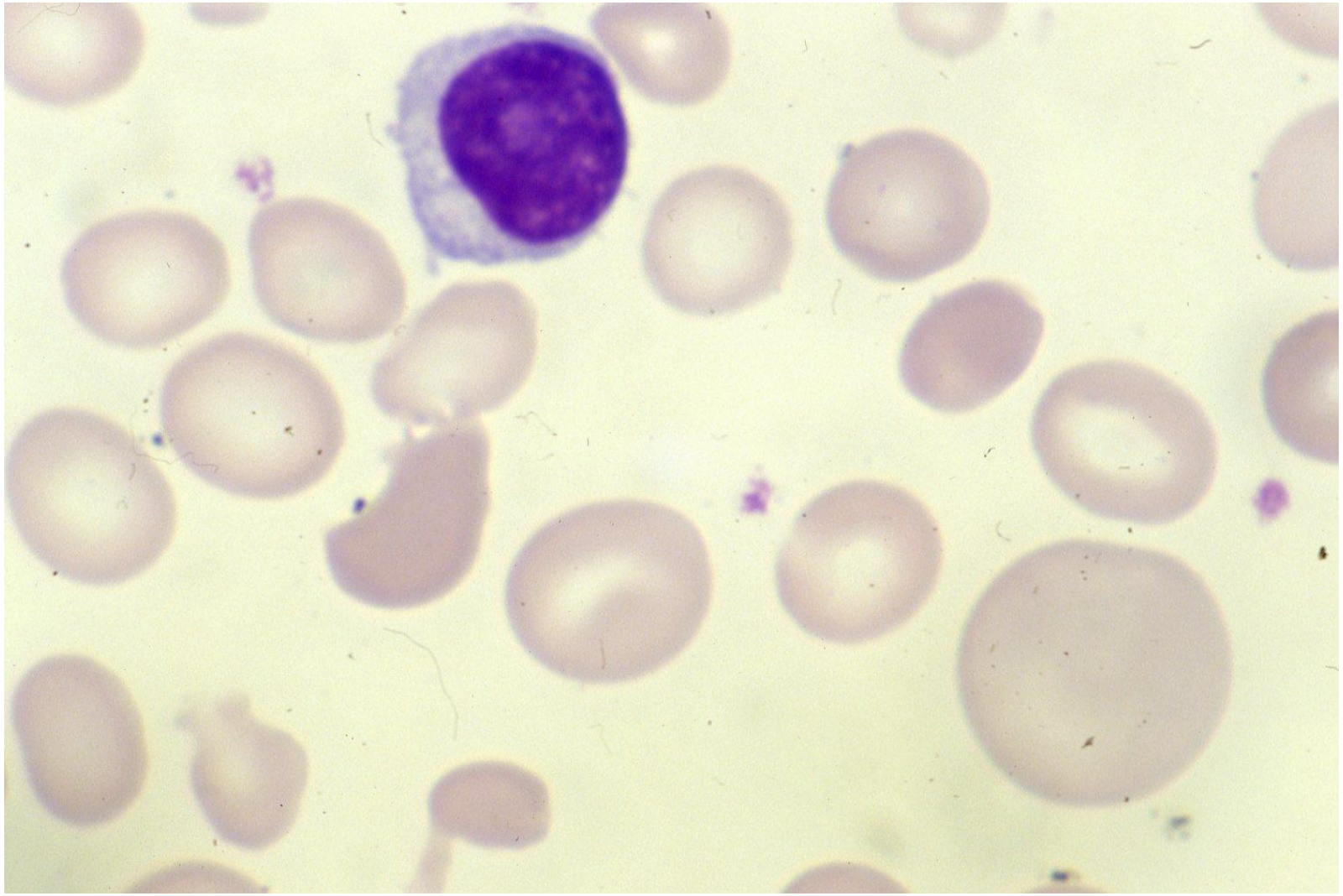
Ref.: Rijal N. Giemsa Stain: Principle, Procedure, Results. https://microbeonline.com/giemsa-stain-principle-procedure-and-results/



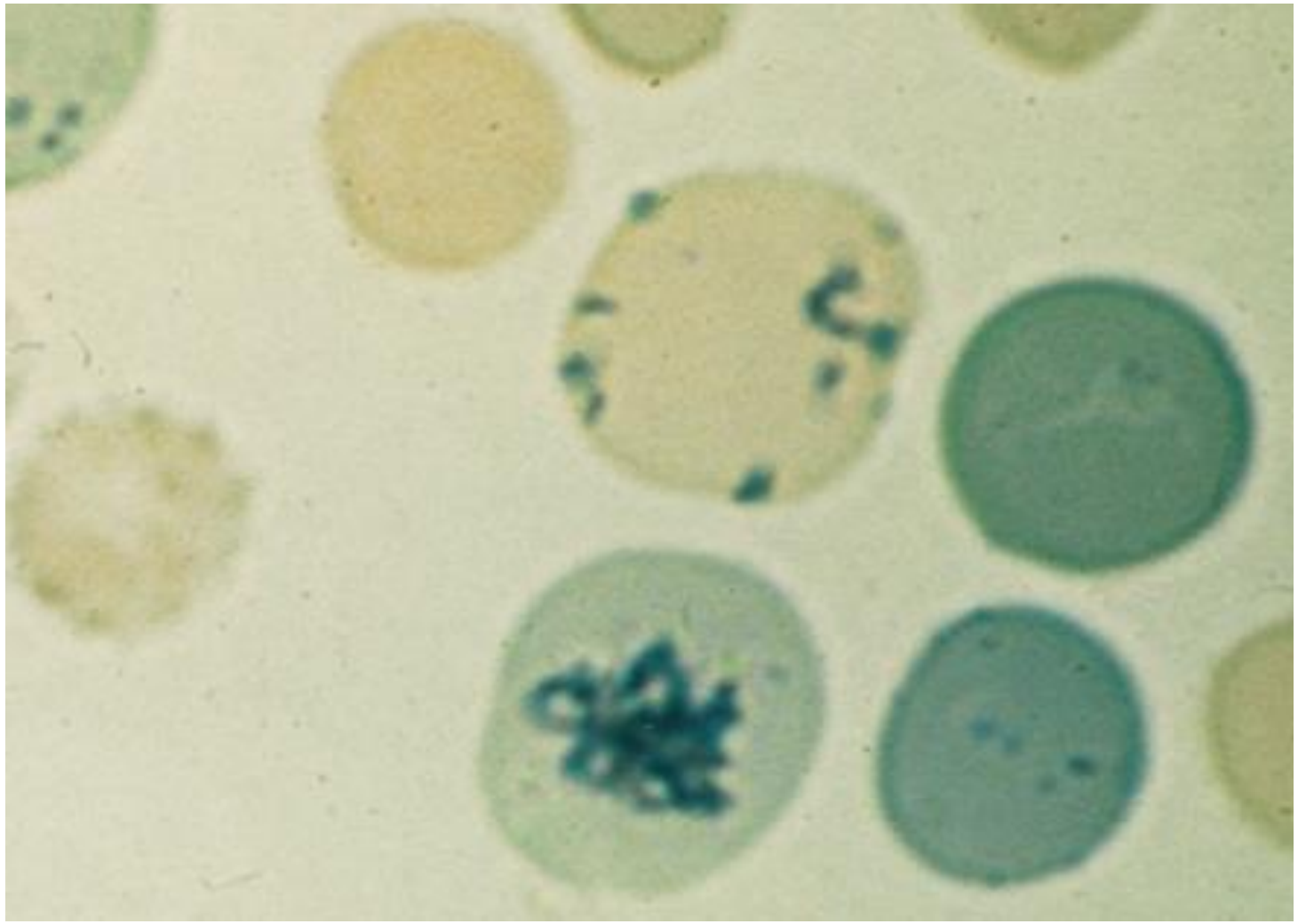
Iron-deficiency anemia (hypochromic anemia). Widening of the central pallor represents the decrease of the hemoglobin content, and is called leptocytes or planocytes. Stomatocytes show the lip-like deformation of the central pallor. May-Giemsa



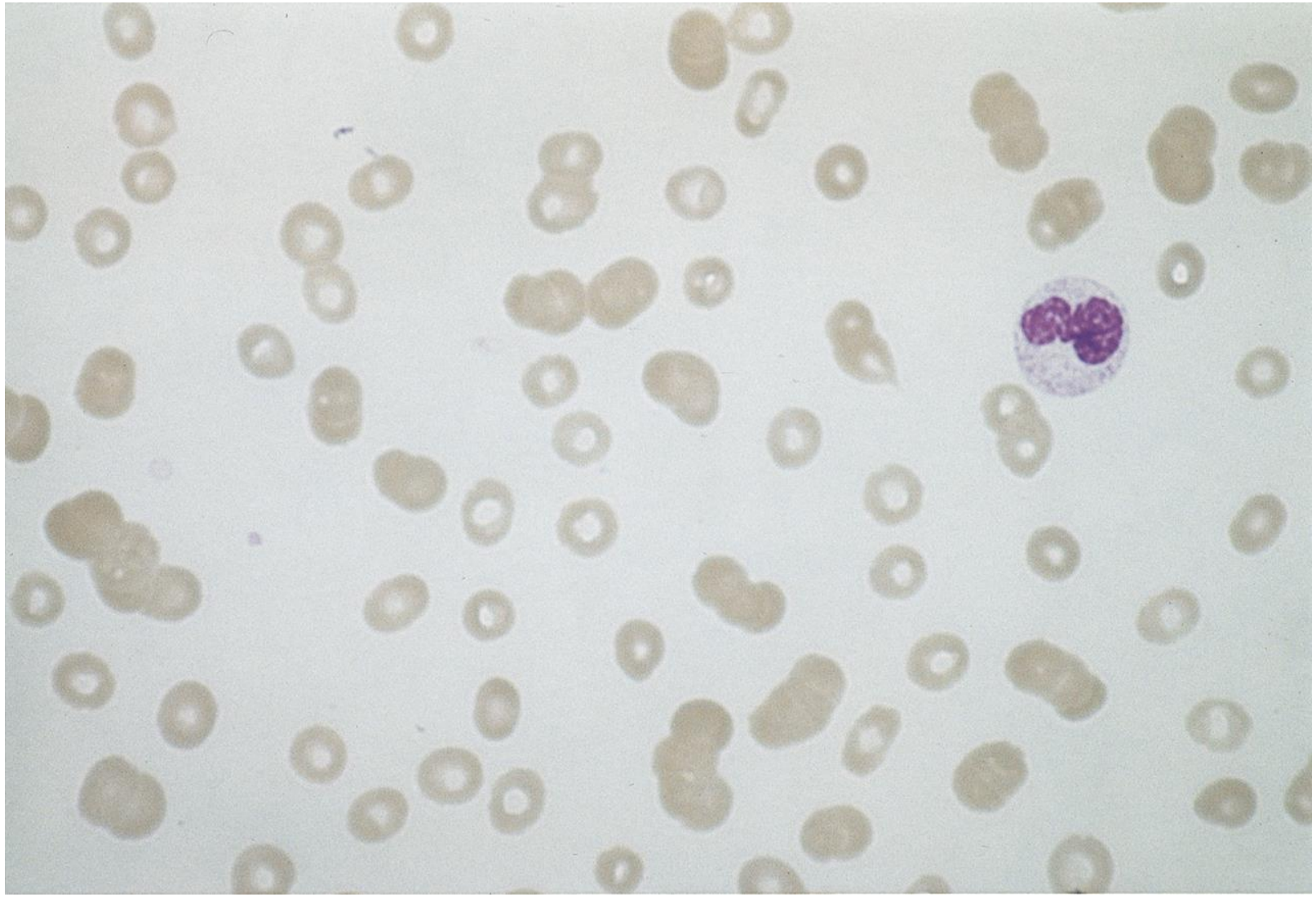
Anisocytosis. The red blood cells are of unequal size. Note a reticulocyte, immature erythrocyte, in the center shows a basophilic granular cytoplasm, representing a reticular (mesh-like) network of ribosomal RNA. May-Giemsa



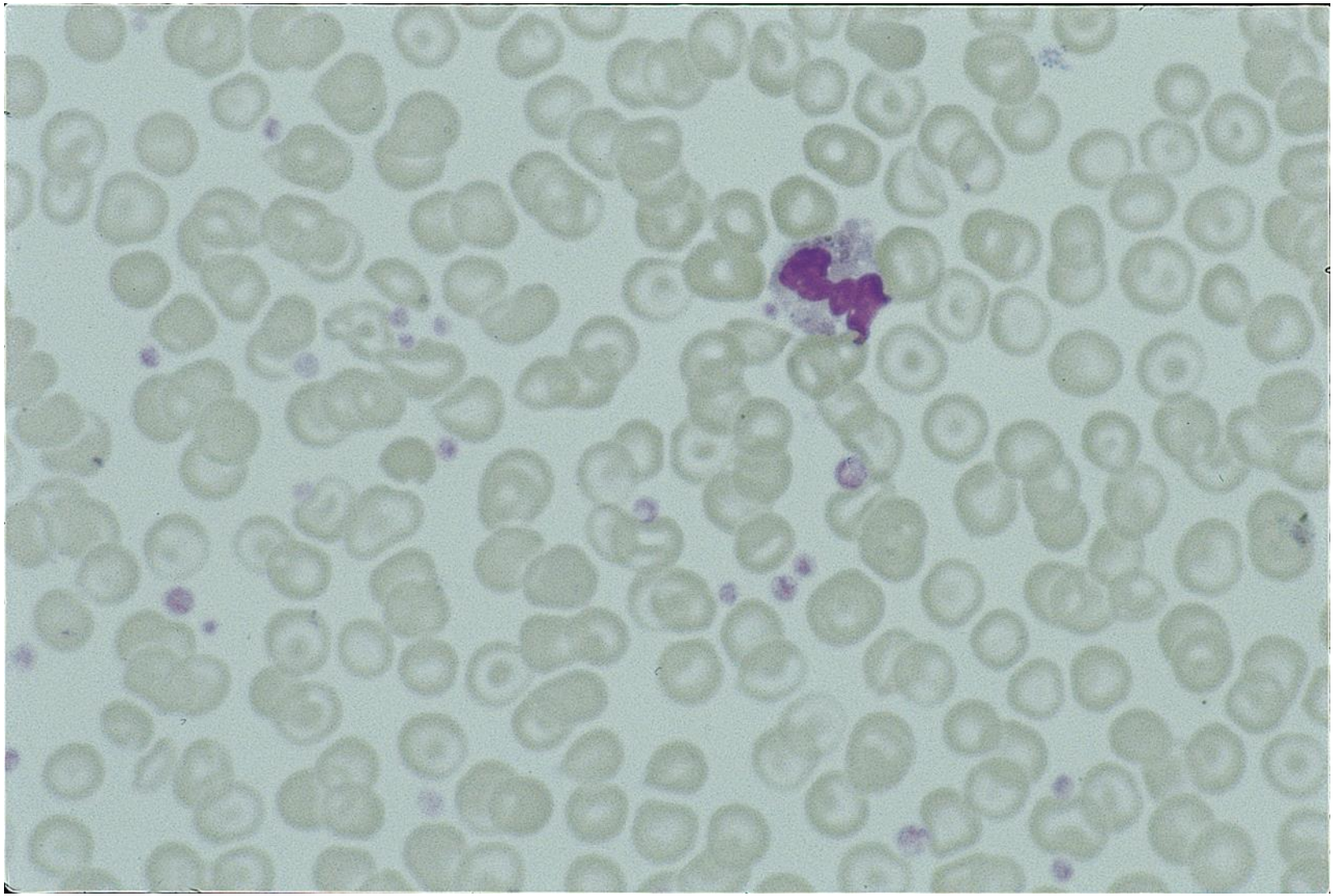
Anisocytosis. The red blood cells are of unequal size. Note a reticulocyte in the right bottom shows a finely basophilic cytoplasm without central pallor. The size is comparable with a lymphocyte located at the left top. May-Giemsa



