for identifying T cells. The vast majority of chronic lymphocytic leukaemias (CLL) was shown to be a monoclonal B cell proliferation with a maturation block. However biclonal proliferations were encountered and a T cell origin was proven in 3 out of 150 CLL. The abnormal cells in 14 patients with the Sezary syndrome were identified as T cells. In most patients with common acute lymphoblastic leukaemia, no B or T markers were detected at the surface of the abnormal cells. These cells possessed neo antigens reactive with non anti-B antibodies present in antisera to CLL cells. In 30% of the cases the T nature of the blast cells appeared likely. In 11 other ALL patients a monoclonal B cell proliferation was found. These patients were usually not affected with common ALL and belonged mostly to two specific entities; in 3 cases the blastic proliferation supervented in patients previously affected with common CLL and in 6 cases the blast cells possessed all the cytological features of Burkitt's tumour cells.

B and T cell markers were also assessed in more than 30 cases of non-Hodgkin malignant lymphomata. Well-differentiated lymphocytic lymphomata and nodular lymphomata were found to be of B cell origin. Most of our cases of diffuse poorly differentiated lymphocytic lymphoma behaved as B cell monoclonal malignancies. The so-called reticulum cell sarcomata probably represent a heterogeneous group. In most cases the large malignant cells appeared to be devoid of B or T cell markers. However in one case a strong affinity receptor for IgG was found and was suggestive of a true histiocytic origin. In 3 patients in whom reticulum cell sarcoma supervened on a previous lymphoid malignancy (chronic lymphocytic leukaemia or Waldenström macroglobulinaemia) the large sarcoma cells belonged to the B cell series and presumably originated from the same clone as the previous lymphoid proliferation since they bore the same immunoglobulin chains.

REFERENCES

BROUET, J. C., FLANDRIN, G. & SELIGMANN, M. (1973) Indications for the Thymus Derived Nature of the Proliferating Cells in Six Patients with Sezary's Syndrome. *New Engl. J. Med.*, **289**, 341.

BROUET, J. C., LABAUME, S. & SELIGMANN, M. (1974) Evaluation of T and B Lymphocyte Membrane Markers in Human non-Hodgkin Malignant Lymphomata. *Br. J. Cancer, Suppl.* 2.

BROUET, J. C., PREUD'HOMME, J. L. & SELIGMANN, M. (1975) The Use of B and T Membrane Markers in the Classification of Human Leukaemias, with Special Reference to Acute Lymphoblastic Leukaemia. *Blood Cells* (in press).

BROUET, J. C., TOBEN, H. R., CHEVALIER, A. & SELIGMANN, M. (1974) T and B Membrane Markers on Blast Cells in 69 Patients with Acute Lymphoblastic Leukaemia. *Ann. Immunol. (Inst. Pasteur)*, **125C**, 691.

PREUD'HOMME, J. L. & SELIGMANN, M. (1972) Surface-bound Immunoglobulins as a Cell Marker in Human Lymphoproliferative Diseases. *Blood*, **40**, 777.

SELIGMANN, M. (1974) B and T Cell Markers in Lymphoid Proliferations. *New Engl. J. Med.*, **290**, 1483.

SELIGMANN, M., PREUD'HOMME, J. L. & BROUET, J. C. (1973) B and T Cell Markers in Human Proliferative Blood Diseases and Primary Immunodeficiences, with Special Reference to Membrane Bound Immunoglobulins. *Transplantn Rev.*, **16**, 85.

SURFACE ANTIGENS OF LEUKAEMIC CELLS

M. F. GREAVES, University College London.

Over the past few years the development of the technology for identifying the selective expression of cell surface markers on various populations of lymphoid cells has been a major contribution towards our current understanding of the organization and function of the immune system (Greaves, Owen and Raff, 1973). In principle this approach should also be applicable to the analysis of leukaemias, lymphomata and in fact malignant cells in general. Thus if a panel of cell surface markers is available which in combination provide a cell surface phenotype characteristic of a particular lymphocyte cell type, say a T cell, then the presence of a similar cell surface profile on a leukaemic cell might be taken to indicate that the latter may have arisen from T cells. This type of investigation might provide a cell refinement to the diagnosis of lymphoreticular malignancies and also insight into the origin and aetiology of the disease (Brown *et al.*, 1974; Harris, 1973).