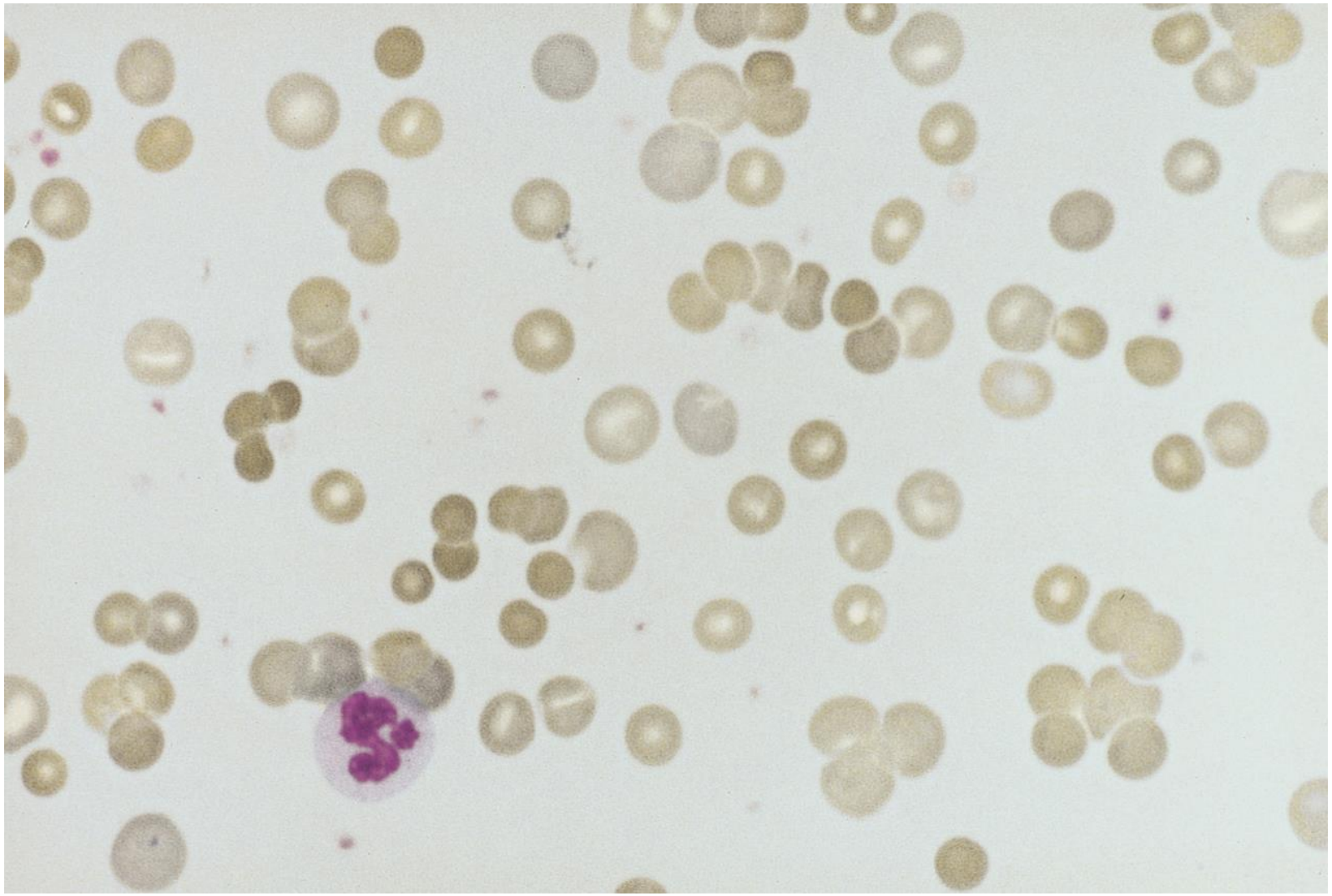
Reticulocytes stained supravitally with New Methylene Blue. Ribosomal remnants in the cytoplasm of the reticulocytes are stained blue. Normal reticulocyte count ranges from 0.5 to 2.5%.



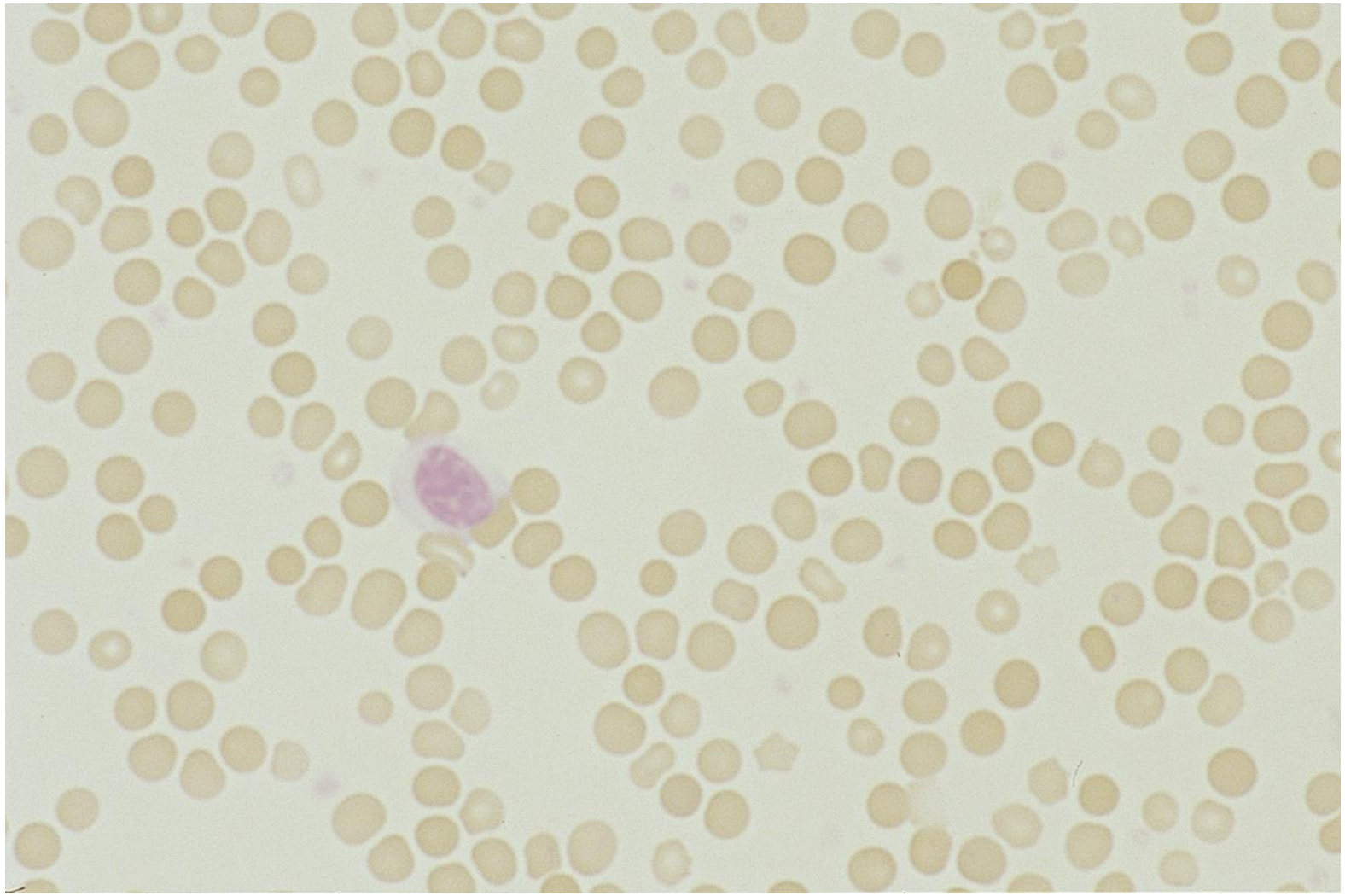
Rouleaux formation of red blood cells. Monoclonal increase of serum IgG (9,800 mg/dL) secreted by multiple myeloma has provoked stacks/aggregations of red blood cells, as a result of hyperviscosity syndrome. May-Giemsa



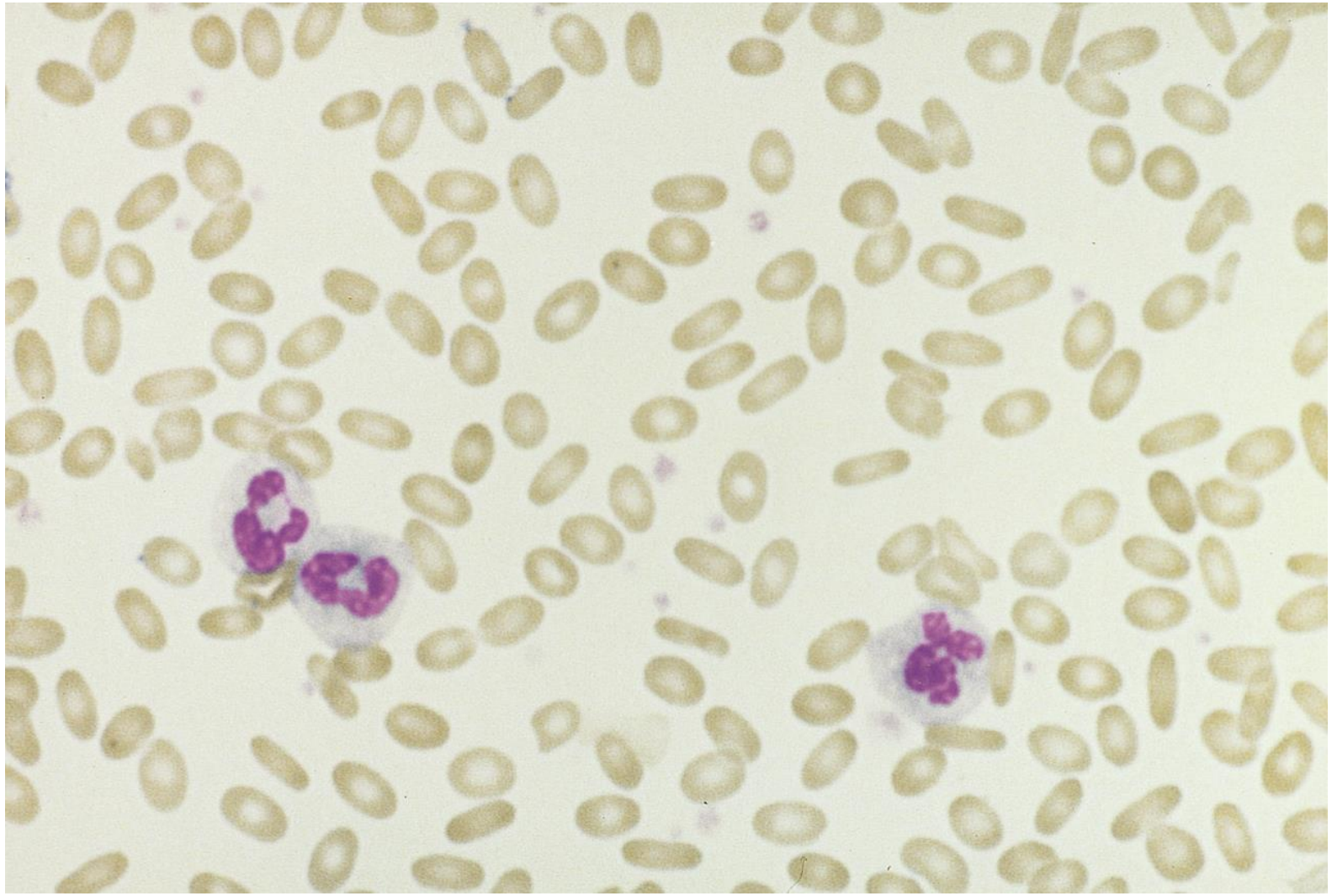
Target cells (codocytes) in hepatic dysfunction. The red blood cells show the appearance of a shooting target with a bullseye (having a dark center). Decrease of activities of lecithin-cholesterol acyltransferase (LCAT) by liver cirrhosis or obstructive jaundice causes to increase red cell membrane fluidity. May-Giemsa



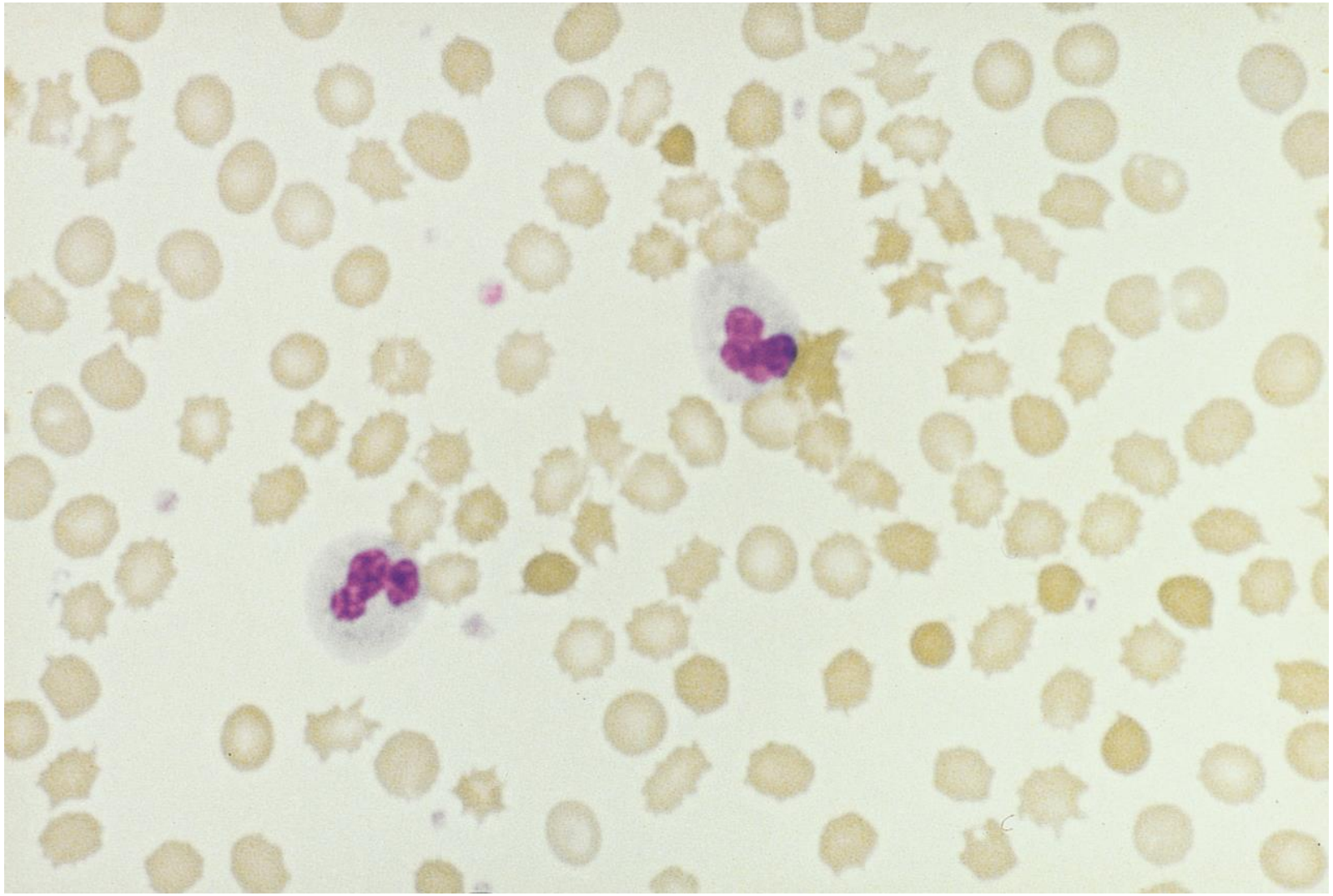
Autoimmune hemolytic anemia (AIHA) accompanying severe anemia (RBC 1,380,000/μL, Hb 5.0 g/dL, Ht 17.8%), positive Coombs tests, decrease of haptoglobin (<10 mg/dL) and increase of LDH (1,290 IU/L). Spherocytes, reticulocytes and stomatocytes are intermingled to show anisocytosis. May-Giemsa



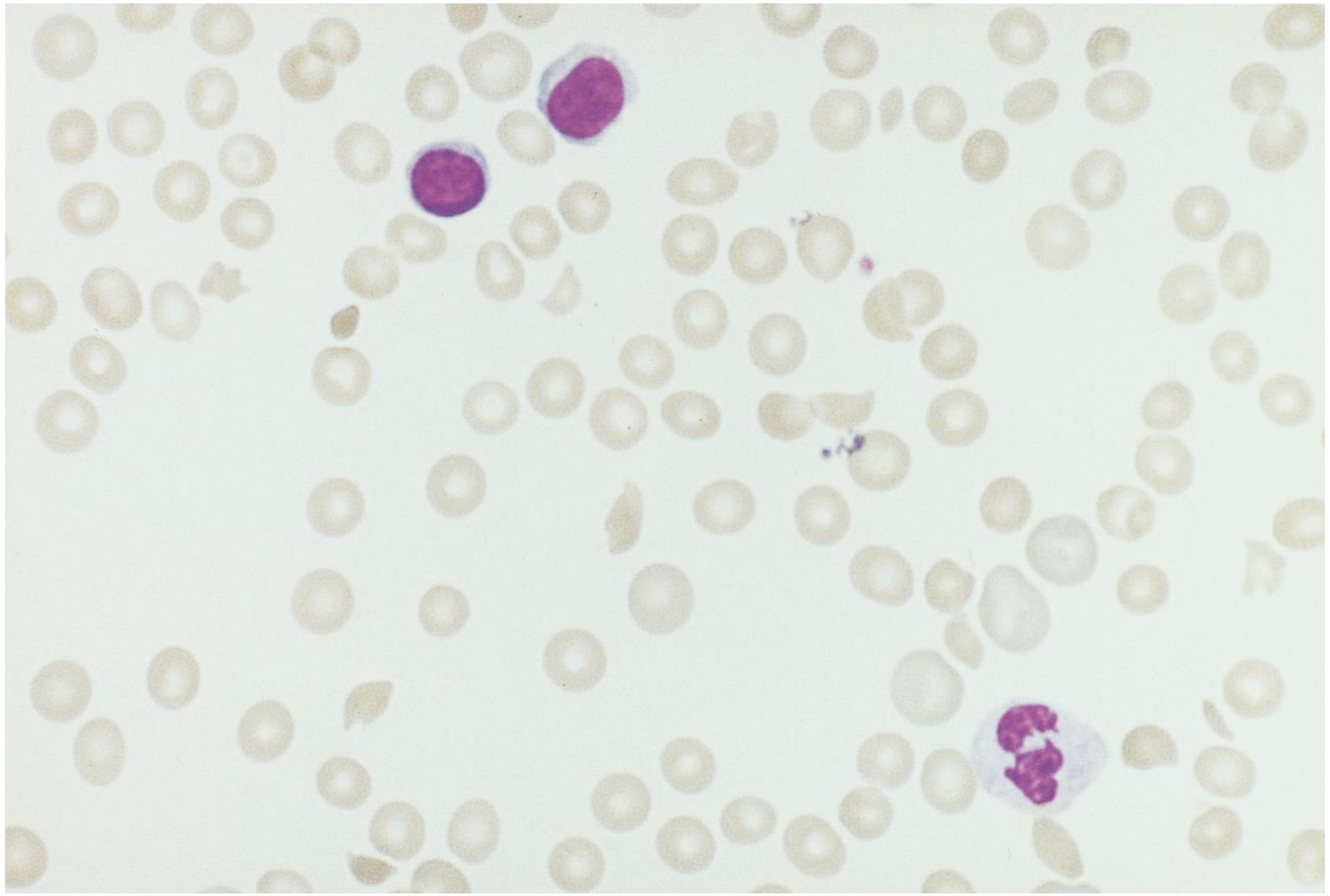
Hereditary spherocytosis, dominantly inherited hemolytic anemia. Due to genetic mutations in the membrane/cytoskeletal proteins, the erythrocytes are unable to maintain their normal biconcave shape. All the red blood cells are spherical in shape. May-Giemsa



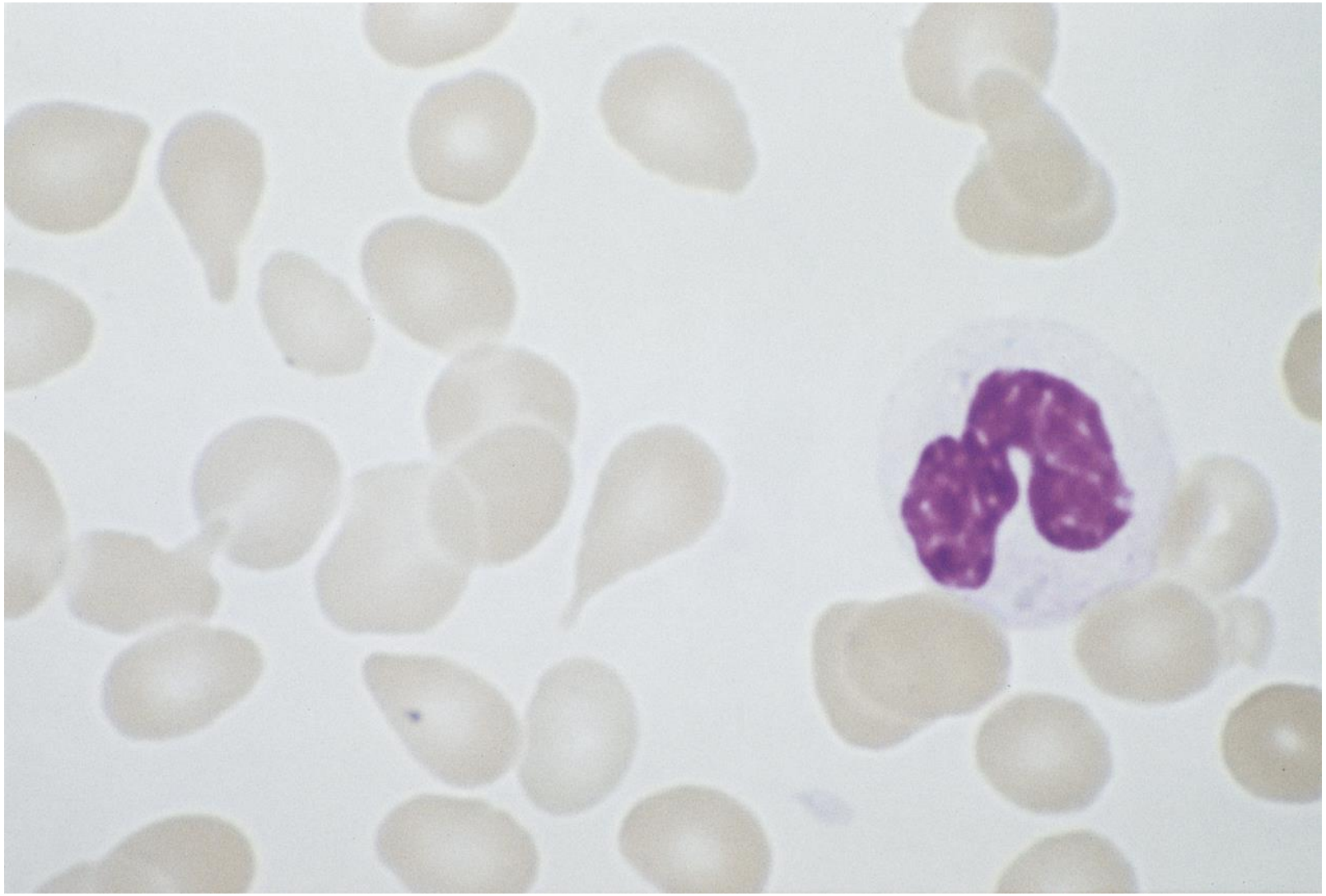
Hereditary elliptocytosis is a cominantly inherited red blood cell membrane disorder characterized by elliptical-shaped erythrocytes. Patients may be asymptomatic or show severe hemolysis. May-Giemsa



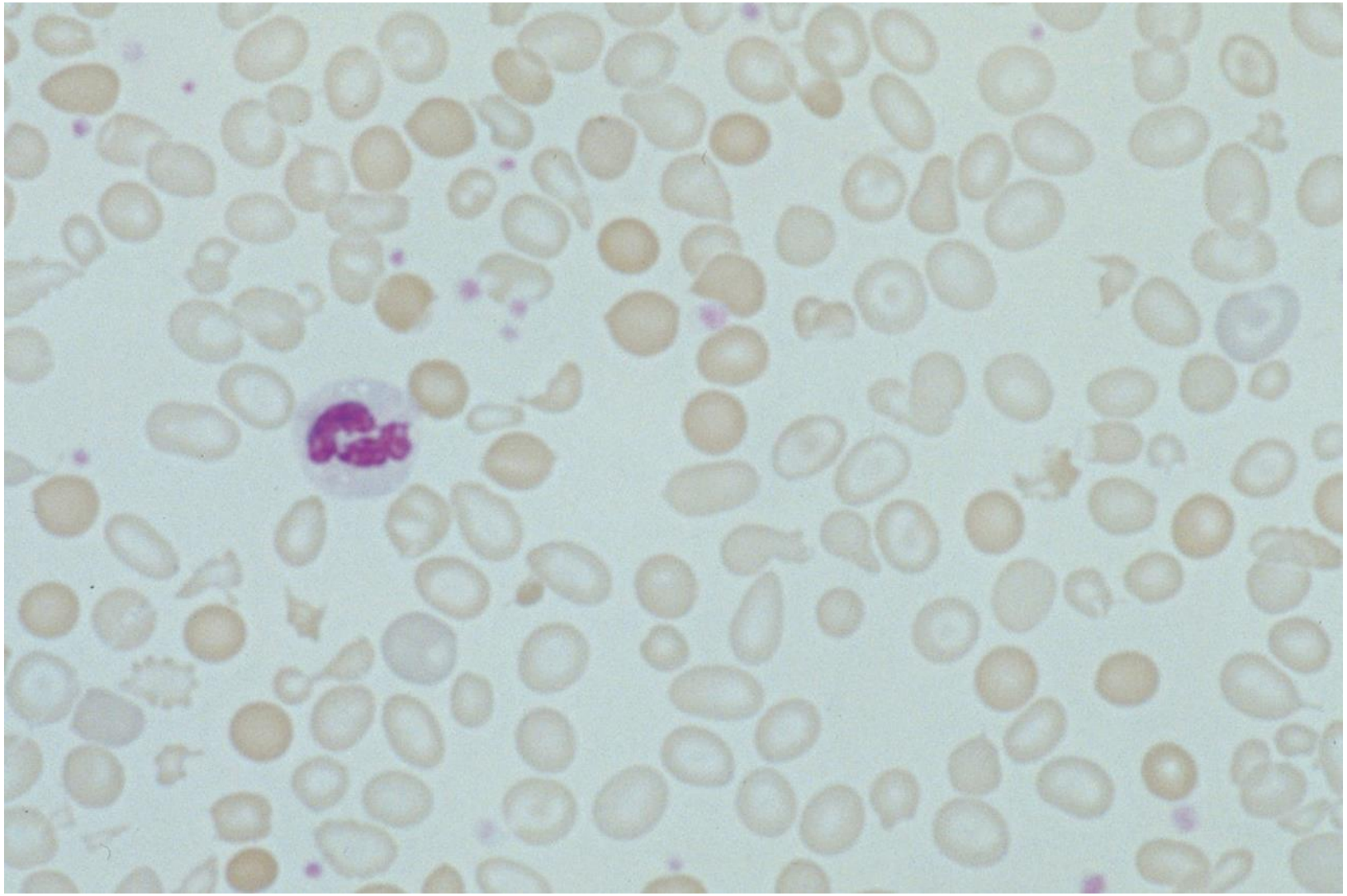
Spiculocytosis seen in a patient with alcoholic liver cirrhosis. Acanthocytes are irregularly spiculated red blood cells, while echinocytes are regularly spiculated cells. A variety of hereditary and acquired disorders may show spiculocytosis. May-Giemsa