Another approach to the identification of leukaemic cells which may hold out even more promise involves the use of antisera which may define cell surface antigens of leukaemic cells which are either entirely restricted to those cells or are at least absent from normal lymphoreticular cells. There is a long history of attempts to produce such discriminating antisera (reviewed in Harris,

1973 and Seligmann *et al.*, 1973), generally however one must conclude that until very recently there was no convincing evidence for success. Recently, however, several encouraging results have been reported. For example, Metzgar and colleagues (Monhanakumar, Metzgar and Miller, 1974) have raised antisera in monkeys which appear to distinguish different leukaemic cells from each other and from normal cells. Baker and Taub (Baker, Ramachander and Taub, 1975) have raised antisera in mice rendered tolerant to normal lymphocyte antigens, which appear to have similar properties.

We have raised antisera in rabbits to acute lymphoblastic leukaemic (ALL) cells by injecting these cells coated with antibodies to normal lymphocytes. The binding of the antisera to various cell types has been studied using immunofluorescent reagents and the analytical capacity of the Fluorescence Activated Cell Sorter—1 (FACS—1) and their full characteristics are described fully elsewhere (Greaves *et al.*, 1975; Brown, Capellaro and Greaves, 1975). In summary, after absorption with red cells, liver and tonsil lymphocytes, the anti-ALL sera do not react with normal resting or dividing foetal or adult lymphocytes and appear on the basis of absorption studies to define three leukaemia associated antigens.

1. A " weak " antigen shared with myelocytes, myeloblastic leukaemia cells and foetal liver (haemopoietic) cells,
2. A strong antigen shared with a subset of intermediate normoblasts found in normal bone marrow and early foetal liver, and
3. An antigen found so far only on non-T cell ALLs, which we regard as a strong candidate for a leukaemia specific antigen.

We have used antisera to ALL to distinguish between non-T ALL, T cell type ALL and other acute leukaemias in untreated patients and more recently have begun to screen patients considered to be in remission for rare leukaemic cells which might indicate residual disease and/or early signs of relapse. The results indicate that leukaemic cells are demonstrable in remission patients. Analysis of cell populations with antileukaemic sera may therefore have important diagnostic and prognostic potential.

REFERENCES

BAKER, M. A., RAMACHANDAR, K. & TAUB, R. N. (1975) Specificity of Heteroantisera to Human Acute Leukaemia Associated Antigens. *J. clin. Invest.* (in press).

BROWN, G., CAPELLARO, D. & GREAVES, M. F. (1975) Leukaemia Associated Antigens in Man. *J. exp. Med.* (in press).

BROWN, G., GREAVES, M. F., LISTER, A., RAPSON, N. & PAPAMICHAEL, M. (1974) Expression of Human T and B Lymphocyte Cell Surface Markers on Leukaemia Cells. *Lancet*, ii, 753.

GREAVES, M. F., BROWN, G., RAPSON, N. & LISTER, T. A. (1975) Antisera to Acute Lymphoblastic Leukaemia Cells. I. An Analysis of Cellular Specificity. *Immunol. clin. Immunopath.* (in press).

GREAVES, M. F., OWEN, J. T. & RAFF, M. C. (1973) T and B Lymphocytes: their Origins, Properties and Roles in Immune Responses. Amsterdam: Excerpta Medica.

HARRIS, R. (1973) Leukaemia Antigens and Immunity in Man. *Nature, Lond.*, **241**, 95.

MONHANAKUMAR, T., METZGAR, R. S. & MILLER, D. S. (1974) Human Leukemia Cell Antigens: Serological Characterization with Xenoantisera. *J. natn. Cancer Inst.*, **52**, 1435.

PEGRUM, G. D. (1973) Leukaemia Antigens. *J. Haemat.*, **24**, 1.

SELIGMANN, M., PREUD'HOMME, J. L. & BROUET, J. C. (1973) *Transplantn Rev.*, **16**, 85.

NEOPLASMS OF THE IMMUNE SYSTEM: CLASSIFICATION BY PRESUMED CELL OF ORIGIN

R. D. COLLINS, Vanderbilt University School of Medicine, Nashville, Tennessee.

Current classifications of malignant lymphomata were developed before the complexities of the immunological system were recognized, and are defective by not providing a conceptual approach to the relationship between lymphoid neoplasms and normal lymphocyte populations. Lukes and Collins (1974*a*, *b*) have recently outlined a classification of lymphoid neoplasms based on modern concepts of the immune system, as well as histological features (Table I). The basic tenet of this proposal is that malignant lymphomata, as neoplasms of the immune system, should be classified according to the kind of lymphocyte from which they arise. Although the clinical usefulness of this proposed classification has not been tested, preliminary studies indicate that most lymphoid neoplasms may be satisfactorily categorized by a combination of functional and structural investigations.

For example, in a recent study at Vanderbilt (Leech *et al.*, 1974; Glick *et al.*, 1974), cells