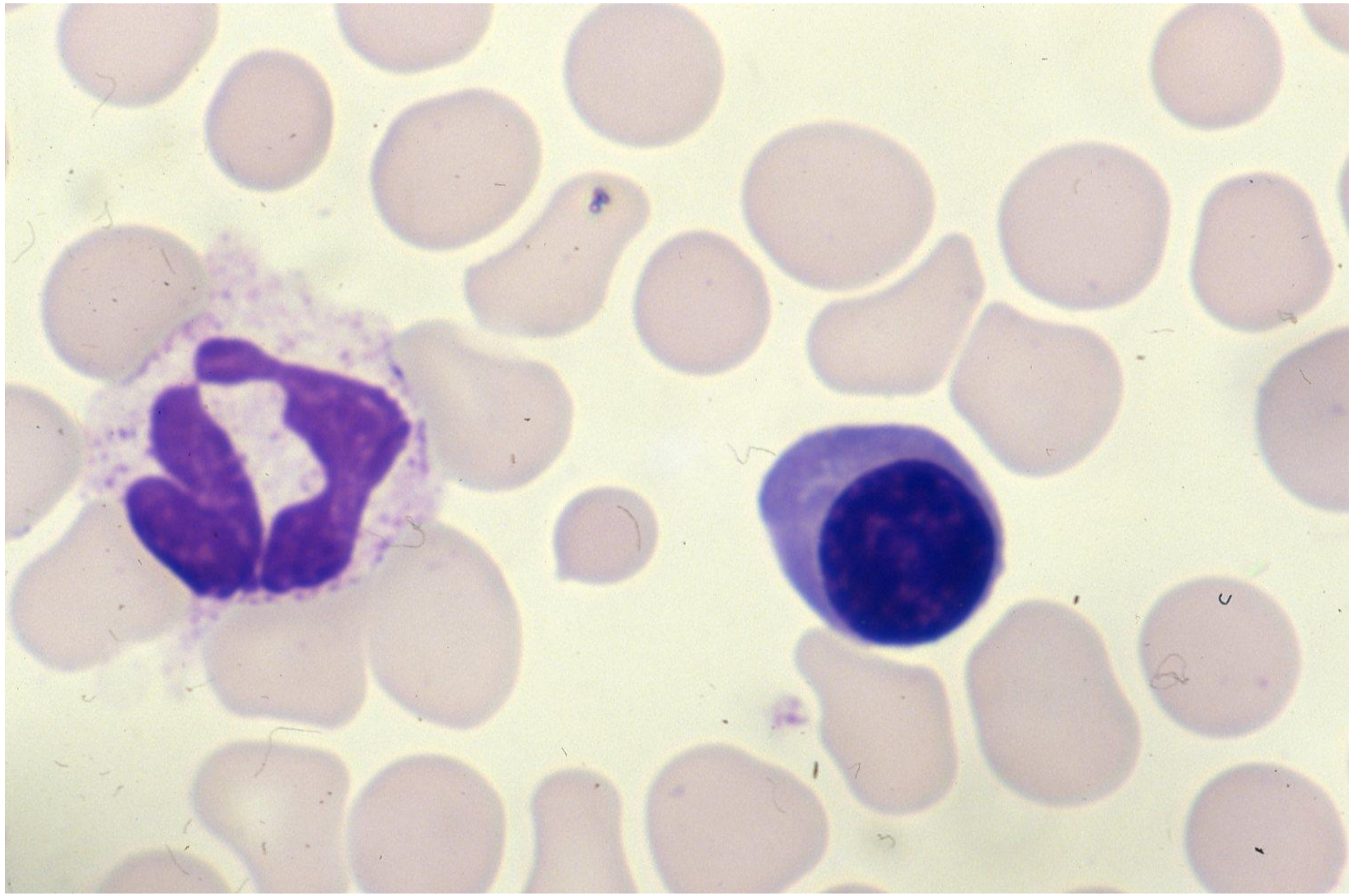
Fragmented red blood cells (schistocytes) seen in thrombotic thrombocytopenic purpura (TTP). They are also called as helmet cells, triangular cells or keratocytes. Schistocytosis is a characteristic feature of microangiopathic hemolytic anemia such as TTP. May-Giemsa



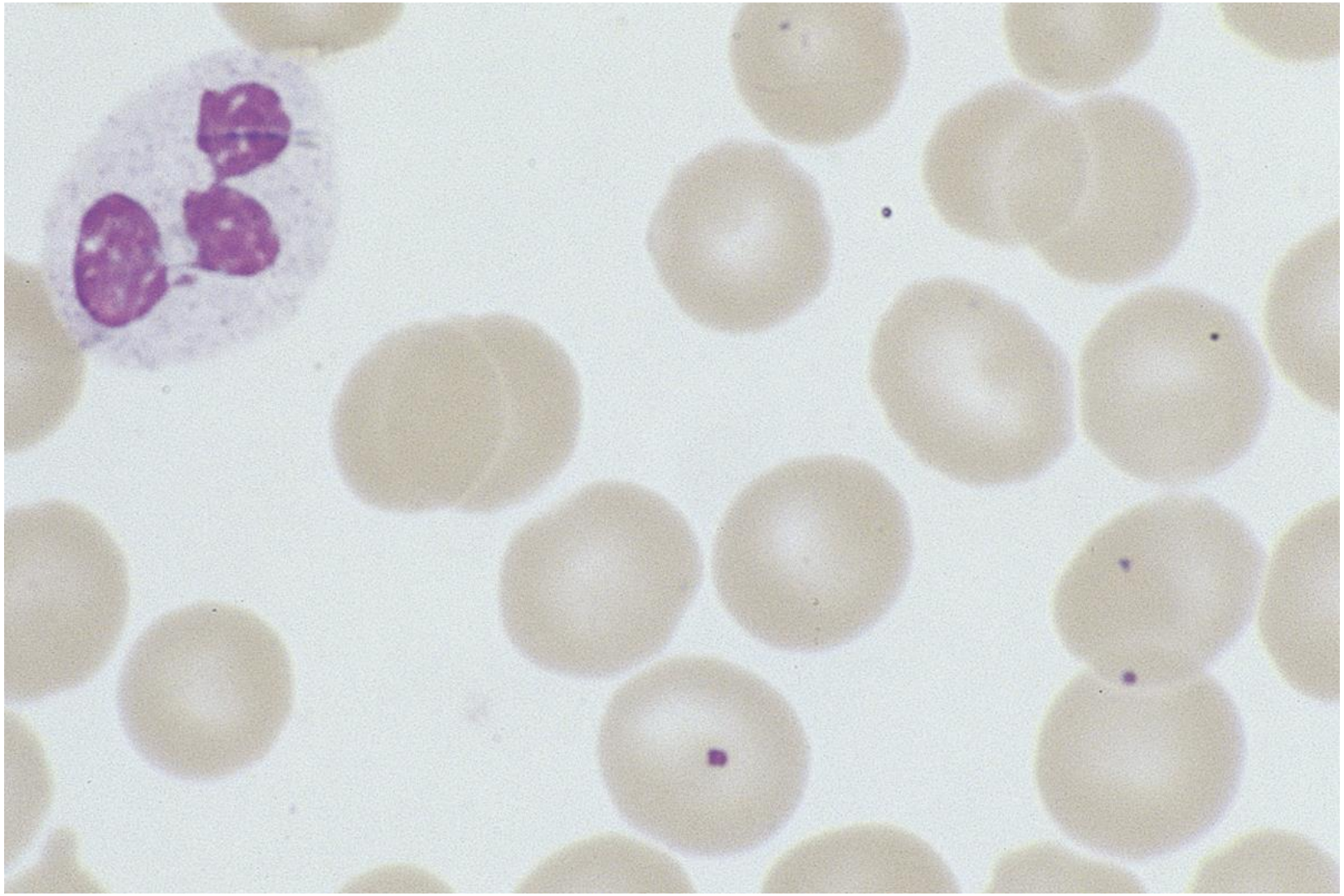
Dacrocytes are a type of poikilocytes shaped like a teardrop. The teardrop cells are found primarily in diseases with bone marrow fibrosis, such as primary myelofibrosis and myelophthisis caused by metastatic cancer. This 58-year-old male patient suffers from primary myelofibrosis. May-Giemsa



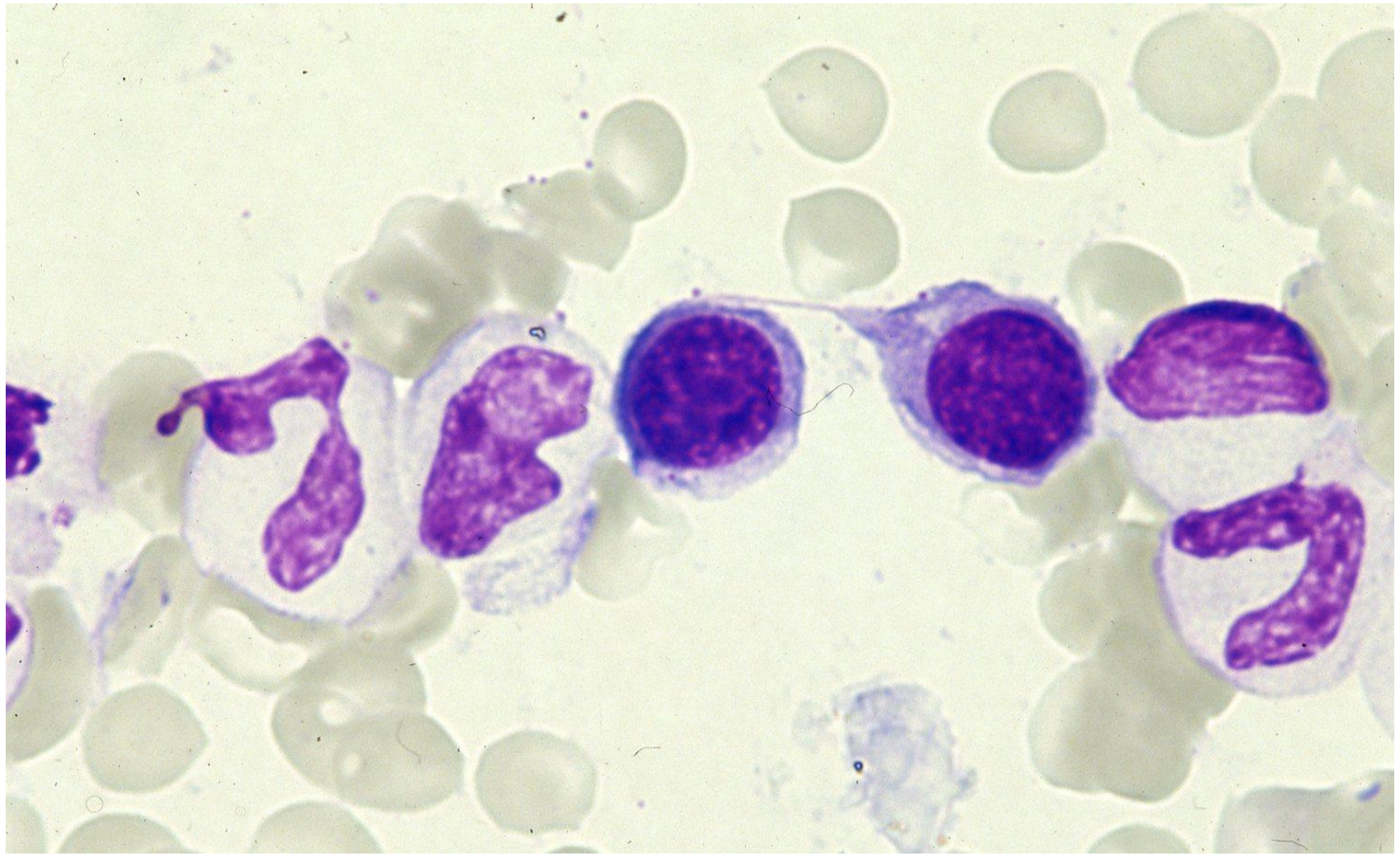
Alpha-thalassemia. A cambodian lady complained of cholelithiasis-related intermittent abdominal pain (RBC 3,000,000/μL, Hb 7.6/dL, Ht 22%). In the background of planocytes with widened central pallor, target cells, schistocytes, acanthocytes, dacrocytes (teardrop cells) and spherocytes are observed. May-Giemsa



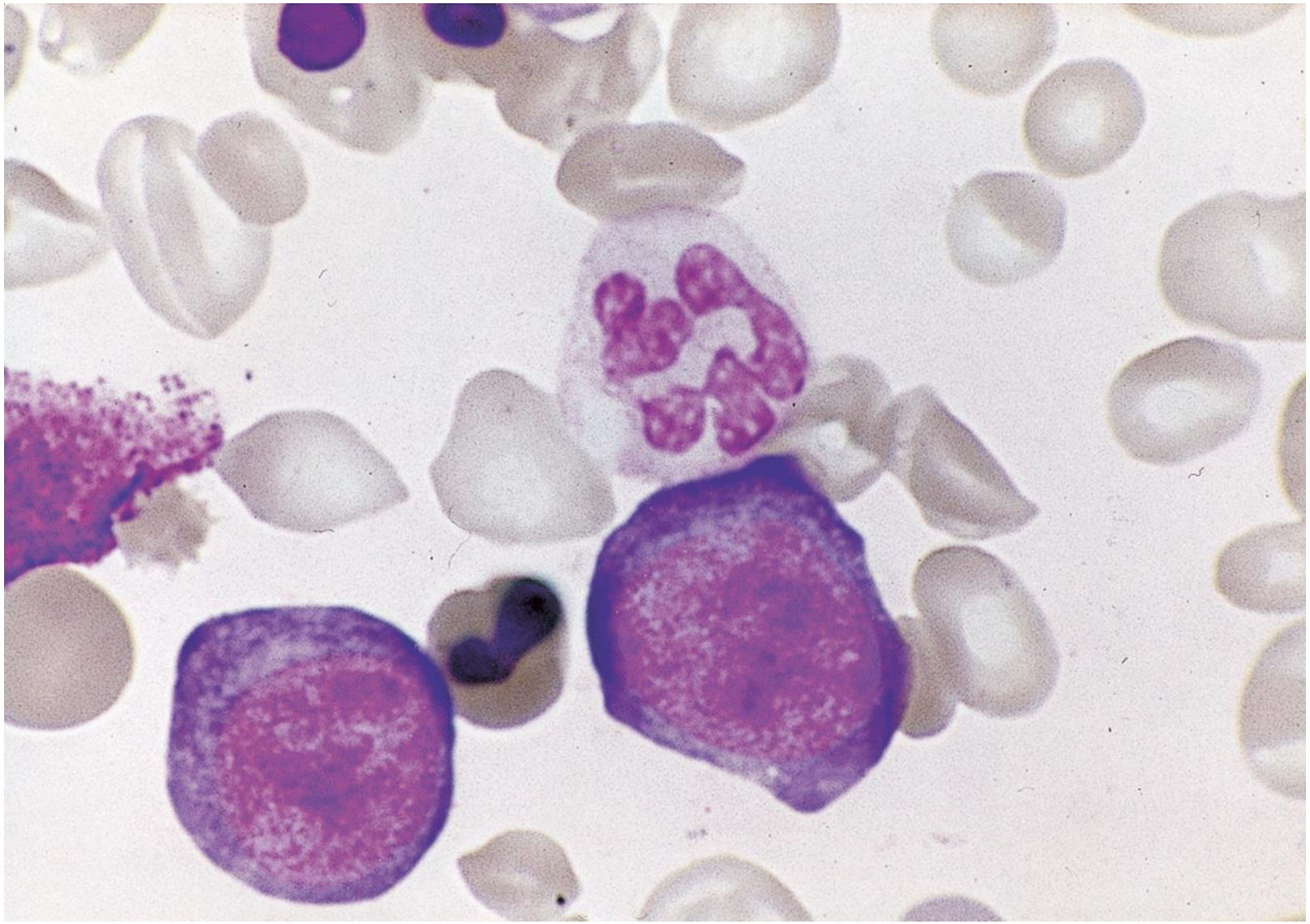
Leukoerythroblastic anemia in a case of marrow carcinomatosis or myelophthisis (the bone marrow is occupied by non-hematopoietic cells). It can be called as leukemoid reaction. An erythroblast is seen in the peripheral blood. Compare the size with neutrophil in the left. May-Giemsa



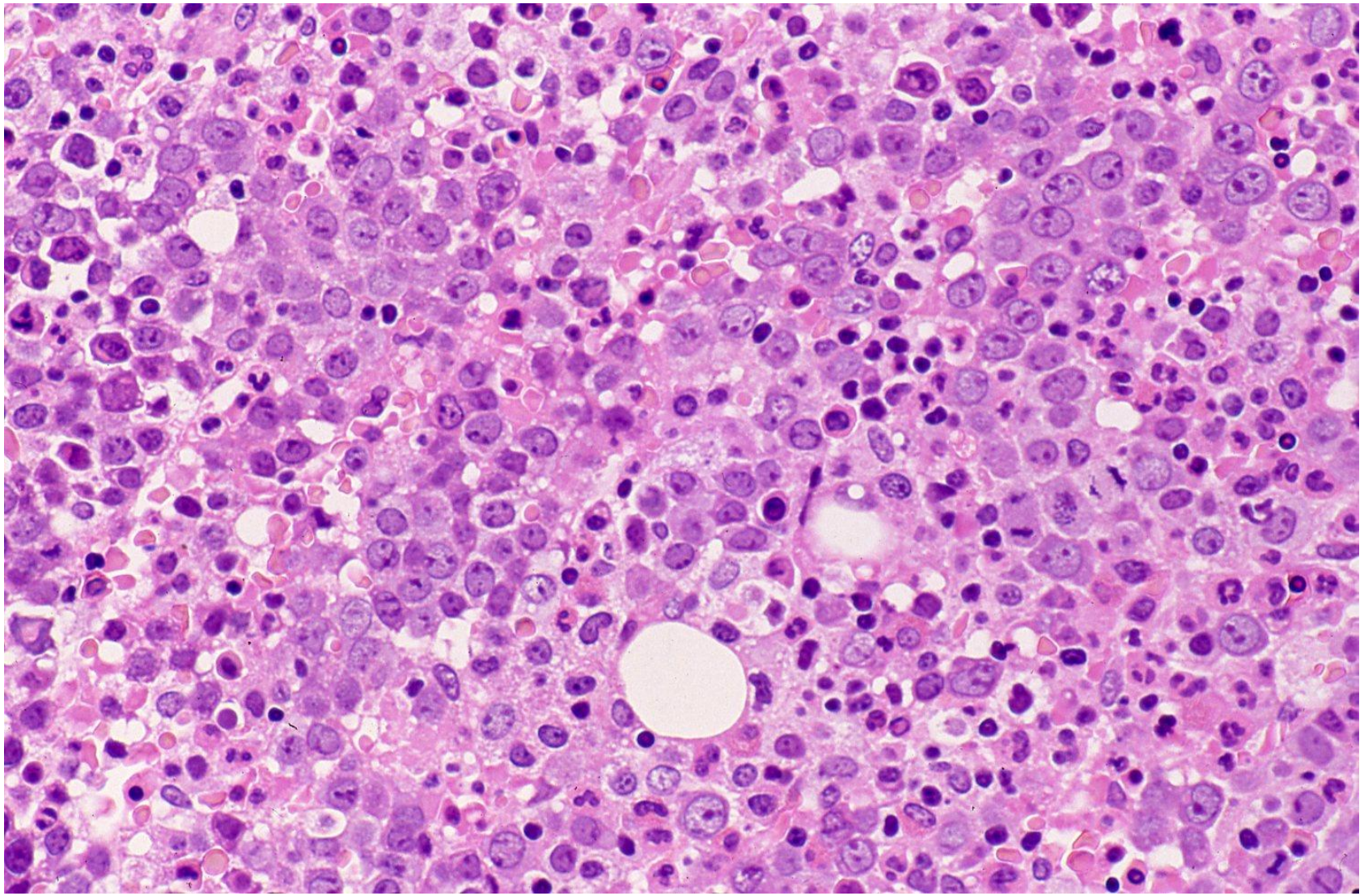
Howell–Jolly bodies seen in a 47-year-old female patient with a history of splenectomy for traumatic accident 4 years ago. Howell-Jolly bodies are a cytopathological finding of basophilic nuclear remnants (clusters of DNA) in circulating erythrocytes, closely related to the lack of splenic function. May-Giemsa



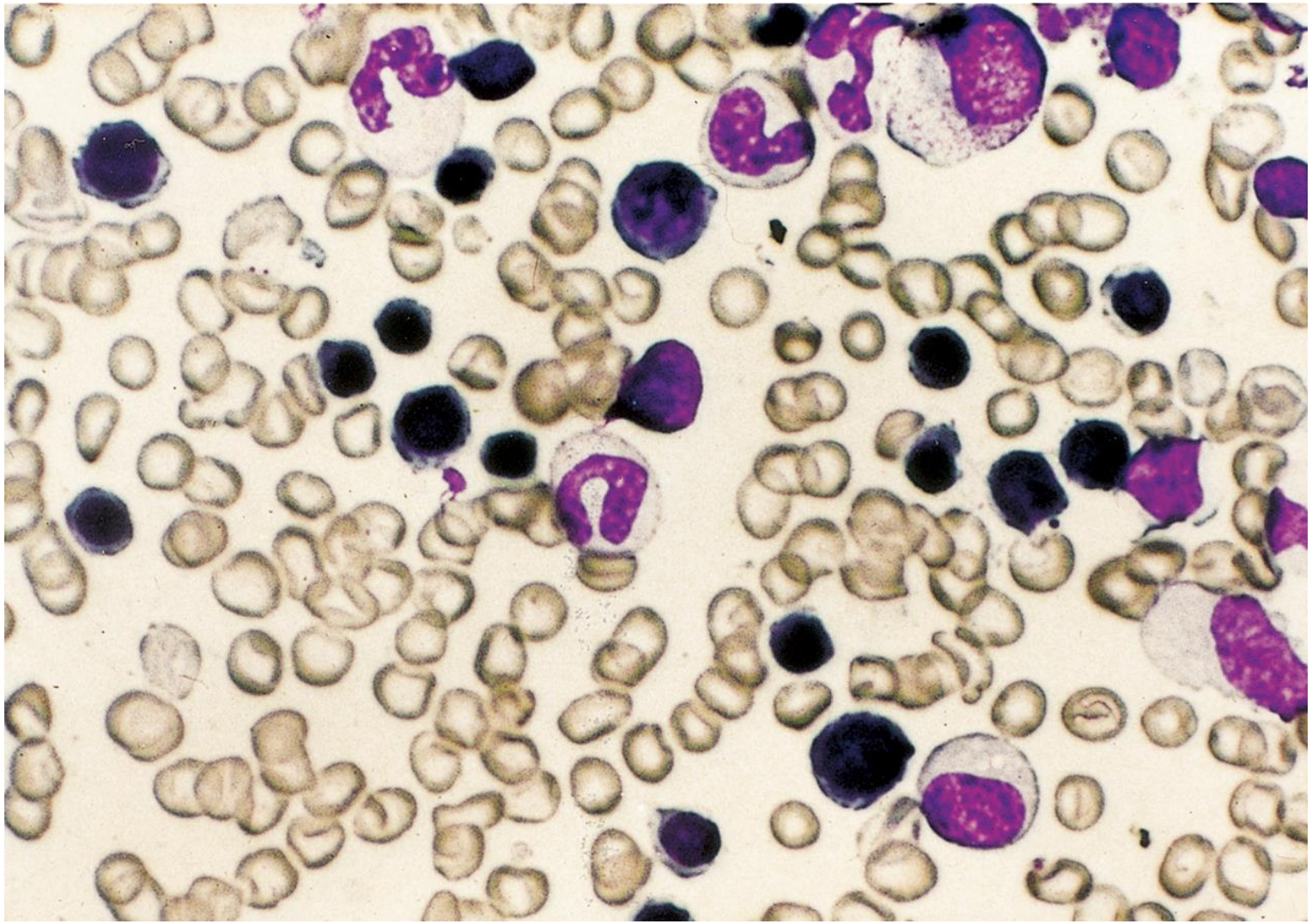
Erythroblasts in normal bone marrow. Two basophilic erythroblasts are seen adjacent to maturing and mature neutrophils. Note the coarse chromatin pattern in nucleated cells of the erythroid series. May-Giemsa



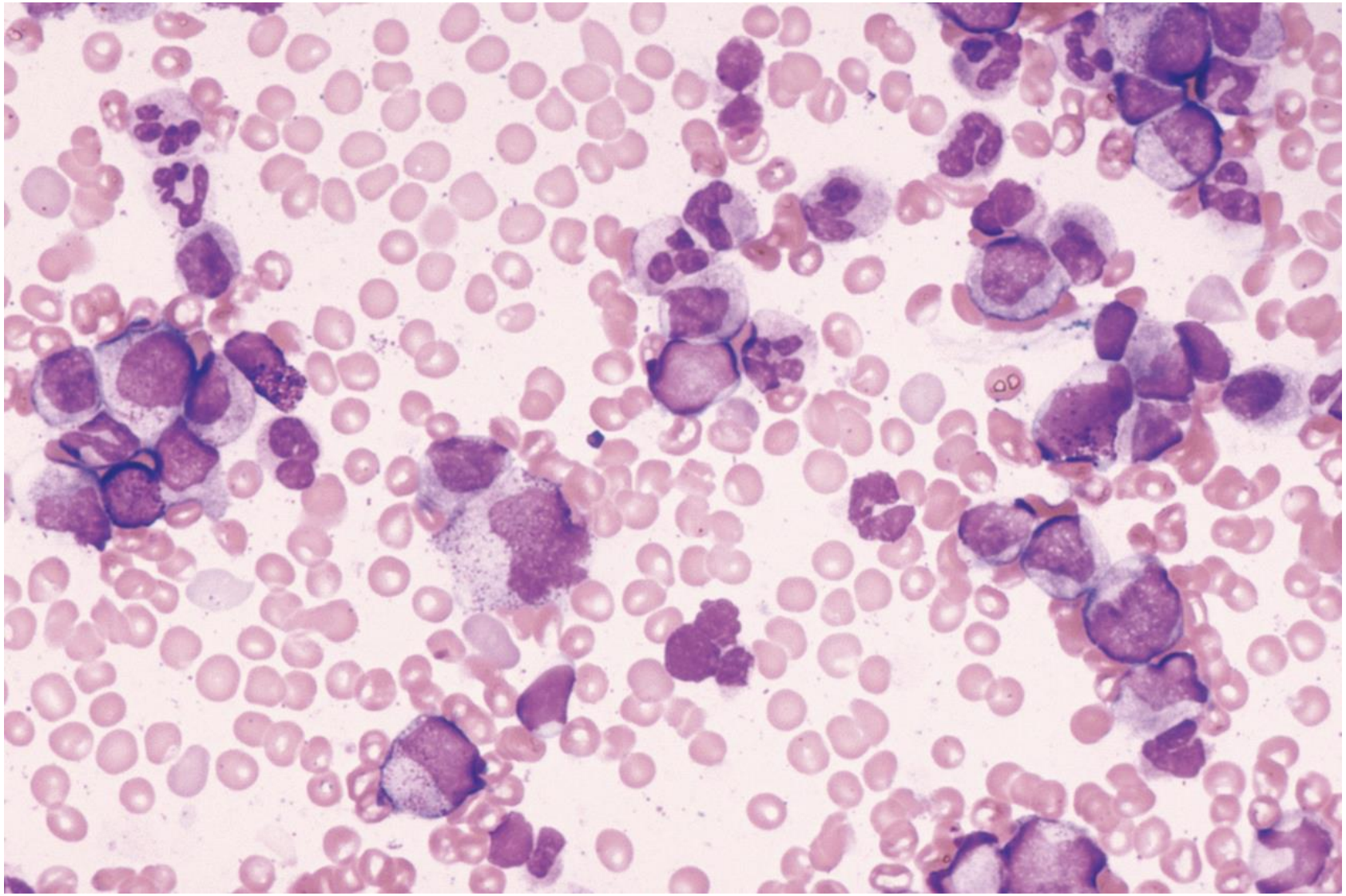
Megaloblastic anemia. Bone marrow aspiration discloses megaloblasts and a hypersegmented neutrophil. This 74-year-old female patient received total gastrectomy 10 years ago. Severe anemia is associated: RBC 930,000/μL, Hb 3.8 g/dL, Ht 12.0%, WBC 1,800/μL, platelets 53,000/μL. May-Giemsa



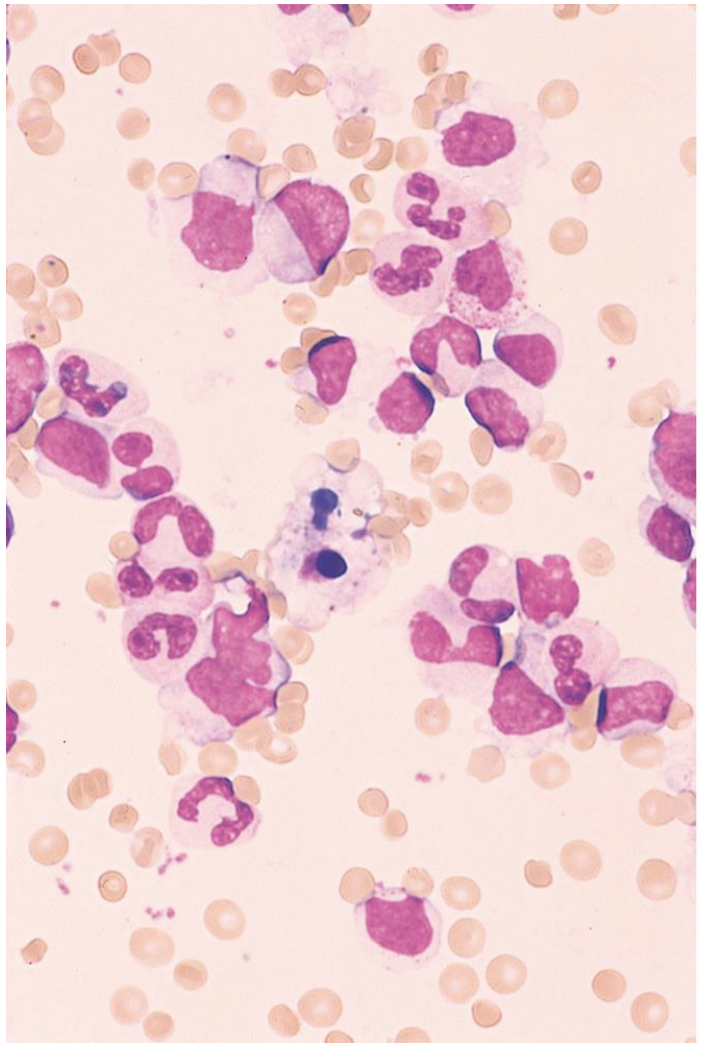
Megaloblastic anemia. The aspirated bone marrow shows marked hypercellularity. Active growth of large-sized megaloblasts with prominent nucleoli and active mitosis somewhat resembles leukemic or lymphomatous infiltration. H&E

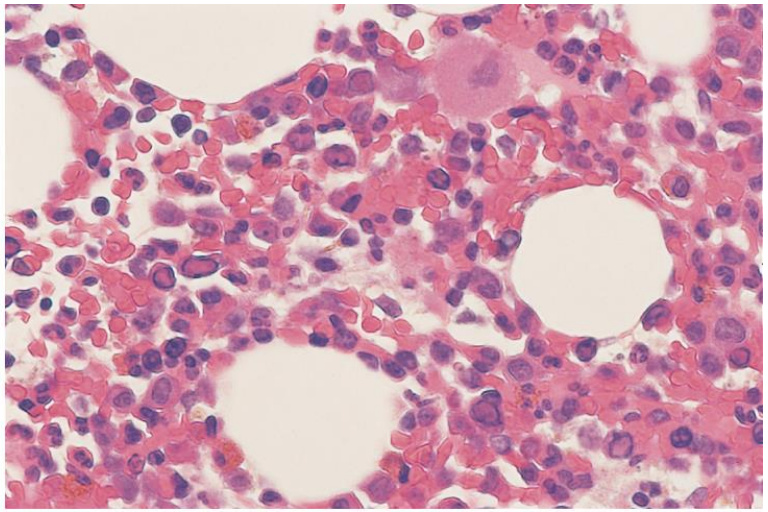


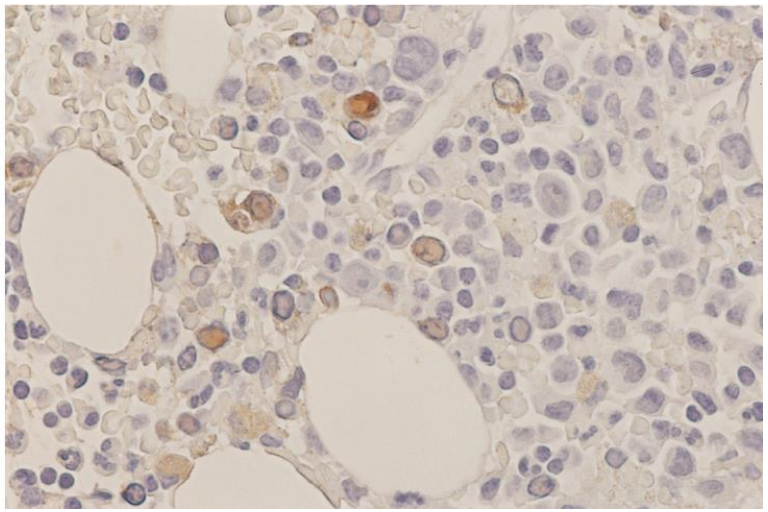
Erythroblastic hyperplasia in the bone marrow in a female patient with iron deficiency anemia. The red blood cells show widened central pallor (planocytes/leptocytes). Hyperplastic small-sized erythroblasts possess scanty basophilic cytoplasm suggesting poor heme synthesis. May-Giemsa



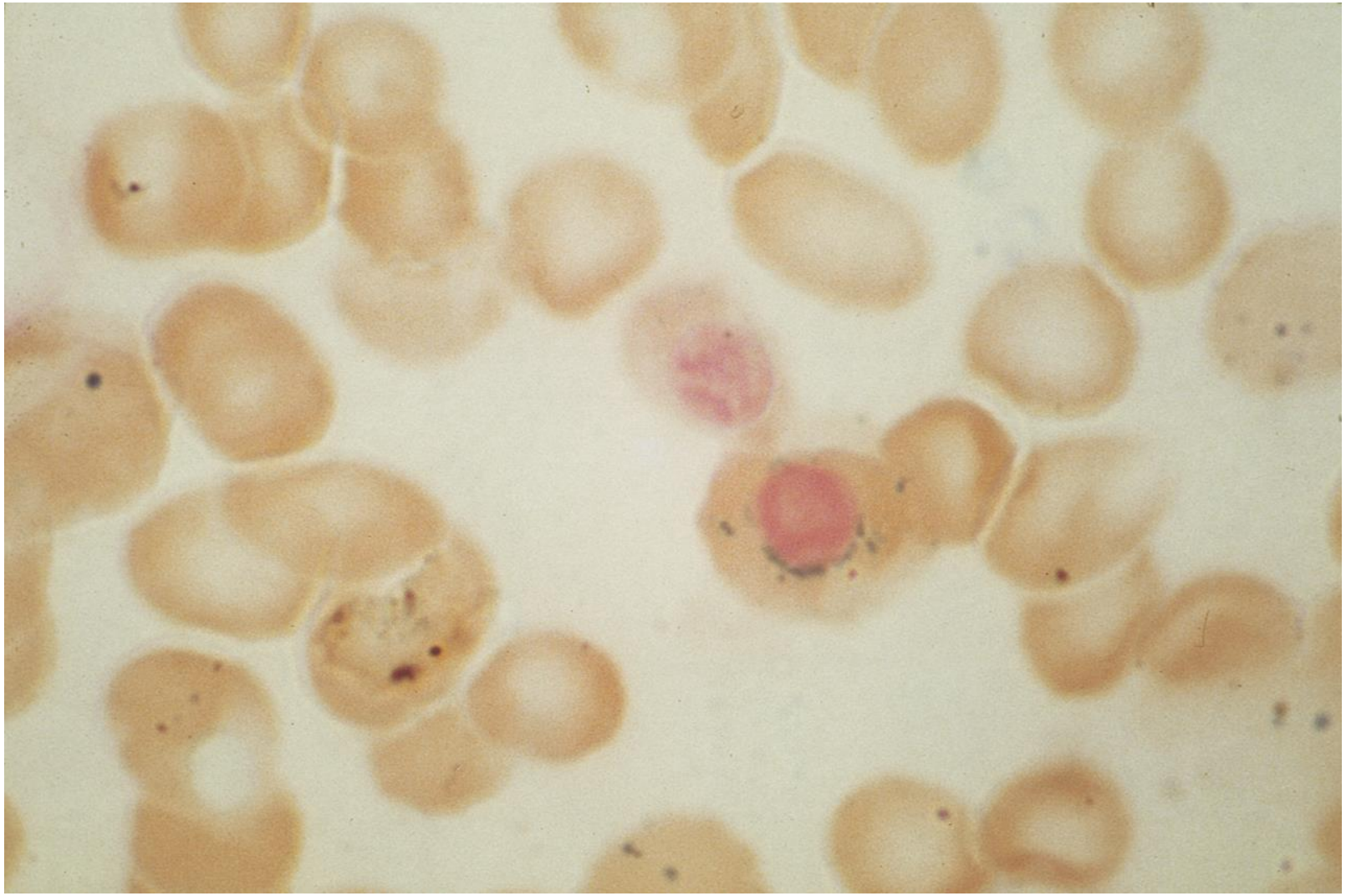
Pure red cell aplasia. Bone marrow aspiration shows myeloid cells with varying differentiation steps, but no erythroblasts are observed. The etiology of this chronic form of pure red cell aplasia in a 52-year-old female patient is unknown. No thymoma is associated. May-Giemsa



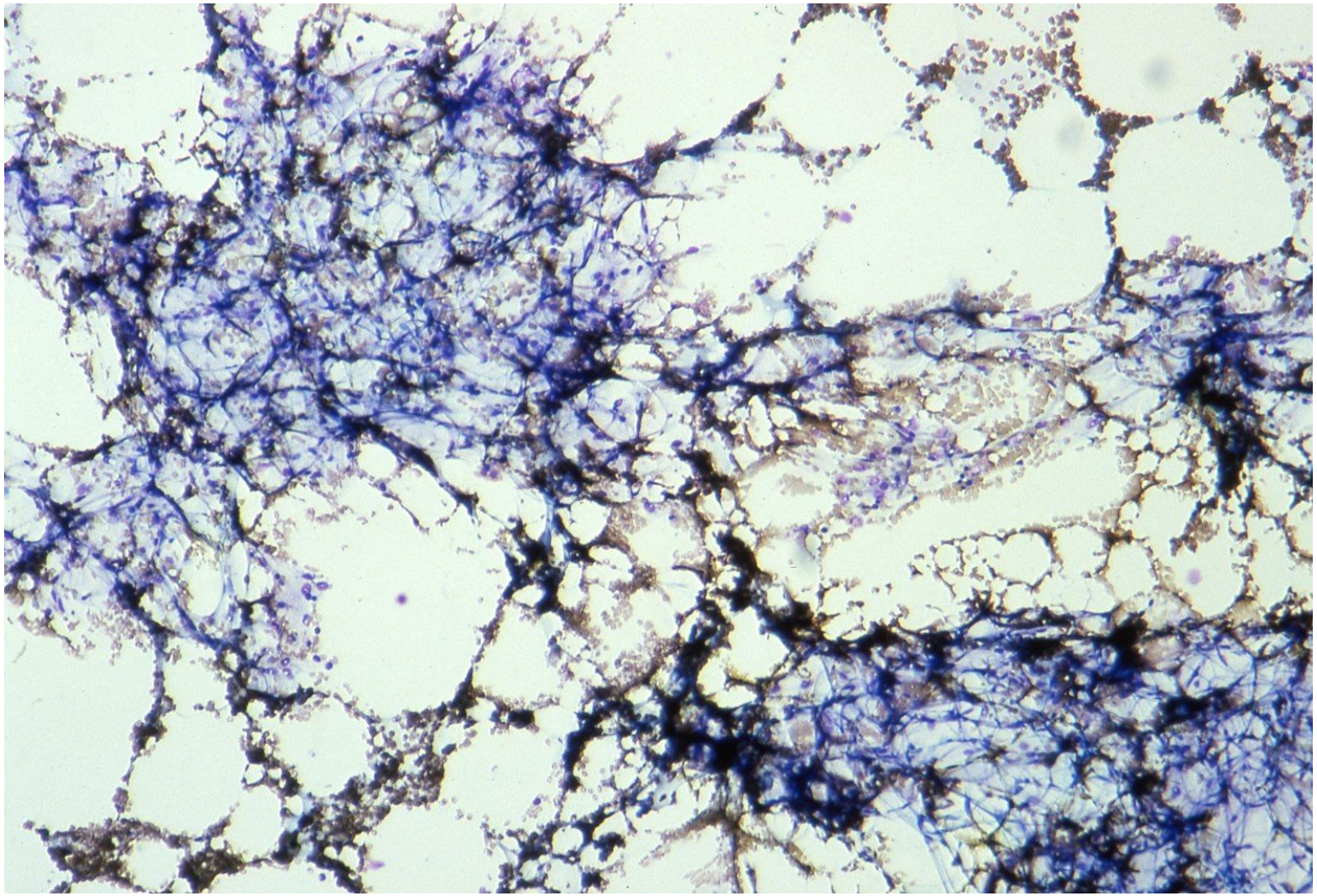




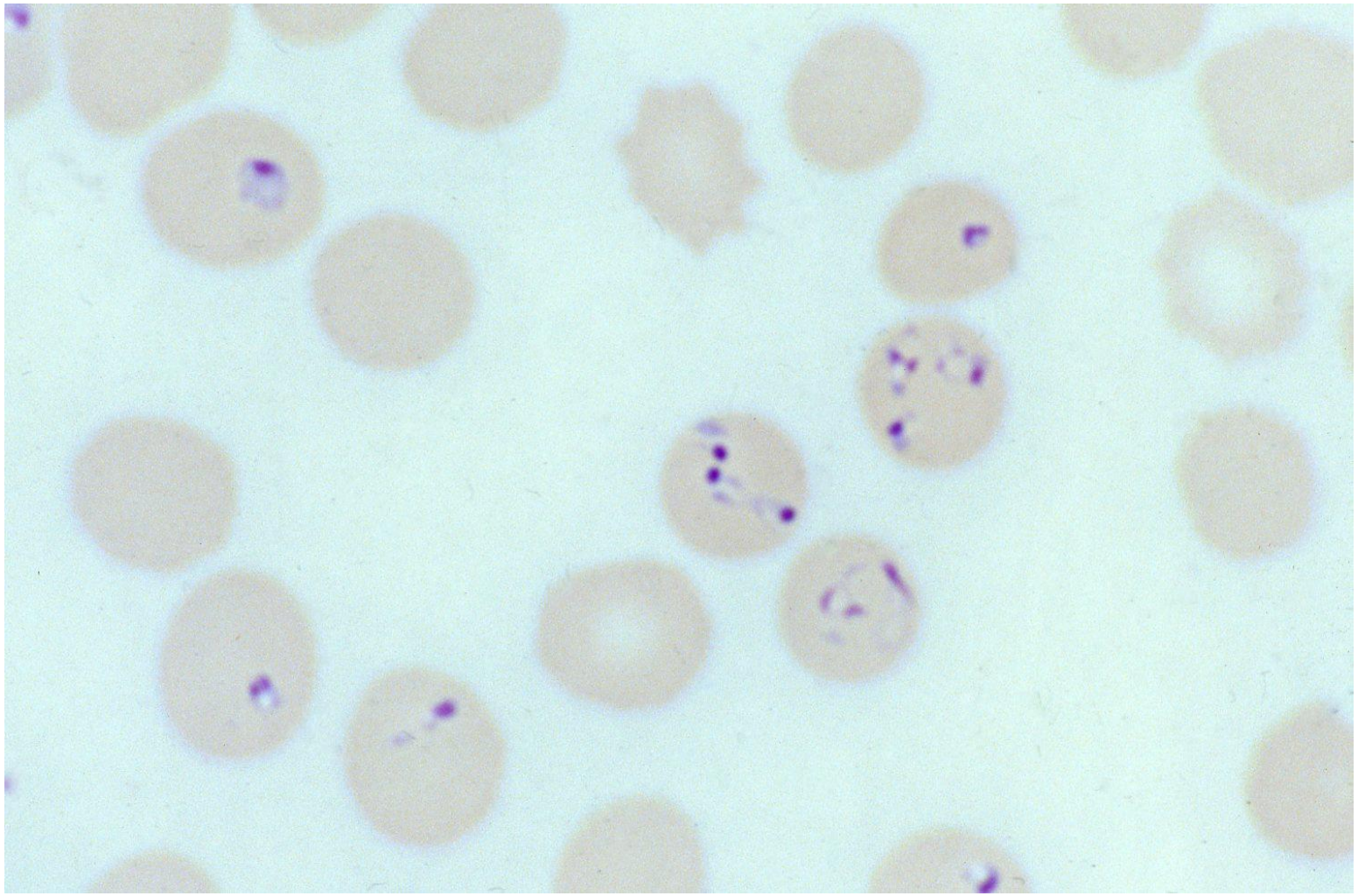
Aplastic crisis in hereditary spherocytosis caused by Parvovirus B19 infection. A 44-year-old female patient with hereditary spherocytosis suffered from erythema infectiosum, and aplastic crisis followed (Ht 12%, WBC 1,900/μL, platelets 160,000/μL). May-Giemsa-stained bone marrow smear (left) shows red cell aplasia and erythrophagocytosis by macrophages. Bone marrow biopsy reveals eosinophilic nuclear inclusion bodies in erythroblasts (right top), where Parvovirus B19 immunoreactivity is demonstrated (right bottom).



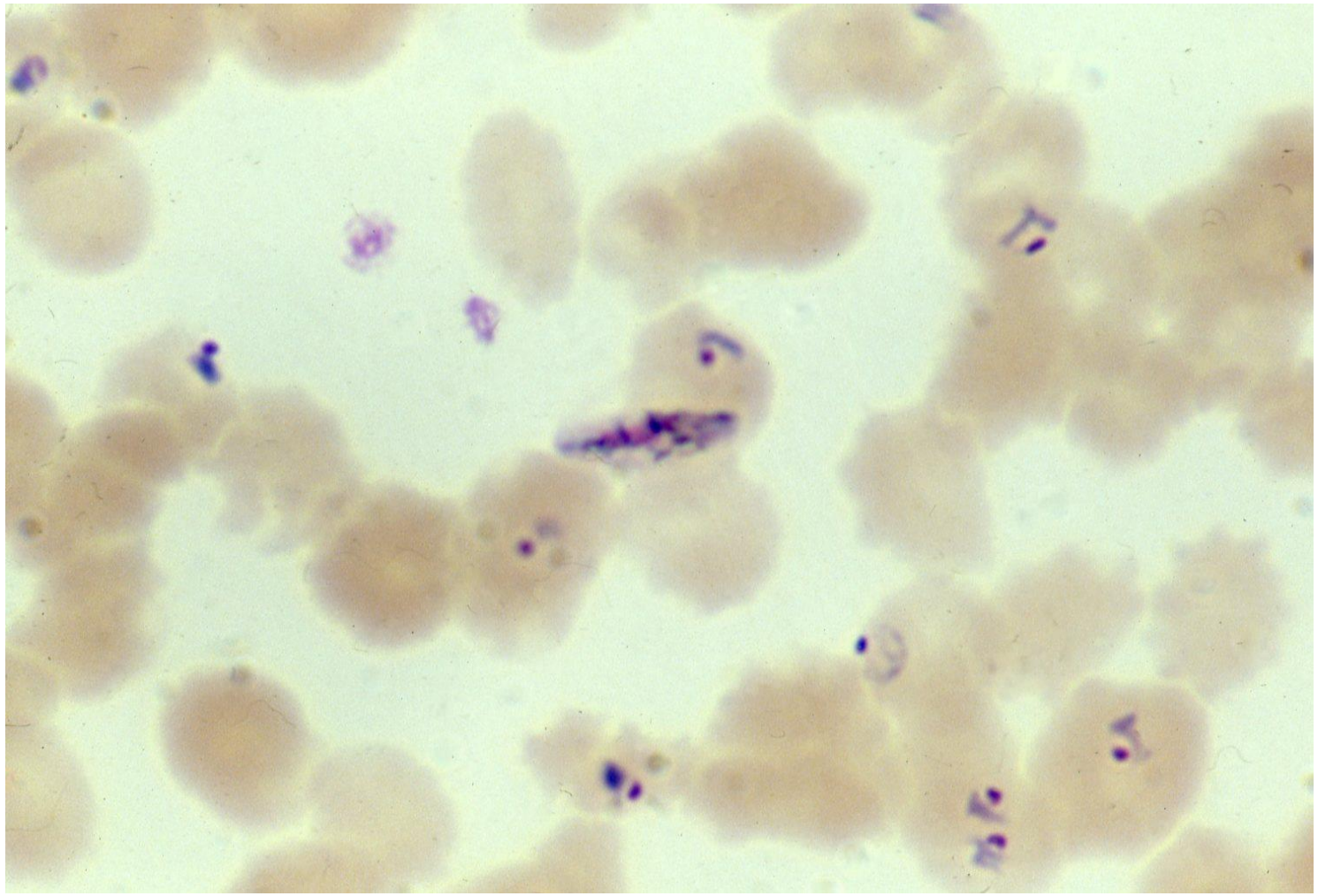
Primary sideroblastic anemia, a subtype of myelodysplastic syndrome (MDS). A 67-year-old male patient accompanies pancytopenia (RBC 2,100,000/μL, WBC 1,200/μL, platelets 52,000/μL). Berlin blue staining demonstrates ringed sideroblasts (hemosiderin granules seen around the nucleus). Siderocyte with Pappenheimer bodies (hemosiderin granules-containing erythrocytes) are also seen. Berlin blue



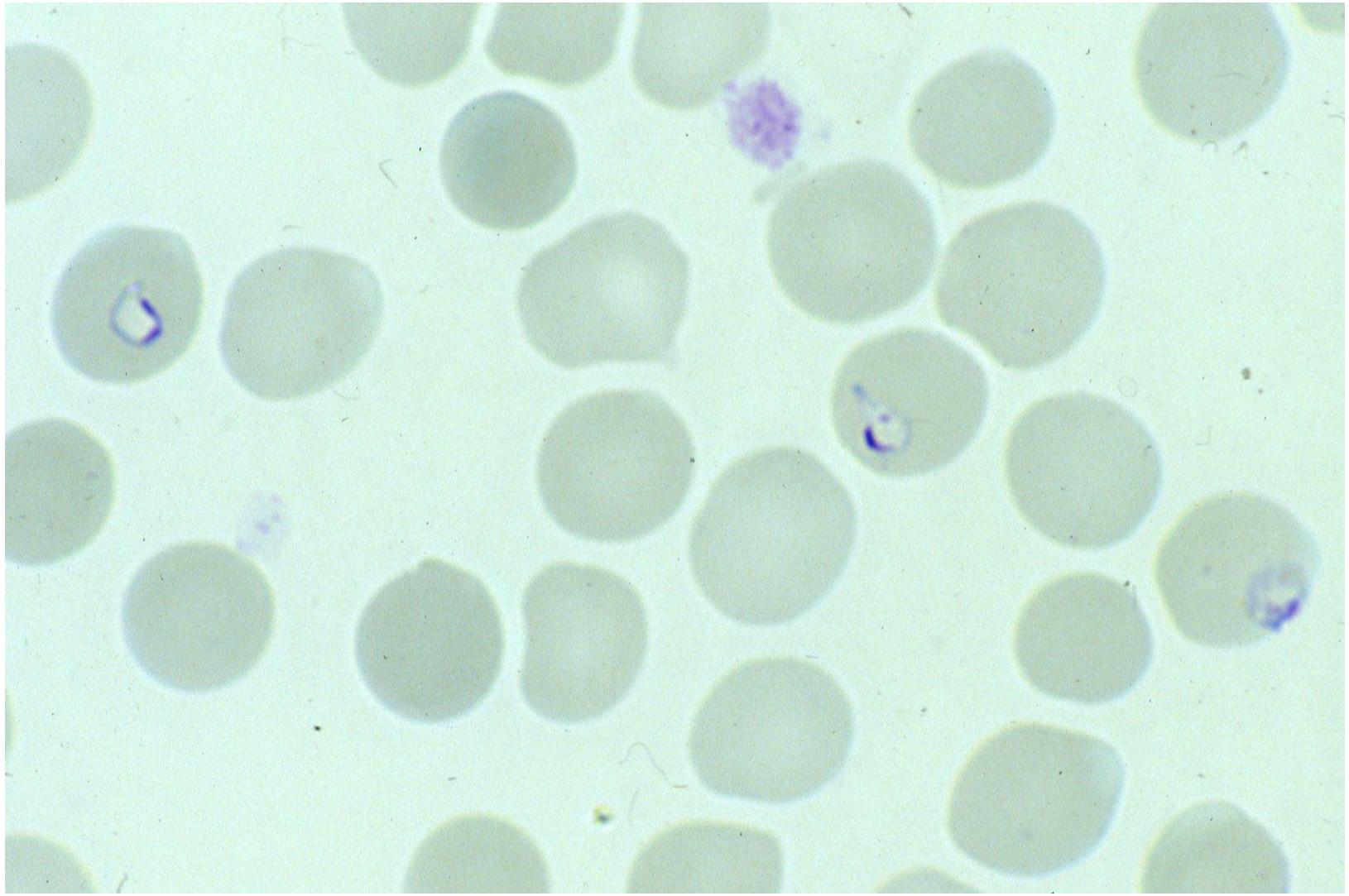
Aplastic anemia. A 35-year-old female patient shows pancytopenia (RBC 2,050,000/μL, WBC 2,400/μL, platelets 22,000/μL). Bone marrow aspiration reveals clusters of mature fat cells. Hematopoietic cells are scarcely seen. May-Giemsa



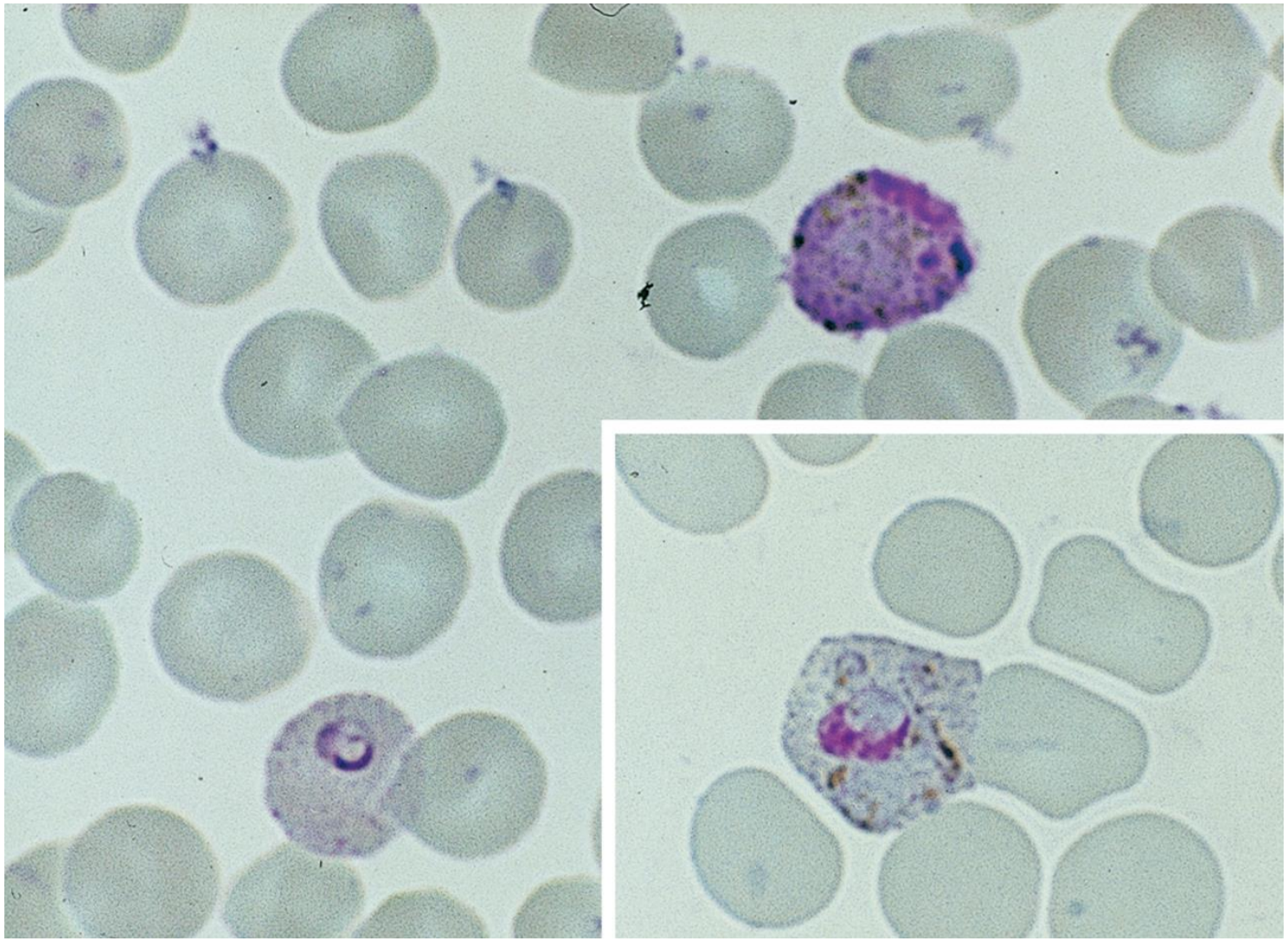
Falciparum malaria. Ring forms of *Plasmodium falciparum* are heavily infected in many erythrocytes. Two to three ring forms are simultaneously infected in single red blood cells. The patient (a 56-year-old Japanese man) died of cerebral malaria. May-Giemsa



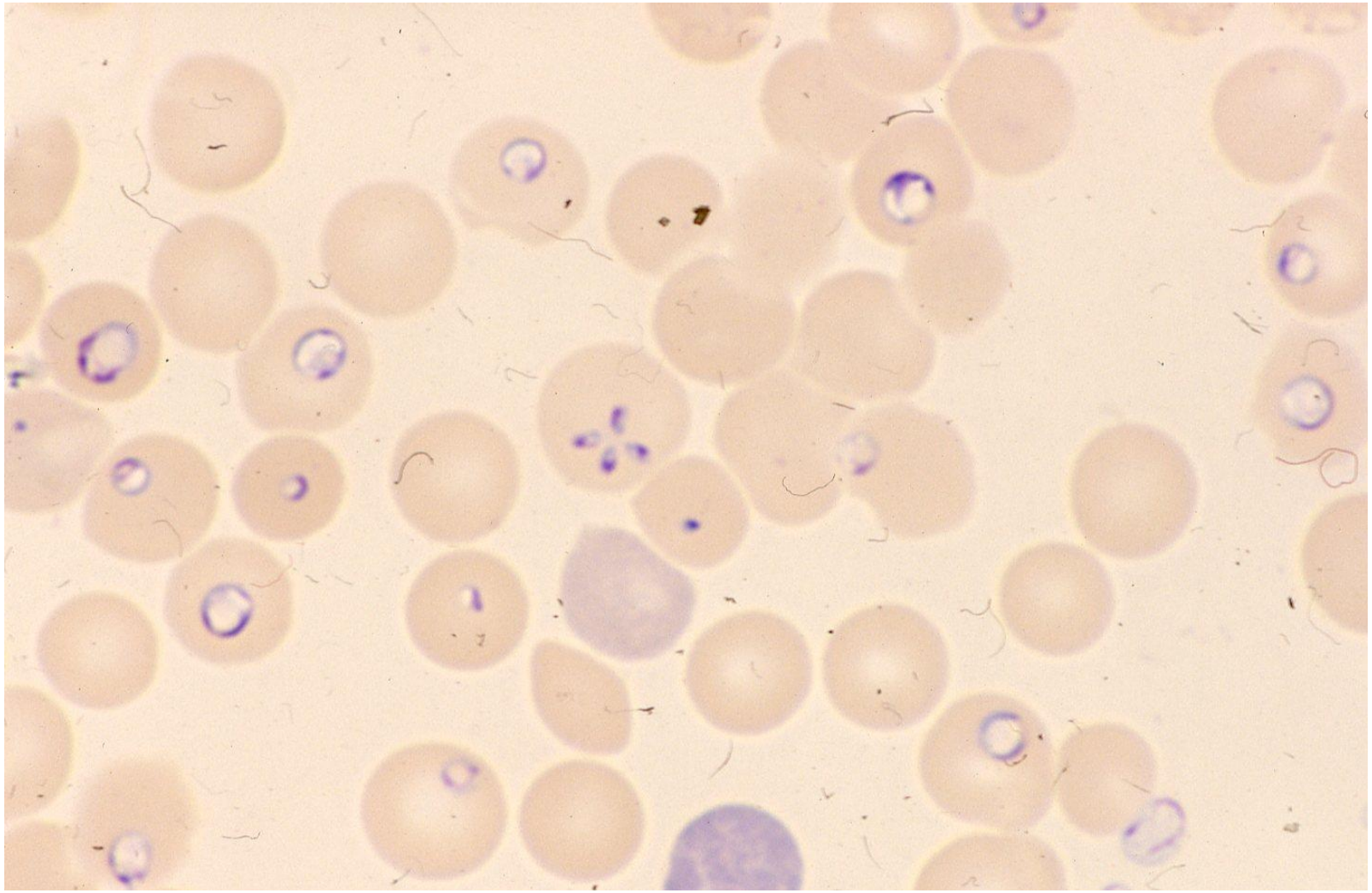
Falciparum malaria. Ring forms of *Plasmodium falciparum* are heavily infected in many erythrocytes. A rod-shaped gametocyte is focally seen. The patient (a 56-year-old Japanese man) died of cerebral malaria. May-Giemsa



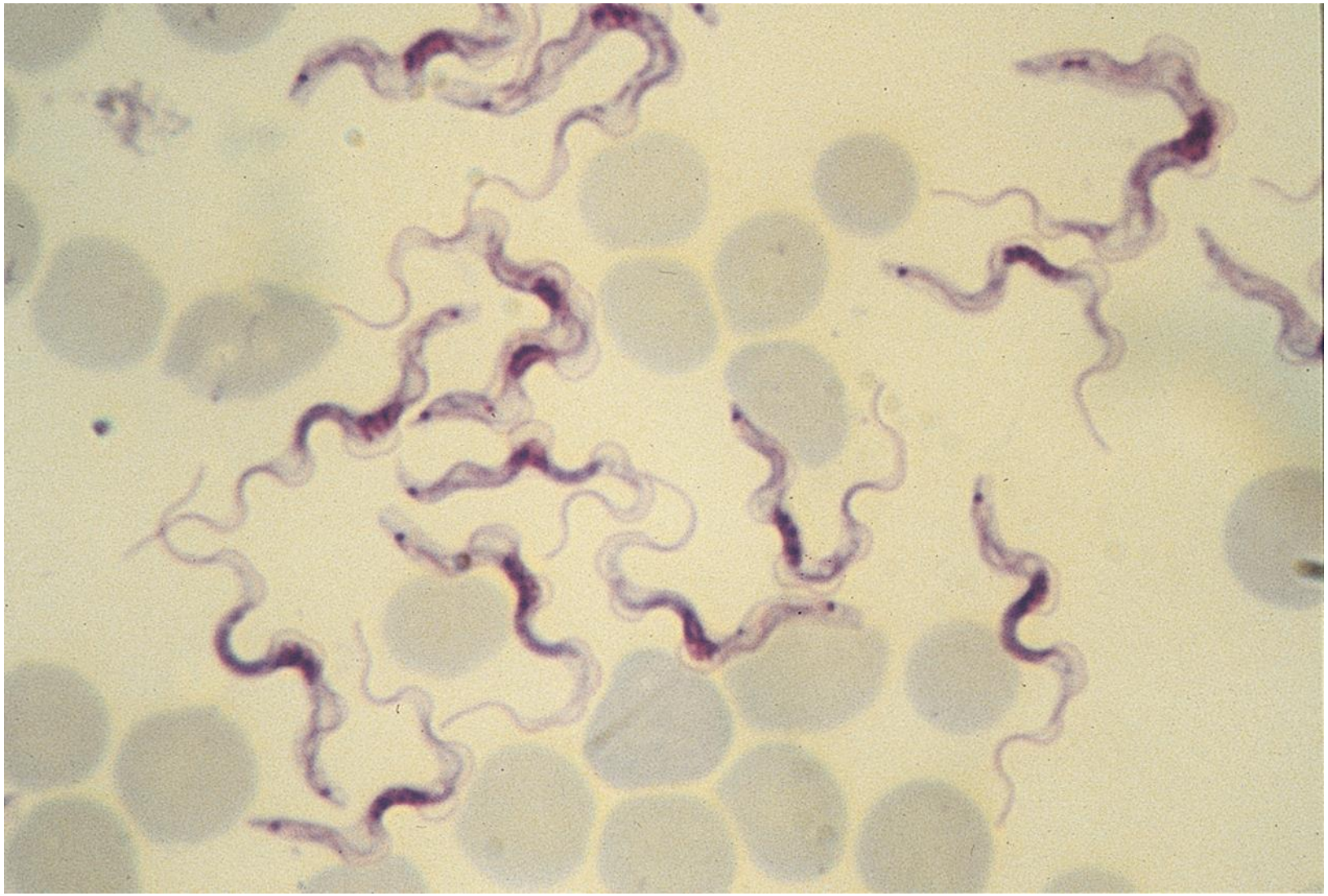
Kenyan female Ekiden runner, a carrier of *Plasmodium falciparum*. She had ring form parasites in the red blood cells, and she completed running in the Ekiden race (long distance road relay).



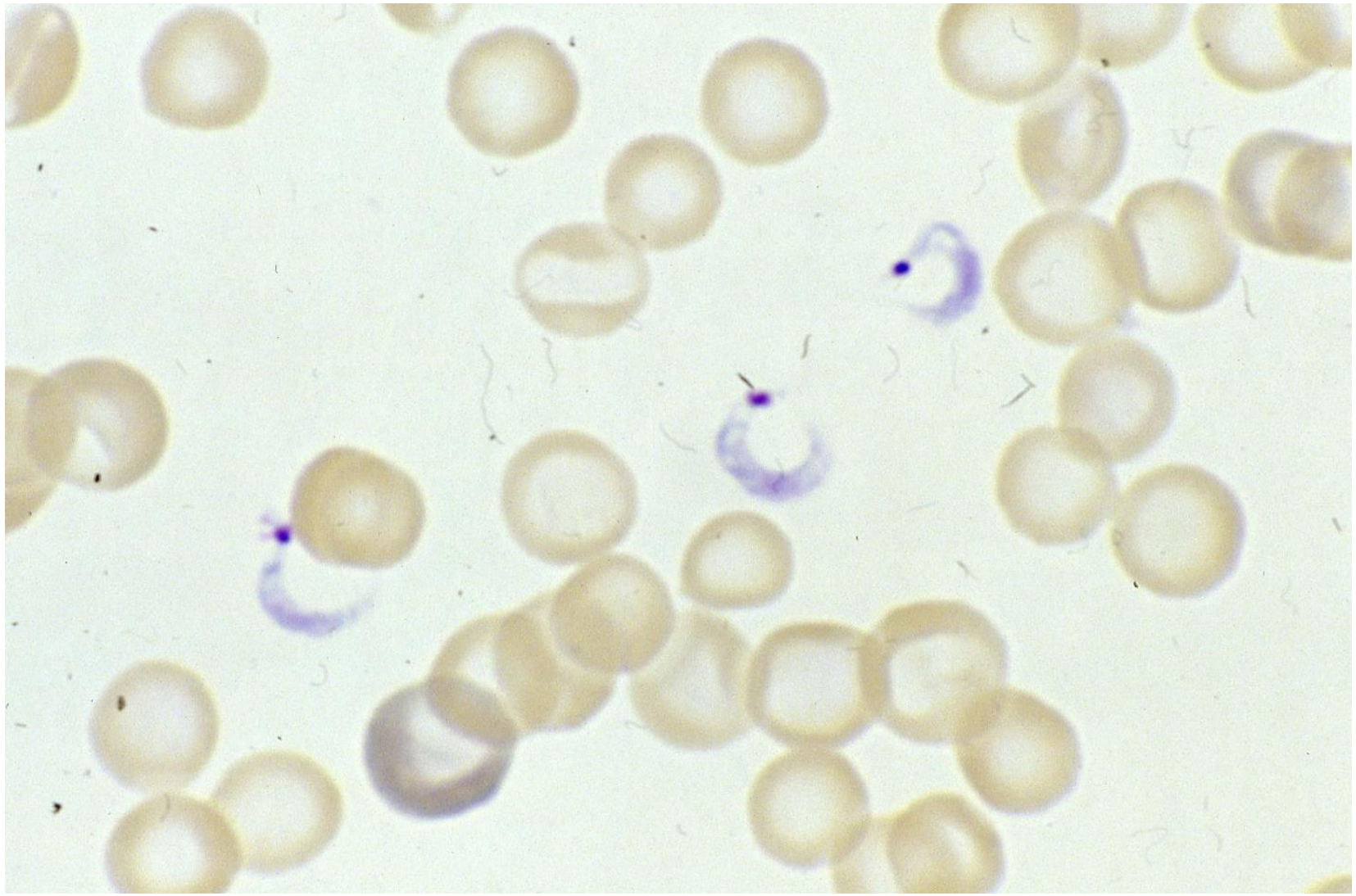
Tertian malaria. A 45-year-old Japanese man stayed in a rural area in Thailand for 2 years. He had high fever every 48 hours. A few ring forms in enlarged erythrocytes with Schüffner's spots and a gametocyte of *Plasmodium vivax* are observed. Inset indicates an ameboid form with fine malaria pigments. May-Giemsa



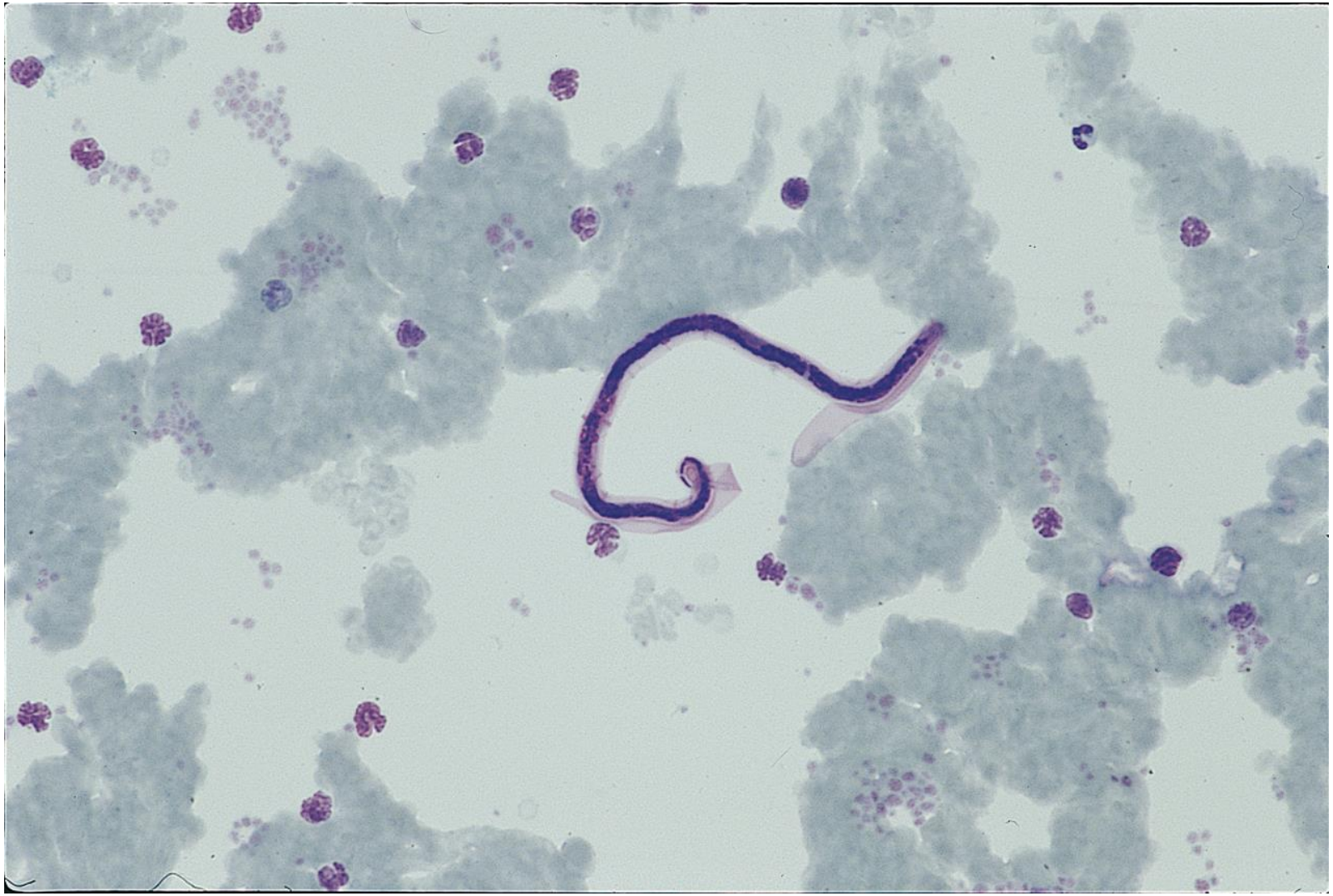
Babesiosis. *Babesia microti* with large ring forms infects rat red blood cells. Merozoites are focally clustered to form a tetrad resembling a maltese cross (in the center). Babesiosis mediated by tick bites is infrequently seen in human being. May-Giemsa



Trypanosoma brucei gambiense in mouse peripheral blood smear. Numbers of trypomastigates are seen. Note long flagella with undulating membrane and small dot-like kinetoplast. May-Giemsa



Trypanosoma cruzi in human peripheral blood smear. A few C-shaped trypomastigates are seen. Note small basophilic dot-like kinetoplast at one end. The size is much smaller than *Trypanosoma brucei gambiense*. May-Giemsa



Filariasis (*Brugia malayi* infestation). A sheathed microfilaria, 200-300 μm in length, is seen on the peripheral blood smear. Brugiasis is endemic in subtropical areas in Asia. In Japan, it is endemic in Hachijo Kojima in the Pacific Ocian. May-Giemsa